

EFFECTS OF SOIL INSECTICIDES ON FIELD CORN TOLERANCE TO
POSTEMERGENCE APPLICATIONS OF MESOTRIONE. S. C. Ditmarsen, S. Nolting,
M. A. Peterson, S. Taylor-Lovell, L. G. Thompson, and B. D. Olson, Dow AgroSciences,
LLC, Indianapolis, IN.

ABSTRACT

Field experiments were conducted at five Midwest locations in 2002 to evaluate the effects of various soil insecticide treatments applied at planting on the tolerance of field corn to subsequent postemergence applications of mesotrione plus atrazine. Insecticide treatments included: chlorpyrifos (Lorsban 15G) at 1X (11.25 g ai/100m of row) and 4X; terbufos (Counter 20CR) at 1X (11.25 g ai/100m of row) and 4X; and telfluthrin (Force 3.0G) at 1X (1.125g ai/100m of row). All insecticide treatments were applied in-furrow. Treatments with no insecticide were included for comparison. Herbicide treatments included postemergence applications of mesotrione + atrazine at 1X (105 + 280 g ai/ha), 2X, and 4X rates and mesotrione alone at the 1X (105 g ai/ha) rate, all applied at the V4 stage of corn growth. All herbicide treatments contained crop oil concentrate at 1.0% v/v and urea-ammonium nitrate solution (UAN 28%) at 2.5% v/v. Visual crop injury evaluations were taken at 0, 3, 7, 14, and 28 days after herbicide application.

The highest level of corn injury was noted at approximately 1 week after herbicide application. Symptoms were mainly an irregular loss of pigmentation in the treated foliage and some growth inhibition. Results of these studies showed that postemergence application of mesotrione + atrazine caused significantly less crop injury following application of chlorpyrifos or telfluthrin than terbufos. Injury from a 2X application rate of mesotrione + atrazine 1 week after application averaged 4, 7, 7, and 19% following treatments of no insecticide, 1X telfluthrin, 1X chlorpyrifos, and 1X terbufos, respectively.

POSTEMERGENCE WEED MANAGEMENT IN FIELD CORN WITH MESOTRIONE.
C. M. Whaley, G. R. Armel, H. P. Wilson, and T. E. Hines, Virginia Tech, Painter.

ABSTRACT

Two experiments were conducted in 2002 at the Eastern Shore Agricultural Research and Extension Center near Painter, Virginia to evaluate the effectiveness of reduced or full-rate herbicide combinations with mesotrione in total postemergence (POST) field corn weed management programs. The first experiment included mesotrione (Callisto) at 0.063 or 0.094 lb ai/A alone and in combination with the prepackage mixture of nicosulfuron plus rimsulfuron plus atrazine (Basis Gold) at 0, 0.39, or 0.78 lb ai/A and atrazine at 0 or 0.25 lb ai/A. The second experiment included Callisto at 0.063 or 0.094 lb/A alone and in combination with the prepackage mixture of nicosulfuron plus rimsulfuron (Steadfast) at 0, 0.023, or 0.047 lb ai/A and atrazine at 0 or 0.5 lb/A. Both experiments included comparison treatments of the prepackage mixture of metolachlor plus atrazine (Bicep II Magnum) applied preemergence (PRE) at 1.78 lb ai/A alone or followed by either a POST application of Basis Gold at 0.78 lb/A or Steadfast at 0.047 lb/A, and either a POST application of Basis Gold at 0.78 lb/A or Steadfast at 0.047 lb/A alone. Experiments were arranged as a randomized complete block design with three replications.

Both experiments were initiated on the same day. Substantial rainfall was recorded following PRE applications of the Bicep II Magnum treatment. All POST herbicide treatments were applied 4 weeks after planting. No significant rainfall occurred within 2 weeks following POST applications. Common ragweed (*Ambrosia artemisiifolia* L.), common lambsquarters (*Chenopodium album* L.), smooth pigweed (*Amaranthus hybridus* L.), and yellow nutsedge (*Cyperus esculentus* L.) ranged from 1 to 6 inches in height at the time of the POST applications. Large crabgrass (*Digitaria sanguinalis* (L.) Scop.) ranged from 1 to 4 inches in height at the time of the POST applications. Visual weed control evaluations were recorded 56 days after treatment (DAT).

At 56 DAT, Bicep II Magnum alone or followed by Basis Gold or Steadfast POST provided excellent control of all broadleaf weeds and large crabgrass. In both experiments, all treatments provided excellent control of smooth pigweed. Common lambsquarters control was excellent with all treatments except Steadfast applied alone. In both experiments, Callisto alone at either rate provided less than 53% common ragweed control. Callisto applied in combination with Basis Gold at 0.39 or 0.78 lb/A or atrazine, however, provided greater than 87% common ragweed control. The combination of Callisto plus Steadfast at any rate provided similar control of common ragweed as Callisto alone, however control was greater than 88% with the addition of atrazine. In both experiments, treatments including Callisto at 0.094 lb/A provided greater large crabgrass control than treatments with Callisto at 0.063 lb/A. Control of large crabgrass was similar with combination treatments including Basis Gold at any rate. Combination treatments including Steadfast at 0.023 or 0.047 lb/A provided greater large crabgrass control than treatments without Steadfast. Callisto at 0.094 lb/A alone or in combination with Basis Gold or atrazine provided greater yellow nutsedge control than treatments with Callisto at 0.063 lb/A. Variable weed height at application and insufficient rainfall following POST applications did not enhance the effectiveness of the POST treatments.

VISUALIZING THE MOVEMENT OF HOST PROTEINS TO EGYPTIAN BROOMRAPE USING GREEN FLUORESCENT PROTEIN. N. Hamamouch, Virginia Tech, Blacksburg; R. Aly, Newe Ya'ar Research Center, Ramat-Yishay, Israel; C. Cramer and J. Westwood, Virginia Tech, Blacksburg.

ABSTRACT

Egyptian broomrape (*Orobanche aegyptiaca* Pers.) is a parasitic weed that subsists on the roots of many dicotyledonous plants and robs them of water, minerals, and photosynthates. While it is known that the parasite acts as a strong sink on the host and withdraws small molecules such as sugars and herbicides, the movement of macromolecules between host and parasite has not been characterized. We are interested in determining whether proteins can move from host to parasite and are using the green fluorescent protein (GFP) as a visible marker to monitor such movement. Our experimental system uses arabidopsis (*Arabidopsis thaliana* L.) and tobacco (*Nicotiana tabacum* L.) host plants that have been transformed with a gene encoding GFP under the regulation of a broomrape-inducible promoter. The promoter used was taken from a defense related isogene of tomato 3-hydroxy-3-methylglutaryl coenzyme A reductase (*HMG2*), a gene that is expressed locally at the site of the parasite ingress and in response to wounding. Two possible routes for protein movement are being investigated, symplastic and apoplastic. One set of transgenic host plants contains an *HMG2:GFP* gene construct that will result in GFP accumulating in the cytoplasm and reveal protein movement through plasmodesmata or phloem sieve plates. Another set of plants contains an *HMG2:SP:GFP* construct, which has a signal peptide directing secretion of GFP to the intercellular space to reveal protein movement through xylem connections. Presence of the transgenes in arabidopsis and tobacco plants has been confirmed by PCR, and expression of the genes has been demonstrated by reverse transcription and western hybridization analysis of GFP. When parasitized, by broomrape, transgenic arabidopsis roots showed GFP fluorescence at the site of broomrape ingress. The observed expression pattern is consistent with *HMG2* regulation in tobacco, and indicates that this gene promoter is working as expected in arabidopsis. Although no GFP has yet been detected in broomrape tubercles, these structures are more opaque than the arabidopsis roots. Detection of GFP inside tubercles is being investigated using fluorescence and confocal microscopy and immunological approaches. These studies will provide insight on protein and macromolecule trafficking from host to broomrape, and could be exploited to optimize delivery and targeting of protein toxins to the parasite.

LUMAX: A NEW, BROAD-SPECTRUM PREEMERGENCE HERBICIDE IN CORN. B. A. Lackey, E. W. Palmer, and R. E. Schmenk, Syngenta Crop Protection, Greensboro, NC.

ABSTRACT

LUMAX is a new preemergence herbicide for control of annual grasses and broadleaf weeds in field corn (*Zea mays* L.), field production seed corn, and field silage corn. LUMAX contains the active ingredients s-metolachlor, mesotrione, and atrazine in a 10:1:3.75 ratio (with benoxacor as a safener), providing three modes of action for flexible, one-pass weed control. Formulated as a suspension emulsion (SE), LUMAX contains 472 gai/L or 3.9 lbai/gal. Extensive testing in 2002 demonstrated that a single application of LUMAX at 2.5-3 qt/A (depending on soil organic matter) was safe to corn and controlled all major broadleaf weeds, including common lambsquarters (*Chenopodium album* L.), common ragweed (*Ambrosia artemisiifolia* L.), velvetleaf (*Abutilon theophrasti* L.), smartweed (*Polygonum sp.*), pigweeds and waterhemp (*Amaranthus sp.*), and yellow nutsedge (*Cyperus esculentus* L.), as well as important grasses including foxtails (*Setaria sp.*), crabgrass (*Digitaria sp.*), barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], and panicums (*Panicum spp.*). LUMAX also controls weeds resistant to ALS inhibitor, triazine, and glyphosate herbicides. LUMAX may be used in conventional, reduced, and no-till systems, may be applied early postemergence to corn up to five inches in height (but prior to weed emergence), and is safe to key rotational crops such as soybeans, cereals, and sorghum. With low mammalian toxicity, good environmental safety, and flexibility for use on all corn hybrids and soil types, LUMAX offers simple and superior weed control to the producer. LUMAX was registered by the EPA in August 2002, and will be available for use during the 2003 growing season.

CAMIX: A NEW MESOTRIONE-BASED PREEMERGENCE CORN HERBICIDE. E. W. Palmer, B. A. Lackey, R. E. Schmenk, and J. D. Smith, Syngenta Crop Protection, Greensboro, NC.

ABSTRACT

Camix is a new preemergence herbicide that was registered by the EPA in August 2002 for use in field production seed corn, field corn, and field silage corn. Camix delivers annual grass and broadleaf control as well as excellent crop safety when applied preemergence. Camix is formulated as a 3.7 lb ai/gallon suspension concentrate (SC) and contains s-metolachlor and mesotrione at a 10:1 ratio plus the safener benoxacor. Camix may be applied at 2 or 2.4 qt/A depending on soil organic matter content. Extensive field testing in 2002 demonstrated excellent control of important grass and broadleaf weeds like giant foxtail (*Setaria faberi* Herrm.), velvetleaf (*Abutilon theophrasti* Medik.), common lambsquarters (*Chenopodium album* L.), and pigweeds (*Amaranthus* sp.). Additionally, Camix controls ALS and triazine resistant weeds found in key corn producing areas. Effective under all tillage regimes, Camix may be applied from 10 days prior to planting until corn is five inches tall, but prior to weed emergence. Camix will be available for use in 2003 primarily in areas that restrict atrazine use.

A COMPARISON OF JOHNSONGRASS CONTROL PROGRAMS IN GLYPHOSATE-RESISTANT AND GLYPHOSATE-SUSCEPTIBLE CORN AND SOYBEAN. H. Menbere and R. L. Ritter, Univ. of Maryland, College Park.

ABSTRACT

A large portion of the soybean [*Glycine max* (L.) Merr.] grown in the U. S. are glyphosate-resistant. However, there are a number of growers that plant glyphosate-susceptible soybean as well. In corn (*Zea mays* L.), the planting of glyphosate-resistant hybrids hasn't grown as dramatically, thus the majority of the corn planted is glyphosate-susceptible. Johnsongrass [*Sorghum halepense* (L.) Pers.] is a perennial grass that invades numerous acres of corn and soybean. The purpose of these studies was to examine the control of johnsongrass in glyphosate-resistant and glyphosate-susceptible corn and soybean. Studies were conducted from 2000 to 2002 at the Wye Research and Education Center located in Queenstown, MD. Early versus late as well as early plus late (split) applications were utilized. Johnsongrass height at the early applications averaged 30 cm in both corn and soybean. Johnsongrass height at the late applications averaged 51 cm in corn and 41 cm in soybean.

In corn, equally effective johnsongrass control was achieved with single or split postemergence applications of Accent (nicosulfuron) in glyphosate-susceptible corn, as compared to single or split postemergence applications of Touchdown or Roundup (glyphosate) in glyphosate-resistant corn. In general, single late postemergence applications provided better control than single early postemergence applications.

In soybean, a single late postemergence application or a split application of Assure (quizalofop), Poast (sethoxydim), or Select (clethodim), provided best season-long johnsongrass control in glyphosate-susceptible soybean. A similar trend was found in glyphosate-resistant soybean, where a single late postemergence application or a split application of Touchdown or Roundup provided best season-long johnsongrass control. Poor johnsongrass control occurred where only one early postemergence application was made in glyphosate-susceptible or glyphosate-resistant soybean.

BIOEFFICACY AND CROP TOLERANCE EVALUATIONS FOR A NEW INNOVATIVE GLYPHOSATE HERBICIDE FORMULATION. J. F. Haldeman, J. A. Koscelny, J. J. Sandbrink, and D. C. Heering, Monsanto Co., St. Louis, MO.

ABSTRACT

The introduction of glyphosate-resistant crops has led to an increased use of glyphosate herbicides for broad-spectrum weed control. In surveys, customers have indicated that they want continued innovation in glyphosate formulations. Customers continue to ask for complete formulations that are more concentrated and provide consistency of performance under a broad range of environmental conditions.

In response to these needs, a new glyphosate formulation has been developed. This new product is formulated as a potassium salt of glyphosate. Formulating as a potassium salt offers various benefits such as higher glyphosate loading and lower viscosity, which are tangible benefits for the consumer.

Extensive research has been conducted in replicated greenhouse, growth chamber and field trials to evaluate the bioefficacy and glyphosate resistant crop tolerance of this new formulation. Bioefficacy has been evaluated in over 400 replicated field trials and over 50 replicated greenhouse/growth chamber trials. At labeled rates, this new glyphosate formulation provided excellent control (>90%) of the majority of weeds evaluated.

Crop tolerance has also been evaluated on glyphosate resistant canola, corn, cotton, soybeans and sugar beets at labeled and/or overlap rates. In addition to visual crop response evaluations, yield data was obtained for the majority of the trials. This new glyphosate formulation had minimal or no affect on the foliage of the various crops and no impact on yield.

MEASURING THE IMPACT OF EARLY-SEASON WEED COMPETITION IN
GLYPHOSATE-RESISTANT CORN AND SOYBEAN. R. L. Ritter and H. Menbere,
Univ. of Maryland, College Park.

ABSTRACT

A large portion of the soybean [*Glycine max* (L.) Merr.] grown in the U. S. are glyphosate-resistant. In drilled, full-season soybean, many growers are finding that one timely application of glyphosate is all that is required to achieve adequate season-long weed control. In corn (*Zea mays* L.), however, the growth of glyphosate-resistant hybrids hasn't been as dramatic. Due to the longer period of growth that corn requires, and due to the fact that corn is grown in wide rows, one timely application of glyphosate may not support adequate season-long weed control.

In 2001 and 2002, studies were conducted with both glyphosate-resistant corn and soybean to investigate the proper timing for postemergence applications of glyphosate. These studies were conducted at the Wye Research and Education Center located in Queenstown, MD. Soybean (Asgrow 4101 - 2001, Asgrow 4301 - 2002) were planted on May 21 both years. Corn was only studied in 2002, with Asgrow RX 670 being planted on April 23. With all three studies, glyphosate applications were made on a weekly basis starting at 1 week after planting and continuing until 12 weeks after planting. Applications were made on separate plots in order to examine the effects of early and late-season weed competition on yield. The primary weed in all three studies was giant foxtail (*Setaria faberi* Herrm.). Yields were obtained with a standard field combine.

In 2001, soybean yield from the plots where glyphosate applications were made 1 and 2 weeks after planting were comparable to the untreated check. Soybean yield increased when applications were made at 3 weeks after planting, with highest yield obtained when applications were made at 5 and 6 weeks after planting. After the 6 week application, yield started to decrease. When applications were made 11 and 12 weeks after planting, yields were comparable to those obtained from the untreated check.

In 2002, corn yield from the plots where glyphosate applications were made 1 and 2 weeks after planting were comparable to the untreated check. Corn yield increased when applications were made at 3 weeks after planting with highest yield obtained when applications were made at 3 and 4 weeks after planting. After the 4 week timing, yield started to decrease; however, good yields were obtained with the 5, 6 and 7 week applications. When applications were made at 8, 9, 10, 11 and 12 weeks after planting, yields were comparable to those obtained from the untreated check.

ABSTRACT

Rose rosette disease (RRD) was identified for the first time in State College, PA in 2002. RRD is believed to be a virus that is spread by an eriophyid mite to certain susceptible rose species. The eriophyid mite inhabits the shoot tips and leaf petal bases of roses and introduces the causal agent of RRD into rose as it feeds. This discovery has alarmed the local rosarian community, but at the same time offers potential biocontrol of weedy multiflora rose (*Rosa multiflora* Thunb. ex Murr.).

RRD is a fatal disease of multiflora rose and some other rose species. Multiflora rose is the dominant host for the disease, so RRD is most common in areas where multiflora rose thrive. RRD is commonplace in W. Virginia and in parts of the Midwest and is scattered throughout numerous other states including Pennsylvania. RRD was identified on multiflora rose in a number of pastures near the University Park campus in 2002. We believe we discovered the beginning of an RRD invasion in the State College area, so we identified three objectives for a mapping project. First, we wanted to document the incidence or occurrence of multiflora rose in several pastures and hedgerows near the Penn State campus. Second we hoped to identify the incidence of RRD within the rose population. Finally, we wanted to establish some baseline data that would enable us to follow the dynamics of RRD infection.

In order to accomplish these objectives, we identified two-1 mile² sampling grids that were representative of multiflora rose infested land near Penn State. We had previously identified several RRD infected plants within one of these grids. We further divided these grids into sixteen 0.25 by 0.25 mile quadrats. Two to four individuals mapped the hedgerow and pasture component of these grids in June through August following 100-foot transects. For hedgerows and pasture, percent multiflora rose and percent RRD infected rose were estimated within each transect. Each transect was georeferenced as well as selective RRD-infected roses.

From this first year's mapping project, multiflora rose was identified throughout both sampling grids. In the sampling grid closest to campus, RRD was present in a number of places. In the second sampling grid more distant from campus, multiflora rose was conspicuous, but RRD was not identified. In the sampling grid near campus, two or three distinct high disease incidence areas or hot spots were identified. In the highest RRD incidence quadrat, multiflora rose was present in about half of the sample area. In about 40% of the sample area, multiflora rose occupied less than 50% of the land area. In only about 8% of this sample area, did multiflora rose make up 50% or more of the hedgerow or pasture. Within this same high incidence quadrat, about two-thirds of the area showed no RRD infected rose. About 5% of this sample area contained multiflora rose that was almost completely infected with RRD, while about 20% had just a few symptoms. In the hedgerow area, percent infection increased as multiflora rose occurrence increased peaking at 67% infection when rose occurrence was 80 to 90%. RRD infection appeared to be more random in more open pasture areas. In general, other areas in the sample grid near campus contained a lower incidence of RRD. Future data should allow us to track RRD movement and potentially identify its potential for multiflora rose biocontrol and the risk to cultivated rose.

COMPARISON OF A NICOSULFURON-BASED AND GLYPHOSATE-BASED PROGRAM FOR POST WEED CONTROL IN CORN. D.D. Lingenfelter, W.S. Curran, Penn State Univ., Univ. Park, PA; M.J. VanGessel, Univ. of Delaware; and B.A. Majek, Rutgers Univ., New Brunswick, NJ.

ABSTRACT

An experiment was conducted at multiple locations in the Northeast in 2000 and 2001 to evaluate the effectiveness of total POST weed control programs over a broad range of conditions. This paper will compare the success of a prepackage mixture of nicosulfuron, rimsulfuron, and atrazine (Basis Gold[®]) plus dicamba to glyphosate alone, glyphosate plus atrazine, and glyphosate plus a prepackage mixture of acetochlor and atrazine (Harness[®] Xtra). All treatments were applied to V-2 (EPOST) and V-4 (MPOST) corn (*Zea mays* L.). Weedy and weed-free checks were also included. Weed biomass by species collected in late summer and grain or silage yield data harvested in the fall were evaluated at each location.

Of 35 locations, 20 different weed species were identified as potential contributors to yield loss. Twenty-nine of the 35 locations reported common lambsquarters (*Chenopodium album* L.), 17 locations reported pigweed (*Amaranthus* spp.), and 14 locations had giant foxtail (*Setaria faberi* Herrm.) and common ragweed (*Ambrosia artemisiifolia* L.). Yellow nutsedge (*Cyperus esculentus* L.) and large crabgrass (*Digitaria sanguinalis* (L.) Scop.) were identified at ten and nine of the 35 locations, respectively.

In terms of weed control, the MPOST timing was more effective than the EPOST timing when averaged over treatment. As expected, glyphosate alone was impacted the most by timing, with the EPOST treatment having less effect on weed biomass, compared to the other treatments. The glyphosate mixtures and the nicosulfuron-based treatment were equal at the MPOST timing when averaged across location. The glyphosate plus atrazine mixture was less effective than the nicosulfuron-based treatment in the EPOST timing. Problem weeds with some total POST treatment locations included quackgrass (*Elytrigia repens* (L.) Nevski) and yellow nutsedge in Maine, common cocklebur (*Xanthium strumarium* L.) and horsenettle (*Solanum carolinense* L.) in Delaware, large crabgrass and yellow foxtail (*Setaria glauca* (L.) Beauv.) in Massachusetts, and common ragweed and giant foxtail at several locations. Regardless of treatment, the untreated check had at least five times more weed biomass than any herbicide treatment regardless of timing.

Excluding the weedy check, corn grain yield ranged from less than 50 bu/acre to more than 200 bu/acre depending on location. When averaged across locations and timings, corn yield did not differ between the glyphosate and nicosulfuron-based treatments, although the glyphosate alone treatment did yield less than the weed-free treatment. In addition, yield in the glyphosate alone EPOST treatment was less than the other EPOST treatments.

TECHNICAL UPDATE ON GLYPHOSATE-RESISTANT ALFALFA. T. E. Dutt, Monsanto Company, Fogelsville, PA; and C. C. Reyes, Monsanto Company, St. Louis, MO.

ABSTRACT

Monsanto Company and Forage Genetics International are jointly developing glyphosate-resistant (Roundup Ready[®]) alfalfa (*Medicago sativa*). Upon completion of USDA, FDA and EPA regulatory review, this technology will be available to growers in a wide range of germplasm through license agreements with seed companies. Glyphosate-resistant alfalfa varieties are the same as any other alfalfa varieties except they are tolerant to labeled glyphosate herbicides (Roundup[®]) when applied over-the-top of an actively growing crop. Testing on select experimental lines has demonstrated crop safety at up to a cumulative 6 lbs. acid equivalent (ae) per acre of glyphosate applied per year on glyphosate-resistant alfalfa. Weed control tests in alfalfa stand establishment (before first cutting) and established stands (after first cutting) have evaluated up to 1.5 lbs. ae glyphosate per acre rates from emergence to 5 days prior to a cutting. Tests evaluating weed control and crop safety in stand establishment were conducted across ten locations under USDA release notifications in New York, Pennsylvania, Ohio, Michigan, Indiana, and Illinois in 2002. Glyphosate provided better weed control and crop safety in glyphosate-resistant alfalfa when compared to herbicides currently used in conventional alfalfa. These tests will be continued in 2003 to evaluate weed control and crop safety in established stands. The targeted timeline for commercialization is 2004-2006.

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CONTROL OF HORSEWEED WITH GLYPHOSATE. T. E. Dutt, Monsanto Company, Fogelsville, PA; G. A. Elmore, Monsanto Company, St. Louis, MO; and D. J. Mayonado, Monsanto Company, Salisbury, MD.

ABSTRACT

Horseweed (*Conyza canadensis*), commonly referred to as marestalk, can be a difficult weed to control with glyphosate. The Monsanto field trial database was searched to determine the historical effectiveness of glyphosate in controlling horseweed. This search of spring burndown applications included data from trials conducted at multiple locations across the United States from 1973 to 2000. Data averages from this search showed better than 90% control of horseweed up to 12 inches tall at application with 0.75 lb. acid equivalent (ae) glyphosate per acre. Control averages dropped to less than 60% as the height of horseweed increased up to 36 inches at application. The addition of 2,4-D at 0.5 lb active ingredient (ai) per acre to glyphosate improved horseweed control. In general, there was better and more consistent control with glyphosate when horseweed was smaller and when 2,4-D was added.

Laboratory and field tests have recently confirmed the presence of glyphosate-resistant horseweed biotypes in Delaware and Tennessee. Field trials were also conducted in New Jersey, Maryland, and Delaware during 2001 and 2002 to determine the most effective programs for control of horseweed with glyphosate in no-till glyphosate-resistant soybeans (*Glycine max*). At a location in New Jersey, spring burndown applications of 0.75 lb. ae/A glyphosate followed by in-crop applications of 0.75 lb ae/A glyphosate provided poor control (<50%) of 3-5 inch horseweed in 2001 but good control (>90%) in 2002. However, across five locations in 2002 (including the New Jersey location mentioned), the same treatments resulted in generally poor control (average of 50%) of horseweed in 4 out of the 5 trials. In these tests, a spring burndown application of 0.75 lb ae/A glyphosate + 0.5 lb. ai/A 2,4-D + 0.016 lb. ai/A cloransulam followed by an in-crop application of 0.75 lb. ae/A glyphosate resulted in an average 94% control with 90% or better control obtained at all locations. Glyphosate + 2,4-D (burndown) followed by glyphosate + cloransulam (in-crop) resulted in an average 90% control with better than 90% control obtained at 3 of 5 locations. Glyphosate + 2,4-D (burndown) followed by glyphosate (in-crop) resulted in an average 80% control with better than 90% control obtained at 2 of 5 locations. Glyphosate (burndown) followed by glyphosate + cloransulam (in-crop) resulted in an average 61% control with better than 90% control obtained at only 1 of 5 locations. Results indicate that control of horseweed with glyphosate can be variable depending on the biotype (susceptible or resistant), stage of growth, and environmental conditions. The addition of 2,4-D increased control of horseweed at burndown. Cloransulam also increased horseweed control especially when combined with 2,4-D at burndown. Testing showed it is best to control horseweed when it is small (<6 inches) with a spring burndown application before soybean planting.

ABSTRACT

In Virginia, Italian ryegrass (*Lolium multiflorum*) has become one of the most troublesome and difficult to control weeds in small grains. Italian ryegrass control has declined due to the development of resistance to diclofop-methyl, which has been the only treatment available for postemergence (POST) control of this species in wheat and barley. Experiments were performed in 2000 and 2001 to evaluate the efficacy of AEF-130060 03 plus AEF-107892 applied POST for the control of Italian ryegrass in barley. Treatments included three POST timings of AEF-130060 03 plus AEF-107892 and two rates. AEF-130060 03 plus AEF-107892 was also combined with various POST small grain herbicides and compared to several delayed preemergence (DPRE) treatments of flufenacet plus metribuzin, and chlorsulfuron plus metsulfuron-methyl alone or followed by one of three POST timings of AEF-130060 03 plus AEF-107892. The effect of methylated sunflower oil and nitrogen combined with AEF-130060 03 plus AEF-107892 were also evaluated. AEF-130060 03 plus AEF-107892 controlled Italian ryegrass at all three timings with or without the addition of other POST herbicides or methylated sunflower oil and nitrogen. The third application timing of AEF-130060 03 plus AEF-107892 commonly resulted in lower yields than the first and second application timings due to increased time of Italian ryegrass competition, increased barley injury, and insufficient time to allow barley recovery from this injury. Transient phytotoxicity to barley occurred following AEF-130060 03 plus AEF-107892 applications, however, the addition of 2,4-D or dicamba to AEF-130060 03 plus AEF-107892 increased barley injury. AEF-130060 03 plus AEF-107892 applied early postemergence (EP) provided Italian ryegrass control and barley yields equivalent to that provided by DPRE applications of flufenacet plus metribuzin when rainfall was received. However, when rainfall was absent AEF-130060 03 plus AEF-107892 provided superior control. Because the efficacy of AEF-130060 03 plus AEF-107892 is not dependant on rainfall, AEF-130060 03 plus AEF-107892 should provide more consistent control of Italian ryegrass than DPRE treatments. Treatments of AEF-130060 03 plus AEF-107892 following a DPRE application of flufenacet plus metribuzin, or chlorsulfuron plus metsulfuron-methyl provided essentially 100% Italian ryegrass control and excellent yields.

ANNUAL WEED CONTROL WITH MESOTRIONE IN FIELD CORN. P. C. Bhowmik¹, E. McGlew¹, D. Sanyal¹ and J. D. Smith², ¹Department of Plant and Soil Sciences, University of Massachusetts, Amherst and ²Syngenta Crop Protection, Bedford, NH.

ABSTRACT

Mesotrione [2-(4-mesy-2-nitrobenzoyl)-3-hydroxycyclohex-2-enone] is relatively a new pigment inhibitor herbicide that is labeled for use in corn (*Zea mays* L.). This herbicide controls susceptible weed species by inhibiting the 4-HPPD enzyme. Field studies were conducted using typical, replicated, small-plot research techniques at our research farm since 1999. Mesotrione was applied PRE or POST, either alone or in combinations with atrazine, and/or acetamide herbicides.

"DKC53-33RR" corn was planted on May 6, 2002. All treatments were applied using a CO₂-backpack sprayer that delivered 20 gpa at 22 psi. PRE treatments were applied on May 9, while POST treatments were applied on June 3 or June 11, 2002. Control of common lambsquarters (*Chenopodium album* L.), common ragweed (*Ambrosia artemisiifolia* L.), yellow foxtail [*Setaria glauca* (L.) Beauv.], large crabgrass [*Digitaria sanguinalis* (L.) Scop.] and fall panicum (*Panicum dichotomiflorum* Michx.) was estimated on a scale of 0 to 100% (0 = no control and 100 = complete control) 4, 8, and 12 after treatment (WAT). Corn injury, silage and grain yields were determined.

All treatments with mesotrione were safe to corn. Mesotrione applied PRE provided excellent control (>95%) of common lambsquarters, redroot pigweed, while mesotrione treatments controlled only 82% of common ragweed. Mesotrione applied POST provided excellent control of these species. In general, mesotrione in combination with grass control herbicides (s-metolachlor or acetochlor) provided excellent control of large crabgrass, yellow foxtail and fall panicum. None of the treatments with mesotrione had any adverse effects on corn silage or grain yields. The treatment with three-way combinations of mesotrione plus s-metolachlor plus atrazine (A12854, Syngenta Crop Protection) at 3.0 qt/A resulted in highest silage (35 ton/A) and grain (179 bu/A) yields of corn in 2002 as compared to 33 ton/A of silage and 154 bu/A of grain yields from the cultivated check. However, the treatment with two-way combinations of mesotrione plus s-metolachlor (A12909) at 2.4 qt/A had similar silage (28 ton/A) and grain (144 bu/A) yields. The untreated plot had only 9 ton/A of silage and 40 bu/A of grain. These results indicate great potential for use of these products in corn production.

ABSTRACT

An experiment was established near Aurora, NY in 2002 to further define the best timing and rate of glyphosate application during the establishment of glyphosate-resistant alfalfa (*Medicago sativa* L. 'RR01BD-164'). The alfalfa was drilled at the rate of 10 lb/A into a firm seedbed on April 18, 2002. Glyphosate treatments were applied early postemergence (EPOST), mid-postemergence (MPOST), and late postemergence (LPOST) when alfalfa was in the first, sixth, and tenth trifoliolate leaf stages of development on May 25, June 8, and June 21, 2002 respectively. Alfalfa was 0.75, 5, and 10 inches tall for the EPOST, MPOST, and LPOST applications respectively. Glyphosate rates ranged from 0.75 to 1.5 lb ae/A at each application timing. At the MPOST timing, glyphosate applications were compared with applications of 0.81 lb ai/A of glyphosate/imazethapyr, 1 oz ai/A of imazethapyr alone and in combinations with 0.5 lb ai/A of 2,4-DB and with 1.25 oz ai/A of clethodim, and 0.63 oz ai/A of imazamox. A randomized complete block design with four replications was used. Weed control ratings were made just prior to harvesting the alfalfa on July 3. Second cutting was harvested on August 12 with botanical separation of the alfalfa and weeds done on representative samples to determine the dry matter yield of each component for individual plots. Forage quality analysis was completed on samples from selected treatments. Alfalfa crowns per unit area were counted following a third harvest on October 30.

The plot area had significant populations of common ragweed (*Ambrosia artemisiifolia* L.), common lambsquarters (*Chenopodium album* L.), yellow foxtail [*Setaria glauca* (L.) Beauv.], and wild mustard [*Brassica kaber* (DC.) L.C. Wheeler]. All MPOST and LPOST applications of glyphosate alone or of the glyphosate/imazethapyr premix provided excellent control of these annual weeds. Although weed control with EPOST glyphosate applications was good, it was evident that some weeds germinated after these EPOST applications. The MPOST application of imazethapyr alone and in combination with clethodim controlled 75 and 70% of the common ragweed respectively, while the combination of imazethapyr plus 2,4-DB controlled 93% of the ragweed. Common lambsquarters control was 55 and 35% with imazethapyr alone and in combination with clethodim respectively. The combination of imazethapyr plus 2,4-DB controlled 97% of the lambsquarters. Control of ragweed and lambsquarters with imazamox was 90 and 84% respectively. Weed dry matter yields with all MPOST and LPOST glyphosate treatments, and with MPOST glyphosate/imazethapyr and imazethapyr plus 2,4-DB treatments were significantly less than weed dry matter from the untreated check. Forage quality analysis and the Univ. of Wisconsin Alfalfa/Grass Evaluation System - 2000 were used to predict milk yield from selected treatments. A milk yield of 1854 lb/A was predicted from the untreated check. The only treatments that predicted milk yields greater than the untreated check were the LPOST application of 0.75 lb/A of glyphosate and the MPOST application of imazethapyr plus clethodim. The latter treatment happened to be one of the treatments with the highest weed dry matter yield.

INTRODUCTION

For the second year out of the past three, volunteer potatoes (VP) have been a management issue for potato growers in central Maine. These untreated VP are a potential source of inoculum for late blight and a competitive weed. Solanaceous weeds are generally difficult to control. Volunteer potatoes are particularly difficult to control as they emerge from the ground at different times and are frequently at different stages of development when one needs to control them.

A post-emergence weed control trial was established on a farm in Exeter, Maine to provide data on VP control. We evaluated standard control measures (Banvel and Marksman) compared to using Callisto a new low rate postemergence weed control product for field corn. We were also interested in evaluating different stickers and adjuvants to assess increased or decreased effectiveness on VP or potential injury to corn. The treatments applied to the corn are presented below:

- 1) Check
- 2) Banvel – 16 oz/ac rate + NIS (0.25% v/v)
- 3) Banvel + Atrazine – 16 oz/ac + 32 oz/ac + NIS (0.25% v/v)
- 4) Callisto - 3 oz + Crop Oil Concentrate (1% v/v) (COC)
- 5) Callisto - 3 oz + COC (1% v/v) + Urea ammonium nitrate (UAN) solution (2.5% v/v)
- 6) Callisto - 3 oz + COC (1% v/v) + UAN (2.5% v/v) + 8 oz/ac atrazine
- 7) Callisto - 4.5 oz + COC (1% v/v) + UAN (2.5% v/v)
- 8) Callisto - 4.5 oz + COC (1% v/v) + UAN (2.5% v/v) + 8 oz/ac atrazine
- 9) Callisto - 6 oz + COC (1% v/v) + UAN (2.5% v/v)
- 10) Callisto - 6 oz + COC (1% v/v) + UAN (2.5% v/v) + 8 oz/ac atrazine
- 11) Callisto - 3 oz/ac + Banvel (16 oz/ac) + NIS (0.25% v/v)
- 12) Callisto - 3 oz + Banvel and Atrazine (16 + 32 oz/ac) + NIS (0.25% v/v)

METHODS

Prior to our establishing this herbicide study, a preemergence application of Prowl (3 pts/ac) and Aatrex (16 oz/ac) were applied to the field at the spike to 1 leaf stage of development. Thus, some potatoes that had already emerged had been slightly injured by the preemergence application while others that emerged after that spray application did not show any damage. Based on our observations of damage on the check plots, the preemergence herbicide did very little damage to VP. Postemergence herbicides were applied on 20 June 2002, and ratings were taken four, ten, and 21 days after application (DAT). Note: this field is in a 3-year rotation (potato followed by corn followed by barley). So, this application of atrazine did not conflict with label guidelines. At four DAT, corn injury and a rating of herbicide effectiveness on VP was made. Corn injury is defined as the percentage of plants exhibiting chlorosis. Herbicide effectiveness on VP was made as a 1 – 10 rating: the lower the number the more effective the herbicide. At 10 and 21 DAT, we also rated corn injury and injury to

VP. We also counted the number of live potato plants potentially able to spread late-blight or other diseases.

RESULTS

We found significant differences in corn injury and VP control at all ratings taken after application of herbicides. Data for each rating period are presented below.

Table 1. Herbicide Effect on Field Corn Injury and Volunteer Potato Control – 4 DAT

Treatment	Corn Injury (% of plants showing injury)	Volunteer Potato Health (1 – 10 rating – (10 healthy))
Check	0.0	8.1
Banvel	9.0	6.1
Banvel + Atrazine	14.2	5.1
Callisto – 3 oz + COC	8.1	4.4
Callisto – 3 oz + UAN + COC	4.2	4.4
Callisto - 3 oz + COC + UAN + .25 lb atrazine	7.0	3.1
Callisto - 4.5 oz + COC + UAN	10.2	4.9
Callisto - 4.5 oz + COC + UAN + 0.25 lb atrazine	26.2	2.1
Callisto - 6 oz + COC + UAN	42.2	2.1
Callisto – 6.0 oz + COC + UAN + 0.25 lb atrazine	30.0	2.6
Callisto - 3 oz/ac + Banvel (16 oz/ac) + NIS	22.5	3.2
Callisto - 3 oz + Banvel and Atrazine + NIS	20.0	2.1
LSD @ 0.05	18	1.2

Crop Injury and VP Control at 4 DAT.

From this first set of data, it appears that VP were most impacted by higher rates of Callisto or Callisto combined with a growth regulator. But, this rating was made early after application and it generally takes more time for an herbicide's impact on VP to be evident. With the higher rates of Callisto and the combination of COC and UAN, corn was injury was significantly higher. While the corn did grow out of this injury, keeping rates of Callisto at 3 oz/ac with COC and UAN appears to keep injury to field corn to an acceptable level. Callisto was significantly more injurious to VP than either Banvel or Banvel and atrazine. The addition of a quarter pound of atrazine significantly increased activity on the VP. From the first evaluation, use of 3 oz/ac Callisto + 0.25 lbs/ac

atrazine and COC (1% v/v) and UAN (2.5% v/v) seems to be as effective as any other treatment evaluated in this study.

Table 2. Herbicide Effect on Field Corn Injury and VP Control – 10 DAT

Treatment	Corn Injury (% Injury)	Volunteer Potato (1 – 10 rating (10 = healthy))	Number of Live Potatoes (number/288 ft ²)
Check	0.0	8.8	70.5
Banvel	0.0	6.8	31.0
Banvel + Atrazine	0.0	7.0	17.0
Callisto – 3 oz + COC	0.0	2.6	8.2
Callisto – 3 oz + UAN + COC	0.0	2.8	4.8
Callisto - 3 oz + COC + UAN + Atz	1.2	1.6	2.8
Callisto - 4.5 oz + COC + UAN	10.0	2.2	4.0
Callisto - 4.5 oz + COC + UAN + Atz	32.5	1.2	1.5
Callisto - 6 oz + COC + UAN	37.5	1.2	1.5
Callisto – 6.0 oz + COC + UAN + Atz	52.5	1.5	1.5
Callisto - 3 oz/ac + Banvel (16 oz/ac) + NIS	0.0	2.5	2.8
Callisto - 3 oz + Banvel and Atrazine + NIS	2.5	1.5	2.2
LSD @ 0.05	9.8	1.0	12.8

Crop Injury and VP Control at 10 DAT.

With the 10 DAT rating, corn injury was evident only at the 4.5 and 6.0 oz/ac Callisto rates. While this injury was common on plants, the degree of injury was slight at 10 DAT. From this data, it appears that keeping Callisto rates at 3 oz/ac with COC and UAN is safe to corn, but higher rates, particularly with adjuvant and crop oil concentrate was injurious to corn. Use of Banvel or Marksman (atrazine and Banvel) did not provide adequate control of VP. At both ratings (4 and 10 DAT), VP appeared significantly healthier and the number of live potatoes were significantly higher than those treated with Callisto. The most effective treatment from the perspective of cost and efficacy appears to be the 3 oz/ac rate of Callisto + crop oil + UAN and ¼ lb of atrazine. Corn injury was slight (7%), and VP health was statistically similar to the 4.5 and 6.0 oz/ac rates of Callisto. There were very few live potatoes in these plots.

Table 3. Herbicide Effect on Field Corn Injury and VP Control – 21 DAT

Treatment	Corn Injury (% Injury)	Volunteer Potato (1 – 10 rating (10 = healthy))	Number of Live Potatoes (number/288 ft ²)
Check	NR	8.5	68
Banvel	NR	7.6	28
Banvel + Atrazine	NR	7.4	18
Callisto – 3 oz + COC	NR	6.2	22
Callisto – 3 oz + UAN + COC	NR	6.8	18
Callisto - 3 oz + COC + UAN + Atz	NR	2.5	5
Callisto - 4.5 oz + COC + UAN	NR	4.5	8
Callisto - 4.5 oz + COC + UAN + Atz	NR	3.8	4
Callisto - 6 oz + COC + UAN	NR	2.8	3.5
Callisto – 6.0 oz + COC + UAN + Atz	NR	3.8	1.5
Callisto - 3 oz/ac + Banvel (16 oz/ac) + NIS	NR	4.2	9
Callisto - 3 oz + Banvel and Atrazine + NIS	NR	3.8	6
LSD @ 0.05	---	1.7	10.5

Crop Injury and Volunteer Potato Control at 21 DAT.

Corn injury was not rated at 21 DAT because the producer had applied UAN as a sidedress application to the entire field. Between the 11 days between applications, a few additional VP emerged which is somewhat disturbing because these potatoes could potentially spread late blight if inoculum were present. However, by the time of this rating, the corn was thigh high and starting to significantly compete with VP. By the final rating, VP vigor rating has increased. This was in part due to the fact that the newly emerged VP did not show the impact that the treated VP did, and in part due to the fact that the plants were recovering slightly from the spray.

Based on this one-year, one-location project, Callisto applied at 3 oz/ac with UAN (2.5% v/v) + ¼ lb of atrazine + crop oil concentrate (1% v/v) appears to be a very effective treatment to control VP. Crop injury in this study was low, VP control was excellent, and the amount of chemical used is minimal. In some years with possibly more challenging weather conditions, the addition of UAN and COC could be more injurious to some corn varieties. But VP are difficult to control, and the combination of the adjuvant and oil was needed to get optimum control.

ABSTRACT

A three-year study was initiated in 2000 to evaluate alfalfa control in no-till corn. Treatments consisted of burndown and postemergence applications of 0.75 lbs ae/A glyphosate in combination with 0.5 lbs ai/A 2,4-D or 0.25 lbs ai/A dicamba. Alfalfa was either cut for hay 3 days prior to planting corn and burndown applications or left uncut. Postemergence applications were made 21 to 25 days after planting when corn was 5 inches tall. Postemergence applications followed burndown applications in uncut alfalfa or no treatment in cut alfalfa. Alfalfa control was greater when glyphosate was applied as a burndown treatment in uncut (71%) compared to cut (42%) alfalfa. The most effective burndown treatment was glyphosate + dicamba in cut (61%) and uncut (84%) alfalfa. Alfalfa control when averaged over all postemergence treatments was similar for cut (92%) and uncut (92%) alfalfa. Alfalfa control was greater following postemergence applications of glyphosate combinations with 2,4-D (96%) or dicamba (95%) compared to glyphosate applied alone (85%). Corn yield was 7% greater with herbicide treatments in uncut compared to cut alfalfa.

ABSTRACT

The invasive vascular flora of Great Gull Island, a 6.9 hectare island, Long Island Sound, New York consists of 111 species within 84 genera and 37 families. The largest families in the flora were Poaceae (22 species) and Asteraceae (18 species). The largest genera were *Polygonum*, *Rosa* and *Trifolium*, each with 3 species. Non-native species, 55% of the flora, were a major component of the natural vegetation.

INTRODUCTION

Great Gull Island, encompassing 6.9 hectares is located in eastern Long Island Sound, New York (40° 12' 07" N Latitude, 72° 07' 09" W Longitude). The island has a long history of human habitation. A portion of the island was farmed by a Little Gull Island Lighthouse keeper in the 1820's. From 1896 to the 1940's, the island's fortifications have played a part in the United States' coastal defense system. The American Museum of Natural History acquired the Island in 1948 as a wildlife preserve(2). To create a favorable nesting habitat for terns, the American Museum of Natural History modified the island's substrate by bulldozing vegetation to create bare soil. The island was also bush-hogged in early spring, to clear vegetation from the ground, to create favorable tern nesting habitat.

Coulter(2) studied the vascular flora of Great Gull Island and identified 129 species of vascular plants. He listed four general plant communities; (1) a shrub community dominated by *Myrica pensylvanica*, (2) a meadow community dominated by non-native grasses, (3) a human disturbed ruderal community composed mostly of forbs, (4) an artificially created meadow community dominated by *Ammophila breviligulata*. However, *Ammophila* and nesting terns were not compatible and *Ammophila* was removed.

The closest climatological station to Great Gull Island is Block Island, Rhode Island, where climate is similar(1). The climate is broadly representative of the humid continental type, though winters are modified by Long Island Sound. Mean January temperature at Block Island is 0.2° C; July is warmest month with mean temperature of 20.4° C. Average annual rainfall is 985.8 mm, and is evenly distributed. December is the wettest month with 96.3 mm of rain, while July is the driest month averaging 66.3 mm. The growing season at Block Island averages 218 days. The last killing frost occurs about April 10, while the first frost occurs about November 14.

METHODS

The vegetation at Great Gull Island was sampled from April 2002 to October 2002. Herbarium voucher specimens for each species were prepared and are deposited at the New York Botanical Garden Herbarium, Bronx, New York. Nomenclature follows Gleason and Cronquist(3). Species richness of vascular flora of Great Gull Island was compared with three New York harbor islands, Ellis Island(4), Liberty Island(5), and Hoffman Island(6) (Table 2). Non-native species richness of

Great Gull Island was also compared with the three aforementioned New York harbor islands.

RESULTS AND DISCUSSION

A preliminary survey of the vascular flora of the Great Gull Island includes 111 species in 84 genera in 37 families (Table 1). Seventy one non-native species compose 64% of the flora. The percentage of non-native species at Great Gull Island, 64%, was similar to the percentage of non-native species at Ellis, Liberty and Hoffman Islands, where the percentage of non-native species ranged from 58 to 65%. The most abundant non-native herbaceous species was *Raphanus raphanistrum*, while *Celastrus orbiculatus* was the most widespread woody alien. The largest genera in the flora were *Polygonum rosa* and *Trifolium*, each with three species. All the *Trifolium* were non-native.

Species richness of the non-native flora of Great Gull Island was compared with three coastal islands in New York harbor (Table 2). The species area quotient of the New York City Harbor Islands was very similar, ranging from 19.8 at Liberty Island to 22.3 at Ellis Island. Both islands are visited by hundreds of thousands of visitors each year; these individuals may be the source of new species. Hoffman Island is isolated from human intrusion and human disturbance, yet has approximately the same species richness as its two human impacted sister New York harbor islands. Species richness at Great Gull Island is lower than that of the New York City harbor islands (Table 2).

Great Gull Island's tern nesting populations are monitored each year by Helen Hays and a volunteer staff of approximately 20 people, of the American Museum of Natural History's Ornithology Research program. These individuals may be the source of seeds of new species, especially invasive non-native vascular plants. Dr. Hays and her volunteers are on the island from April to mid September.

Species richness of the non-native flora of Great Gull Island was compared with three coastal island in New York harbor (Table 3). The species area quotient of the New York City Harbor Islands was very similar, ranging from 13 at both Ellis and Liberty Islands to 13.5 at Hoffman Island. The non-native species area quotient for Great Gull Island was lower, 10 species/ha.

Table 1. A summary of the vascular flora of Great Gull Island, New York.

	Dicots	Monocots	Total
Families	31	6	37
Genera	62	22	84
Species	81	30	111
Native	35	5	40
Non-Native	46	25	71

Table 2. Comparison of species richness among Great Gull Island, New York with three other coastal islands.

	Area (ha ²)	Species Richness	Spp Area Quotient
Ellis Island, NY(4)	11.1	248	22.3
Liberty Island, NY(5)	4.9	97	19.8
Hoffman Island, NY(6)	4	87	21.8
Great Gull Island	7.1	111	15.6

Table 3. Comparison of non-native species richness among Great Gull Island, New York with three other coastal islands.

	Area (ha ²)	Species Richness	Spp Area Quotient
Ellis Island, NY(4)	11.1	144	13
Liberty Island, NY(5)	4.9	63	13
Hoffman Island, NY(6)	4	54	13.5
Great Gull Island	7.1	71	10

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ABSTRACT

Star-of-Bethlehem (*Ornithogalum umbellatum*, L.), tree-of-heaven (*Ailanthus altissima* (Mill.) Swingle), and trifoliolate orange (*Poncirus trifoliata* (L.) Raf.) are escaped ornamentals that resist mowing, and are difficult to control. Populations of each are increasing. Star-of-Bethlehem, a problem in pasture and hay fields, normally grows vegetative from January to June. During this time it is a menace to growers by interfering with spring hay and forage quality. Experiments were conducted in March 2000 and 2001 in Nelson County, VA to determine control options for Star-of-Bethlehem. Herbicides tested included: 2,4-D, 2,4-D + dicamba, 2,4-D + picloram, 2,4-D + triclopyr, dicamba, glufosinate, glyphosate, imazethapyr, metribuzin, metsulfuron, paraquat, thifensulfuron + tribenuron, triclopyr, and tribenuron. Paraquat at 1.0 kg ai/ha applied twice at a 3 wk interval and dicamba applied once at 1.1 kg ai/ha controlled Star-of-Bethlehem at least 80% 1 year after herbicide treatment. All other treatments controlled Star-of-Bethlehem less than 50%.

Tree-of-Heaven is common along roadsides in Virginia and North Carolina. Tree-of-heaven produces root sprouts in response to cutting, thus increasing the number of plants following cutting operations. Cut stump herbicide treatments control a variety of woody species. An experiment was conducted along Interstate 81 in Virginia to determine control options for tree-of-heaven using cut-stump treatments of triclopyr or imazapyr applied alone or together. Number of tree-of-heaven sprouts was counted 7, 12, and 40 weeks after treatment (WAT). Trees were cut with a chain saw and herbicides applied to wet the cut stump surface. Herbicides were mixed at various volumetric rates with a nonionic surfactant as the carrier. Herbicides rates (% v/v) included imazapyr + triclopyr at 1 and 20%, respectively or 3 and 15%, respectively; imazapyr alone at 5% v/v; and triclopyr alone at 20% v/v. At 40 WAT, triclopyr reduced tree-of-heaven sprouts 86% and more than imazapyr (67%) when compared to the nontreated control, which had 28 sprouts. Mixing imazapyr and triclopyr did not decrease number of sprouts compared to triclopyr alone.

Trifoliolate orange can be a tenacious weed once established in pastures or noncrop areas. Its thorns deter herbivory and seed production enable it to form large, dense patches. Field trials were conducted in North Carolina to determine control options for trifoliolate orange. Herbicides treatments included dicamba at 1% v/v, metsulfuron at 0.07 kg ai/ha, and imazapyr at 2% v/v. A nonionic surfactant was mixed with each treatment at 0.5% v/v. Imazapyr, metsulfuron, and dicamba controlled trifoliolate orange 95, 90, and 35%, respectively 11 WAT.

A NEW HERBICIDE FOR AQUATIC USE: BAS 693H. K. E. Kalmowitz, J. H. Birk, BASF Corporation, Research Triangle Park, NC; and J. L. Vollmer, BASF Corporation, Laramie, WY.

ABSTRACT

BAS 693H herbicide is currently under review by Environmental Protection Agency (EPA) for an aquatic use label. The active ingredient, imazapyr, has been registered and used as an effective broad-spectrum herbicide in forestry and vegetation management sites for over 15 years. BAS 693H has been evaluated under an Experimental Use Permit (EUP) since 1995 for aquatic and terrestrial/ wetland uses. BAS 693H is in the imidazolinone family of chemistry and has low toxicity to mammals, birds, fish and reptiles. Research and EUP data supports BAS 693H for use on floating, emerged and riparian species for aquatic and wetland sites. No biological activity has been reported to algae species and little to no activity is evident to submersed species. The half-life of BAS 693H is approximately 7-14 days in an aqueous environment; breakdown occurs through aqueous photolysis and microbial action to end products carbon, hydrogen, oxygen and nitrogen. Application methods to deliver the herbicide can provide selective control of targeted weed species and flexibility for time-of-application at the site.

Data demonstrates that BAS 693H provides season-long control of key invasive emergent and shoreline species. Examples of excellent control reported in research and EUP trials are purple loosestrife (*Lythrum salicaria*), cattail species (*Typha* spp.), alligator weed (*Alternanthera philoxeroides*), sedge species (*Carex* and *Cyperus* spp.), common reed (*Phragmites* spp.), water hyacinth (*Eichhornia crassipes*) and waterlettuce (*Pistia stratiodes*) when evaluated at rate ranges of 0.5-1.5 lb a.e./surface acre. Elsewhere in the country, effective use of BAS 693H has been observed with control of invasive terrestrial species saltcedar (*Tamarix* spp.), Malaleuca (*Melaleuca quinquenervia*), and Chinese tallow tree (*Sapium sebiferum*).

BAS 693H, when registered, can provide a new aquatic-weed-control option for restoration of aquatic, wetland and riparian areas.

ABSTRACT

Crownvetch (*Coronilla varia* L.) is a non-native perennial legume introduced in the United States for soil stabilization plantings, a practice that has been used extensively along roadways. However, due to the aggressiveness of crownvetch, some desirable and native vegetation species have been displaced. Limited research is available on renovation methods aimed at crownvetch removal and replacement with more desirable species. Using an integrated approach, this study was conducted to determine the effect of two fescue species, fescue seeding rate, and vegetation management on the establishment of a fescue and little bluestem [*Schizachyrium scoparium* (Michx.) Nash] mix and the removal of crownvetch.

Hard fescue (*Festuca ovina* var. *duriuscula* 'Minotaur') and creeping red fescue (*Festuca rubra* 'Pathfinder') were studied at two seeding rates (56 kg/ha and 112 kg/ha). Little bluestem was seeded at a constant rate of 11 kg/ha across all treatments. Vegetation management included untreated, mow to 7.6 cm at 6 and 12 weeks after planting (WAP), herbicide application of 2,4-D, dicamba, and clopyralid at 6 and 12 WAP, and herbicide application followed by mow 7 to 10 days later. The study was conducted over two years at two different locations. The soil at the Pleasant Gap, PA site was a Hagerstown-Opequon and Nolin complex on a 0 to 3% slope and a Murrill soil series on a 3 to 8% slope at the Rock Springs site. Plots were established on May 4, 2001 at Rock Springs and May 8, 2001 at Pleasant Gap. To optimize grass emergence the Rock Springs site was irrigated during the first 4 WAP.

At the Pleasant Gap site both creeping red and hard fescue produced similar amounts of biomass (211.9 g/m² and 223.2 g/m² respectively) while creeping red fescue (349.9 g/m²) out produced hard fescue (244.8 g/m²) at Rock Springs at the end of the year after establishment. Seeding rate had no effect on fescue biomass at the end of year after establishment. Fescue biomass at Pleasant Gap (613.8 g/m²) and Rock Springs (515.0 g/m²) was the greatest with the herbicide application only. There was no difference in fescue species on little bluestem biomass although a trend toward better little bluestem establishment was identified with hard fescue. Little bluestem establishment was greater with 56 kg/ha fescue than 112 kg/ha (significant at 0.10 level) at Rock Springs and there was no difference at Pleasant Gap. The herbicide application plus mow significantly increased little bluestem biomass (10.11 g/m²) at Pleasant Gap compared to the untreated (0.66 g/m²). Neither fescue species selection nor fescue seeding rate had an effect on reducing crownvetch biomass. However, crownvetch biomass was reduced with herbicide application plus mow to 1.4 g/m² and 0.3 g/m², respectively at Pleasant Gap and Rock Springs as compared to the untreated (150.7 g/m² and 217.8 g/m²).

When considering a crownvetch renovation hard fescue seeded at 56 kg/ha and managed with herbicide application plus mow during establishment year and the year after establishment increased or was no different than other treatments in the establishment of little bluestem while removing crownvetch. Future research will include determining the appropriate seeding rate mix of hard fescue and little bluestem as well as the success of this mix on steeper slopes.

ABSTRACT

Management of Japanese stiltgrass [*Microstegium vimineum* (Trin.) A. Camus] is a growing concern for many land managers. Japanese stiltgrass is a C₄ annual grass with a unique shade adaptation that allows it to form dense stands and outcompete native vegetation. Previous studies were conducted in containers to elucidate efficacy of a broad range of herbicides. Based on these results, two graminicides, fenoxaprop and sethoxydim, as well as imazapic, which is the only herbicide to list Japanese stiltgrass on its label, were chosen for future evaluation. The objectives were to compare herbicides, rates, timing and frequency required to control Japanese stiltgrass in established stands under forest cover.

An experiment was conducted in Wake County, NC to compare ½-label and full-label rates of fenoxaprop (0.10 and 0.19 kg ai/ha, applied with a nonionic surfactant) and sethoxydim (0.28 and 0.56 kg ai/ha). Herbicides were applied on 23 May (6 to 7 leaf, 0 to 1 tiller). Half of the plots were retreated four weeks after the initial treatment. Applications were made with a CO₂-pressurized backpack sprayer calibrated to deliver 280 L/ha at 407 kPa. Based on late-season visual evaluations, only the ½-label rate of sethoxydim applied once was significantly poorer than the other treatments, which all provided greater than 80% control.

Another experiment was conducted in Raleigh, NC and Virginia Beach, VA to compare early season (pre-tiller), mid-season (tillering), and late-season (pre-anthesis) applications of fenoxaprop (0.19 kg ai/ha, applied with a nonionic surfactant in NC, not VA), imazapic (0.07 kg ai/ha, applied with a nonionic surfactant), and sethoxydim (0.56 kg ai/ha). In NC, application dates were 25 April, 18 July, and 7 October. Applications were made with a CO₂-pressurized backpack sprayer calibrated to deliver 280 L/ha at 407 kPa. All early and mid-season applications provided excellent and statistically equivalent control of Japanese stiltgrass. Four weeks after treatment, late-season applications did not adequately control Japanese stiltgrass; however, they may be acting slower due to cooler weather and larger plant size. In the first VA run, application dates were 9 May, 11 June, and 22 July. Applications were made with a CO₂-pressurized backpack sprayer calibrated to deliver 234 L/ha at 207 kPa. Based on late-season visual evaluations, all treatments provided statistically similar levels of control ranging from 73 to 95%. In the second VA run, the early season treatment was omitted and mid- and late-season application dates were 22 July and 19 Aug with the same sprayer configurations. Based on late-season visual evaluations, all treatments provided 71 to 89% control of Japanese stiltgrass. Both NC and VA experienced severe drought conditions, and therefore all results must be validated with more typical rainfall.

In natural areas, where postemergence control of Japanese stiltgrass is desired, but eradication of other native vegetation is not desired, land managers have selective herbicide options available for management and restoration of plant communities.

PRE- AND POSTEMERGENCE CONTROL COMPARISONS FOR JAPANESE STILTGRASS A.E. Gover, J.M. Johnson, L.J. Kuhns, Penn State Univ., University Park; and D.A. Burton, The Schuylkill Center for Environmental Education, Philadelphia, PA.

ABSTRACT

Four field trials evaluating control of Japanese stiltgrass [*Microstegium vimineum* (Trin.) A. Camus] with pre- or postemergence treatments were conducted in wooded settings in Philadelphia or State College, PA. Complete control was observed with preemergence treatments of imazapic at 0.062, 0.094, or 0.12 lb/ac; oxyfluorfen at 0.75 lb/ac; and pendimethalin at 2 lb/ac. Preemergence applications of proflaminate at 0.65 or 0.98 lb/ac, and oryzalin at 2 lb/ac provided 93, 97, and 98 percent control, respectively. Corn gluten meal at 1160 lb/ac did not provide any observable reduction. Glyphosate applied August 12 at 0.75 lb ae/ac provided 100 percent control in two different trials; while an application of 0.38 lb ae/ac on August 12 was rated at 99 percent control in Philadelphia, and Centre County applications on July 29, August 15, and September 3 provided 100 percent control. Glufosinate provided 100 percent control applied at either 0.25 or 0.5 lb/ac, when applied between July 29 and September 3. String trimming on August 12 in two trials resulted in 92 and 93 percent control. An August 12 application of imazapic (0.062 or 0.094 lb/ac), quizalofop-P (0.023 or 0.046 lb/ac), fluazifop-P (0.21 lb/ac), sethoxydim (0.19 lb/ac), or clethodim (0.095 lb/ac) provided injury that ranged from 15 to 85 percent when rated September 6, but all treatments prevented seed set.

INTRODUCTION

Japanese stiltgrass is a shade tolerant, C₄ annual grass first recorded in the US in 1919, in Tennessee. Its range has expanded from Florida to Texas, with a current northern limit of Illinois to Connecticut (7) and Massachusetts¹. It occurs most commonly in areas of partial shade subjected to disturbance, such as roads, trails, rights-of-way, and flood-prone riparian corridors; as well as areas impacted by herbivory by white-tailed deer (*Odocoileus virginiana* Zimmerman)(1, 5, 6), turf areas, and ornamental beds (2, 4). Stiltgrass can produce up to 1000 seeds/plant, in terminal and axillary inflorescences, and seed viability in the soil has been demonstrated to be at least three years (1,6). It has a sprawling, decumbent growth habit, and was given the stiltgrass name because it produces reflexed processes at the nodes which elevate the stems off the soil surface, and take root upon contact with the soil. Stiltgrass is able to form near-monocultures, displaces existing vegetation (1), has not been observed as serving as a wildlife food source (6), and alters soil chemistry functions (3). As part of an ongoing effort to identify management approaches, trials evaluating preemergence herbicides, resulting vegetation after use of pre- or postemergence herbicides, and postemergence controls were established in Philadelphia, PA in conjunction with a management workshop; and a trial evaluating the effect of application timing of postemergence herbicides on stiltgrass control was established near State College, PA.

¹New England Invasive Plant Group. A newsletter of invasive plant control activities in New England. Volume 1, Spring 2002.

MATERIALS AND METHODS

Preemergence Herbicide Comparison.

The trial was located at the Schuylkill Center for Environmental Education (SCEE), Philadelphia, PA, on a NW facing slope, (approximately 10 percent) under a canopy of red oak (*Quercus rubra* L.), black oak (*Quercus velutina* Lam.), red maple (*Acer rubrum* L.), sassafras [*Sassafras albidum* (Nutt.) Nees], and black birch (*Betula lenta* L.). The treatments were applied to 12 by 25 ft plots, arranged in a randomized complete block with three replications, on April 11, 2002. In order to work around trees within the plots, a single-nozzle boom equipped with a Spraying Systems XR 8002 VS tip was utilized, with the spray fan parallel to the boom wand, delivering 20 gal/ac. The application was made with a CO₂-powered sprayer, at 24 psi. Understory vegetative cover was less than 1 percent. The most common species was garlic mustard [*Alliaria petiolata* (M.Bieb) Cavara & Grande], present both as overwintered rosettes as well as seedlings; followed by Japanese barberry (*Berberis thunbergii* DC), nimblewill (*Muhlenbergia schreberi* J.F. Gmel), and deertongue (*Panicum clandestinum* L.). Herbicide treatments included pendimethalin (N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine) at 2 lb/ac; oryzalin (4-(dipropylamino)-3,5-dinitrobenzenesulfonamide) at 2 lb/ac; prodiamine (2,4 dinitro-N³,N³-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine) at 0.65 or 0.98 lb/ac; oxyfluorfen (2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene) at 0.75 lb/ac; imazapic ((±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid) at 0.062, 0.094, or 0.12 lb/ac; and corn gluten meal (CAS Reg. No. 66071-96-3) at 1160 lb/ac. Stiltgrass germination was first observed at the SCEE on south-facing areas on April 3, 2002, and germinated stiltgrass at the coleoptile stage was observed in the trial area on the day of application. Soil temperatures at application were 58, 57, 56, and 52 degrees F at 0, 1, 3, and 6 in, respectively. Beginning immediately after application, plots treated with pendimethalin, oryzalin, prodiamine, or corn gluten meal were watered with the equivalent of 0.12 in of rain. In addition to the untreated control, a 4 ft wide untreated alley was left between each plot. Visual ratings of percent control were taken August 12, 2002, 122 days after treatment (DAT).

Resulting Vegetation Following Pre- or Postemergence Treatment.

This trial was located adjacent to the preemergence trial at the SCEE, on the same NW facing slope. Site vegetation was similar, with the addition of tree-of-heaven [*Ailanthus altissima* (Mill.) Swingle]. Preemergence treatments included pendimethalin at 2 lb/ac, and imazapic at 0.094 lb/ac, and were applied April 11, 2002, using the same spray equipment and technique described in the preemergence trial. Plots were 12 by 25 ft, arranged in a randomized complete block with three replications, with a 4 ft untreated alley between plots. Postemergence applications were made August 12, 2002, using the same spray apparatus used for the preemergence treatments, and included imazapic at 0.094 lb/ac plus a non-ionic surfactant² (NIS) at 0.1 percent (v/v), glufosinate (2-amino-4-(hydroxymethylphosphinyl)butanoic acid) at 0.5 lb/ac,

² Qwikwet 357 organosilicone-based non-ionic surfactant, Exacto Chemical Company, Richmond, IL.

glyphosate³ (N-(phosphonomethyl)glycine) at 0.75 lb ae/ac, quizalofop-P ((R)-2-[4-[(6-chloro-2-quinoxalinyloxy]phenoxy]propanoic acid) at 0.046 lb/ac plus a crop oil concentrate⁴ (COC) at 1.0 percent (v/v), and mowing with string trimmer at ground level. Understory vegetative cover was less than 1 percent on April 11, and ranged from 35 to 70 percent in the plots receiving treatment on August 12. Stiltgrass was by far the most prevalent species, followed by sassafras suckers and oriental bittersweet (*Celastrus orbiculatus* Thunb.). Stiltgrass was exhibiting symptoms of drought stress on August 12. Stiltgrass injury and botanical composition were evaluated September 5, 2002.

Postemergence Treatment Comparison.

This trial was established on August 12, 2002, along an unpaved roadway at the SCEE, on both cut and fill material. Plots were 10 by 25 ft, arranged in a randomized complete block design with three replications. The stiltgrass canopy was 8 to 18 in tall, and drought symptoms were evident in most of the plots. Herbicide applications were made using the same spray apparatus described for the preemergence trial. The treatments included glyphosate³ at 0.38 and 0.75 lb ae/ac, glufosinate at 0.5 lb/ac, imazapic at 0.062 lb/ac, quizalofop-P at 0.025 lb/ac, fluazifop-P ((R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid) at 0.21 lb/ac, sethoxydim (2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one) at 0.19 lb/ac, clethodim ((E,E)-(±)-2-[1-[[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one) at 0.095 lb/ac, and mowing at ground level with a string trimmer. Imazapic and fluazifop-P treatments included NIS², and quizalofop-P, sethoxydim, and clethodim treatments included COC⁴ (Table 2). Ratings of stiltgrass injury were taken September 6 and 18, and final stiltgrass seeding observations were made November 5, 2002.

Effect of Application Timing on Efficacy of Postemergence Treatments.

Glyphosate³ at 0.38 lb ae/ac, glufosinate at 0.25 lb ac, or quizalofop-P at 0.023 lb ac plus COC⁴, were each applied on July 29, August 15, and September 3, 2002, to 6 by 20 ft plots arranged in a randomized complete block design with three replications. The site was a right-of-way for an underground communications cable running through a forest. Stiltgrass comprised about 95 percent of the vegetation. Other species included white snakeroot (*Eupatorium rugosum* Houtt.), garlic mustard, wild garlic (*Allium vineale* L.) and Japanese barberry. Applications were made with a CO₂-powered, hand held boom equipped with Spraying Systems XR 8002 VS tips, delivering 20 gal/ac at 26 psi. The stiltgrass canopy ranged from 10 to 24 in tall during the application window. Stiltgrass was vegetative on July 29 and August 15, and at boot stage on September 3. Ratings of stiltgrass injury and vegetative cover were taken October 17, 2002.

³ Touchdown Pro, diammonium salt of glyphosate, 3 lb acid equivalent per gallon, Syngenta Professional Products, Syngenta Crop Protection, Inc., Greensboro, NC.

⁴ Clean Cut crop oil concentrate, Arborchem Products Company, Mechanicsburg, PA.

RESULTS

Preemergence Herbicide Comparison.

Weed pressure in the trial was light, and the untreated check plots averaged 15 percent vegetative cover on August 12, 122 DAT, the corn gluten treated plots averaged 18 percent, and herbicide treated plots ranged from 1 to 3 percent. The pendimethalin, oxyfluorfen, and imazapic treatments provided complete control. Plots treated with oryzalin, and proflaminate at 0.65 or 0.98 lb/ac were rated at 98, 97, and 93 percent control, respectively. Corn gluten did not provide any observable effect on stiltgrass. Sassafras suckers were the most common vegetation in the study area, and the only species to establish in herbicide-treated plots after application. The only species observed to establish from seed during the trial in any plot were stiltgrass and garlic mustard, which was observed in the untreated, corn gluten, and proflaminate treated plots.

Resulting Vegetation Following Pre- or Postemergence Treatment.

Preemergence applications of pendimethalin or imazapic prevented stiltgrass establishment, and resulted in similar vegetation (Table 1). Glufosinate, glyphosate, and mowing treatments were rated at 100 to 92 percent stiltgrass injury, and were not significantly different. None of these three treatments eliminated woody species such as sassafras or Oriental bittersweet, and only glyphosate eliminated garlic mustard that was present. Quizalofop-P and post-applied imazapic caused significantly less injury than the other postemergence treatments, but seed set was prevented.

Table 1. Summary of treatment effects on stiltgrass (MCGVM) injury and remnant vegetation, Philadelphia, PA. Preemergence (PRE) treatments were applied April 11, 2002. Postemergence treatments (POST) were applied August 12, 2002. All plots were rated September 5, 2002. Each value is the mean of three replications. The analysis of variance did not include the untreated check.

Treatment	Application Rate (lb/ac)	Application Timing	MCGVM Injury (%)	Vegetative Cover (%)	Prevalent Species*
untreated	---	---	0	2	MCGVM, ALAPE, ELOR
pendimethalin	2.0	PRE	100	1	SSAAL, CELOR
imazapic	0.094	PRE	100	1	SSAAL, CELOR
imazapic + NIS	0.094 0.1 % v/v	POST	43	4	MCGVM, CELOR
glufosinate	0.5	POST	100	1	ALAPE, LONJA, CELOR
glyphosate	0.75	POST	98	2	CELOR, SSAAL
quizalofop-P + COC	0.046 1.0 % v/v	POST	80	5	MCGVM, ALAPE, CELOR
string trim	---	POST	92	1	MCGVM, CELOR, ALAPE
LSD (p=0.05)			9	n.s.	

*Bayer Codes: ALAPE - garlic mustard, CELOR - Oriental bittersweet, LONJA - Japanese honeysuckle (*Lonicera japonica* Thunb.), MCGVM - stiltgrass, SSAAL - sassafras.

Postemergence Treatment Comparison.

When evaluated for seed production on November 5, 2002, filled-out seed was observed only in the untreated checks and buffer strips, and at the edge of a single imazapic treated plot. The treatments were all effective, and varied only in the amount of tissue necrosis and rate of symptom onset. Increased injury was observed when the plots treated with imazapic, quizalofop-P, fluazifop-P, sethoxydim, and clethodim were evaluated September 18, 12 days after the initial injury rating (Table 2).

Table 2. Summary of postemergence treatment effects on stiltgrass injury, Philadelphia, PA. Treatments were applied August 12, 2002, and evaluated on September 6 and 12, 2002. Each value is the mean of three replications. The analysis of variance did not include the untreated check.

Treatment	Application Rate (lb/ac)	Stiltgrass Injury	
		Sep 6 (%)	Sep 18 (%)
untreated	---	0	0
glyphosate	0.38	99	99
glyphosate	0.75	100	100
glufosinate	0.5	100	100
imazapic + NIS	0.062 0.1 % v/v	15	35
quizalofop-P + COC	0.023 1.0 % v/v	85	95
fluazifop-P + NIS	0.21 0.1 % v/v	33	48
sethoxydim + COC	0.19 32 oz/ac	57	82
clethodim + COC	0.095 1.0 % v/v	55	62
string trim	---	93	93
LSD (p=0.05)		14	

Effect of Application Timing on Efficacy of Postemergence Treatments.

When evaluated October 17, all florets examined in herbicide treated plots were sterile, and had emerged from the leaf sheath in only a few individuals within plots treated with quizalofop-P on September 3. From a control perspective, all treatments were equally effective - the differences were in how quickly the stiltgrass canopy was eliminated. There was a significant interaction between herbicide and application timing for stiltgrass injury, total vegetative cover, and stiltgrass cover. Glyphosate treated plots were rated at 100 percent injury for all application timings; while glufosinate treatments were rated at 100, 99, and 100 percent; and quizalofop-P treatments were rated at 99, 97, and 67 percent injury for the July 29, August 15, and September 3 applications, respectively.

CONCLUSIONS

These four trials add further evidence to the commonly reported experience that stiltgrass is readily controlled with many herbicides, as well as mowing. Stiltgrass was effectively controlled with rates of glyphosate and glufosinate below recommended label rates; and clethodim, fluazifop-P, imazapic, quizalofop-P, and sethoxydim were effective when used at the lowest labeled rates. The caveat is timing. Postemergence herbicides can be applied too late to prevent viable seed set, and postemergence treatments made earlier in the season have been reported as less effective, particularly with glufosinate (4); and stiltgrass tolerates mowing initiated early in the season, which allows it to be a weed in turf. In the settings where these trials were conducted, prevention of seed set without elimination of the treated plants was still a highly favorable outcome, as there was very little desirable vegetation to be released from competition. Where elimination of the treated plants is desired, the herbicide choices are reduced. The combination of herbicide types and timings, and low use rates provides land managers considerable flexibility in developing an integrated stiltgrass management program that incorporates mechanical, chemical, and cultural approaches such as establishing competing groundcover.

ACKNOWLEDGEMENTS

The authors wish to thank Jonathan Henry for his technical assistance.

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ABSTRACT

A trial was conducted to compare the effect of application timing on reducing the resprouts of tree-of-heaven (*Ailanthus altissima* [Mill.] Swingle) with basal bark treatments. The phenological timings chosen were bud swell, full leaf expansion, post seed development, and dormancy. The corresponding application dates were April 20, July 12, September 13, and November 20, 2001, respectively.

This trial was located along I-81 south near the off ramp to SR 114 near Mechanicsburg, PA. The study area was a south facing cut slope with a large, established stand of tree-of-heaven. The herbicide mixture used in the study included 1 lb/gal triclopyr, diluted in a commercial basal oil^{1/}, plus a dye indicator. The treatments were applied to completely cover the lower 30 cm of each stem. The average volume applied per treatment ranged from 209 to 303 L/ha. Application equipment included backpack sprayers equipped with a Spraying Systems #5500 Adjustable ConeJet nozzle with a Y-2 tip. The area was arranged in a randomized complete block design with three replications. Plot size was 12.2 by 12.2 m with 6.1 by 6.1 m subplots located in the center of each. All data was collected within each subplot. Initial stem counts and tree diameters were taken at the time of treatment. The initial data for the untreated plots was recorded on October 18, 2001. Tree diameters were measured at approximately 15 cm above the soil surface. Resprout information was collected between August 1 and 5, 2002 for all treatments.

Prior to treatment the plots averaged from 117 to 188 stems/subplot. Basal area ranged from 632 to 1354 cm². By August 2002, the average number of sprouts within each subplot had increased from the original count. Basal area decreased for all treated plots regardless of timing. All treated stems were controlled and only first and second year resprouts were counted. Basal area ranged from 43 to 92 cm² for the treated plots. This represents from 4.1 to 17.6 percent of what originally was present. The resprout basal area for the untreated check is reported as percent increase due to sprouting and does not include the basal area of the living, original stems. Resprout height varied from 27 to 46 cm for the treatments. There were no statistical differences found between any of the treatment dates for any of the data collected. The untreated check was not included in the statistical analysis.

Previous work had suggested that there was a correlation between application timing using basal bark treatments on tree-of-heaven and the amount of resprouting. The results of this test did not reproduce these previous observations. Basal bark applications made to tree-of-heaven serve to reduce the basal area by controlling the large treated stems. Some degree of resprouting can be expected regardless of the time of year the application is made. Primary control measures made on ailanthus require a follow-up to ensure proper management of this species.

^{1/} A 1:3 mixture of Garlon 4 (4 lb triclopyr acid/gal, as the butoxyethyl ester, Dow AgroSciences, Indianapolis, IN) and Arborchem Basal Oil (Arborchem Products, Mechanicsburg, PA).

Table 1: Summary of original stem number and basal area, plus the resprout stem number, basal area, and average resprout height within a 37 m² sub-plot for each treatment. The number in parentheses next to resprout stem number indicates the percent increase in stem number from the original. The number in parentheses following the resprout basal area represents the percent of resprout basal area compared to the original basal area present for that treatment. Initial data was collected at application timing for the treated plots. All applications were conducted in 2001. Resprout information was taken between August 1 and 5, 2002. Each value is the mean of three replications.

Application Timing	Original		Resprout		
	Stem No.	Basal Area (cm ²)	Stem No.	Basal Area (cm ²)	Height (cm)
untreated ^a	117	1064	235 (167%)	26 (3.2%)	19
Apr 20	157	1149	197 (137%)	74 (8.0%)	46
Jul 12	160	1354	270 (226%)	63 (5.6%)	27
Sep 13	188	1004	295 (217%)	43 (4.1%)	29
Nov 20	157	632	487 (324%)	92 (17.6%)	27
LSD (p=0.05)	n.s.	n.s.	n.s. (n.s.)	n.s. (n.s.)	n.s.

^aThe untreated check was not included in the statistical analysis.

EVALUATION OF SPRAYABLE HERBICIDES FOR CONTAINER-GROWN ORNAMENTALS. J. F. Ahrens, Connecticut Agric. Exp. Stn., Windsor; S. Barolli and R. Gray, Imperial Nurseries, Granby, CT.

ABSTRACT

Our objective is to expand the database of plant tolerances to sprayable herbicides not currently registered or in wide use. Alternative herbicides are essential, and knowledge of herbicide tolerances for many ornamentals is lacking. Herbicides were applied with a hand-held CO₂ backpack sprayer with 8004 nozzles (Spraying Systems Co) delivering 50 gal/A. Treatments on 6/12/02 were repeated on 7/30/02 and 9/26/02. Thirteen herbicide treatments and an untreated control were arranged in RCB with four replicates. Experimental units were three 2-gal containers of each of seven ornamentals and three 1-gal containers of Japanese painted fern (*Athyrium niponicum* 'Pictum'). The other plants were juniper (*Juniperus horizontalis* 'Wiltoni'), azalea (*Rhododendron* 'Stewartsonian'), bigleaf hydrangea (*Hydrangea macrophylla* 'Merritts Supreme'), pee gee hydrangea (*Hydrangea paniculata* 'Grandiflora'), bog rosemary (*Andromeda polifolia*), dwarf burning bush (*Euonymus alatus* 'Compactus') and clematis (*Clematis x jackmanii*). The juniper, bigleaf hydrangea and azalea were 1-gal plants repotted into 2-gal with 70% pine bark, 15% sand and 15% peat by volume. The rosemary, fern and clematis were in 100% pine bark. The rosemary and fern had some liverwort (*Marchantia polymorpha* L.) growing in them, whereas all others were in fresh soil mix. The burning bush and pee gee hydrangea were in 25% sand, 25% peat and 50% bark by volume. All but the burning bush were actively growing at first treatment. Sprays were on wet foliage and were followed by irrigation within 45 min.

The thirteen herbicide treatments were dithiopyr 0.25, 0.5 and 1.0 lb/A, trifluralin 2, 4 and 8 lb/A, diuron 0.25, 0.5 and 1.0 lb/A, and four combinations of isoxaben 0.75 lb/A with either prodiamine 0.65 lb/A, pendimethalin WDG 3.3 lb/A, dithiopyr 0.5 lb/A or trifluralin 2 lb/A. No treatment injured pee gee hydrangea after two applications and these were not treated a third time. A month following the third application on 9/26/02 none of the treatments had injured burning bush, juniper or azalea. Rosemary was significantly injured only by isoxaben + pendimethalin. This injury (chlorosis) developed after the second application. Unlike pee gee, the bigleaf hydrangea was excessively injured by all treatments except diuron 0.25 lb/A. Diuron 0.25 lb/A also was the least damaging to clematis whereas all others caused excessive injury. All treatments injured fern excessively. Weeds were counted and pulled at about 4-week intervals in 12 containers in each plot. Those counted included the rosemary and fern, which were not repotted and had more weed seeds. One spray of diuron at 0.25, 0.5 and 1.0 lb/A gave 60, 80 and 100% control of liverwort, and the second spray gave 100% control at all rates. The main weeds in the untreated containers were bittercress (*Cardamine* spp), comprising 73 and 88% and prostrate spurge (*Euphorbia supina* Raf.) comprising 16 and 6% in the two 2-month periods. Trifluralin, 2 and 4 lb/A, gave poor control of bittercress, and diuron at all rates gave no control of spurge. Liverwort control by diuron seemed to increase spurge. Percentage controls of all weeds for the 2- and 4-month periods were as follows: dithiopyr 0.5 lb/A - 82 and 98%, trifluralin 4 lb/A - 63 and 65%, diuron 0.25 lb/A - 57 and 85%, isoxaben + pendimethalin - 88 and 96%, isoxaben + dithiopyr - 70 and 86%, isoxaben + prodiamine - 53 and 78%, and isoxaben + trifluralin - 55 and 70%.

ABSTRACT

Two experiments were conducted in 2002 at a Connecticut nursery to evaluate herbicides for activity on liverwort (*Marchantia polymorpha* L.) growing in containers. A covered and partially heated hoophouse was the site for one experiment. Liverwort was prevalent in 3-gallon containers of Japanese andromeda (*Pieris japonica* 'Compacta') and 1-gallon containers of mountain laurel (*Kalmia latifolia* 'Olympic Fire'). The shrubs were dormant, very small, and had been sheared tightly 1 day before treatments were applied on February 27. Containers were arranged in randomized complete blocks with four replicates. Each plot consisted of three pots each of andromeda and laurel. Air temperature at time of treatment was 40 F. Granular treatments were applied with a calibrated, auger-fed drop spreader. Spray treatments were applied in a volume of 30 gal/A with a CO₂-pressurized sprayer equipped with a 3-nozzle boom and 8003 VS tips. Treatments consisted of oxadiazon 50WP (4 lb/A ai) plus copper sulfate (13.6 lb/A ai) spray, flumioxazin 51WDG (0.17 and 0.34 lb/A ai) sprays, flumioxazin 0.17G (0.17 and 0.34 lb/A ai) granules, and an untreated check. Granules were applied over the top of dry foliage, immediately followed by overhead watering for 1 min. Then sprays were applied over wet foliage, followed by overhead watering for 15 min.

Liverwort control (0 = none; 10 = complete) and plant injury (0 = none; 10 = plant dead) were evaluated visually during the spring of 2002. On April 9, liverwort control ratings were between 6.3 and 7.5 for all herbicide treatments. By May 7, all treatments had controlled most of the liverwort, with ratings between 7.9 and 9.5. The low rate of flumioxazin granules had the lowest rating. The high rate of flumioxazin spray and the oxadiazon plus copper sulfate treatment provided the best control. No herbicide injury was observed on laurel, which remained dormant until after May 7. On June 4, laurel vigor was poor and variable, probably due to the severe shearing in February. For andromeda, injury ratings on April 9 were between 0.8 and 1.7 for all herbicide treatments. On May 7, andromeda treated with flumioxazin showed little or no injury, but plants treated with oxadiazon plus copper sulfate had an injury rating of 2.3.

The other experiment was conducted in a greenhouse with rhododendron (*Rhododendron catawbiense* 'Nova Zembla'), deciduous azalea (*Rhododendron* 'Orchid Lights'), mountain laurel (*Kalmia latifolia* 'Minuet') and wintercreeper (*Euonymus fortunei* 'Regal Gold') growing in 4- by 4-in pots with considerable liverwort. Plants were dormant, except azaleas had ½ to ¾ inch of new growth when treatments were applied on February 27. Plots, containing three pots of each shrub, were replicated three times. Treatments, applied as described above, consisted of copper sulfate (13.6 lb/A ai) alone or combined with oxadiazon 50WP (4 lb/A ai), flumioxazin 51WDG (0.34 lb/A ai), flumioxazin 0.17G (0.34 lb/A ai), and an untreated check. On April 9, liverwort control ratings for all treatments were between 8.7 and 9.2. On June 4, control ratings were copper sulfate, 5.7; oxadiazon + copper sulfate, 10.0; flumioxazin 51WG, 10.0, and flumioxazin 0.17G, 9.3. Birdseye pearlwort (*Sagina procumbens* L.) was not controlled by any treatment. On April 9, the new growth of azalea was injured severely by oxadiazon + copper sulfate (7.7) and flumioxazin 51WG (5.7) sprays. Oxadiazon + copper sulfate also injured mountain laurel (1.7). No other injury ratings exceeded 1.0.

ABSTRACT

Asiatic dayflower (*Commelina communis* L.), an annual monocot in the spiderwort family, is becoming a troublesome weed in Christmas tree, nursery and landscape plantings in the Northeast. We evaluated fifteen herbicides for dayflower control in 2001. Flumioxazin, azafeniden, and oxyfluorfen plus s-metolachlor gave excellent control of dayflower (1). We conducted an experiment in 2002 at the same site in an attempt to confirm these results. The site is a conifer nursery in Brooklyn, CT. A large seedbank of dayflower exists in the gravelly sandy loam soil in which conifer seedlings are grown. The 2002 experiment was conducted in beds of balsam fir [*Abies balsamea* (L.) Mill.] that were planted as 2-year-old seedlings and had been established for 2 years. Plots were 4½-ft wide by 7-ft long. Herbicide treatments were applied with a hand-held boom equipped with three 8003 VS nozzle tips calibrated to deliver 30 gal/A. Treatments were replicated in four randomized complete blocks.

Our goal was to apply the herbicides prior to dayflower emergence. However, because of record-setting heat in the third week of April 2002, many dayflower seedlings had already emerged to a height of up to ½ inch by the time we applied treatments on April 24. Dayflower seedlings continued to emerge well into May. Most balsam firs were still dormant on April 24, but a few buds had opened with up to ½ inch of new growth. The soil was moist, and the air temperature was 56 F at time of treatment. Treatments consisted of isoxaben (0.5 and 1.0 lb/A), s-metolachlor (1.67 and 3.34 lb/A), s-metolachlor (3.34 lb/A) plus oxyfluorfen (0.5 lb/A), s-metolachlor (3.34 lb/A) plus simazine (1.5 lb/A), sulfometuron-methyl (0.38 oz/A), flumioxazin (0.25 and 0.5 lb/A), and azafeniden (0.5 and 1.0 lb/A). More than 1 inch of rain fell in the next 4 days, and May rainfall was slightly above normal.

Visual evaluations of Asiatic dayflower control and balsam fir injury were recorded on May 7, May 30, June 21 and August 21. None of the treatments caused significant injury to the firs, but considerable frost damage occurred to new needle growth in May. Isoxaben had little to no activity on dayflower, and s-metolachlor at the high rate (3.34 lb/A) controlled no more than 70% of dayflower at any evaluation. Oxyfluorfen plus s-metolachlor provided very good dayflower control early in the season (94% on May 7 and 89% on May 30), but only 63% control on August 21. Simazine plus s-metolachlor provided fair early-season control (75% on May 7 and 83% on May 30), but only 60% control on August 21. Dayflower control provided by sulfometuron-methyl was between 65 and 80% at all evaluations.

Flumioxazin and azafeniden provided excellent season-long control of dayflower, regardless of application rate. Both herbicides controlled between 92 and 99% of dayflower, even at the August 21 evaluation. Neither herbicide is currently registered for use in Christmas trees or nursery stock, but flumioxazin has a special local needs registration in some states and may be approved by the U.S. EPA for these crops in the near future. On the other hand, the manufacturer of azafeniden has announced that it will no longer pursue registration of this herbicide for ornamental crops.

1) Ahrens, J. F. and T. L. Mervosh. 2002. Preliminary results with herbicides for control of Asiatic dayflower in conifer beds. Proc. NEWSS 56:67.

ABSTRACT

As a result of increasing financial and environmental concerns, reducing herbicide use while still maintaining profitable ornamental crop production has been the recent focus of considerable research. This study compares two bark mulches that were found effective for providing long-term weed control in 1998, 2000 and 2001 when treated with various herbicides. The objective of this study was to investigate the extent of efficacy and duration of long-term weed control of two bark mulches treated with either of three preemergent herbicides for ornamental weed control. The two bark mulches were Douglas fir and pine nuggets, applied alone or in combination with three herbicides flumioxazin 51% (Sureguard) applied 0.25 lbs/ ac (ai), oryzalin 40% (Surflan) applied at 2 lbs/ ac (ai) or acetochlor 42% (Degree) applied at 2.5 lbs/ ac (ai). The herbicide treated bark was compared to a control (weedy check), direct sprays of the herbicides and mulch applied alone to the container surface for a total of 12 treatments. One-quarter teaspoon of seeds per pot of, common chickweed (*Stellaria media*), annual bluegrass (*Poa annua*), and prostrate spurge (*Euphorbia maculata*) were broadcast over the container surfaces, just prior to application of the prepared herbicide-treated carriers. The trial started on August 1, 2001. Visual ratings were evaluated twice at 121 DAT and 303 DAT. Ratings were based on a 1-10 scale where, 0 represents no control, 10 represents complete control and 7 or above represents commercially acceptable. Dry weights were also taken after 303 DAT. 121 DAT, four treatments gave a rating of 7 or higher, only one was a direct spray, acetochlor 42%. At 303 DAT, 6 treatments had a rating of 7 or higher, again only one was a direct spray, acetochlor 42%. The best three treatments and their averaged ratings, over the two evaluation dates were Douglas fir treated with acetochlor (8.4), acetochlor direct spray (7.9), and Douglas fir with the oryzalin (7.9). The three least efficacious treatments were the direct application of oryzalin, untreated pine nuggets and the acetochlor plus pine nuggets. Only the direct application of acetochlor provided commercially acceptable control. As expected, the direct applications of oryzalin and flumioxazin provided below commercially acceptable long-term control.

ORNAMENTAL WEED CONTROL RESEARCH IN THE IR-4 PROGRAM DURING
2002. J. R. Frank, IR-4 Project, Rutgers Univ., North Brunswick, New Jersey

ABSTRACT

Over 650 Ornamental research trials were conducted by the IR-4 project in 2002. These trials were carried out by 40 state, federal and independent researchers at 38 locations in 23 states. Research was conducted on 22 herbicides and four plant growth regulators. Seven weed scientists in the Northeast region helped in this research.

No Biopesticide ornamental weed control projects were conducted during 2002.

IR-4 Ornamental research for the green industry includes Floral, Forestry, Nursery, and Turf production and maintenance. Research areas also includes the Commercial Landscape, Interior Plantscape and Plant Propagation included tissue culture.

During 2002, 406 new Ornamental National Label Registrations were obtained. Herbicides accounted for 160 of these registrations. Label expansions included those for Clethodim (Envoy), Dithiopyr (Dimension), Isoxaben (Gallery), Isoxaben + Trifluralin (Snapshot), S- Metolachlor (Pennant Magnum), Oryzalin (Surflan), Pendimethalin (Pendulum) and Trifluralin (Treflan). Five label expansions for the plant growth regulator Chlormequat Chloride (Cycocel) were also obtained during the same period. Over 9800 National Label Registrations including 1927 herbicides and 124 plant growth regulators have been obtained.

ABSTRACT

Asiatic dayflower (*Commelina communis* L.) is an annual monocot that resembles a dicot. It can creep along the ground, rooting at the nodes, and cover large areas. Or, if it grows into a tree with low branches it can ascend up into the tree using the branches for support. Asiatic dayflower has been reported as a serious weed problem in several Christmas tree plantations in Pennsylvania and Maryland that were using standard herbicide-based weed control programs. The standard programs actually increased dayflower populations by releasing it from competition from other weeds. The objective of this study was to evaluate a variety of preemergence herbicides alone, or in combination, that might control the dayflower. The preemergence treatments used are presented in Table 1. They were applied on March 29, 2002 to Douglas fir that had been established in the field for five years. Treatments were applied as direct sprays through an OC02 nozzle in the equivalent of 20 gallons per acre (gpa). Dayflower cover was rated on May 30, nine weeks after treatment (WAT). Trees were evaluated for signs of injury and dayflower control was rated on July 24, 2002, 17 WAT, on a scale of 1 - 10, with 1 = no control and 10 = total control.

By May 30 there was little germination or growth of the dayflower in the control plots or any of the areas treated with azafenidin, flumioxazin, or the oxyfluorfen + metolachlor combination (Table 1). When applied alone, both isoxaben and sulfometuron stimulated the germination of dayflower. Isoxaben also appeared to stimulate its growth. Areas treated with oxyfluorfen and metolachlor had percent cover and dayflower heights comparable to the control. Adding isoxaben to them resulted in stimulated germination and growth of the dayflower.

By July 24 (17 WAT), both rates of azafenidin and the high rate of flumioxazin provided the best dayflower control, with control ratings ranging from 8.3 to 10. Areas treated with oxyfluorfen and metolachlor had ratings comparable to the untreated control. Isoxaben applied alone or in combination had the lowest control ratings. Treated plots were covered with vigorously growing dayflower. Plots treated with the low rate of sulfometuron had more dayflower than the control, while plots treated with the high rate were comparable to the control. However, though the dayflower cover was dense in sulfometuron treated plots, its growth was suppressed. It was stunted, chlorotic, and appeared to be incapable of flowering. There were no indications that any of the treatments caused any injury to the trees.

The results of this study are baffling. It can not be determined why dayflower growth was so light in the control plots. The entire study area had been uniformly covered with dayflower every year for at least the previous three years, so there should have been seed uniformly distributed throughout the area. There had been a late frost and dry weather prior to the May and July evaluations, but they did not seem to inhibit the germination or growth of dayflower in the isoxaben treated plots. Azafenidin and the high rate of flumioxazin provided the best dayflower control.

Table 1. Preemergence herbicide applications were made on March 29, 2002. Percent cover and maximum dayflower height, in inches, was taken on May 30, 2002, nine weeks after treatment (WAT). On July 24, 2002, 17 WAT, weed control ratings were made on a scale of 1 to 10, with 1= no control and 10=total weed control.

Treatments	Rate Lbs./A	May 30, 2002		July 24, 2002
		Percent cover ^{1/}	Height of dayflower (in)	Weed Control
1. Control		4 b	3.7 cd	5.0 d
2. Oxyfluorfen 2XL Isoxaben 75 DF Metolachlor 7.64E	0.75 0.75 2.9	67 a	11.3 a	1.7 f
3. Oxyfluorfen 2XL Metolachlor 7.64E	1.0 1.9	4 b	3.3 cd	6.3 cd
4. Oxyfluorfen 2XL Metolachlor 7.64E	1.0 3.8	2 b	2.7 cde	5.3 d
5. Isoxaben 75DF	0.5	55 a	10.7 a	1.3 f
6. Isoxaben 75DF	1.0	60 a	7.3 b	1.7 f
7. Flumioxazin 50WDG	0.25	1 b	3.0 cd	7.0 bcd
8. Flumioxazin 50WDG	0.5	0.3 b	1.0 de	9.0 ab
9. Azafenidin 80 WDG	0.38	0.8 b	1.7 cde	8.3 abc
10. Azafenidin 80 WDG	0.75	0 b	0 e	10.0 a
11. Sulfometuron 75 WDG	0.023	60 a	4.0 c	2.5 ef
12. Sulfometuron 75 WDG	0.047	40 a	2.7 cde	4.7 de

^{1/} Means within columns, followed by the same letter, do not differ at the 5% level of significance (DMRT)

ABSTRACT

Goal 2E (oxyfluorfen) is labeled for broadleaf and grass weed control in conifer seedbeds, transplant beds and field plantings. Sureguard 51DF (flumioxazin) has a similar mode-of-action, and has provided similar levels of weed control at lower use rates. No injury to dormant conifers has been reported from Sureguard, but actively growing conifers differ in susceptibility to Sureguard. Furthermore, Sureguard has not been evaluated for safety on young conifer seedlings. Atlantic white cedar (*Chamaecyparis thyoides*) is a native conifer of growing importance in southeastern U.S. flood plain reforestation efforts. Currently, no herbicides are labeled for use in Atlantic white cedar seedbeds. This study was conducted to evaluate and compare the safety of Goal and Sureguard applied over-the-top of Atlantic white cedar seedlings.

The treatments were Goal at 0.25 and 0.5 lb ai/A, with and without 0.25% v/v non-ionic surfactant, compared to Sureguard at 0.25 lb ai/A with 0.25% v/v non-ionic surfactant. The seedlings, with 0.5-1.0" of new growth, were growing in cell packs in a greenhouse. The treatments were applied 2/26/02 using a CO₂ pressurized backpack sprayer with two 8003 flat fan nozzles and calibrated to deliver 30 gallons per acre. Visual estimates of the percent of foliage damaged were conducted one week after application and then periodically through the first week of May.

One week after treatment, needle burn was apparent in all the treatments, but the Sureguard treatment produced the most severe damage (41%). Increasing oxyfluorfen dose and the addition of surfactant increased injury. Damage on the contacted foliage from Sureguard and Goal at 0.5 lb ai/A remained throughout the study. However, injury in all treatments was limited to the foliage existing at the time of treatment and new growth that emerged after treatment showed no signs of injury.

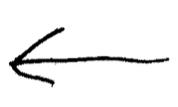
These data are consistent with previous research in which Goal and Sureguard injured some actively growing conifers. And, the injury from Sureguard to actively growing conifers is greater than that observed with labeled rates of Goal. However, weed control equivalent to labeled rates of Goal may be obtained with lower rates of Sureguard. For example: in container experiments we have found that 0.34 lb ai/A Sureguard provides similar preemergence weed control as 2 lb ai/A Goal. Therefore, further research is underway to evaluate the safety of lower doses and alternative application timing of Sureguard on seedling Atlantic white cedar.

Table 1. Goal (oxyfluorfen) and Sureguard (flumioxazin) injury to Atlantic white cedar (*Chamaecyparis thyoides*) seedlings.

Treatment	Rate (lb ai/A)	3/5/02	3/14/02	3/28/02	5/5/02
Goal	0.25	10c	13d	14c	14c
Goal	0.5	23b	26bc	24c	23bc
Goal + NIS	0.25	21b	24c	24c	17c
Goal + NIS	0.5	26b	34ab	40b	33ab
Sureguard	0.25	41a	41a	50a	36a

Means within a column followed by the same letter are not statistically different, based on a LSD means separation at $p = 0.05$.

HA
 HAN CR 5.5
 MANU KR
 ORBAIR 2.18
 BP 3.4
 BOO 1.38
 H.C. 49%
 ORBAIR 78%



GALLERY +

FACTOR
PEND
SURFLAN

FALL OH2

IMPROVED METHODS OF APPLYING HERBICIDES IN CONTAINER-GROWN ORNAMENTALS. S. Barolli, Imperial Nurseries, Granby, CT; J. F. Ahrens, Connecticut Agric. Exp. Stn., Windsor; and R. Gray, Imperial Nurseries, Granby, CT.

ABSTRACT

Primarily because of the need for overwintering structures (hoophouses), traditional herbicide applications in container nurseries in the northeastern U.S. have involved hand-held rotary spreaders and granular formulations such as OH-2 (oxyfluorfen + pendimethalin). At Imperial Nurseries this method required about 5.6 man-hours per acre, per application, and precision was poor, resulting in many weed escapes. In 1999, costs for hand weeding alone averaged \$800 per acre, in addition to three or four herbicide applications, on 140 acres of containers.

A two-section high clearance boom, mounted on a John Deere 6000 tractor, fabricated out of extruded aluminum, has been used the last 3 years. Equipped with Turbo FloodJet nozzles (TF-5, Spraying Systems Co) spaced at 40 in, the two sections and middle can spray a width up to 101 ft, which treats four 14-ft houses, aisles and the roadway in one pass. At 2 mph the sprayer applies 50 gal/A. The herbicides currently used include isoxaben in combination with proflam, oryzalin or pendimethalin, applied four times per season.

Because weeds start to emerge before all of the plastic covers are removed from hoophouses in the spring, the first application is made after venting but before plastic removal. We use backpacks equipped with a KLC-5 (Spraying Systems Co) nozzle to spray a 14-ft swath (1). With two passes at 3 ft/sec, we apply 14 gal/A. This system is also used on newly potted containers the day after potting.

Using the backpacks for the first spray, the overhead boom for the second, third and fourth, and the hand-held granular spreader for the fall application, total costs of weeding labor and herbicide per plant were reduced 10%, while costs for weeding alone were reduced 20% in 2001, compared with 1999 when hand-cranked granules were primarily used.

In 2002, to increase precision of the fall granular application, a Gandy Orbit-Air Model 64FS12 was mounted on a tractor bucket loader to pass over single rows of hoophouses. Tests showed this to improve uniformity of granule distribution over hand cranking, and man-hours to apply the granules were reduced 61% in 2002 compared to 2001. The net result is that in 2002 the total costs of weeding labor and herbicide were reduced 22% per plant from 1999 and costs for weeding labor alone were reduced 43%.

The protocol for sprays involves a brief irrigation to wet plant foliage just before spraying, and a 25-min irrigation soon after spraying. Another advantage of sprays is that applications can start early in the day when wind is down and plant foliage is wet with dew, whereas during active plant growth, granular applications of current products may injure wet, tender growth. A requirement for high clearance sprays or granules is that the operation ceases when wind begins to affect distribution.

1) Ahrens J.F. 1982. Modifying knapsack sprayers for herbicide applications. Proc. NEWSS 36: 290-291.

~~KALC5~~ - 14' SWATH

ABSTRACT

In the landscape and nursery industries, there is increasing demand for the production of native ornamental species. As is the case with non-native species, there is a dearth of information about the tolerance of many species to many of the herbicides currently on the market. Over the last six years, several studies have been conducted at the Long Island Horticultural Research and Extension Center examining the tolerance of several native species to a range of herbicides. All studies were conducted on either herbaceous perennials or woody shrub species that had been recently transplanted into containers filled with soilless media.

In several studies, pendimethalin 2 G, 3.8 CS or 60 WDG was applied at 2.0 or 4.0 lbs./a(a.i.) to *Aronia melanocarpa*, *Aster novi-belgii*, *Dennstaedtia punctilobula*, *Eupatorium purpureum*, *Ilex opaca*, *Itea virginica*, *Juniperus horizontalis*, *Liatris pycnostachya*, *Liatris spicata*, *Monarda didyma*, *Myrica pensylvanica*, *Oenothera fruticosa*, *Osmunda regalis*, *Phlox subulata*, *Physostegia virginiana*, *Polystichum acrostichoides*, *Potentilla fruticosa*, *Potentilla fruticosa* or *Viburnum trilobum*. The results of visual evaluations indicate that *Monarda didyma* and *Polystichum acrostichoides* were injured by both rates but *Dennstaedtia punctilobula* and *Phlox subulata* were visibly injured only by the higher rate 60 WDG formulation.

In another study, Regal O-O 3%G (oxyfluorfen 1% and oxadiazon 2%) was applied at 3.0, 6.0 and 12.0 lbs. *Asclepias tuberosa*, *Boltonia asteroides*, *Clethra alnifolia*, *Cornus alternifolia*, *Itea virginica* and *Monarda didyma* tolerated the 12.0 lb./a (4X) rate.

In a third set of studies, the postemergence graminicide, clethodim was applied at 0.25, 0.5 and 1.0 lbs/a(a.i.) to *Aster novi-belgii*, *Athyrium filix-femina*, *Boltonia asteroides*, *Clethra alnifolia*, *Dryopteris celsa*, *Echinacea purpureum*, *Ilex opaca*, *Itea virginica*, *Monarda didyma*, *Osmunda regalis* or *Prunus maritima*. The results indicate that *Echinacea purpureum* and *Osmunda regalis* were visibly injured only at the highest rate tested.

ABSTRACT

Controlling weeds is a dilemma each producer of Christmas trees faces. Over the past several years few active ingredients for weed control have been introduced in this market, leaving producers relatively few weed control options. In time growers in the Midwestern United States, and particularly in Michigan, have seen an influx of weeds such as Hoary alyssum (*Berteroa incana*) that no commercially available herbicide except glyphosate controls. This shift in weed populations has required growers to increase the use of glyphosate as the primary means for weed control. Flumioxazin is a new herbicide being developed by Valent U.S.A. Corporation for use in Christmas tree plantations. Flumioxazin has shown excellent plant safety and provides residual control of several aggressive weeds such as Hoary alyssum. Due to the recent increase in reports of glyphosate resistant weeds, Christmas tree growers throughout the Northeast and Midwest are looking for alternative weed control programs. Experiments were conducted the past three growing seasons at the Mathisen Tree Farms in Greenville, MI to evaluate the potential use of flumioxazin on Christmas trees. The objective of these trials was to evaluate the performance of spring and fall applications of flumioxazin on trees produced for the Christmas tree market. In addition to evaluating flumioxazin, several compounds including glyphosate were also evaluated. However, acceptable levels of weed control were not obtained in treatments that did not contain either a fall or spring application of flumioxazin. Weeds have tremendous reproductive capabilities, thus implementation of control practices which may require the use of a residual herbicide is critical in preventing widespread infestations in Christmas trees. Overall, of the treatments evaluated only flumioxazin provided acceptable residual weed control that could reduce a growers requirement for using glyphosate as the primary weed control tool.

GLADIOLUS RESPONSE TO PREEMERGENCE AND POSTEMERGENCE
HERBICIDES. R. J. Richardson and B. H. Zandstra, Michigan State Univ., East
Lansing.

ABSTRACT

Few herbicide options are available for broadleaf weed control in gladiolus and the available products will not control all broadleaf weeds for the entire growing season. Field studies were conducted near Bronson, MI, to evaluate weed control and gladiolus injury from 14 preemergence (PRE) herbicides and 13 postemergence (POST) herbicides. An untreated control was included for comparison to herbicide treated plots. In the PRE study, gladiolus injury was generally greatest with oxyfluorfen, clomazone or imazamox. Imazamox resulted in severe stunting of the crop, while oxyfluorfen and clomazone resulted in necrotic lesions or bleaching of the leaves, respectively. Visible injury with other herbicides was low, although small necrotic leaf lesions were occasionally observed. Gladiolus treated with metolachlor, halosulfuron or flumioxazin had more flower stalks per plot than the untreated control. Stalk height, stalk shape, and flowers per stalk did not differ between treated plots and the untreated control. However, more differences among these variables may have been present with a standard fertilization regime. Giant foxtail (*Setaria faberi* Herrm.) control was greater than 80% with pendimethalin, oryzalin, oxyfluorfen, flumioxazin, and clomazone. Common ragweed (*Ambrosia artemisiifolia* L.) control was greatest with flumioxazin, although this did not differ from control with mesotrione, halosulfuron, oxyfluorfen, linuron, and prometryn. Yellow nutsedge (*Cyperus esculentus* L.) control did not exceed 80% with any treatment, but several herbicides did reduce the nutsedge population as compared to the untreated control. In the POST study, only clopyralid had adequate crop safety to warrant further research. Other herbicides resulted in severe injury or complete death of gladiolus.

DISTRIBUTION AND CONTROL OF INVASIVE WEEDS IN MICHIGAN NURSERIES.
R. J. Richardson, B. H. Zandstra, E. J. Carlson, and T. A. Dudek, Michigan State Univ.,
East Lansing.

ABSTRACT

Inula britannica L. and yellow fieldcress [*Rorippa sylvestris* (L.) Bess.] are perennial, invasive weed species that can produce large quantities of seed and vegetatively reproduce from roots. These species have been identified in several Michigan locations and *Inula britannica* has been confirmed in one homeowner site. Field and greenhouse studies were conducted to evaluate possible herbicidal control methods for each of these weeds. Glyphosate, glufosinate, clopyralid, dicamba, 2,4-D, flumioxazin, halosulfuron, imazapic and other herbicides were included in trials with each species. *Inula britannica* field studies were conducted in a standing crop of Hosta. Control of regrowth from rosette-stage or bolted *Inula britannica* was obtained with glufosinate, triclopyr plus clopyralid, clopyralid, triclopyr, 2,4-D, or 2,4-D plus clopyralid while Hosta tolerance was generally only acceptable with clopyralid. Glyphosate, imazapic, and halosulfuron did not adequately control the weed. In yellow fieldcress studies, 2,4-D, glyphosate, glufosinate, and 2,4-D plus clopyralid controlled the weed greater than 90%. Clopyralid and ethametsulfuron were not effective in controlling yellow fieldcress.

ABSTRACT

A study was initiated at two Christmas tree farms in the fall of 2001 to determine the length of weed control provided by the standard, simazine, and two herbicides not yet labeled for use in Christmas trees, azafenidin and flumioxazin. Fraser firs were treated at both farms; Douglas fir was treated at one of them. All treatments included glyphosate to eliminate existing weeds at the time the preemergence herbicides were applied. Simazine was applied at 1 or 2 lbs./ac, flumioxazin at 0.25 or 0.38 lbs./ac, and azafenidin at 0.38 and 0.5 lbs./ac. Applications were made with an OC02 nozzle directed to contact the lower parts of the trees. Weed control and plant injury were evaluated in early June 2002. On both sites at which Fraser fir was treated, the flumioxazin and azafenidin provided good to excellent weed control through early June. At the site on which the Douglas fir were grown the flumioxazin and azafenidin provided barely acceptable control, but it was significantly better than the control provided by simazine at 1 lb./ac. None of the Fraser fir were injured by any of the treatments. There was limited tip dieback on some of the Douglas fir that received the azafenidin treatments.

The treatments listed in Table 2 were applied on April 2 and April 23, 2002 to established Fraser fir and newly planted Canaan fir. The treatments were applied over-the-top through 8004E nozzles. Plants were evaluated for injury and weed control ratings were made 13 (Canaan fir) and 16 (Fraser fir) weeks after treatment (WAT). In addition, plant mortality in the newly planted Canaan fir was counted at 13 WAT. All of the preemergence herbicide treatments applied in April provided good to excellent weed control through July at both sites. The only treatment that rated lower than the other treatments at one site and time was simazine plus pendimethalin plus oxyfluorfen at Kuhns Farm on July 20. It had a control rating of 8.0, compared to the other treatments that were rated at least 9.5. The number of dead trees in the untreated control plots was much higher than in any of the treated plots. It was a very dry summer and the weed competition in these plots overwhelmed the newly planted trees and resulted in over 80% mortality. Mortality in the treated plots ranged from 3 to 30%. This is further proof of the value of having a good weed control program in place the year of planting.

INTRODUCTION

An application of glyphosate plus simazine can be made in the fall as a directed spray to the lower one-third to one-half of all conifers grown as Christmas trees in the northeastern United States. The glyphosate kills existing weeds and the simazine prevents the growth of winter annuals. However, at the recommended rate of 1 to 2 lbs./ac simazine, it does not provide control very far into the following spring. A treatment that would provide control 6 or 8 weeks into the spring growing season would give growers additional flexibility regarding the timing of their spring preemergence herbicide application. The first objective of this study was to determine how long into the following spring fall applications of flumioxazin and azafenidin would provide a high level of weed control.

The triazine herbicides atrazine and simazine have been used in Christmas tree plantations for more than 40 years. Problems with triazine resistant weeds have developed in many plantations. The second objective of this study was to evaluate the weed control provided by flumioxazin and azafenidin in sites where weeds that are known to develop triazine resistance occur.

METHODS AND MATERIALS

The studies were conducted at Kuhns Tree Farm in Boalsburg, PA, and McCurdy's Tree Farm in Dillsburg, PA. On September 19 and October 2, 2001 the treatments presented in Table 1 were applied to Fraser fir (*Abies fraseri* (Pursh) Poir) at Kuhns Tree Farm, and Fraser fir and Douglas fir (*Pseudotsuga menziesii* (Mirb) Franco) at McCurdy's Tree Farm, respectively. The Fraser fir at Kuhns had been planted in early-April, 2001 as 10 to 14 inch tall 2-2 transplants. At McCurdy's the Fraser fir were planted in spring of 2000 and the Douglas fir were planted in spring of 1999 both as 2-2 transplants. The treatments were applied as directed sprays through OC02 nozzles at 30 psi in the equivalent of 22 GPA. The lower half of both sides of the trees was intentionally contacted. The air and soil temperatures at Kuhns' farm were 72 and 63°F, and at McCurdy's were 79 and 70° F, respectively. Plots were 50 ft by 3ft, and there were 10 plants per plot. Experimental design was a randomized complete block design with three replications per treatment. Plants were evaluated for injury and weed control ratings were made June 5 at Kuhns and April 23 and June 3, 2002 at McCurdy's.

Preemergence herbicide applications were made on April 2 and April 23, 2002 at Kuhns' and McCurdy's, respectively. Treatments listed in Table 2 were applied to Fraser fir at Kuhns' Farm that had been planted in early-April, 2001 as 10 to 14 inch tall 2-2 transplants. The plants treated at McCurdy's were 2-2 Canaan fir (*Abies balsamea phanerolepis* Fern.) that were planted the week before application. The treatments were applied over-the-top through 8004E nozzles at 30 psi in the equivalent of 20 GPA. The air and soil temperatures at Kuhns' farm were 62 and 42° F, and at McCurdy's were 52 and 48° F, respectively. Plots were 50 ft by 3ft, and there were 10 plants per plot. Experimental design was a randomized complete block design with three replications per treatment. Plants were evaluated for injury and weed control ratings were made on June 5 [9 weeks after treatment (WAT)] and July 20 (16 WAT) at Kuhns and June 3 (6 WAT) and July 23 (13 WAT) at McCurdy's. In addition, plant mortality was counted on July 23 at McCurdy's.

RESULTS AND DISCUSSION

The Fraser fir at McCurdy's had very few weeds present on April 23, 2002 (Table 1). Plots treated with glyphosate plus flumioxazin or azafenidin in the fall were weed free. Plots treated with glyphosate alone, or glyphosate plus simazine, in the fall had a few weeds growing in them. The predominant weeds were yellow rocket (*Barbarea vulgaris* R. Br.), purple deadnettle (*Lamium purpureum* L), common ragweed (*Ambrosia artemisiifolia* L) seedlings, and western salsify (*Tragopogon dubius* Scop.). On June 3, the treatments including flumioxazin or azafenidin were still providing excellent control. The plots were almost weed-free except for giant foxtail (*Setaria faberi* Herrm.), which was present in almost all of the plots treated with these two herbicides. Plots treated with glyphosate plus simazine in the fall had significantly fewer weeds than the plots

treated with glyphosate alone. The predominant weeds in the plots treated with glyphosate alone were common ragweed, giant foxtail, common lambsquarter (*Chenopodium album* L.), and shepherds-purse (*Capsella bursa-pastoris* (L.) Medicus). Other weeds present were common dandelion (*Taraxacum officinale* Weber in Wiggers), Pennsylvania smartweed (*Polygonum pennsylvanicum* L.), common groundsel (*Senecio vulgaris* L.), common yellow woodsorrel (*Oxalis stricta* L.), and field pennycress (*Thlaspi arvense* L.). Where simazine was added to the glyphosate, the predominant weeds were giant foxtail, common ragweed, field pennycress, and purple deadnettle. Other weeds present were velvetleaf (*Abutilon theophrasti* Medicus), common lambsquarter, Pennsylvania smartweed, and common groundsel.

The Douglas fir at McCurdy's had more weeds present on April 23, 2002 than were in the Fraser fir. Plots treated with glyphosate plus flumioxazin or azafenidin in the fall were almost weed free. They had some Canada thistle and very small, stunted common dandelion in them. Plots treated with glyphosate alone, or glyphosate plus simazine, had similar amounts of weeds growing in them. The predominant weeds were common dandelion, Canada thistle (*Cirsium arvense* (L.) Scop.), prickly lettuce (*Lactuca serriola* L.), common groundsel, and Virginia pepperweed (*Lepidium virginicum* L.). By June 3, the level of control had decreased. Plots treated with the high rate of azafenidin still had a control rating of 8.0, which was significantly higher than plots treated with glyphosate alone or with simazine. Plots treated with flumioxazin, or azafenidin at the low rate, had control ratings of 6.5 to 6.7, which are marginally acceptable in a production system. The predominant weeds in the plots treated with flumioxazin or azafenidin were common dandelion and giant foxtail. Control ratings for plots receiving glyphosate plus simazine in the fall were no higher than the plots receiving glyphosate alone. The predominant weeds in these plots were dandelion, giant foxtail, Virginia pepperweed, prickly lettuce, and Pennsylvania smartweed.

At Kuhns Farm, on June 5, 2002, the plots receiving glyphosate alone in the fall ranged from 50 to 100% cover. The predominant weeds in the plots were common ragweed and maretail (*Conyza canadensis* (L.) Cronq.). Other weeds present included Pennsylvania smartweed, field pennycress, common yellow woodsorrel, mouseear chickweed (*Cerastium vulgatum* L.) and green foxtail (*Setaria viridis* (L.) Beauv.). The plots receiving glyphosate plus simazine in the fall did not have significantly higher control ratings than the plots receiving glyphosate alone. The plots receiving flumioxazin and azafenidin had significantly higher control ratings than the plots receiving glyphosate alone or with simazine. The level of control in these plots was adequate to allow growers to delay their preemergence applications until this time.

Table 1. Weed control on Fraser Fir at Kuhns Tree Farm and Fraser Fir and Douglas Fir at McCurdy's Tree Farm. Treatments were applied on September 19, 2001 at Kuhns and evaluated on June 5. At McCurdy's the treatments were applied on October 2, 2001 and evaluated on April 23 and June 3, 2002. Weed control ratings are presented on a scale of 1 to 10, with 1 = no control and 10=total control.

Treatments	Rate Lbs./ A	Kuhns	McCurdy's			
		June 5 Fraser ^{1/}	April 23		June 3	
			Fraser	Douglas	Fraser	Douglas
Glyphosate 4L	1.5	1.0 c	9.5 ab	5.5 b	1.3 c	1.7 c
Simazine 4L	1	4.0 c	9.4 b	6.8 ab	3.3 b	2.7 c
Glyphosate 4L	1.5					
Simazine 4L	2	4.0 c	9.7 ab	7.5 ab	4.7 b	4.7 bc
Glyphosate 4L	1.5					
Flumioxazin 50 WDG	0.25	8.3 ab	10 a	8.9 a	9.1 a	6.7 ab
Glyphosate 4L	1.5					
Flumioxazin 50 WDG	0.38	9.4 a	10 a	9.8 a	9.7 a	6.5 ab
Glyphosate 4L	1.5					
Azafenidin 80 WDG	0.38	8.5 ab	10 a	9.8 a	9.9 a	6.7 ab
Glyphosate 4L	1.5					
Azafenidin 80 WDG	0.5	6.8 b	10 a	9.8 a	9.9 a	8.0 a
Glyphosate 4L	1.5					

^{1/} Means within columns, followed by the same letter, do not differ at the 5% level of significance (DMRT)

All of the preemergence herbicide treatments applied in April provided good to excellent weed control through July (Table 2) at both sites. The only treatment that rated lower than the other treatments at one site and time was simazine plus pendimethalin plus oxyfluorfen at Kuhns Farm on July 20. It had a control rating of 8.0, compared to the other treatments that were rated at least 9.5. The predominant weeds in the control plots at Kuhns on June 5 were marestalk, common ragweed and Pennsylvania smartweed. Marestalk was the dominant weed in the treated plots. By July 20, the same weeds dominated the control plots. Other weeds present were wild carrot (*Daucus carota* L.), giant foxtail, common yellow woodsorrel, common lambsquarter and yellow foxtail (*Setaria glauca* (L.) Beauv.). The treated plots were almost completely weed free on July 20. The predominant weeds in these plots were tumble pigweed (*Amaranthus albus* L.), and common ragweed. Foxtails were present in all but plots treated with pendimethalin.

On June 3 at McCurdy's the untreated control plots were covered with weeds while all of the treatments provided excellent control. By July 23 the untreated plots were totally covered by dense stands of weeds. The predominant weeds present in the

control plots were red sorrel (*Rumex acetosella* L.), hard fescue (*Festuca brevipila* Tracey), common lambsquarter, and common ragweed. Other weeds present were common pokeweed (*Phytolacca americana* L.), hemp dogbane (*Apocynum cannabinum* L), tumble pigweed, goldenrod (*Solidago* sp.), yellow nutsedge (*Cyperus esculentus* L.), *Rubus* sp. and poison-ivy (*Toxicodendron radicans* (L.) Ktze.). On July 23 (13 WAT) weed control in all treated plots was rated between 8.0 and 9.0. However, they provided almost total control of annual weeds. The predominant weeds in treated plots were the perennials horsenettle (*Solanum carolinense* L), Canada thistle, goldenrod, hemp dogbane, and *Rubus* spp.

The number of dead trees in the untreated control plots was much higher than in any of the treated plots. It was a very dry summer and the weed competition in these plots overwhelmed the newly planted trees and resulted in over 80% mortality. Mortality in the treated plots ranged from 3 to 30%. This is further proof of the value of having a good weed control program in place the year of planting.

Table 2. Preemergence herbicides applied at Kuhns Tree Farm and McCurdy's Tree Farm on April 2, and 23, 2002 respectively. Weed control ratings were done June 5 and July 20, 2002 at Kuhns (nine and 16 weeks after treatment –WAT) and June 3 and July 23, 2002 (seven and 14 WAT) at McCurdy's. Weed control ratings are presented on a scale of 1 to 10, with 1 = no control and 10=total control. Tree mortality was evaluated at McCurdy's on July 23. Data presented is average over three reps.

Treatment	Rate Lbs./ Acre	Weed Control					Average # Dead Trees
		Kuhns		McCurdy's			
		June 5 ^{1/}	July 20	June 3	July 23	July 23	
Control		1.0 c	1.7 c	1.3 c	1.0 b	8.3a	
Simazine 4L	2.5	9.7 ab	8.0 b	9.9 ab	8.0 a	1.7 b	
Pendimethalin 3.3 EC	2.5						
Oxyfluorfen 2XL	0.5						
Isoxaben 75DF	0.75	9.4 b	9.8 a	9.8 ab	8.7 a	1.7 b	
Pendimethalin 3.3 EL	2.5						
Oxyfluorfen 2XL	0.5						
Flumioxazin 50DF	0.25	9.9 ab	9.6 a	9.0 b	8.2 a	2.7 b	
Flumioxazin 50DF	0.38	9.8 ab	9.7 a	9.9 ab	8.7 a	2.3 b	
Flumioxazin 50DF	0.25	10.0 a	9.5 a	10.0 a	9.0 a	3.0 b	
Simazine 4L	2.5						
Flumioxazin 50DF	0.25	9.9 ab	9.8 a	9.9 ab	8.8 a	1.7 b	
Pendimethalin 3.3EC	2.5						
Flumioxazin 50DF	0.25	9.9 ab	9.9 a	9.9 ab	9.0 a	1.0 b	
Simazine 4L	2.5						
Pendimethalin 3.3 EC	2.5						
Azafenidin 80DF	0.4	9.9 ab	9.5 a	9.9 ab	8.7 a	0.3 b	
Azafenidin 80DF	0.4	9.9 ab	9.8 a	9.9 ab	8.0 a	2.0 b	
Pendimethalin 3.3 EC	2.5						

^{1/} Means within columns, followed by the same letter, do not differ at the 5% level of significance (DMRT)

THE EFFECTS OF COMPOSTED ORGANIC WASTE PRODUCTS ON WEED POPULATIONS IN FIELD GROWN WOODY NURSERY PRODUCTION. T. L. Harpster, J. C. Sellmer, and L. J. Kuhns, Penn State Univ., University Park.

ABSTRACT

Field nursery production of woody ornamentals reduces organic matter content and overall soil structure within the field. Nursery operations must rebuild their soils regularly through either green manure production or compost additions. In April 2000, 4.8 cubic yards of Spent Mushroom Substrate (SMS); Penn State Compost (PSU), dining hall waste co-composted with manure; State College Municipal Waste (SCMW), composted leaves and brush; and University Area Joint Authority composted sewage waste (UAJA) were evenly applied and incorporated into 30 by 30 foot at the Penn State Univ. Horticulture Farm at Rock Springs, to compare the short and long-term impact of compost amendments on the physical properties of nursery field soil, growth of ornamental nursery stock, and weed growth. A standard weed control program consisting of spring preemergence applications of either oxyfluorfen, oryzalin and simazine at 2 lb./ac, or isoxaben at 0.75 lb./ac and metolachlor at 3 lb./ac, and fall applications of simazine at 1 lb./ac and glyphosate at 2 lb./ac were used.

Dominant weed types changed over the three years from perennial and annual grasses - yellow foxtail (*Setaria glauca* (L.) Beauv.), giant foxtail (*Setaria faberi* Herrm.), green foxtail (*Setaria viridis* (L.) Beauv.), large crabgrass (*Digitaria sanguinalis* (L.) Scop) quackgrass (*Elytrigia repens* (L.) Nevski) and goosegrass (*Eleusine indica* (L.) Gaertn.) - to annual broadleaf weeds - common lambsquarter (*Chenopodium album* L.), redroot (*Amaranthus retroflexus* L.) and tumble pigweed (*Amaranthus albus* L.), and wild buckwheat (*Polygonum convolvulus* L.). Regular fall treatments of glyphosate helped to control the perennial grasses.

Overall, weed mass based on total dry weight increased over the three years of the study. During the first growing season, the preemergence herbicide treatments (oryzalin, simazine, and oxyfluorfen) were not effective in preventing weed growth as demonstrated by the nearly 10 fold increase in total weed biomass compared to the compost free control within two months of herbicide application. Among the compost treatments, the UAJA plots produced significantly more weed biomass than the compost free control plots. While no significant difference in weed biomass was found among compost amended plots. After the second season, the PSU compost plots were significantly higher in total weed numbers compared to the SMS, UAJA, and compost free control plots. In addition, the PSU compost plots were significantly higher in percent weed coverage compared to the compost free control plots, but not the other three compost treated plots. After the third growing season, no significant differences in total weed biomass or percent weed coverage were found among the treatments. The overall equilibration in percent weed coverage and total weed biomass among the treatments suggest the factors within the compost amendments that enhanced initial weed growth have diminished.

Our studies indicate 1) standard weed control strategies are not effective during the first years after the addition of compost; 2) compost amended plots yielded higher weed biomass; and 3) the total weed biomass and weed coverage equilibrated over time amongst the treatments. In conclusion, nursery producers need to know that

addition of composted organic matter will enhance environmental conditions for weed growth in the short term.

COMPARISON OF HERBICIDE TREATED BARKS AND PELLETIZED LEAF MULCH FOR ORNAMENTAL WEED CONTROL. H.M. Mathers, L.T. Case, A. A. Stoven, S. B. Johansen, and J. A. Pope, Ohio State Univ., Columbus.

ABSTRACT

Nursery growers estimate they spend \$500 to \$4000 per acre for manual removal of weeds, depending upon the weed species being removed. Reduction of this expense with improved weed control methodologies would have a significant impact on the industry. This study took place in two locations, Ohio State Univ., Columbus, OH and Univ. of Illinois, Champagne, IL (data not shown). It compares herbicide treated pine bark and rice hulls, which were found extremely effective for increasing and extending efficacy in studies in 2001, with herbicide impregnated Douglas fir bark pellets and herbicide treated leaf pellets. The objectives of this study were to determine the phytotoxicity and extent and duration of efficacy of 15 treatments. Efficacy treatments were seeded with Annual Bluegrass (*Poa annua*), Spurge (*Euphorbia maculata*). Phytotoxicity was evaluated with *Thuja occidentalis* 'Nana', *Spiraea x nipponica* 'Snowmound' and *Spiraea x bumalda* 'Goldflame'. The preemergent products tested were diuron 80% (Karmex DF) 1 (ai) lb/acre, oryzalin 40% (Surflan AS) 2 (ai) lb/ acre and diuron impregnated Douglas Fir Pellets at rates of 0.0004 oz, 0.004 oz and 0.07 oz. The herbicide treated bark was compared to an untreated control (weedy check), direct sprays of the herbicides and mulch alone. Efficacy and phytotoxicity began June 4, 2002 and were conducted in 1-gallon (3.8 L) pots. Efficacy and phytotoxicity evaluations were conducted at 45 and 112 d after treatment (DAT) by collecting dry weights and visual ratings. The visual rating of efficacy was conducted on a scale of 0 to 10 where 0 represents no control, 10 complete control and 7 or above, commercially acceptable. The visual rating for phytotoxicity was on a scale of 1 to 10 where 1 represents no injury, 10 complete kill, and 3 or below represents commercially acceptable. Only the leaf pellets treated with diuron provided above commercially acceptable weed control at 45 DAT. At 112 DAT the leaf pellets treated with diuron provided a rating of 4.4. The untreated leaf pellets had a rating of 0.6 averaged over the two evaluation dates, which was only slightly better efficacy than that provided by the control. The remaining fourteen treatments provided below commercially acceptable weed control at 45 and 112 DAT. All treatments except the direct application of diuron provided phytotoxicity ratings below 3 or commercially acceptable at 45 and 112 DAT. Date was not significant in the phytotoxicity evaluation.

ABSTRACT

Problems associated with herbicide use in ornamental production and maintenance includes improper calibration, the need for multiple applications and as with other crops, off-site movement of herbicides through leaching, run-off and spray drift. Examination of new chemicals or formulations and innovative methodologies that could reduce these problems is vital to the industry. The objective of this study was to evaluate the extent and duration of efficacy and phytotoxicity of two new formulations of dichlobenil (Casoron 50WP and Casoron L), applied alone or onto two bark mulches, pine nuggets or shredded hardwood. The herbicide treated bark was compared to a control (weedy check), direct sprays of the herbicides and mulch alone. Three granular preemergent herbicides, one not registered for container use, dichlobenil (Casoron 4G) and two new formulation of flumioxazin (Broadstar 0.17G, VC1351 and VC1362) were also evaluated for a total of 12 treatments. The trial started on June 10, 2002. Visual ratings and dry weights were evaluated for efficacy and phytotoxicity at 2, 4, 8 and 15 weeks after treatment (WAT). Ratings of efficacy were based on a 1-10 scale where, 0 represents no control, 10 represents complete control and 7 or above represents commercially acceptable. A visual rating score of 1, no injury, to 10, complete kill, and with 3 or below, commercially acceptable, was used to evaluate phytotoxicity. Phytotoxicity was evaluated on two species, *Salvia* 'May Night' and *Spireae X bumalda* 'Goldflame' transplanted as plugs approximately 8 inches in length into 1 gal. pots and placed in full sun. The two most efficacious treatments at 2, 4, 8 and 15 WAT were hardwood bark treated with Casoron 50WP and pine nuggets treated with Casoron L. The hardwood bark with Casoron 50 WP was providing an efficacy rating of 7.9 and the pine nuggets with Casoron L 7.0 in the analyses of combined dates 2, 4, 8 and 15 WAT. There was no significant difference in efficacy provided by the untreated hardwood bark and pine nuggets. The control provided by the untreated mulch was only slightly better than the control with a rating of 0.3 over the four combined dates. The Casoron L and Casoron 50 WP applied as directed sprays onto the container surfaces provided below commercially acceptable weed control in the analyses of combined dates 2, 4, 8 and 15 WAT, with ratings of 2.9 and 2.6 respectively. The Casoron 4G was consistently the most phytotoxic treatment in the trial. The Casoron 4G had a rating of 4.5, in the analyses of combined dates 2, 4, 8 and 15 WAT. Date was not significant in the phytotoxicity evaluation.

IMPACT OF WEED DENSITY AND REMOVAL TIMING ON SINGLE-PASS POST WEED CONTROL AND CORN GRAIN YIELD. B.A. Scott, M.J. VanGessel, Univ. of Delaware, Georgetown; M.W. Myers, W.S. Curran, Penn State Univ., University Park; and B.A. Majek, Rutgers Univ., Bridgeton, NJ.

ABSTRACT

The need for Integrated Pest Management practices has brought total post-emergence weed control programs to the forefront of agriculture. In order for farmers in the northeastern US to make environmentally sound yet practical, cost-effective herbicide applications, it is important to have an understanding of how weed density and weed removal timing affect corn growth and yield. A study was established at two locations in DE, two locations in PA, and one location in NJ to determine the effect of weed density and application timing on a single-pass POST weed control program. This study was conducted two years.

The study was a split-block design with four replications. All sites were conventionally tilled, and both irrigated and non-irrigated sites were used in the first year. In year two, all studies were conducted under non-irrigated conditions. Three 'weed' densities of safener-treated forage sorghum were seeded to create uniform weed populations. First year seeding rates were 72 seeds/m² (high), 10 seeds/m² (medium), or 3 seeds/m² (low). To increase the number of established plants in the second year, high, medium, and low seeding rates were 145 seeds/m², 31 seeds/m², or 6 seeds/m², respectively. The study area was lightly cultivated and glyphosate-resistant corn was planted at normal seeding rates. A PRE treatment of s-metolachlor + atrazine at 2.4 kg ai/ha was broadcast over the entire study to control weed infestations. Study treatments consisted of glyphosate at 1.1 kg ai/ha applied to each weed density at V2, V4, V6, and V8 corn stages. In the first year, sorghum was reseeded at the respective density three days after glyphosate application. This was done to simulate additional weed emergence. Based on results of the first year, only the V2 and V4 stages were reseeded in the second year. A weed-free and a full season competition treatment were included at all densities.

Sorghum size and density were collected in two 0.5m² areas per plot prior to each removal timing and at 7, 14, and 21 days after reseeding. Twelve weeks after corn planting, two 0.5m² sorghum biomass samples were removed, dried, and weighed. At corn maturity, the two center rows of each plot were harvested for yield.

In DE and PA, four out of six locations showed the interaction between weed density and removal timing was significant for corn grain yield. Weed removal in the low and medium densities, regardless of timing, did not reduce corn yield. However, yield loss was observed at the high density. At the high weed density, yield loss was not the same for all weed removal timings. This varied with location. At the two remaining locations, main effects were significant, but the interaction was not significant.

ABSTRACT

The Roosevelt-Vanderbilt National Historic Sites (site) are a complex of six parcels collectively distinguished as the Vanderbilt Mansion, the Home of Franklin D. Roosevelt and the Eleanor Roosevelt National Historic Site. The 800-acre site complex is located in Hyde Park in the beautiful and historic Hudson River Valley of New York State. Each historic site has more than 70 acres of second growth, mixed-hardwood forest accessible to the public by the Hyde Park Trail, numerous ponds, streams, meadows and old fields. More than half of the site's acreage overlooks and borders the east shoreline of the Hudson River.

The mission of the site is to maintain and preserve the interpretive historical period associated with each estate. Over the last fifteen years, invasive exotic (non-native) plant species have become an ever-increasing threat to the cultural use and natural resources of these historic sites. Funding was acquired to hire a biological science technician to conduct an invasive plant assessment and inventory of the sites in the summer of 2002. Year 2000 aerial photographs were used to divide the sites into 200-meter high-resolution grids. Within each of these grids, cultural boundaries, habitat boundaries, hiking trails and property lines (unit) were determined. The inventory was conducted by walking within each unit and the perimeter of each unit. Each historic site was investigated for the presence of more than 120 non-native plants known as or potential invaders of natural areas.

A total of 58 non-native plants were identified in the site complex. Thirty-one of these species were known cultivated components of the landscape or formal gardens during the historical time periods associated with the site complex. These non-native species were categorized as invasive or non-invasive in this site complex based on prolific seed production and dispersal, rapid colonization or rampant vegetative spread, threat to native species or high cost of removal and control. Species were also grouped as either 1) cultivated and naturalized, 2) cultivated only or 3) introduced by other than cultivation and naturalized.

Based on this assessment, 60% of the non-native species are invasive. Twenty-two species are currently cultivated in the site and are growing wild in the site's cultural and natural resource areas. Eighty-two percent are invasive in this group. Fourteen non-native species are restricted to cultivated areas and formal gardens. Four species in this group (29%) were categorized as invasive due to isolated escapes. Twenty-two non-native species have entered the sites primarily through adjacent properties and have not recently been cultivated in the landscape or formal gardens. Fifty-nine percent in this group are invasive in the site's cultural and natural resource areas.

Five-leaf akebia (*Akebia quinata* (Houtt.) Decne.), black swallow-wort (*Cynanchum louiseae* Kartesz & Gandhi), common reed (*Phragmites australis* (Cav.) Trin. ex Steud.), Japanese knotweed (*Polygonum cuspidatum* Sieb. & Zucc.) and water chestnut (*Trapa natans* L.) ranked the highest in the threat and risk assessment of the non-native invasive species identified in the site. Patch locations for these invasives were mapped (GPS) or documented on aerial photographs. The findings of this assessment will be used to prepare a strategic management plan to control invasive exotic species in the Roosevelt-Vanderbilt National Historic Sites.

ABSTRACT

A cooperative effort among growers and researchers is underway to determine if Beach plums (*Prunus maritima*) can be commercially cultivated. One of the barriers to efficient production is lack of adequate weed control. These studies were conducted to determine if young beach plum transplants can tolerate commercially available herbicides that are already registered for other tree fruit species.

In one study, seedling beach plums, were planted in the field in the spring of 2001. In 2001 and again in 2002, four herbicides were applied at 1/2X, 1X and 2X normal label rates. The herbicides evaluated: napropamide, simazine, oryzalin and fluazifop-p (2001 only) are already registered for use on domestic plums (*Prunus domestica*). The results of two years of application indicate a relatively high rate of tolerance to these herbicides. The exception being that the highest rate of simazine did inhibit beach plum growth to a slight but significant extent.

A second study was conducted to determine if a new liquid formulation of the preemergence herbicide dichlobenil (Casoron) offers greater or longer lasting efficacy against a perennial weed species. The test was established in small beach plum orchard which had been planted to three year old seedlings the previous year. The treatments, which consisted of two formulations (4% G and 1.38L) at 4 and 6 lbs./a (a.i.) were applied on April 25, 2002 when the air temperature was 53°F and the soil surface was 50°F. Four hours following the application, 0.3" of rain occurred which incorporated the treatments well into the Riverhead sandy loam. Plant height and the branch spread (width) were measured 66 and 132 days after treatment. The results of those measurements indicate that there was no adverse effect of any of the treatments on the growth of these young fruit trees during the course of the growing season. The results of the 10 week post-treatment evaluation indicates that the liquid formulation was providing significantly better control of dandelion than the granular formulation. Ground ivy was only controlled better by the liquid formulation at the higher rate of application.

ABSTRACT

The objectives of these studies were to evaluate 1) the efficacy of vinegar to control weeds when used as a directed spray at the base of crops, 2) rates and volume of vinegar required to achieve weed control when broadcast, and 3) soil drench as a method of control for Canada thistle. The results are based on one year's data and need to be repeated.

The efficacy of vinegar and sensitivity of crops to vinegar were studied in two different experiments. Vinegar at acetic acid concentrations of 10% and 20% was sprayed at the base of the plants in 20 foot rows in corn (*Zea mays* L. 'FC95 PLUS' planted on May 10, 2002) and vegetable soybean (*Glycine max* 'Lancos' planted on May 10, May 30 and June 4, 2002). The corn plants were 40 days old and the soybean plants were 55, 61 and 80 days old at the time of the first spray (early treatment). In a separate set of plots a second spray (late treatment) was done when the corn plants were 55 days and the soybean plants were 68, 74 and 93 days old. Separate weedy control and weed free controls were established for each set. The crops and weeds were visually rated for injury, damage and vigor one week after application of vinegar on a scale of 0 to 100 where, 0 equals no effect and 100 equals death. Dry weights were obtained at the end of the experiment. In a second field experiment foliar and basal treatments of 10% and 20% vinegar were compared in a randomized complete block design.

The injury to corn in the first experiment ranged from 5-35%. The replicated experiments suggested that the foliar application damaged corn more than the basal spray and the 20% application was more injurious to corn than the 10% application. The injury rating ranged from 25 to 50% for the foliar application and 5 to 20% when applied to the base of the plants. Weed control in plots dominated by giant foxtail (*Setaria faberi* Herrm.) ranged from 100% for early sprays and 55% when sprayed late. In the pigweed (*Amaranthus hybridus* L.) dominated plots, weed control ranged from 100 for early spray to 85 for late spray. The corn grain yields did not show significant differences for all treatments from the weed free controls but the coefficient of variability was very high at 55% due to extreme droughty conditions.

The crop injury in soybeans ranged from 5 to 45%, with the younger plants showing more injury than older plants. The soybean crop showed less injury with 10% vinegar than by the 20% concentration. The soybean yields did not show significant differences among the weed free controls and the vinegar treatments. In all the trials weed control ranged from 90 to 100 percent.

In a separate investigation, in 2002, of vinegar concentration and application volumes, field and greenhouse grown weeds were sprayed with 10 and 20% vinegar at 30, 60 and 90 gallons per acre (GPA) in replicated trials. The visual rating of weed kill showed that 20% vinegar at 90 GPA was not sufficient to control grasses and other annual weeds when the weeds were about 50 days old. This suggests that vinegar may not be appropriate for broadcast application on established annual weeds but is more suitable for spot applications to leaf runoff where weed control has been good. However, seedling weeds may be susceptible to broadcast applications.

Canada thistle (*Cirsium arvense* L. Scop) seedlings as young as 30 days old are readily killed by vinegar treatments as low as 10% acetic acid concentrations. (Jay Radhakrishnan, et al 2001. Vinegar as a potential herbicide for organic agriculture. Proceedings Northeast Weed Science Society. vol. 56, p100). An investigation of the effect of vinegar soil drench in an established Canada thistle patch was conducted on an Elkton silt loam soil. Open bottom circular pans having an area of 34 square feet were placed in a Canada thistle field and 5 gallons of 20% or 30% vinegar were applied on 10 October 2001 within the pan area. In a third treatment the soil surface within the pan area was lightly cultivated, destroying the top growth of Canada thistle prior to the application of 5 gallons of 20% vinegar. The total stem numbers, plant biomass and soil pH was determined by destructive sampling in October 2001, November of 2001 and at the beginning of April the following year. The results showed 90% reduction in the number of stems and plant biomass in all vinegar treatments compared to the control. However, applying 20% vinegar with or without cultivation and 30% vinegar drench did not produce significant differences in Canada thistle growth. The pH of the soils ranged from 5.9 to 6.6 at the beginning of the experiment in October 2001 and declined to 4.7 to 5.2 in the vinegar treated plots a month later. However, the pH in the treated plots ranged from 5.8 to 7.1 by April of the following year.

EVALUATION OF VINEGAR AND CORN GLUTEN FOR WEED CONTROL IN FIELD-GROWN SWEET PEPPER. R. S. Chandran, West Virginia Univ., Morgantown.

ABSTRACT

Field experiments were conducted in Morgantown, West Virginia, in 2000, 2001 and 2002, to evaluate various methods of weed management in organically grown sweet pepper (*Capsicum annuum* L.). In 2000 and 2001, straw mulch (2", 4", and 8"), black plastic, and hand-cultivation treatments were evaluated in non-irrigated pepper. Plots with buckwheat as a cover crop in 2000, established during the cropping season and tilled later into the soil, were also evaluated for weed control the following year. Experiments in 2002 compared hand-cultivation, plastic mulch, and 4" straw mulch, to vinegar applied at 4.5, 9.0 and 18% (vol/vol, acetic acid), and corn gluten applied at 20, 40 and 80 lbs/1000 sqft for weed control in irrigated pepper. In 2000 and 2001, plastic mulch increased pepper yields by 50 and 150%, compared to plots that received hand-cultivation, or 8" straw mulch, respectively. Twenty-fold pepper yield increases were noted in plastic mulch plots compared to untreated plots. Dry shoot weight of pepper plants correlated well ($R=0.88$) with total pepper yield. Hand-cultivated plots and plastic mulch plots resulted in similar root dry wt of pepper, but caused ten-fold increases of root dry wt than untreated plots, however, roots were 35% longer in pepper grown on plastic mulch plots compared to hand-cultivated pepper. Buckwheat residues did not suppress weeds to cause significant yield increases the following year. In year 2002, corn gluten applied at 80 lbs/1000 sqft reduced weed counts by 78% at 3 weeks after treatment and 32% at 2 months after treatment. Directed application of vinegar to actively growing weeds at all three concentrations provided >90% control of carpetweed (*Mulogo verticillata* L.), Canada thistle [*Cirsium arvense* (L.) Scop.], yellow woodsorrel (*Oxalis stricta* L.), common purslane (*Portulaca oleracea* L.), common lambsquarters (*Chenopodium album* L.), smooth pigweed (*Amaranthus hybridus* L), and velvet leaf (*Abutilon theophrasti* Medicus), and 50% control of yellow nutsedge (*Cyperus esculentus* L.) when applied at 18%. However, total weed counts 1 MAT recorded only 20 to 30% reductions from vinegar treated plots compared to control. In 2002, hand-cultivated plots and plastic mulch plots gave 25-fold, and 19-fold higher yields, respectively, than untreated plots.

ABSTRACT

Pesticide usage information is important to design environmental monitoring programs, to assess benefits and risks of active ingredients, and to analyze usage trends as affected by regulatory and farm policies. Use estimates by crop and state provide regulators and policymakers with a clear understanding of which pesticides are important in crop production and preferred by growers. Unfortunately, except for California, yearly compilation of usage estimates for all crops and active ingredients are not available for other states. USDA's National Agricultural Statistics Service (NASS) surveys growers of most fruit, vegetable, and field crops on a regular basis but only major states are covered.

The National Center for Food and Agricultural Policy (NCFAP) has created the only publicly-available comprehensive pesticide use database for the US and maintained it for the past ten years. NCFAP's database includes 87 crops, 48 states, and 200 active ingredients. The database also includes 15,000+ records of the use of individual active ingredients by crop and state and estimates of the percent of crop acreage treated and average application rate per acre. Financial support for the maintenance of this database is obtained from USDA, USGS, agrichemical companies, and commodity organizations. NCFAP has released two national updates of its database so far, for 1992 and 1997. NCFAP's 1992 herbicide use estimates were published by WSSA in "Crop Losses Due to Weeds in the United States-1992". The NCFAP's pesticide use database is regularly cited by EPA in the assembly of pesticide use profiles as part of its regulatory actions and is also a main source of data in USGS's NAWQA program.

NCFAP's primary sources of data include compilations from USDA's NASS and the California DPR. Other sources include USDA's Crop Profile documents, annual surveys of MN/ND sugarbeet growers, annual compilations of herbicide use in cotton as published by the National Cotton Council, and special surveys conducted in individual states such as ND. For states and crops not covered by the available surveys, NCFAP conducts a survey of Extension Service specialists who provide pesticide use recommendations to growers and who have considerable anecdotal knowledge of which pesticides growers are using. These Extension contacts are particularly important in Northeastern states due to the absence of survey data. More than 300 Extension specialists have provided data for the 1992 and 1997 databases. Prior to its release, NCFAP sends preliminary pesticide use data to the agrochemical registrants for reviews of the accuracy of the estimates.

NCFAP has begun the process of updating its national pesticide use database for 2002. NCFAP will input 2002 data from NASS surveys and Extension specialists, complete its industry review, and release the complete database for 2002 in November of 2003. NCFAP will post the 2002 database on its website (www.ncfap.org), which currently houses the 1992 and 1997 databases. Changes in pesticide use between 1997 and 2002 will be analyzed and discussed at various professional meetings.

THE GENETIC CHARACTERIZATION OF *PSEUDOMONAS SYRINGAE* PV. *TAGETIS*, A BIOCONTROL AGENT OF CANADA THISTLE. H. Kong, C.B. Blackwood, J.S. Buyers, J. Lydon, USDA/ARS/Sustainable Agricultural Systems Laboratory, Beltsville, MD; T.J. Gulya, Jr., USDA/ARS/SASL/Sunflower Research Laboratory, Fargo, ND.

ABSTRACT

Pseudomonas syringae pv. *tagetis*, a plant pathogen being considered as a biological control agent of Canada thistle (*Cirsium arvense* (L.) Scop.), produces tagetitoxin, an inhibitor of RNA polymerase which results in chlorosis of developing shoot tissues. Although the bacteria is known to effect several Composite plant species and has been reported in several countries, little is known of its genetic diversity. Here we report the genetic relatedness of 18 strains of *Ps.* pv. *tagetis* with respect to each other and to other *Pseudomonas syringae* pathovars and two closely related species, *Pseudomonas savastanoi*, based on 16S-23S intergenic spacer (ITS) sequences. The 16S-23S spacer regions were amplified by PCR, the purified PCR products cloned in a pGEM vector, and the sequence data determined using an ABI 373A DNA Sequencer and Big Dye terminators. The size of the 16S-23S ITS region was 526 bp in length for all 18 *Ps.* pv. *tagetis* strains tested. Half of the 18 *Ps.* pv. *tagetis* strains tested had the identical 526 bp sequence, while the other half differed from these at only one to three base positions, all of which occurred in the ITS region downstream from the tRNA^{Ala} gene. Thus, based on the 16S-23S ITS regions, there is very little divergence within this pathovar (99.4% to 99.8% homology). The genetic differences that exist were not correlated with differences in host plant or geographical origin. The 16S-23S ITS sequences of the seven *P. syringae* pathovars and two *P. savastanoi* pathovars tested ranged in size from 530 bp to 545 bp and showed significant heterogeneity from the 16S-23S sequences of *Ps.* pv. *tagetis*. Including base differences from substitutions, deletions, and additions, sequence homologies of *Ps.* pv. *tagetis* and the other closely related species tested varied from 82.5% to 97.3%. Thus, while not useful in determining differences within the species, the use of the 16S-23S ITS region of *Ps.* pv. *tagetis* provides a method of distinguishing this species from other closely related *Pseudomonas* species.

DEMONSTRATING THE USE OF MULTIPLE NOZZLE SPRAY BOOMS IN INDIA AND NEPAL.¹ R. R. Bellinder, A. J. Miller, R. K. Malik, J. D. Ranjit, P. R. Hobbs, L. S. Brar, G. Singh, S. Singh, and A. Yadav

ABSTRACT

In 1998, Indian regulatory agencies approved the registration of CGA 184927, MON 37500, and fenoxaprop for postemergence control of isoproturon-resistant littleseed canarygrass (*Phalaris minor* Retz.). Herbicides used in rice and wheat prior to 1998 were generally mixed with sand or urea and spread by hand. Foliar pesticide spray applications consisted primarily of insecticides and fungicides that were applied to high value crops. These pesticides were often sprayed to runoff with backpack sprayers that were equipped with single hollow cone or flood nozzles. Applicators walked through the fields, swinging the wands in sweeping motions and uneven pesticide distribution and over-application resulted from these applications. The newly registered postemergence herbicides were applied with the same equipment and in the same fashion. Following these applications, control of littleseed canarygrass was strikingly inconsistent and growers blamed the lack of control on the manufacturers. It was clear that basic understanding of application techniques was lacking. In response to this, an application training workshop was developed and taken to India and Nepal in 2000. The workshops focused on teaching participants how to use and construct multiple nozzle booms, the importance of flat fan nozzles, calibration, drift avoidance, and applicator safety. To date, approximately 3000 farmers, extension agents, scientists, and industry representatives have attended 30+ workshops. The participants have been unanimously enthusiastic about the value of the workshops. Although simplistic, the adoption of this technology will significantly decrease the amounts of herbicides applied and will increase efficacy and efficiency.

¹ Paper accepted for publication in Weed Tech Volume 16.

CAREFUL MOWING NEARLY ELIMINATES SICKLEPOD SEEDBANK RETURN IN A SHORT CANOPY CROP. M.G. Burton, North Carolina State Univ., Raleigh.

ABSTRACT

Crop rotations involving crops with short canopies may allow net reductions in the seedbank of some weedy annual forbs. Because these weeds tend to produce nearly all of their reproductive structures above the competing short crop canopy, mowing may nearly eliminate seedbank return. Although crop yield losses due to weed interference with the crop may still occur, long-term management in organic or low-input systems may benefit. Weed control is usually identified as the greatest concern and most troublesome aspect of organic food and fiber production systems. Sweetpotato was used as the model short-canopy crop (in contrast to soybean) and sicklepod (*Senna obtusifolia*) was the model weed. Sicklepod is a non-native, troublesome weed that affects crop production in the southeastern United States. A large-seeded indeterminate annual forb, sicklepod is both a competitive weed and a prolific producer of seed. Used in a crop rotation, timely mowing in crops with naturally short canopies may provide a means of reducing return of seedrain to the soil seedbank. When competing with a crop that has a moderate to tall canopy (e.g. soybean or maize), sicklepod begins flowering and continues vertical growth. Since the crop is also continuing vertical growth, many sicklepod fruit are established below the final height of the crop canopy (Figure 1). As an indeterminate weed, flowering and fruiting continue with more of the younger fruit being set nearer the top of the plant and above the crop canopy (Figure 2). If mowing above the soybean canopy were possible, many of the more mature fruit would be left behind in the field. Since sicklepod quickly grows above the canopy of sweetpotato, and because the sweetpotato canopy does not have pronounced increase in height, nearly all sicklepod fruit are set above the canopy of sweetpotato. On 17 September 2001 (repeated in 2002), 25 sicklepod plants were selected and marked with flagging tape in soybean field and 46 sicklepod plants were selected and marked in a sweetpotato field in Goldsboro, NC. Both fields were managed without the use of pesticides. One-half of the sicklepod plants (23) in sweet-potato were then mowed with a bushhog just above the crop canopy. The bushhog deck height was set as low as possible such that few sweetpotato leaves would be removed during the mowing operation. Two-weeks later, the day before scheduled sweetpotato harvest, all fruit were removed from the sicklepod plants. These pods were sorted into size and color classes (small green, large green, or yellow). Sicklepod fruit collected from the soybean field were also separated into "above" or "below" categories based upon where they occurred relative to the canopy of adjacent soybean plants. Pods were counted and dried to constant weight at 60 C. Average reproductive biomass of mowed sicklepod plants was reduced by 97% (Figure 3). Although regrowth of branches on many sicklepod plants was as much as 0.5 m, all fruit of mowed plants were small due to short time for development. Seeds within small green pods have almost no cotylendony resources and are not believed to be capable of producing viable seedlings. On average, sicklepod plants in the unmowed treatment had about 10 pods that were yellow (Figure 4), which is the point believed to be associated with seed physiological maturity. Optimal mowing practices would be so low as to remove few leaves of the crop and would occur before viable seed have been formed in sicklepod fruit, but must also consider the reproductive phenology of other weeds (e.g. *Amaranthus* spp.) that are present. Studies are underway to determine if

sicklepod seeds dispersed from immature pods by mowing are capable of producing viable seedlings.



COMPARISON OF TWO METHODS TO ESTIMATE WEED POPULATIONS IN FIELD-SCALE AGRICULTURAL RESEARCH. R.D. Stout, M.G. Burton, H.M. Linker, North Carolina State Univ., Raleigh.

ABSTRACT

The population dynamics of weedy plant species in agricultural fields is important to field management and scouting methods can assist in describing the spatial distribution within fields. There are many scouting methods that result in recommendations for whole-field or extremely coarse-scale management but do not describe the spatial aspects of weed population dynamics within the field. A cotton field in Goldsboro, NC, was scouted for weeds using two different methods and these methods were then compared to an actual count. The field was divided using a 7.6m (25ft) square grid and each grid intersection was flagged. The first scouting method consisted of estimating the weed densities by walking three passes within each 7.6m cell. The estimate was a species-specific rating of density based on perceived weed density. The second method consisted of making an actual count of all weeds present in a 0.84m² (9ft²) quadrat at every grid intersection. The second method also included drawing polygons around weed patches throughout the field using a differentially-corrected GPS backpack. The four intersection counts representing the corners of each cell were averaged using a "moving window" approach and the resulting values were reclassified (on a unit area basis) to the same scale used in the estimated cell count rating. The actual density of weeds per cell was used as a standard for comparison of the scouting methods and each scouting method was evaluated against the actual cell counts data using residual analysis. Preliminary results indicate that the estimated cell count rating was the most accurate in describing the spatial distribution of weeds in the field. The intersection method was more likely to underestimate the actual weed density than was the estimated count approach. However, the intersection method procedure took much less time.

MICROBOTRYUM CARDUI, A POTENTIAL BIOLOGICAL CONTROL AGENT FOR *CARDUUS* THISTLES IN THE U.S. D. K. Berner, L. K. Paxson, D. G. Luster, and M. McMahon, USDA-ARS, Fort Detrick, MD.

ABSTRACT

Carduus species and the related thistles *Silybum marianum* (L.) Gaertn. and *Onopordum acanthium* L. are problematic invasive weeds in the USA and targets of classical biological control efforts. During a pathogen collection trip in June 2001, numerous smutted capitula of *Silybum marianum* (L.) Gaertn. syn. *Carduus marianus* L. (milk thistle) were found in a weedy field in southeastern Greece (39° 23.97' N, 22° 25.68' E). Infected plants were mixed with apparently healthy *S. marianum* plants in the field. When smutted capitula were split open, powdery masses of teliospores were found in the ovaries of all florets. All of the capitula on infected plants were similarly infected, and no seeds were found from infected plants. As all capitula and florets on diseased plants were infected, it is suggestive that the infections were systemic. Teliospores from smutted ovaries conformed to the description for *Microbotryum cardui* (A. Fischer v. Waldh.) Vánky (syn. *Ustilago cardui* A. Fischer v. Waldh.): globose, pale brown, 14-18 µm diameter, coarsely reticulate with coarse wings on the margins extending out 2-3 µm. Florets of *S. marianum* and *Onopordum arabica* were inoculated with sporidial cultures of *M. cardui*, and the organism was recovered from embryos of the resulting seeds of both species. Plants developing from seeds with infected embryos might be systemically infected and produce only smutted florets and capitula, but this has not yet been conclusively demonstrated. No infection has yet been produced by inoculating seedlings of these and other species, and it is theorized that infection takes place by the growth of an infectious hypha down the stigma and style and into the ovary of developing flowers. Eight other reported hosts of *M. cardui* are all weedy species of *Carduus*. Both the narrow host range and the effectiveness of the smut in eliminating weed reproduction make *M. cardui* a good candidate agent for biological control of *S. marianum*, *Onopordum acanthium*, and possibly other *Carduus* thistles in the USA.

DIQUAT PLUS GLYPHOSATE FOR RAPID-SYMPTOM VEGETATION CONTROL IN TURF. W.L. Barker, S.D. Askew, J.B. Beam, Virginia Tech, Blacksburg; and D.C. Riego, Monsanto Co., Carmel, IN.

ABSTRACT

Herbicides used for edging and renovation in a turf and ornamental setting need to be fast acting and nonselective. Consumers desire a product that delivers next day visible symptoms. Glyphosate controls vegetation in the long term, however the length of time needed to produce visible symptoms is often unsatisfactory. A common practice in the turf and ornamental industry has been to mix pelargonic acid and other related fatty acids with glyphosate to produce rapid symptoms to complement the glyphosate treatment. However, pelargonic acid has reduced glyphosate efficacy leading to plant regrowth that normally would not occur following treatment of glyphosate alone. A new approach to attaining rapid symptoms in total vegetation control is mixing diquat and glyphosate. Improper diquat rate or adjuvant can also lead to decreased glyphosate efficacy. Field studies were conducted at Blacksburg, VA in 2001 and 2002 to evaluate several proprietary mixtures of diquat + glyphosate compared to glufosinate and glyphosate alone. Data from the registered diquat + glyphosate mixture (i.e. Quik Pro™) will be discussed. The objective of these studies is to determine timing of rapid symptoms and long-term weed control when using glyphosate, glyphosate + diquat, and glufosinate in an established tall fescue (*Festuca arundinacea* Schreb.) sward infested with white clover (*Trifolium repens* L.) and buckhorn plantain (*Plantago lanceolata* L.). Two studies were conducted as randomized complete block designs with treatments replicated four times and nontreated controls included for comparison. An additional two non-replicated demonstrations were also conducted and serve as additional replication in the combined analysis. Weed control was evaluated 1, 2, 4, 7, 14, 28, and 56 days after treatment (DAT). Data were subjected to analysis of variance using the PROC GLM function in SAS.

When averaged over two trials, diquat + glyphosate controlled tall fescue and white clover between 55 and 60% 1 day after treatment (DAT). Visible symptoms were not apparent until 4 to 7 d following glyphosate treatment. Glyphosate controlled tall fescue and white clover equivalent to diquat + glyphosate at 21 DAT or later. At 56 DAT, glyphosate and diquat + glyphosate completely controlled tall fescue and white clover. Glufosinate controlled tall fescue 50% 4 DAT and 80% 7 DAT, however, tall fescue completely recovered by 56 DAT. Glufosinate controlled white clover equivalent to glyphosate and diquat + glyphosate. Buckhorn plantain completely recovered from glufosinate injury and partially recovered from glyphosate and diquat + glyphosate injury at 56 DAT.

ABSTRACT

Smooth pigweed (*Amaranthus hybridus* L.) seed were collected from 1993 to 1999 at seven locations on Delmarva where imazaquin or imazethapyr failed to provide acceptable control. At each location, imazaquin or imazethapyr selection pressure was imposed over several years. Seed from imazaquin selected populations (R1, R3, and R4) were collected from separate fields in Maryland, while seed from imazethapyr selected populations were collected from fields in Virginia (R5), Maryland (R6 and R8), and Delaware (R7).

Greenhouse experiments were conducted from 2000 to 2002 to evaluate the response of the R5, R6, R7, and R8 populations and an ALS-susceptible population (S) to four ALS-inhibiting herbicide classes. Imidazolinone (imazethapyr), sulfonlyurea (chlorimuron and thifensulfuron), pyrimidinyloxybenzoate (pyrithiobac), and triazolopyrimidine (cloransulam-methyl) herbicides were applied postemergence at 0.01, 0.1, 1, 10, or 100 times commercial use rates. All populations exhibited high-level resistance to imazethapyr and low-level cross-resistance to chlorimuron, thifensulfuron, and pyrithiobac when compared to the S population. In addition, populations R5 and R6 exhibited low-level cross-resistance to cloransulam-methyl, whereas populations R7 and R8 had increased sensitivity to this herbicide as compared to the S population. Populations R1, R3, and R4 were previously characterized in 1997 and 1998 as having high-level resistance to imazethapyr and low-level cross-resistance to chlorimuron. However, these populations were more susceptible to thifensulfuron, pyrithiobac, and cloransulam-methyl as compared to the S population.

Comparison of ALS gene sequences from R and S populations revealed mutations within conserved domains previously reported to confer ALS-resistance. All populations selected with imazaquin (R1, R3, and R4) had amino acid substitutions of alanine to threonine in domain C, whereas all imazethapyr selected populations (R5, R6, R7, and R8) had amino acid substitutions of serine to asparagine in domain E of the ALS gene. Amino acid substitutions identified in the ALS gene of these populations correlate with the herbicide cross-resistance patterns observed at the whole plant level, but does not completely explain the response to cloransulam-methyl. The finding that selection with imazaquin or imazethapyr was associated with specific amino acid changes raises intriguing questions.

INVENTORY AND ASSOCIATED SITE ATTRIBUTES OF INVASIVE WEED SPECIES
IN THE RIDGE AND VALLEY PHYSIOGRAPHIC REGION. B.P. Jones, D.A.
Mortensen, R. Humston, Penn. State Univ., University Park; D. Keech and E. Raesly,
The Nature Conservancy, Clear Spring, MD

ABSTRACT

Invasive plant species have increasingly become a threat to both agricultural and forest ecosystems. Such species can decrease the diversity of native species and decrease the productivity of all ecosystems by filling niches otherwise occupied by native species. In order to further understand relationships between invasive species and their environment, an invasive species inventory was conducted in the Green Ridge State Forest in eastern Allegany County, Maryland. Thirteen species were inventoried, including *Ailanthus altissima*, *Alliaria petiolata*, *Berberis thunbergii*, *Centaurea maculosa*, *Coronilla varia*, *Elaeagnus umbellata*, *Linaria vulgaris*, *Lonicera japonica*, *Lonicera spp.*, *Microstegium vimineum*, *Polygonum cuspidatum*, *Polygonum perfoliatum*, and *Rosa multiflora*. The inventory was conducted by establishing 125 transects 300m in length and perpendicular to primary and secondary roads throughout an 80,000 acre tract of forest. Each transect consisted of five sample locations on each side of the road, beginning on the road edge and at 10, 50, 100, and 150m into the forest. At each geo-referenced sample location, approximately 80 m² in area, percent cover of each species was recorded. Site characteristics, including landscape position, aspect, slope, canopy closure, forest type, and a number of disturbance indicators were also recorded at each sampling location. The inventory revealed varying degrees of invasion throughout the forest, with four species (*M. vimineum*, *M. rosa*, *A. altissima*, and *A. petiolata*) being most abundant. Logistic regression was performed to identify significant site attributes relating to the weed occurrence. While no singular site attribute was significant for all species, soil disturbance, aspect, and road surface type was significant for three of the four species. Slope and canopy were significant for two of the species, while proximity to the road edge, landscape position, and forest type were significant for *M. vimineum*, *A. petiolata*, and *A. altissima*, respectively.

IMPACT OF TILLAGE REGIME AND WEED MANAGEMENT STRATEGY ON THE ABUNDANCE OF ANNUAL AND PERENNIAL WEEDS IN CORN. A. DiTommaso and C.L. Mohler, Cornell Univ., Ithaca, NY

ABSTRACT

To successfully implement a site-specific weed management program, the spatial and temporal variability of weed populations must first be determined. It is well established that weeds are not distributed randomly or homogeneously across a field, as they often occur in discrete patches. Weed patch stability will likely differ among weed species and will largely be dependent on the specific crop and weed management system used. The objective of this study was to determine the abundance of weed populations within a corn field under zone and chisel tillage and subjected to one of four weed management practices: (1) pre-emergent broadcast herbicide application at full rate, (2) pre-emergent broadcast herbicide application at 2/3x rate, (3) pre-emergent banded herbicide application at full rate with inter-row cultivation, and (4) pre-emergent banded herbicide application at 2/3x rate with inter-row cultivation. These treatments were applied to plots in both 2001 and 2002. The chisel and zone-tillage plots were in place for five years in 2002. In a pre-plant survey in 2002, tillage regime had a significant ($p < 0.05$) impact on percentage cover of several perennial species including common dandelion (*Taraxacum officinale* Weber) and quackgrass (*Elytrigia repens* (L.) Nevski). As expected, the cover of these species was greatest in zone-till plots compared with chisel till plots. Herbicide application method (broadcast versus banded + cultivation) and dose were found to have relatively less impact on the percentage cover of perennials compared with tillage. The impact of tillage on the abundance of weed species in an early summer survey was variable and species specific. For instance, the abundance of summer annual species such as common lambsquarters (*Chenopodium album* L.), common ragweed (*Ambrosia artemisiifolia* L.) and velvetleaf (*Abutilon theophrasti* Medic.) was significantly greater in the chisel till plots compared with the zone-till plots whereas perennial species such as quackgrass and common milkweed (*Asclepias syriaca* L.) were more abundant in the zone till plots. Herbicide application method had a more substantial impact on weed abundance than herbicide dose. Findings to date from this long-term research project indicate that the response of weed species to the tillage regimes and weed management tactics used is highly variable.

ABSTRACT

In Virginia, annual and perennial weed control in pastures and hayfields is an important aspect of successful forage management. Recently, the registration of two herbicides has increased growers' options for the control of broadleaf weeds in pastures and hayfields. These two herbicides are Redeem^{*} R&P and Grazon^{*} P+D. Redeem R&P contains 2.25 and 0.75 lbs ai/gallon of triclopyr and clopyralid, respectively. Grazon P+D contains 0.24 and 2.0 lb ai/gallon of picloram and 2,4-D, respectively. Grazon P+D is a restricted use herbicide and is only recommended for use in selected counties in Virginia, primarily in the western portion of the state. These limitations for distribution are due to the picloram content of Grazon P+D, which can cause injury to tobacco, tomato, and other sensitive broadleaf crops at very low concentrations. Experiments were initiated in 2001 and 2002 to evaluate the efficacy of Redeem R&P and Grazon P+D on some of the common weeds in pastures and hayfields in Virginia. Experiments were arranged in a randomized complete block design and conducted at multiple sites throughout Virginia. Treatments included several rates of Redeem R&P and Grazon P+D, as well as many standard treatments commonly used for broadleaf weed control in Virginia. Experiments evaluated the control of spiny amaranth (*Amaranthus spinosus*), Canada thistle (*Cirsium arvense*), horsenettle (*Solanum carolinense*), yellow crownbeard (*Verbesina occidentalis*), wild carrot (*Daucus carota*), broadleaf plantain (*Plantago major*), buckhorn plantain (*Plantago lanceolata*), poison ivy (*Toxicodendron radicans*), and bladder campion (*Silene vulgaris*). At least 80% spiny pigweed control was achieved at 8 weeks after treatment (WAT) with 0.2 ounces per acre of Ally in combination with 1.5 pints of Redeem R&P, 2 pints of 2,4-D, 2 pints of Grazon P+D, or 2 pints of Pastureguard^{*}. Ally, however, applied alone at 0.2 ounces per acre controlled spiny pigweed 87% at 8 WAT. Both Grazon P+D and Redeem R&P controlled Canada thistle greater than 90% at 1 month after treatment (MAT) with rates of 1 pint per acre or greater. Ally, however, applied at 0.3 ounces per acre controlled Canada thistle only 81% at 1 MAT. Combinations of 2,4-D and Banvel provided approximately the same level of control of Canada thistle as Ally. Grazon P+D at 3 pints per acre controlled horsenettle 95% at 6 WAT. Redeem R&P and Ally applied at 3 pints and 0.3 ounces per acre, respectively, provided less than 50% control of horsenettle at 6 WAT. Yellow crownbeard was controlled 93% and 83% in 2001 and 2002, respectively, with 2 pints per acre of Grazon P+D. However, at least 3 pints of Redeem R&P per acre were required to achieve this same level of yellow crownbeard control. Crossbow, 2,4-D alone, and 2,4-D plus Banvel also provided between 67 and 83% yellow crownbeard control. Applications of Banvel or Ally alone, however, resulted in less than 50% yellow crownbeard control. One quart of 2,4-D alone or in combination with Banvel controlled both plantain species greater than 90%. Effective control of wild carrot and the two plantain species was accomplished with applications of Grazon P+D and Redeem R&P at rates of 2 to 4 pints per acre and 3 to 4 pints per acre, respectively. Poison ivy control of 70% or greater was provided by 2,4-D in combination

^{*} Registered trademark of Dow AgroSciences, LLC

with dicamba, 3 to 4 pints per acre of Grazon P+D, and 4 pints of Redeem R&P. The highest level of control of bladder campion was observed with 0.3 ounces of Ally per acre. Bladder campion control with Ally, however, was only 66%. The use of the other herbicides typically resulted in less than 50% control.

INTRODUCTION

While concern over genetically-engineered (GE) crops continues, usage by U.S. farmers continues to increase. Most of the soybeans and cotton grown in the U.S. are GE, but only about a third of the corn grown in the U.S. is GE. This is partly because the corn weed management appears to be more difficult than that found for Roundup Ready soybeans. There is also more concern over corn pollen transport. For instance, Maine corn growers who choose to purchase GE seed are provided with information to help them reduce the potential for pollen drift. Maine organic corn growers can have no GE proteins in their feed, and as such GE corn pollen is viewed in Maine as a source of diffuse pollution. Much like growers are forbidden to spray pesticides when conditions suitable for significant drift, growers have been asked to use setbacks away from other fields to prevent the risk of GE pollen transport. Following a vandalism incident at the Univ. of Maine Roger's Farm, we received a grant from the Maine Agricultural Center to study corn pollen movement. We established a study from 1999 – 2001 to monitor GE corn pollen movement from a one-acre plot of Roundup Ready corn into nearby cornfields. The goals of this research were to: 1) determine the optimum timing and rate of glyphosate for Roundup Ready corn; and 2) determine amount of cross-pollination of GE corn into a conventional corn hybrid. For this paper, we will focus only on the second objective.

METHODS

Roundup Ready and conventional corn hybrids were planted at the Rogers Farm in Stillwater, ME between 15 and 17 May 1999, on 20 May 2000, and 17 May 2002. Each hybrid planted was an 83-85 day maturity hybrid. The GE corn (DeKalb DK335 RR) and the conventional hybrid were planted at $78,496 \text{ seeds ha}^{-1}$. In 1999, the GE study area was 3454 m^2 located between the two other studies. One recipient field was located 30 m east of the GE study. The other recipient field was located 350 m SW of the GE corn source. Since summer season prevailing winds are predominantly southwesterly, the field 30 m E represented a scenario more favorable for cross-pollination than the weed control study. In 2000, field layout was similar except that the second receiving field was located 105 m S of the GE pollen source. In 2001, we had only one receiving field which was planted to pre-screened open-pollinated corn varieties. This corn was located from 25 – 35 m due E of the GE pollen source. We subdivided each field potentially receiving GM corn pollen into 12 subplots (each subplot was 23.5 m^2) to measure cross pollination. Corn was harvested 19 September, 1999, 22 September 2000, and 25 September 2001. Corn (50 ears) was harvested from each 23.5 m^2 subplot of each study. Corn was dried to $< 12\%$ moisture and shelled. Approximately 200 seeds from each subplot were sown per 0.14 m^2 flats. The greenhouse screening study was replicated four times each year. The conventional hybrid and DK355 were included with the corn offspring to test purity of initial seed source. Plants were watered daily and fertilized twice with NPK fertilizer. At growth stage V2, glyphosate was applied at $1.12 \text{ kg ai ha}^{-1}$. After 10 days, plants survival was

assessed. Selected glyphosate resistant plants were submitted for polymerase chain reaction tests to confirm the presence of the transgene.

RESULTS

In 2000, we found significant GE contamination (0.16%) of GE corn in the conventional corn used to monitor drift. So, we will report only on the 1999 and 2001 findings. In 1999, we did not find any cross contamination in the corn planted 350 m southwest of the GE corn. Typical prevailing winds did not favor transport to that site, and we found no survival of corn offspring harvested from that site. We did find some cross-pollination into the conventional corn planted between 30 and 50 m due east of the GE corn (Table 1.)

Table 1. Cross-pollination Results from 1999.

Corn Seed Tested	Mean Germination	Mean Survival	Sum Survival	Percent Survival
DK-355 (GE)	511	502	2008/2044	98.2
Conv. Hybrid	475	0	0/1880	0
DK-355 offspring	689	503	2016/2756	72.5
30-m E	691	7	29/2764	1.04
35-m E	701	0.75	3/2804	0.11
40-m E	716	0.25	1/2864	0.03
350-m SW	555	0	0/2092	0

From these data, it is apparent that the highest amount of cross-pollination occurs is in the conventional corn planted closest to the GE corn, and the amount of cross-pollination drops off with distance from the source. Again, we found no cross-pollination at the 350m distance from the corn pollen source. In 2001, we found similar results. In this case, the corn was planted slightly closer to the GE source (25-m E – 35 m E), and there was no distant corn field used to test longer distant pollen travel in 2001 (Table 2).

Table 2. Cross-pollination Results from 2001.

Corn Seed Tested	Mean Germination	Mean Survival	Sum Survival	Percent Survival
DK-355 (GE)	511	502	2290/2299	99.6
Open Pollinated	475	0	0/1880	0
DK-355 offspring	689	503	1715/2297	74.6
25-m E	724	12	29/2174	1.04
30-m E	709	7	21/2128	0.9
35-m E	745	2	8/2235	0.35

These data confirm that while cross-pollination does occur, the amount is minimal. While this work has only been conducted with a small amount of GE source pollen (approximately one acre), it should provide Maine growers with some confidence that if they follow the recommendations provided to them when they purchase the seed, they should be able to limit their risk of cross-pollination. While corn pollen has not been considered to be a source of diffuse pollution, given new USDA organic regulations, perhaps it is time to reconsider this.

EXAMINATION OF ORNAMENTAL WEED CONTROL USING MICRO-ENCAPSULATED HERBICIDE TREATED BARK MULCHES. H.M. Mathers, L.T. Case, A. A. Stoven, S. B. Johansen, and J. A. Pope, Ohio State Univ., Columbus.

ABSTRACT

Weed control can take many forms in containers and container yards; physical control, cultural control and chemical control are the most common. Integration of two or more methods of weed control may produce a positive interaction. Extending the duration of efficacy of preemergent herbicides would benefit the nursery industry. However, reduced phytotoxicity should be an important consideration when new products are developed. This study examined the use of two Monsanto microencapsulated products, Alachlor 41.5% (Micro-tech) and Acetochlor 42% (Degree), as well as two current formulations of these products Alachlor 45 % (Lasso) and Acetochlor 76% (Harness) in combination with Douglas fir and pine bark at two dilution rates 10 and 50 gallons per acre. The Douglas fir bark in trials in 1998 and 2000 seemed to bind the herbicides tested and possibly acted as slow release carriers for the herbicides or reduced their leaching potential. The herbicide treated bark was compared to a control (weedy check), direct sprays of the herbicides and mulch applied alone to the container surface for a total of 27 treatments. The objective of this study was to determine if the combination of slow release formulations with slow release bark carriers gave extended efficacy. Efficacy and phytotoxicity began June 4, 2002. Efficacy was studied with, Common Chickweed, Annual Bluegrass, and Prostrate Spurge. Assessments of efficacy were made at 42 and 107 d after treatment (DAT) of treatments using a visual rating. Ratings for efficacy were based on a 0-10 scale where 0=poor control and 10=perfect control. Fourteen of the 27 treatments had commercially acceptable weed control (7 or higher) combined over the two evaluation dates; and after 107 d, 7 of these treatments had commercially acceptable weed control. Nine of the top fourteen treatments were combinations of mulch and herbicides. Only the direct spray of Harness applied at 10 gallons per acre of water was providing commercially acceptable weed control after 107 DAT. Dilution rate had no significant effect on efficacy of sprays onto mulch.

CHANGES IN WEED POPULATIONS DUE TO REPEATED USE OF HERBICIDE-RESISTANT CROPS. Sujatha Sankula, National Center Food Agricultural Policy, Washington, DC; Mark VanGessel and Barbara Scott, Univ. of Delaware, Georgetown.

ABSTRACT

Weed community composition and density are often in flux. Shifts in weed species composition are likely to occur as a result of selective forces of weed management. There is concern that repeated use of herbicide resistant crops can select for weed species that survive or adapt to those weed management treatments, leading to population shifts. This research investigated the potential changes in weed populations that may result from rotation of herbicide-resistant corn and soybeans as well as conventional herbicide programs. Specific rotations included glyphosate-resistant soybean (GRS) followed by glyphosate-resistant corn, GRS followed by glufosinate-resistant corn, GRS followed by imidazolinone-resistant corn, GRS followed by corn treated with PRE herbicides, GRS followed by weed-free corn, or GRS followed by corn with no herbicide treatment. Research was conducted at three locations, one location for 6 years and two locations for three years. Total weed densities and species diversity coefficients were greater in the corn rotation than soybean at crop harvest. Changes in species composition were a result of in-effective weed control for a specific crop. However, if weed control was sufficient in the following crop, total weed density and species diversity were not impacted in that following crop. Surprisingly, poor weed control in the corn crop had little impact on weed control in the rotational soybeans. Herbicide treatments were applied in a timely fashion which ensured maximum levels of weed control.

CULTIVAR AND MATURATION EFFECTS ON THE ALLELOCHEMICAL CONTENT OF TEN CULTIVARS OF RYE . S. C. Reberg-Horton, Univ. of Maine, Orono; N. G. Creamer, D.A. Danehower, G. Ma, D.W. Monks, J. P. Murphy, N.N. Ranells, J.D. Williamson, and J.D. Burton, North Carolina State Univ., Raleigh.

ABSTRACT

Assessing the literature on rye allelopathy in an effort to optimize weed management has been difficult due to widely varying and inconsistent estimates of the amount of weed suppression provided by a rye cover crop mulch. This study was initiated to examine several factors that could influence the weed suppressiveness of rye: kill date, cultivar and fertility. Ten cultivars of rye were planted with four rates of nitrogen fertilization, and tissue from these treatments was harvested three times during the growing season. Careful observations of the developmental stage for each cultivar were made at every harvest. Two approaches were employed to measure the impact of these factors on weed suppressiveness. Bioassays were used to monitor general phytotoxicity and High Performance Liquid Chromatography (HPLC) was used to quantify the allelochemical DIBOA (2,4-dihydroxy-1,4-(2H)benzoxazine-3-one). Both methods found evidence for reduced allelochemical concentrations at later harvest dates. Cultivar differences were also apparent, with the slow to mature cultivar 'Wheeler' retaining higher concentrations later in the season. The decline in allelochemical concentrations as plants age and mature may help explain why estimates of weed suppression due to allelopathy have varied so widely in the literature about rye.

ABSTRACT

Field dodder (*Cuscuta campestris*) is a summer annual, obligate parasitic weed of increasing importance in greenhouse-grown and landscape plantings of flowering annual bedding plants. In recent years I have observed landscape plantings of petunia and vinca, and greenhouse grown vinca heavily infested with dodder. Once attached to the host, dodder cannot be selectively removed and the host must be either killed with a non-selective herbicide or removed with the weed. The seeds of dodder are long-lived; therefore, once the soil is infested with dodder a long-term management plan is needed. The only herbicide labeled for selective control of dodder is DCPA (Dacthal). However, Dacthal must be applied preemergence, with high rates and multiple applications to achieve full season control; and, Dacthal is an expensive treatment. Clearly, alternative dodder control guidelines are needed. Some vegetable crops have been screened for host resistance to dodder but no such reports are available for bedding plants. In this project we conducted a dodder host preference screening of sixteen annual bedding plant species.

Bedding plants were potted into 3-liter pots using a pine bark + sand (7:1 v/v) substrate on June 14, 2002. Species included petunia, calibrachoa 'Liricashower Rose', salvia 'Red and White', portulaca 'Yubi Rose', verbena 'Homestead Purple', ornamental sweet potato 'Sweet Caroline Burgundy', marigold 'Safari Yellow', gomphrena 'Lavender Lady', scaevola, vinca, impatiens 'Dazzler Coral', coleus 'Aurora Stoplight', snapdragon 'Liberty Rose Pink', and begonia 'Super Olympia White'. The first ten were in full sun; the latter six were placed in 50% shade. Plants were overhead watered daily. Plants were allowed to establish for two weeks then ¼ teaspoon per pot of field dodder seeds were scattered on the substrate surface. Four replicates of each species were seeded. Percent crop canopy occupied by field dodder was evaluated 4, 6, and 8 weeks later.

Significant differences in dodder growth were seen among species. Petunia was clearly the most preferred host with over 80% canopy coverage by 4 weeks after seeding. By 8 weeks after seeding petunia, salvia, snapdragon and impatiens each had over 80% of the plant canopies covered by dodder. Vinca and portulacca had little dodder growth 4 weeks after treatment but by 8 weeks dodder cover had increased to about 47% and 19% respectively. The other species appear to be non-preferred hosts. Essentially no dodder growth was observed on gomphrena, marigold, ornamental sweet potato, and scaevola. One other observation that warrants further investigation is that vinca, begonia, and coleus appear to be non-preferred hosts for seedling attachment of dodder but successful attachment following encroachment from adjacent infested hosts was observed.

These data clearly demonstrate that differences in dodder host preference exist among common shade-tolerant and sun-tolerant bedding plants. In landscape beds with a history of dodder infestations it would be advisable to avoid planting petunia, select dodder-tolerant bedding plant species for future plantings.

WEED CONTROL IN POTATOES USING WEEDCAST TO TIME CULTIVATION. D.J. Doohan, Joel Felix, Ohio State Univ., Wooster; J.A. Ivany, Agriculture and Agri-Food Canada, Charlottetown, PE, Canada; and George O. Kegode, North Dakota State Univ., Fargo.

ABSTRACT

WeedCast computer model was evaluated as a decision aid to determine cultivation time in potatoes at Wooster, OH, Charlottetown, PE, Canada, and Fargo, ND in 2001 and 2002 using a split-plot design with cultivation time as the main plots and +/- herbicides as subplots. Main plots were cultivated each time the model predicted 15, 30, or 60% weed emergence for the predominant species on the site. Subplots were either treated with metolachlor + metribuzin at 1.68 and 0.5 kg ai/ha, respectively, or left unsprayed. Subplots within the control were weeded only at layby. Otherwise, potatoes were grown using standard cultural practices as recommended by the respective extension services. Cultivation timing was predicted using *Amaranthus* spp and *Polygonum pensylvanicum* in 2001 and 2002, respectively, at Wooster and *Chenopodium album* at Charlottetown. *Solanum ptychanthum* was the indicator at Fargo in 2002. Plots treated with herbicides had lower numbers of weeds m⁻² at Wooster and Charlottetown in 2001. Weed control for the different cultivation timings varied between years. Cultivation timing based on 15% predicted emergence of *Amaranthus* spp and *C. album* resulted in better weed control at Wooster and Charlottetown, respectively, in 2001. In 2002, however, 30% emergence of *P. pensylvanicum* was the best predictor at Wooster. Weed pressure was high in the cultivation-only plots regardless of cultivation timing. Total fresh weed biomass was 216 to 680 g m⁻² for cultivation only plots at final cultivation time, compared to only 0 to 16 g m⁻² for herbicide treated plots at Charlottetown. There was no apparent pattern for treatment effects at the Fargo site in 2002, but cultivation alone at 30% predicted *S. ptychanthum* emergence and provided the best suppression of *Amaranthus retroflexus*. At Charlottetown in 2002, the 15% predicted emergence of *C. album* timing resulted in best weed control with successively later cultivation giving poorer results. Marketable yield at Charlottetown and Wooster in 2001 on herbicide plots were generally 33% higher than any of the cultivation alone treatments. The study will be repeated in 2003 to confirm the results.

ABSTRACT

The IR-4 Project is a publicly funded effort to support the registration of pest control products on minor use crops. Despite a climate in which there are fewer new herbicides available for evaluation in minor crops the IR-4 Project continued to be active in weed science in 2003, conducting residue studies and submitting petitions for weed control.

Petitions submitted the EPA by IR-4 since October, 2001 include: 2,4-D on hops; bentazon on peach; cycloate on swiss chard; clethodim on spinach, leafy Brassica subgroup (includes collards, mustard greens, kale, and turnip greens), and mint; clomazone on mint; DCPA on basil, chives, coriander, dill, ginseng, oriental radish, marjoram, and parsley; dichlobenil on rhubarb; ethalfluralin on potato and rapeseed (includes mustard seed); glufosinate on blueberry; glyphosate on garlic; linuron on horseradish; mesotrione on popcorn; oxyfluorfen on strawberry (annual and perennial) and hops; pendimethalin on pome fruits (includes apple and pear), stone fruits (includes apricot, cherry, peach, and plum), and pomegranate; s-metolachlor on green onion (includes leek); and sulfentrazone on potato, lima bean, and asparagus. In addition, a petition requesting that imazamox be exempt from tolerance (covers requests for chicory (roots), Belgian endive, foliage of legume vegetables and soybeans, and clover grown for seed) was submitted.

From October 2001 to date, EPA has published Notices of Filing in the Federal Register for the use of: dicamba on sweet corn forage and stover; ethalfluralin on canola and safflower; glufosinate on blueberry; halosulfuron on snap bean and dry bean; and sethoxydim on the herb subgroup (excludes lemongrass), tropical orchard crops, lingonberry, juneberry, and salal.

During their 2002 work year to date, the EPA has established tolerances for: bentazon on clover; clethodim in leafy Brassica subgroup (includes mustard greens, collards, kale), turnip tops, and mint; clomazone on mint; clopyralid on flax, strawberry, hops, rapeseed, canola (includes crambe and mustard seed), spinach, stone fruit (includes apricot, cherry, peach, plum), garden beet (tops and roots), leafy Brassica subgroup (includes collards, mustard greens, kale), turnip (tops and roots), cranberry, head and stem Brassica subgroup (includes broccoli, Brussels sprouts, cabbage, cauliflower, kohlrabi, Chinese cabbage), and sweet corn; diflufenzopyr on forage grass, sweet corn, and popcorn; ethalfluralin on canola (includes crambe); halosulfuron on melon subgroup (includes cantaloupe and watermelon); imazamox on legume vegetables (includes snap bean, dry bean, succulent pea, dry pea, lima bean, guar, garbanzo); paraquat on dry pea; and triflurosulfuron on chicory root.

The status of these and other IR-4 Project studies will be updated.

ABSTRACT

In response to growers' requests, six years of research were conducted to determine posttransplant cabbage tolerance to pendimethalin EC. Trials evaluated variety response, transplant plug size, uptake site, and anatomical effects. Collectively, the data indicated that pendimethalin EC cannot be used safely posttransplant on cabbage at greater than 0.5 lb ai/A, and even at that low rate, it cannot be safely used with Dual Magnum, as growers would prefer to do. In January 2002 a new capsule suspension (CS) formulation (Prowl H₂O) became available for testing. Initial greenhouse trials with cabbage and lettuce indicated significantly increased crop safety with Prowl H₂O. However, it was noted that the new formulation provided less control of pendimethalin-sensitive species than the EC formulation in preemergence (PRE) greenhouse weed control screens. It has been suggested that the polymer-coated particles that make up the CS formulation require an alternating drying and wetting cycle to release pendimethalin from the capsules. During the 2002 field season applications of both formulations were applied PRE in potatoes, carrots, and onions, early postemergence (EPOST) in potatoes and peas, postemergence (POST) in carrots, pretransplant in tomatoes, and posttransplant in tomatoes, peppers and cabbage. Initial crop injury with Prowl EC was 10 to 15% greater than with Prowl H₂O applications PRE in carrots, EPOST in potatoes, and posttransplant in peppers and tomatoes, however there were no yield differences between formulations in any of these crops. Significant and persistent crop injury occurred with Prowl EC PRE applications in onions and EPOST applications in peas. No difference between the formulations was seen with applications PRE in potatoes, pretransplant in tomatoes, and POST in carrots. Transplanted cabbage tolerated up to 2.0 lb ai of Prowl H₂O without significant yield reductions, whereas Prowl EC (1 to 3 lb ai) caused unacceptable injury and reduced yields. No Prowl H₂O tank-mix combination with Dual Magnum was acceptable. Managing weed control with the new formulation may require a mind-set adjustment. The observations made in trials where Prowl H₂O was applied POST to very small weeds indicated that the safety observed in the vegetable crops is also seen in weeds, i.e. lack of control was apparent. In tomato, pepper, and onion trials, excessive rain, 6 and 7 inches, in May and June, respectively, may have decreased the release of the active ingredient from the polymer-coated particles in the capsule suspension. While in most growing regions and most seasons this would not be problematic, in 2002 reduced control of pigweed, galinsoga, and annual grasses with PRE applications of Prowl H₂O was observed.

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TOLERANCE OF VARIOUS SWEET CORN VARIETIES TO MESOTRIONE. B. K. Hearn, M. A. Isaacs, Q. R. Johnson, Univ. of Delaware, Georgetown.

ABSTRACT

Mesotrione is a preemergence (PRE) and postemergence (POST) broadleaf herbicide labeled for field corn (*Zea mays*). Preliminary research has shown mesotrione tolerance on selected sweet corn varieties. The removal of Cyanazine (Bladex) has left producers with few weed control strategies for sweet corn use in Delaware. Therefore, a field experiment was conducted in 2002 at Georgetown, DE to evaluate Mesotrione tolerance to the following sweet corn varieties: Bonus (SE), Jubilee Plus (SS), GSS 9299 (SS), and BSS 1690 (SS). PRE treatments included S- metolachlor (Dual II Magnum 1.6 lb ai/A) combined with Atrazine (0.75 lb ai/A). Dual II Magnum (1.6 lb ai/A) combined with Atrazine (0.75 lb ai/A) plus mesotrione (Callisto, 0.187, 0.374 lb ai/A). A12909 (2.06 lb ai/A), A12854 (2.75 lb ai/A), and Callisto (0.187 lb ai/A) applied alone. POST treatments included Callisto (0.094 lb ai/A) applied alone and in combination with Atrazine (0.25 lb ai/A) with either COC (1% v/v), NIS (0.25% v/v), and or 30% UAN (2.5% v/v).

The experimental design was a split-plot with 3 replications. The herbicide treatment was the main plot and sweet corn variety the sub-plot. Plots were 20 feet wide by 25 feet long, treatments were applied with a tractor mounted sprayer delivering a spray volume of 25 gpa at 29 psi. Data collected consisted of crop stand counts, crop injury, and yield. Yield data was collected from the center 10' of 2 rows and included number of ears per plot and ear weight (husked and unhusked).

Weed control throughout the study was excellent. No significant crop injury was observed with any of the varieties regardless of herbicide treatment. No differences were observed from the yield data collected. From this research, it appears callisto can provide excellent weed control with no crop injury on Bonus, Jubilee plus, GSS 9299, and BSS 1690 sweet corn varieties.

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SWEET CORN TOLERANCE TO MESOTRIONE. J.M. Jemison, Jr., and H.J. Wilson,
Univ. of Maine, Orono

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ABSTRACT

Sweet corn growers have a very limited number of weed control products available that do not cause potential damage to crops planted the following year. In this trial, part of a multi-state effort this year, we assessed the possibility of using mesotrione pre and postemergence in sweet corn production. The project goals were to assess crop tolerance, influence on crop yield, and weed control. Five commonly grown sweet corn varieties of sweet corn were planted on 22 May 2002: Silver Queen; Kandy Korn; Bodaceous; Prime Plus; and Serendipity. Aatrex (1 pt/ac) and Dual (1.5 pt/ac) were applied preemergence on five of eight weed control treatments. Mesotrione was applied preemergence in two forms: as Camix (Callisto + Dual at 4.5 pts/ac) or as Lumax (Callisto + Atrazine + Dual at 5.6 pt/ac). We were also interested in evaluating sweet corn response to mesotrione applied at 3 oz/ac (recommended rate) with adjuvants and different sticker combinations. There were four postemergence treatments: mesotrione applied with urea-ammonium nitrate (UAN) and crop oil concentrate (COC) (2.5% and 1% v/v respectively); mesotrione with UAN and NIS (2.5% and 0.25% v/v, respectively); mesotrione with COC (1% v/v), and mesotrione with atrazine and COC (0.25 lb ai/ac and 1% v/v). Evaluations were made at 7 and 18 days after treatment for numbers of injured plants as well as the amount of the plant expressing the injury. Total and marketable yield estimates were made at harvest.

Rainfall was adequate to activate the herbicides applied pre and postemergence. We saw no injury to any variety when mesotrione (Camix or Lumax) was applied preemergence. Early season weed control with the mesotrione premixes was excellent, particularly the three-way combination on nutsedge (*Cyperus esculentus*). We found significantly higher yields with Lumax and Camix compared to Bicep II magnum applied preemergence. A second flush of mustard in the bicep plots was sufficient competition for nutrients and water to negatively influence yield. Injury from Lumax or Camix was negligible. There was significant injury to sweet corn from some of the postemergence treatments. The addition of the adjuvant UAN to any treatment caused significantly more injury to the corn, and the injury was visible throughout the year. Injury rating data collected at 18 DAT indicated that the plants treated with mesotrione with UAN and COC had 85% of the plants exhibiting injury on 6% of the plant compared to 1% of the plants exhibiting injury on less than 0.1% of the plant. In addition, marketable yield was reduced where UAN and COC were used in combination with 3 oz/ac of mesotrione. Use of COC or NIS alone did not cause significant injury or reduction in yield. It appears that inclusion of UAN on a sweet corn label should not be included if registration of mesotrione for sweet corn is pursued. This work and other similar projects this year have provided useful information on both the effectiveness of weed control with mesotrione and which adjuvant/sticker combinations are safe for the crop.

ABSTRACT

Mesotrione was registered for use in the United States in 2001 for broadleaf weed control in field corn. There has been considerable interest in using mesotrione in sweet corn. Greenhouse and field studies were conducted during 2002 to evaluate the tolerance of various sweet corn (*Zea mays* L.) hybrids to mesotrione. In greenhouse studies, 14 processing and 28 fresh market sweet corn hybrids were evaluated for tolerance to postemergence applications of mesotrione at 105 and 210 g ai/ha. Adjuvant treatments included 1% v/v crop oil concentrate (COC) with both rates of mesotrione and 1% v/v COC plus 2.5% v/v urea ammonium nitrogen (UAN) with 105 g ai/ha of mesotrione. Applications were applied to sweet corn at the two to three leaf stage. In field studies, 16 processing and 22 fresh market sweet corn hybrids were evaluated for tolerance to mesotrione. Individual hybrids were evaluated at one to nine sites. Preemergence treatments in the field studies included 1,780 g ai/ha S-metolachlor plus 841 g ai/ha atrazine (used as the control treatment), S-metolachlor plus mesotrione (Camix™) at 2,315 g ai/ha, and S-metolachlor plus atrazine plus mesotrione (Lumax™) at 3,084 g ai/ha. Postemergence treatments included 105 g ai/ha mesotrione with and without 280 g ai/ha atrazine plus 1% v/v COC. Mesotrione (105 g ai/ha) was also applied with 1% v/v COC plus 2.5% v/v UAN and 0.25% v/v non-ionic surfactant (NIS) plus 2.5% v/v UAN. S-metolachlor at 1,780 g ai/ha plus 841 g ai/ha atrazine was applied preemergence in all of the postemergence treatments.

In greenhouse studies, mesotrione caused slight injury (bleaching) on most hybrids and significant bleaching on eight of the 42 hybrids tested. Increasing the rate of mesotrione from 105 to 210 g ai/ha significantly increased bleaching on most hybrids. Conversely, the addition of UAN did not significantly increase the amount of bleaching compared with COC alone.

In field studies, mesotrione was generally safe to sweet corn causing little to no injury on most hybrids at most locations. Camix and Lumax were safe at most locations and on most hybrids. Injury occurred on a couple of hybrids which rarely resulted in reduced yields compared with the S-metolachlor plus atrazine control. Injury from postemergence applications of mesotrione occurred more frequently than from preemergence applications, but yields were rarely reduced compared to the control treatment. Injury also occurred more frequently when UAN was mixed with mesotrione. Mesotrione plus COC, with or without atrazine, caused little injury and rarely affected yields. Mesotrione may provide an effective, safe herbicide option for controlling broadleaf weeds in sweet corn.

EFFECT OF REPEAT APPLICATIONS OF DICHLOBENIL ON YIELD COMPONENTS OF CRANBERRY. H.A Sandler, J. Mason, Univ. of Massachusetts, East Wareham; and T.A. Bewick, USDA-CSREES, Washington, DC.

ABSTRACT

Massachusetts cranberry growers have expressed concerns that annual repeat applications of high rates of dichlobenil caused direct vine injury or increased susceptibility of the vines to environmental or pest stresses. The few available studies on dichlobenil use in cranberry have conflicting results, and the long-term impact of high rates of dichlobenil on cranberry productivity and health, as well as weed abundance, has not been previously documented. Field studies were established at two commercial farms; one set of replicated, herbicide-treated plots were established in a high-weed area and another set was established in a low-weed area at each site (cv. Howes and Early Black). These studies examined the effects of four years of repeat annual applications of zero, low ($1.8 \text{ kg a.i. ha}^{-1}$), and high ($4.5 \text{ kg a.i. ha}^{-1}$) rates of dichlobenil on yield components, upright characteristics, and weed abundance in commercial cranberry farms.

These studies indicated minimal negative impact of repeat annual applications of dichlobenil. As of this writing, analyses have indicated that herbicide application did not adversely affect upright productivity, biomass production, or percentage fruit set. No yield parameters were negatively affected by either low or high rates of dichlobenil. Herbicide application appeared to decrease the percentage weed cover, but wide variability of data prevented statistical separation. Species richness decreased as herbicide rate increased. Data are still being analyzed to determine any additional effects.

The presence of weeds, rather than herbicide application, was the important determinant of yield performance. Vines in high-weed areas produced less marketable fruit and had lower percentage fruit set than vines growing in low-weed areas. The effect of weed presence on upright parameters was variable. Though the effect varied by sampling date, both weed presence and herbicide application impacted cranberry root length. Cranberry root length was shortest in plots that received low-rate herbicide applications. Root length was shorter on vines grown in high-weed areas compared to vines in low-weed areas. Results suggest that repeat annual applications of dichlobenil to commercial cranberry beds may be considered as part of a viable integrated weed management program with minimal long-term risk.

INFLUENCE OF NO-TILL AND RYE MULCHING PRACTICES ON FRUIT MATURITY AND WEED SUPPRESSION IN PUMPKIN. H. S. Rapp and R. R. Bellinder, Cornell Univ., Ithaca, NY.

ABSTRACT

Pumpkin (*Cucurbita pepo*) is a high value crop of increasing importance in New York State and weed control is a major cost of production. Field experiments were conducted in 2001 and 2002 to study the effects of various tillage and mulching practices on fruit maturity and weed suppression. The tillage treatments included conventional tillage (CT), discing (D), strip-tilling (ST), no-tilling with rye removed (RR), and no-tilling with standing rye (SR). All tillage treatments were evaluated both with and without a preemergence application of ethalfluralin + halosulfuron (1.5 + 0.036 kg ai/ha, resp.). To evaluate the effect of rye residue alone, handweeded CT and ST treatments were added in 2002. Rainfall patterns in the two seasons contributed to differences in crop response to the herbicides. In 2001, 7.6 cm of rain fell in the 7 d following herbicide application. In 2002, soils were saturated by 11.4 cm of rain in the 10 d before planting but only 1.8 cm fell in the 7 d after herbicide application. In 2001, total yields (numbers, weight) did not differ with tillage practice, whether with or without herbicides. However, the herbicides delayed maturity significantly in all tillage treatments. Conventional and RR produced a significantly larger percentage of mature fruit than did SR in both treated and untreated plots. In 2002, weed populations were significantly greater, and less herbicide injury occurred than in 2001. In this year, regardless of herbicide application, SR produced a significantly greater number of mature fruit than did D. However, the percentage of mature fruit produced did not differ with tillage. Herbicide treatments were significantly more productive than untreated plots in all treatments. Although weed populations were less in 2001 than in 2002, in both years the herbicides provided effective control. In general, in both years, all types of reduced tillage with rye residue resulted in fewer weeds than CT.

ABSTRACT

Weeds continue to cause serious problems in cranberry (*Vaccinium macrocarpon* Ait.) production. Greenhouse and field screening has identified quinclorac, chlorimuron, and mesotrione as potentially useful herbicides for use in cranberries with good crop safety. Quinclorac has demonstrated good crop safety at up to 1.0 lb ai/a applied to dormant cranberries in early May or to actively growing and blooming cranberries in June. Mesotrione has demonstrated good crop safety at up to 1.5 lb ai/a applied at the same timings. Chlorimuron has demonstrated good crop safety at 0.02 lb ai/a, but has caused some temporary chlorosis and reduced yield when applied to cranberries at higher rates, up to 0.08 lb ai/a in early May or June. Experiments conducted to evaluate the control of serious cranberry weeds in growers' bogs have indicated that each herbicide has the potential to control weeds that cannot currently be easily controlled in cranberries.

Quinclorac applied at 0.25 to 0.5 lb ai/a has controlled swampcandle (*Lysimachia terrestris* (L.) B.S.P.), also known as yellow loosestrife to cranberry growers, when applied in July near or shortly after the weed blooms. Mesotrione applied at 0.375 lb ai/a in the spring has controlled soft rush (*Juncus effusus* L.) and red-root (*Lachnanthes tinctoria* (Walt.) Ell.). Redroot is a special problem in cranberry bogs due to the desirability of the root as a winter food for waterfowl, which can extensively damage bogs in the winter while digging the roots of the weed. Chlorimuron, quinclorac, and mesotrione all controlled false nutsedge (*Cyperus strigosus* L.) when applied in May or June. None of the herbicides controlled seedling red maple (*Acer rubrum* L.).

OVERSEEDED RYEGRASS TO BERMUDAGRASS TRANSITION WITH NEW SULFONYLUREA HERBICIDES. W.L. Barker, S.D. Askew, and J.B. Beam, Virginia Tech, Blacksburg.

ABSTRACT

Typically, bermudagrass (*Cynodon dactylon* (L.) Pers.) fairways are overseeded with perennial ryegrass (*Lolium perenne* L.) in early fall within the climatic transition zone to maintain a green surface throughout the year. To promote optimal post-dormancy bermudagrass growth and development, perennial ryegrass should be controlled in the spring. Currently in the US, three sulfonylurea herbicides (chlorsulfuron, metsulfuron, and rimsulfuron) are registered for use in established bermudagrass to control overseeded perennial ryegrass or other weedy grasses. In addition, three other sulfonylurea herbicides (flazasulfuron, foramsulfuron, and trifloxysulfuron) are under evaluation for possible registration in the US. Six field trials were conducted at three locations in 2002 to evaluate differential perennial ryegrass control and bermudagrass injury from the herbicides flazasulfuron, foramsulfuron, metsulfuron, rimsulfuron, and trifloxysulfuron. Studies were conducted as randomized complete block designs with four replications at Keswick Club in Keswick VA, London Downs Golf Club in Forest, VA, and the Turfgrass Research Center in Blacksburg, VA. Treatments in one study included different rates of flazasulfuron (9, 18, 26, 39, and 53 g ai/ha) compared to a single rate of metsulfuron (21.0 g ai/ha). In another study, five foramsulfuron treatments were compared to metsulfuron at 21 g ai/ha, rimsulfuron at 18 g ai/ha, and trifloxysulfuron at 10 g ai/ha. Foramsulfuron was applied alone at 15, 30, and 45 g ai/ha or at 30 g ai/ha with methylated seed oil adjuvant (MSO) at 1% (v/v) or MSO + urea ammonium nitrate at 30% v/v. In both studies, all herbicide treatments except foramsulfuron included nonionic surfactant at 0.25% v/v. Nontreated controls were also included in each study for comparison.

Flazasulfuron rate did not influence perennial ryegrass control at most evaluation times. Regardless of location, foramsulfuron, flazasulfuron, metsulfuron, rimsulfuron, and trifloxysulfuron controlled perennial ryegrass at least 90% 4 weeks after treatment (WAT). Bermudagrass injury was less than 20% throughout the experiments. All herbicide treatments increased bermudagrass coverage between 20 and 47% 12 WAT. At London Downs, mature annual bluegrass (*Poa annua* L.) control was assessed. The herbicides evaluated controlled annual bluegrass in the following order: foramsulfuron \geq rimsulfuron $>$ trifloxysulfuron $>$ flazasulfuron \geq metsulfuron. Results indicate all of these herbicides can successfully aid bermudagrass post-dormancy transition by controlling perennial ryegrass.

POTENTIAL USE OF V-10029 FOR WEED CONTROL IN COOL-SEASON TURFGRASS. D. W. Lycan, S. E. Hart, Rutgers, Rutgers Univ., New Brunswick; and J. Fausey, Valent USA Corp., Lansing, MI.

ABSTRACT

Field experiments were conducted in 2002 in New Jersey to evaluate V-10029 for safety on various cool-season turfgrass species and control of annual bluegrass (*Poa annua* ssp. *annua*) and roughstalk bluegrass (*P. trivialis*). All herbicide treatments were applied to mature stands of turf using a CO₂ backpack sprayer delivering 40 gal/A.

Turf tolerance studies were established on June 11, 2002 on Kentucky bluegrass (*Poa pratensis* 'Gnome'), perennial ryegrass (*Lolium perenne* 'Jet'), tall fescue (*Festuca arundinacea* 'Houndog 5'), and Chewings fine fescue (*Festuca rubra* ssp. *falax* 'Shadow II'). Treatments consisted of single applications of V-10029 at 15, 30, 45, 60, and 120 g ai/A. Visual injury data and clipping weights were taken at 35 and 70 d after treatment (DAT). Clipping weights were converted to per cent growth reduction based on the untreated checks. At 35 DAT, injury was evident in Kentucky bluegrass plots treated with 30 g or greater. Visual injury ranged from 8 to 26%, while growth reduction values were 19 to 35%. By 70 DAT growth reduction was still evident in plots treated with higher rates. Perennial ryegrass and tall fescue injury at 35 DAT was minimal and by 70 DAT all plots recovered from initial injury and growth reduction. Fine fescue showed significant growth reduction from rates of 45 g and greater at 35 DAT. A treatment of 120 g resulted in 28% growth reduction at this time. Evaluations at 70 DAT were not taken due to poor fine fescue performance during severe environmental stresses.

Two separate studies were established in the spring of 2002 to evaluate V-10029 for *Poa annua* and *P. trivialis* control in creeping bentgrass (*Agrostis palustris* 'L-93'). Treatments consisted of V-10029 at 15 g ai/A applied once, twice (4 week interval, *P. trivialis* study only), and four times (2 week intervals); 30 g ai/A applied once and twice (4 week interval); and 60 g ai/A applied once. Per cent weed population reduction was calculated per plot from populations present at study initiation and those present at each evaluation date. By 16 d after final application, *P. annua* populations in untreated check plots decreased by an average of 23% due to seasonal fluctuations. Four applications of V-10029 at 15 g or one 60 g application resulted in 34 and 44% *P. annua* population reduction, respectively. Other V-10029 treatments resulted in *P. annua* population reduction values that were not statistically different than the untreated check. *Poa trivialis* population reduction increased with increasing rates of V-10029. Single applications at 15, 30, 45, and 60 g ai/A resulted in 17, 28, 44, and 50% population reduction, respectively, at 8 weeks after treatment. *Poa trivialis* populations in untreated check plots decreased by an average of 14% by this time. Multiple applications of V-10029 resulted in greater population reduction as compared to single applications. Four applications at 15 g resulted in 68% *P. trivialis* population reduction by 16 d after final application. In both studies, creeping bentgrass showed good tolerance to V-10029. Plots receiving two applications within two weeks displayed initial chlorosis levels of 10 to 20% but fully recovered within two weeks.

These studies suggest that V-10029 has the ability to reduce *Poa annua* and *P. trivialis* populations in established turfgrass. Creeping bentgrass, perennial ryegrass, and tall fescue tolerance to V-10029 applications appears to be acceptable, while the tolerance of Kentucky bluegrass and fine fescue is more questionable.

ABSTRACT

Prohexadione calcium is a gibberellin inhibitor like paclobutrazol and trinexapac-ethyl. Trinexapac-ethyl and paclobutrazol reduce clipping biomass and mowing requirements in most species of turfgrass. Paclobutrazol also controls annual bluegrass (*Poa annua* L.). Prohexadione calcium was tested for turfgrass growth management and annual bluegrass control in Virginia. In the growth management experiment, plots were mowed weekly for 10 wk and clipping biomass was assessed beginning in August of 2001 and 2002, and in June 2002. Species tested in the field were established stands of bermudagrass (*Cynodon dactylon* (L.) Pers. 'Vamont'), Kentucky bluegrass (*Poa pratensis* L. 'Midnight'), perennial ryegrass (*Lolium perenne* L. 'Prosport'), and zoysiagrass (*Zoysia japonica* Steud. 'Korean common' and 'Meyer') and in the greenhouse perennial ryegrass, fine fescue (*Festuca rubra* var. *commutata* 'Chewings') and Kentucky bluegrass 'Viva'. One day after the second mowing, prohexadione calcium was applied at 0, 0.14, 0.27, 0.41, 0.54, and 0.68 kg ai/ha with a nonionic surfactant (NIS) at 0.25 % (v/v). Trinexapac-ethyl was applied twice at the label rate for each species on a 4 wk interval as a comparison treatment. A second prohexadione calcium treatment was applied 3 wk after the first. In field and greenhouse experiments, prohexadione calcium reduced clipping weights compared to the nontreated control. When averaged over 2 greenhouse trials and based on regression equations, prohexadione calcium reduced turfgrass clipping biomass equal to the label rate of trinexapac-ethyl when applied at 0.4 kg ai/ha in fine fescue, 0.2 kg ai/ha in Kentucky bluegrass, and 0.7 kg ai/ha in perennial ryegrass. When averaged over 3 field trials, prohexadione calcium reduced turfgrass clipping biomass equivalent to label rates of trinexapac-ethyl when applied at 0.2 kg ai/ha in Kentucky bluegrass, 0.7 kg ai/ha in perennial ryegrass, 0.7 kg ai/ha in bermudagrass, and 0.3 kg ai/ha in zoysiagrass.

In annual bluegrass control experiments, prohexadione calcium was applied at the same rates and timings as in the growth management experiments at the Virginia Tech Golf Course (VTGC) in Blacksburg, VA, Chantilly Turf Farms in Chantilly, VA, and Stony Creek Golf Course in Wintergreen, VA. At the VTGC a third treatment of prohexadione calcium was made 3 wk after the second and ethofumesate was included (1.5 kg ai/ha, applied twice) as a comparison. At Wintergreen and Chantilly, paclobutrazol (0.56 kg ai/ha, applied twice) was the comparison. Adjuvant tests were also included at all locations, crop oil concentrate (COC) at 1% v/v and methylated seed oil (MSO) were tankmixed with prohexadione calcium at 0.41 kg ai/ha. At the VTGC, ethofumesate controlled annual bluegrass at least 90% starting at 8 WAT. Prohexadione calcium at 0.41 kg ai/ha + NIS controlled annual bluegrass at least 70% at all locations 12 WAT. Control was not altered with the addition of COC or MSO and was not different compared to paclobutrazol at any location. Prohexadione calcium injured turfgrass less than paclobutrazol and ethofumesate. Results indicate prohexadione calcium can be a viable option for chemical turf management and annual bluegrass control.

ABSTRACT

The first study was conducted on a mature stand of "Penneagle" fairway height creeping bentgrass (*Agrostis stolonifera*), at the Valentine Turfgrass Research Center, Penn State Univ., University Park, Pa. The objective of the study was to determine the phytotoxicity of selected broadleaf herbicides on fairway height creeping bentgrass. All of the treatments were applied on June 7, 2002 using a three foot CO₂ powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The individual plot size was 30 square feet. The study area was mowed with a reel mower at one half inch with clippings returned. No significant phytotoxicity was observed on the June 8 rating date (24 hours after application). However, on the June 10 rating date (three days after application) phytotoxicity was evident on bentgrass treated with all treatments. Although phytotoxicity was evident, only bentgrass treated with Speed Zone at the high rate, Power Zone, Trimec Classic, EH 1349 at the high rate, and NB 30165 had phytotoxicity ratings that were below acceptable. By the June 14 rating, only Power Zone at the low rate and Trimec Southern treated turf had acceptable phytotoxicity ratings. On June 21, most of the injured turf had recovered to acceptable ratings with the exception of that which was treated with Speed Zone at the high rate. Interestingly, on the June 28 rating date Speed Zone at the high rate continued to cause unacceptable phytotoxicity ratings, but turf treated with Speed Zone St. Augustine at the high rate, Trimec Classic and EH 1349 also caused unacceptable phytotoxicity ratings. Only Speed Zone at the high rate caused unacceptable phytotoxicity on any rating after June 28 (July 2). The second study was conducted on a mature stand of "Penneagle" creeping bentgrass (*Agrostis stolonifera*) at the Valentine Turfgrass Research Center, Penn State Univ., University Park, PA. The objective of the study was to assess the phytotoxic effect of multiple applications of Acclaim Extra on fairway height "Penneagle" creeping bentgrass. This study was a randomized complete block design with three replications. All treatments were applied on June 4, June 19, July 1, July 16, and July 31, 2002 using a three foot CO₂ powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The test site was maintained similar to that of a golf course fairway with respect to irrigation, fertilization and mowing. The test area was maintained at 0.5 inch using a reel mower that collected the clippings three times per week. Both rates (label and 2X) of Acclaim Extra caused unacceptable phytotoxicity on "Penneagle" creeping bentgrass on June 28, July 3, and July 26. Turf treated with the 2X rate was found to have unacceptable phytotoxicity ratings on all dates except July 18. It appears that caution should be exercised when making sequential applications of Acclaim Extra on "Penneagle" creeping bentgrass even when using the label rate.

SMOOTH CRABGRASS CONTROL WITH FENOXAPROP AND QUINCLORAC AND THEIR EFFECTS ON BENTGRASS QUALITY. P.H. Dernoeden, C.A. Bigelow, and J.E. Kaminski, Univ. of Maryland, College Park.

ABSTRACT

Fenoxaprop (Acclaim Extra) and quinclorac (Drive) are used to control smooth crabgrass (*Digitaria ischaemum*) and both are labeled for use on creeping bentgrass (*Agrostis stolonifera*) fairways. Both herbicides can discolor or injure bentgrass. The objectives of this study were: 1) to compare the effectiveness of four fenoxaprop formulations and Drive applied in various timings for smooth crabgrass control; and 2) to assess tolerance of fairway height bentgrass to these herbicides. In the efficacy study, there were three application timings involving different control strategies. Acclaim Extra and three TADS (fenoxaprop) forms were applied on a 21-day interval beginning on 1 May 2002 when crabgrass was in the 1-2 leaf stage to mimic use on bentgrass fairways. Drive treatments were initiated on 21 June to mimic use on bentgrass fairways. Acclaim Extra treatments initiated 3 July were intended to mimic the use of this product on perennial ryegrass (*Lolium perenne*) fairways. The efficacy study was conducted in perennial ryegrass mowed to a height of 1.5 inches. Percent of plot area covered with smooth crabgrass was visually assessed on a 0 to 100%. Crabgrass pressure was severe, and treatments with cover ratings exceeding 5% were considered to be commercially unacceptable. The bentgrass tolerance study was conducted on a two year old stand of 'L-93' creeping bentgrass maintained at 0.6 inches. All fenoxaprop treatments were applied at 0.016 lb ai/A (lb/A) on 21-day intervals between 1 May and 23 July. Drive was applied at 0.5 lb/A twice on a 14-day interval and 0.33 lb/A three times on a 14-day interval beginning on 12 June. Drive was applied alone or tank-mixed with a liquid chelated iron plus nitrogen safener (Fe + N). For both studies, herbicides were applied in 50 gpa using a CO₂ pressurized sprayer. The soil was a silt loam with a pH of 6.8 and 3.6% OM. Plots were 5 ft x 5 ft and arranged in a randomized complete block with four replications. Data were subjected to ANOVA, and significantly different means were separated by the LSD test at P = 0.05.

Crabgrass control. Three fenoxaprop 0.58EC formulations were compared to Acclaim Extra 0.57EW and applied five times on a 21-day interval in the bentgrass fairway program. Data collected between 19 and 31 July revealed no significant differences among treatments (Table 1). Data collected 9 August, however, showed that Acclaim Extra had provided better crabgrass control than TADS 15326. Although not significantly different from TADS 15325 and TADS 14626, only Acclaim Extra had provided commercially acceptable (i.e., >5% crabgrass cover) control. Sequential Drive treatments provided excellent control; whereas, the single application provided commercially unacceptable control. Both Acclaim Extra treatments provided effective control in a single application in the ryegrass fairway program.

Bentgrass Tolerance. Fenoxaprop applications were initiated in an early timing (i.e., 1 May), and did not cause any noticeable discoloration between 1 and 22 May (data not shown). Following the second application, however, fenoxaprop elicited an unacceptable color and quality from late-May through June, but all plots recovered by 10 July. Injury appeared as foliar yellowing and some thinning of the stand. TADS 15325-treated plots displayed significantly better quality and color than plots treated with Acclaim Extra between 28 May and 25 June. Fenoxaprop applications made after

3 July did not cause any additional injury. Drive treatments, initiated at a mid-postemergence timing (12 June), reduced bentgrass quality. The injury appeared as an overall patchy yellowing and slight thinning of the canopy. Drive applied alone at 0.5 lb/A reduced quality when compared to untreated plots on all rating dates. Drive (0.5 lb/A) tank-mixed with Fe + N resulted in better quality, when compared to Drive alone on most dates. By 19 July, Drive (0.5 lb/A) plus Fe + N-treated plots had quality ratings equivalent to untreated plots. Plots treated with 0.33 lb/A rate of Drive had quality similar to plots treated with 0.5 lb/A on most dates. As was the case for the 0.5 lb/A rate alone, quality of plots treated with the 0.33 lb/A rate alone were inferior to the untreated control on nearly all rating dates. Drive (0.33 lb/A) tank-mixed with Fe + N resulted in quality that was similar to untreated plots on most dates. Where Drive was applied with Fe + N, however, the turf still experienced some thinning, but the yellow was minimized. Plots treated with Drive alone continued to exhibit a reduction in quality when the study was ended on 16 August.

Table 1. Postemergence crabgrass control efficacy with four fenoxaprop formulations and Drive, 2002.

Treatment	Rate lb ai/A	Interval/Timin	% crabgrass cover		
		g Days	19 July	31 July	9 Aug
TADS 15325 0.58EC	0.016	21-d ^{1/}	3bc ^{4/}	3bc	6cd
TADS 15326 0.58EC	0.016	21-d	4b	5b	11b
TADS 14625 0.58EC	0.016	21-d	4b	4b	7bcd
Acclaim Extra 0.57EW	0.016	21-d	3bcd	3bcd	3de
Drive 75DF + 1% MSO	0.75	EPO ^{2/}	1cd	4b	10bc
Drive 75DF + 1% MSO	0.5 + 0.5	EPO	0d	0d	0e
Drive 75DF + 1% MSO	0.33 + 0.33 + 0.33	EPO	0d	0d	1e
Acclaim Extra 0.57EW	0.09	MPO ^{3/}	0d	0d	4de
Acclaim Extra 0.57EW	0.12	MPO	0d	0d	1e
Untreated	--	--	48a	63a	85a

^{1/}Treatments initiated at 1 – 2 leaf (L) crabgrass and applied: 1 May; 22 May; 12 June; and 3 and 23 July 2002 in the bentgrass fairway program.

^{2/}Treatments initiated at 3-4L crabgrass and applied: 21 June (all); 3 July (0.5 & 0.33 lb/A); 9 July (0.33 lb/A) 2002. Drive was tank-mixed with 1% v/v methylated seed oil (MSO).

^{3/}Treatments applied at 4L-2T crabgrass on 23 July 2002 in the ryegrass fairway program.

^{4/}Means in a column followed by the same letter are not significantly different according to the LSD test at $P = 0.05$.

PREEMERGENCE HERBICIDES FOR SMOOTH CRABGRASS CONTROL
GENERALLY PERFORMED POORLY IN MARYLAND IN 2002. P.H. Dernoeden, C.A.
Bigelow, and J.E. Kaminski, University of Maryland, College Park.

ABSTRACT

Experimental herbicides or new formulations of available preemergence products are continuously evaluated for smooth crabgrass (*Digitaria ischaemum* [Schreb] Schreb.ex Muhl) control performance. Two trials were conducted in 2002 in perennial ryegrass (*Lolium perenne* L.) turf mowed to a height of 2.5 inches. Herbicides were applied in 50 gpa using a CO₂ pressurized (35 psi) sprayer equipped with an 8004E nozzle. Herbicides were applied 29 March and sequential treatments were applied on 22 May 2002. The sites were irrigated within 24 hrs of each herbicide application. Due to an extended period of drought the sites were irrigated frequently throughout the summer. Soil was a silt loam with a pH of 5.9 and 3.4% OM. Crabgrass seedlings were observed 10 April, but most germination occurred after mid-May. Plots were 5ft x 5ft and were arranged in a randomized complete block with 4 replications. Percent of plot area covered with smooth crabgrass was assessed visually on a 0 to 100% scale where 0 = no crabgrass and 100 = entire plot area covered with crabgrass. Smooth crabgrass pressure was uniform and severe across the sites. Treatments with crabgrass cover ratings below 10% were considered to have provided excellent control. Data were subjected to ANOVA and significantly different means were separated at $P = 0.05$.

Mesotrione was applied in single and sequential applications in a preemergence timing and once in a postemergence timing (i.e., 22 May; crabgrass 1-3 leaf stage). Mesotrione was tank-mixed with X-77 non-ionic surfactant (NIS) at 0.25% v/v. Data collected 18 July showed that all Mesotrione treatments provided poor smooth crabgrass control (Table 1). By 16 Aug, only the 0.50 lb/A rate applied postemergence had reduced crabgrass levels significantly, when compared to the untreated control. Mesotrione applied postemergence or as sequential (not single pre-timing treatments) elicited a brilliant chlorosis in the perennial ryegrass turf for about 7 to 10 days. Crabgrass plants treated postemergence with Mesotrione were bleached white, but plants generally recovered. Given the severe crabgrass pressure, all Barricade (proflaminate) treatments and Dimension (dithiopyr, 0.25+0.25 lb/A) were judged to have provided excellent crabgrass control.

The second study compared two Pendulum (pendimethalin) formulations (3.3EC and 3.8CS) applied once at 2.0 lb/A or sequentially at 1.5 + 1.5 lb/A. Furthermore, several granular homeowners products were evaluated as follows: Scotts Turf Builder With Halts (pendimethalin, 1.5 lb/A); Sta-Green Premium Crab-Ex (dithiopyr, 0.252 lb/A); Vigoro Ultra Turf Pre (dithiopyr, 0.252 lb/A); Schultz Expert Gard. Prem. (proflaminate, 0.314 lb/A); Sam's Choice Crab. Prev. (proflaminate, 0.39 lb/A); Preen's Green Lawns (benefin + trifluralin, 3.03 lb/A); Lesco Dimension (dithiopyr, 0.155 lb/A); Scotts Super Turf Builder With Halts (pendimethalin, 1.5 lb/A); Scotts Step 1 Crab. Prev. (pendimethalin, 1.5 lb/A); Fert-i-lome Lawn Food + Weed Prev. (proflaminate 0.66 lb/A); and Dynaweed (corn gluten, 15 + 15 lb/prod./1000ft²). None of the granular homeowner products effectively controlled smooth crabgrass (data not shown). Among the granular products, best control was provided by Preen's Green Lawns (45% crabgrass cover) and Fert-i-lome Lawn Food (32% crabgrass cover). The Pendulum 3.8CS treatments provided better crabgrass control than their counterpart 3.3EC treatments. Given the

exceptionally severe levels of crabgrass, only Pendulum 3.8CS (1.5+1.5 lb/A) was judged to have provided good control (13% crabgrass cover).

Table 1. Smooth crabgrass control with Mesotrione, Barricade and Dimension, 2002.

Herbicide ^{1/}	Rate lb ai/A	Timing	% crabgrass cover	
			18 July	16 Aug
Mesotrione 480SC+0.25% NIS ^{2/}	0.125	Pre	63a ^{3/}	94ab
Mesotrione 480SC + 0.25% NIS	0.25	Pre	56ab	95ab
Mesotrione 480SC + 0.25% NIS	0.50	Pre	63a	96a
Mesotrione 480SC + 0.25% NIS	0.125+0.125	Pre + Seq.	53a-d	96a
Mesotrione 480SC + 0.25% NIS	0.125 + 0.25	Pre + Seq.	41cde	90abc
Mesotrione 480SC + 0.25% NIS	0.25 + 0.25	Pre + Seq.	38e	86bc
Barricade 65WG	0.75	Pre	1f	5e
Barricade 4L	0.75	Pre	2f	7de
Barricade 4L	0.50 + 0.25	Pre + Seq.	<1f	3e
Dimension 40WSP	0.25 + 0.25	Pre + Seq.	1f	7de
Dimension 40WSP	0.50	Pre	1f	15d
Mesotrione 480SC + 0.25% NIS	0.125	Post	53abc	91abc
Mesotrione 480SC + 0.25% NIS	0.25	Post	48b-e	89abc
Mesotrione 480SC + 0.25% NIS	0.50	Post	39de	85c
Untreated	--	--	58ab	95ab

^{1/}All herbicides were applied 29 March and sequentials were applied 22 May 2002. Postemergence treatments were applied 22 May 2002.

^{2/}NIS = X-77

^{3/}Means in a column followed by the same letter are not significantly different according to the LSD test at $P = 0.05$.

ABSTRACT

Study I: A PRE/POST smooth crabgrass (*Digitaria ischaemum*) control trial was conducted on a mature fairway height stand of "SR 4200"perennial ryegrass (*Lolium perenne* L.)/*Poa annua* at the Valentine Turfgrass Research Center, Penn State Univ., University Park, PA. The objective of the study was to determine the efficacy of selected preemergence and postemergence herbicides for the control of smooth crabgrass in fairway height perennial ryegrass. This study was a randomized complete block design with three replications. Treatments were applied on June 17, 2002 using a three foot CO₂ powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The test site was maintained at 0.5 inches to simulate a golf course fairway. Crabgrass control was rated on August 16 and Dimension 40WP at 0.5 lbs ai/A, Dimension 40WP plus 2 oz/M of MacroSorb Foliar, Acclaim Extra plus pendimethalin, Drive 75 DF with MSO, without MSO, and with MacroSorb Foliar, at the 0.75 lbs ai/A rate, and Drive 75DF at the 0.5 lbs ai/A rate with MacroSorb Foliar all provided commercially acceptable crabgrass control. It appeared that the 2 oz/M MacroSorb Foliar tank mix addition to Drive 75DF enhanced efficacy.

Study II: Postemergence smooth crabgrass control was conducted on a mature fairway height stand of "SR 4200"perennial ryegrass/*Poa annua* at the Valentine Turfgrass Research Center, Penn State Univ., University Park, PA. The objective of the study was to determine the efficacy of selected postemergence herbicides for the control of smooth crabgrass in fairway height perennial ryegrass. This study was a randomized complete block design with three replications. Treatments were applied on July 10, 2002 using a three foot CO₂ powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The test site was maintained at 0.5 inches to simulate a golf course fairway. None of the Drive 75DF nor mesotrione treatments provided acceptable crabgrass control (>85%). However, when MacroSorb Foliar at 2 oz/M was included with Drive 75DF, control was enhanced. The addition of 2 oz/M of MacroSorb Foliar also enhanced the efficacy of Acclaim Extra at all rates, even the 10 oz/A rate (less than half that of label recommendation) provided acceptable control.

ABSTRACT

A preemergence smooth crabgrass (*Digitaria ischaemum*) control trial was conducted on a mature stand of fairway height "SR 4200" perennial ryegrass (*Lolium perenne* L.)/*Poa annua* at the Valentine Turfgrass Research Center, Penn State Univ., University Park, PA. The objective of the study was to determine the efficacy of selected preemergence herbicides for the control of smooth crabgrass in fairway height perennial ryegrass. The study was a randomized complete block design with three replications. Treatments were applied on April 18, 2002 using a three foot CO₂ powered boom sprayer calibrated to deliver 80 gpa using two, flat fan, 11004 nozzles at 40 psi. Some treatments were re-applied six weeks later on May 30, 2002. Granular treatments were applied with a shaker jar. After application the entire test site received approximately 1.3 inches of water. On April 18, 2002, 0.5 lb N/M was applied from urea and 0.5 lb N/M from a 31-0-0 IBDU fertilizer to treatments that did not contain any nitrogen as a herbicide carrier. Smooth crabgrass germination was first noted in the test site on April 19, 2002. On April 24, and May 21, 2002 a frost eliminated smooth crabgrass that was present in voids in the test area. Weather data from the Penn State weather station at University Park, PA recorded frost each morning from May 19 through May 22, 2002, inclusive. Smooth crabgrass pressure was rated as being severe in the study site, as infestation in the untreated plots was nearly 100%. Acceptable control was considered for ratings of 85% or greater. In May, some thinning of the annual bluegrass in the study area was observed. Although the amount of thinning was not considered to be of practical significance (33.3% was best), the Pendulum 3.3EC applied at 2 lbs ai/A thinned the annual bluegrass significantly more than any other treatment. None of the mesotrione treatments controlled crabgrass to a commercially acceptable degree. The best crabgrass control (>85%) was provided by an application of Dimension 40WP at 0.25 lbs ai/A followed six weeks later by another 0.25 lbs ai/A, and Dimension 40WP at 0.5 lbs ai/A, while Barricade 65WDG at 0.75 and a Barricade split application at 0.325 lbs ai/A followed by another 0.325 lbs ai/A six weeks later, both provided 83.3% control (very near commercial acceptance). In addition, the Barricade 65WDG at 0.65 lbs ai/A provided control greater than 80%.

ABSTRACT

The first study was conducted on a mature stand of perennial ryegrass (*Lolium perenne* L) at the Valentine Turfgrass Research Center, Penn State Univ., Univ. Park, PA. The test site was mowed at one inch and irrigated to prevent wilt. The objective of the study was to determine the efficacy of selected broadleaf herbicides for the control of dandelion (*Taraxacum officinale*), common plantain (*Plantago major*), and white clover (*Trifolium repens*). This study was a randomized complete block design with three replications. All of the treatments were applied on June 7, 2002 using a three foot CO₂ powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The individual plot size was 30 square feet. With regard to the control of dandelion, white clover, and common plantain in the perennial ryegrass trial, all treatments resulted in excellent control of white clover and common plantain. However, the control of dandelion was highly variable across the treatments. For example, on the July 16 rating date, no treatment controlled dandelion better than 63.9%. By the July 29 rating date, only the Speed Zone at the low rate and Speed Zone St. Augustine at the low rate had relatively poor dandelion control compared to the rest of the treatments. The second study was conducted on a mature mixed stand of perennial ryegrass (*Lolium perenne* L.), Kentucky bluegrass (*Poa pratensis*) and fine fescue (*Festuca* spp.) on a home lawn in Julian, PA. The objective of the study was to determine the efficacy of broadleaf weed herbicides for the control of ground ivy (*Glechoma hederacea*). Although there were many types of broadleaf weeds in the stand they were not uniform enough to evaluate control on a species by species basis. The term "other weed" (used in this abstract) thus refers to buckhorn plantain (*Plantago lanceolata*), common plantain, dog fennel (*Anthemis cotula*), slender speedwell (*Veronica filiformis*), wild violet (*Viola* spp.), wild strawberry (*Fragaria virginiana*), yellow woodsorrel (*Oxalis stricta*), white clover, dandelion, yellow hawkweed (*Hieracium pretense*), mouse ear chickweed (*Cerastium vulgatum*), thymeleaf speedwell (*Veronica serpyllifolia*), healall (*Prunella vulgaris*), wild carrot (*Daucus carota*), and yarrow (*Achillea millefolium*) that were present at the time of the herbicide application. The study was a randomized complete block design with three replications. All of the treatments were applied on June 10, 2002 using a three foot CO₂ powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. Ratings were taken on June 10, July 8, and Aug 5, 2002. Each plot was rated for ground ivy cover and other weed cover prior to treatment. The site was mowed at two inches with a rotary mower with clippings returned. The site was not irrigated. Ground ivy control was highly variable from treatment to treatment. Sprayed formulations provided better control than granular materials. Speed Zone, Drive plus 2,4-D and MSO, Confront and Trimec Classic tended to provide the best and most lasting control of ground ivy. Control of the other weeds on the site was also variable, but the sprayed formulations again were typically more efficacious than the granular formulations.

ABSTRACT

This study was conducted on a mixed stand of creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass *Poa annua* at the Penn State Blue Golf Course in State College, PA. The objective of the study was to evaluate selected growth regulators, with and without additional adjuvants for the seedhead suppression of *Poa annua* under putting green conditions. Treatments were applied on April 12, 2002 using a three-foot CO₂ powered boom sprayer calibrated to deliver 40 GPA using two 6504 flat fan nozzles at 40 psi. The turf was maintained using cultural practices for irrigation, mowing, and fertilization that would be typical for a green. However, core cultivation was performed on the study area on May 1, 2002 and mowing resumed on May 5, 2002. All treatments provided at least 70% seedhead suppression on the May 10 rating date compared to the untreated control. Embark T/O at 40 oz/A with Ferromec at 5 oz/A and the combination of Proxy and Primo MAXX at 5 oz/M and 0.125 oz/M respectively had significantly less seedhead suppression than Embark T/O at 40 oz/A, Embark T/O at 40 oz/A with Ferromec at 5 oz/M and Seaweed Cocktail at 0.25 gal/A, and Embark T/O at 40 oz/A with MacroSorb Foliar at 8 oz/M. On April 15, no treated turf was rated below 7 (an acceptable level). However, on April 18, turf treated with Embark T/O at 40 oz/A, Embark T/O at 40 oz/A with Ferromec at 5 oz/M and MacroSorb Foliar at 8 oz/M had color ratings slightly below acceptable (6.7). On April 26, turf treated with Proxy at 5 oz/M and Primo MAXX at 0.125 oz/M and Proxy at 5 oz/M with Primo MAXX at 0.125 oz/M plus MacroSorb Foliar at 4 and 8 oz/M had color comparable to the untreated check. It appeared the best treatments, considering seedhead suppression and color, were the Proxy at 5 oz/M and Primo MAXX at 0.125 oz/M plus MacroSorb Foliar at both 4 and 8 oz/M.

ABSTRACT

This study was conducted on a mature stand of creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*) at the Valentine Turfgrass Research Center, Penn State Univ., University Park, PA. The objective of the study was to determine the efficacy of plant growth regulators and bio-stimulants by color ratings and determinations of plant height and foliar yield. This study was a randomized complete block design with three replications. All treatments were applied on June 5, June 19, July 2, July 16, July 31, 2002 using a three foot CO₂ powered boom sprayer calibrated to deliver 40 gpa using two, flat fan, 11004 nozzles at 40 psi. The test site was maintained similar to that of a golf course putting green with respect to irrigation, fertilization and mowing. Turfgrass height was measured using a Turfcheck 1 prism. After the June 5 application date Coron was substituted for ammonium sulfate as a nitrogen source as the ammonium sulfate caused significant phytotoxicity. At no time did color ratings reveal that treated turf was in an unacceptable condition after switching the nitrogen source to Coron. However, on June 10, turf treated with Primo Maxx, Kick, Potent-Sea, N-Hance, Base One, and Coron tended to have poorer color than untreated turf. Throughout the course of the study, there was a consistent tendency for turf that was treated with all materials to have color better than the untreated control. On some dates, significant differences were found for height measurements. For example, on June 10, turf treated with Primo Maxx, Astron, and Coron; Primo Maxx, Kick, Potent-Sea, N-Hance, Base One, and Coron; Primo Maxx, MacroSorb Foliar, and Coron; Primo Maxx and Coron; Primo Maxx and Gary's Green 18-3-4; and Primo Maxx, Gary's Green 18-3-4, and Gary's Green PK Plus 3-21-18 had lower height than untreated turf. However, by June 24 turf treated with Primo Maxx, Kick, Potent-Sea, N-Hance, Base One and Coron was found to have a height higher than untreated turf. On July 8, turf treated with Primo Maxx was shorter than untreated turf and turf that had received Coron and Gary's Green 18-3-4 with Primo Maxx. On July 16, only turf treated with Primo Maxx was shorter than the untreated turf. The other two dates on which a treated turf was found to have a height difference from the untreated turf was on August 12. On this date, turf treated with Primo Maxx plus Coron was shorter than the untreated turf. However, on August 19 the reverse response was found. With exception of turf treated with Coron or that treated with Primo Maxx and Gary's Green 18-3-4, all other treated turf had lower clipping yields than untreated turf on June 10, 17, and 24. By July 1, only turf treated with Primo Maxx; Primo Maxx, Astron and Coron; Primo Maxx and Coron; and Primo Maxx, Gary's Green 18-3-4 plus Gary's PK Plus 3-21-18 had lower clipping yields. On July 8, only turf treated with Coron alone and that treated with Primo Maxx, Kick, Potent-Sea, N-Hance, Base One and Coron had clipping yields similar to the untreated check, all other treatments caused significantly lower clipping yields. On July 16, no treatments caused significantly lower yields than untreated turf, however, turf treated with Primo Maxx alone had less yield than turf treated with Coron alone. On July 22, only turf treated with Coron alone and Primo Maxx with Gary's Green 18-3-4 plus Gary's PK Plus 3-21-18 had yields similar to the untreated turf, all other treated turf had lower yields than the untreated turf. On Aug 5, turf treated with Primo Maxx had less clipping yield than the untreated turf. In addition, turf treated with Primo Maxx, produced less yield than turf treated with Primo Maxx, Astron, and Coron; Primo Maxx, Kick, Potent-Sea, N-Hance, Base One, and Coron; Primo Maxx, MacroSorb Foliar, and Coron; and Coron alone. On August 12, only turf treated with Primo Maxx had less yield than untreated turf. By August 19, turf treated with Primo Maxx, Kick, Potent-Sea, N-Hance, Base One, and Coron; Primo Maxx, MacroSorb Foliar, and Coron; Primo Maxx plus Coron; and Primo Maxx, Gary's Green 18-3-4, and Gary's Green PK Plus 3-21-18, had yields that were significantly higher than untreated turf.

ABSTRACT

A premix combination product of glyphosate (Touchdown®) + diquat was evaluated in 2002 at Syngenta research stations and on University campuses. Both a concentrate and RTU (ready to use) product were evaluated for homeowner use at rates of 710 gae/ha. Test conditions varied across the US and weeds evaluated were of regional interest. Improved speed of activity was observed from the pre-mixes compared to straight glyphosate on FESRU (*Festuca rubra*) in RI, grass control in MD, foxtail (*Setaria species*) in NY, dandelion (*Taraxacum officinale*) across several sites. The RTU premix formulation, when weeds across sites were evaluated, improved speed of activity between 2-5-DAT compared to glyphosate alone. One location tested Monsanto's QuikPro™ in comparison to the Touchdown® pre-mix; the Syngenta pre-mix provided speed of control greater than QuikPro™ against many target species. The Syngenta RTU premix was also as efficacious as the comparable tankmix of Roundup® + diquat mixture. Timecourse of weed control will be shown and discussed. For homeowners desiring rapid results the addition of diquat to glyphosate will fill a need.

RESPONSE OF GLYPHOSATE TOLERANT TALL AND FINE FESCUE TO MULTIPLE APPLICATIONS OF GLYPHOSATE. S.E. Hart, Rutgers Univ., New Brunswick, NJ; J.F. Derr, Virginia Tech Univ., Virginia Beach.; C. Rose-Fricke, Pure Seed Testing, Hubbard, OR; D.W. Lycan and W.A. Meyer, Rutgers Univ., New Brunswick, NJ.

ABSTRACT

Field experiments were conducted in 2002 at the Rutgers Plant Science Research Center in Adelphia, NJ and at the Virginia Tech, Hampton Roads Agricultural Research and Extension Center in Virginia Beach, VA to evaluate the tolerance of tall fescue (*Festuca arundinacea* 'Pure Gold' and 'Tomohawk RT') and hard-fine fescue (*Festuca longifolia* 'Aurora Gold') to direct applications of glyphosate. These fescue varieties had been selected for increased glyphosate tolerance by recurrent selection. Tall fescue varieties 'Tomohawk' and hard-fine fescue variety 'Intrigue' (NJ) and 'Discover' (VA) which had not undergone recurrent selection were also included in the study. All varieties were established in the fall of 2001. In the spring/summer of 2002 glyphosate was applied one, two or three times at four to five week intervals at application rates of 0.05, 0.09, 0.188, 0.38, 0.56, 0.75 and 1.5 lbs ae/A. Initial applications were made on May 10 and May 16 at VA and NJ, respectively. All herbicide applications were applied with a CO₂ backpack sprayer delivering 40 gallons per acre.

Single applications of glyphosate at 0.56 lb/A and multiple applications at 0.19 lb/A caused significant visual injury to all three tall fescue varieties. In some cases 'Pure Gold' and 'Tomohawk RT' exhibited a higher degree of tolerance to glyphosate than 'Tomohawk'. However, this increase in tolerance may not be sufficient to allow for the direct use of glyphosate at application rates required for weed control.

Single applications of glyphosate at 0.56 lb/A and 0.38 lb/A caused significant visual injury to the susceptible fine fescue lines 'Discover' and 'Intrigue'. Glyphosate injury increased on these lines as subsequent applications were applied at these rates. In contrast, fine fescue variety 'Aurora Gold' was tolerant (<20% visual injury one month after treatment) to single applications of glyphosate up to 0.75 lb/A and was showing recovery from 1.5 lb/A into August. 'Aurora Gold' exhibited this same level of tolerance to multiple applications of glyphosate at 0.56 lb/A in VA and 0.75 lb/A in NJ.

The results of these studies suggest that conventional plant breeding techniques can be utilized to increase the level of glyphosate tolerance in tall and fine fescue. However, increases in tolerance in tall fescue may not be sufficient enough to allow for direct use of glyphosate for weed control purposes. Increases in glyphosate tolerance in fine fescue were significant, and tolerance levels in 'Aurora Gold' fine fescue may be sufficient to allow for direct use of glyphosate at rates as high as 0.75 lb/A.

ABSTRACT

Trifloxysulfuron sodium (CGA 362622) is a new sulfonylurea herbicide under evaluation by Syngenta™ for use in warm-season turf. The herbicide has activity on both broadleaf and grass weeds including Virginia buttonweed (*Diodia virginiana* L.) and perennial ryegrass (*Lolium perenne* L.). Since trifloxysulfuron is safe for use in bermudagrass [*Cynodon dactylon* (L.) Pers.], it could be used to control overseeded perennial ryegrass during bermudagrass post-dormancy transition. Three field studies were conducted between 2001 and 2002 at two Virginia golf courses to evaluate trifloxysulfuron sodium for removal of overseeded ryegrass and effects on bermudagrass green up during spring transition. The study was conducted at Keswick Club near Keswick, VA in spring 2001 and 2002 and at London Downs Golf Course near Forest, VA in 2002. Ten treatments were arranged in a randomized complete block design with three replications. Herbicides were first applied on May 10 in 2001 and May 15, 2002 at Keswick and on May 16, 2002 at London Downs. Sequential treatments were applied 1 month after initial treatments at all locations. Herbicides were applied with flat fan 8002 nozzles at a carrier volume of 280 L/ha. The carrier was water at pH near 7.4 plus nonionic surfactant at 0.25% v/v where appropriate. Trifloxysulfuron was applied at 2.5, 5, 10, and 15 g ai/ha either as a single treatment or with a second treatment one month later. A single treatment of pronamide served as a comparison in addition to a nontreated control, which was included to facilitate visual estimation of turf quality, ryegrass control, and bermudagrass injury. Treatments were evaluated at 1, 2, 4, 8, and 12 weeks after initial treatment. Data were subjected to ANOVA with sums of squares partitioned to evaluate the effects of trial, trifloxysulfuron rate, number of trifloxysulfuron treatments, and the comparison treatment pronamide. The hyperbolic function was fitted to perennial ryegrass control over time and estimated parameters i (ryegrass control as time approaches zero) and a (asymptote of late-season ryegrass control) were determined using the PROC NLIN function in SAS.

The estimated asymptote of late-season perennial ryegrass control was near 100% for all trifloxysulfuron treatments. In this experiment, i values tend to approximate the speed of perennial ryegrass control obtained by various treatments. Estimated i values always increased as trifloxysulfuron rate increased. When trifloxysulfuron was applied once at 2.5, 5, 10, and 15 g ai/ha, i values were 45, 75, 76, and 116, respectively. When trifloxysulfuron was applied twice at the same rates, i values were 28, 58, 97, and 115, respectively. By comparison, the i value for pronamide was 20 and numerically lower than all trifloxysulfuron treatments. Typically, the asymptote was lower and took more time to reach as trifloxysulfuron rate decreased. Although bermudagrass green up was sometimes slower following treatment of trifloxysulfuron at 10 or 15 g ai/ha, all treatments increased turf quality compared to the nontreated check by 8 WAT. Results indicate that trifloxysulfuron applied once at 10 g ai/ha controls perennial ryegrass quicker than pronamide but may temporarily slow bermudagrass post-dormancy transition. Trifloxysulfuron applied twice at 2.5 to 5 g ai/ha controls perennial ryegrass at a speed comparable to pronamide and does not injure bermudagrass.

ABSTRACT

Isoxaflutole and mesotrione were included in 37 Virginia research trials between 2001 and 2003 and found to control a variety of broadleaf and grass weeds in cool-season turf. When treated at rates between 0.11 and 0.56 kg ai/ha, isoxaflutole and mesotrione can safely be used as foliar sprays or at seeding of Kentucky bluegrass (*Poa pratensis* L.), perennial ryegrass (*Lolium perenne* L.), and tall fescue (*Festuca arundinacea* Schreb.). Turfgrass injury increases with increasing rate and increasing air/soil temperature. Results indicate that single treatments of isoxaflutole are generally more effective than single treatments of mesotrione when applied at equivalent rates. A given rate of mesotrione controls weeds postemergence more effectively when split into two treatments at 2- to 3-week intervals compared to a single full-rate treatment. Isoxaflutole at 0.21 kg ai/ha controlled white clover (*Trifolium repens* L.) 93% 63 days after treatment (DAT) and not different than label-recommended treatments of triclopyr plus clopyralid, quinclorac, and 2,4-D plus dicamba plus MCPP. Single treatments of mesotrione did not effectively control white clover. Isoxaflutole and mesotrione each at 0.17 kg ai/ha controlled ground ivy (*Glechoma hederacea* L.) 95% 25 DAT. However, both herbicides controlled ground ivy less than 60% 95 DAT. Spring treatments of isoxaflutole and mesotrione each at 0.28 kg ai/ha applied twice at 2- to 4-week intervals controlled quackgrass [*Elytrigia repens* (L.) Nevski] 70% and 56%, respectively 12 WAT and creeping bentgrass (*Agrostis stolonifera* L.) 70% 136 DAT. Isoxaflutole at 0.56 kg ai/ha did not control common bermudagrass [*Cynodon dactylon* (L.) Pers.] 146 DAT while the same amount of herbicide subdivided into 5 monthly treatments controlled bermudagrass 93%. Mesotrione suppressed bermudagrass but did not control bermudagrass. A single treatment of isoxaflutole at 0.17 kg ai/ha or mesotrione at 0.28 kg ai/ha controlled nimblewill (*Muhlenbergia schreberi* i.F.Gmel.) at least 95% 21 DAT. Isoxaflutole at 0.17 and 0.28 kg ai/ha controlled flowering goosegrass [*Eleusine indica* (L.) Gaertn.] at least 78% 44 DAT and equivalent to fenoxaprop at 0.1 kg ai/ha. Mesotrione at 0.28 kg ai/ha controlled 10-cm diameter Virginia buttonweed (*Diodia virginiana* L.) 96% 47 DAT and 16-cm diameter Virginia buttonweed 68% 40 DAT. Isoxaflutole at 0.28 kg ai/ha and mesotrione at 0.45 kg ai/ha controlled large crabgrass [*Digitaria sanguinalis* (L.) Scop.] at least 85% 50 DAT and equivalent to fenoxaprop at 0.1 kg ai/ha. Isoxaflutole at 0.17 kg ai/ha applied PRE controlled green foxtail [*Setaria viridis* (L.) Beauv.], giant foxtail (*S. faberi* Herrm.), yellow foxtail [*S. glauca* (L.) Beauv.], goosegrass, and large crabgrass at least 95% 70 DAT in greenhouse experiments. In spring-seeded tall fescue, mesotrione and isoxaflutole PRE at 0.28 kg ai/ha controlled smooth crabgrass [*D. ischaemum* (Schreb. ex Schweig.) Schreb.], seedling yellow woodsorrel (*Oxalis stricta* L.), seedling broadleaf plantain (*Plantago major* L.), common lambsquarters (*Chenopodium album* L.), and henbit (*Lamium amplexicaule* L.) equivalent or better than siduron PRE followed by 2,4-D plus dicamba plus MCPP. In greenhouse experiments, increasing mesotrione PRE rates between 0.03 and 0.56 kg ai/ha increased Kentucky bluegrass, tall fescue, and perennial ryegrass injury. However, only Kentucky bluegrass was persistently injured for more than 14 DAT when rates were 0.28 kg ai/ha or greater. In these greenhouse studies, pendimethalin PRE at 1.7 kg ai/ha completely killed all turfgrass species.

A MICROENCAPSULATED PENDIMETHALIN FOR TURF AND ORNAMENTALS.
K. J. Miller, BASF Corporation, Chesterfield, VA; K. E. Kalmowitz and J. Zawierucha,
BASF Corporation, Research Triangle Park, NC.

ABSTRACT

Pendulum® AquaCap™ is a water-based capsule suspension of pendimethalin recently approved for use in turf, ornamentals and other non-crop uses for preemergence weed control. AquaCap contains 3.8 lbs active ingredient per gallon as a microencapsulated formulation. This formulation is characterized by a thin polymer capsule that surrounds the aqueous active ingredient. Capsules remain intact during loading, mixing and application and will then rupture as a result of wetting/drying and heating/cooling cycles. In 2001 and 2002 field tests were conducted to compare AquaCap to other pendimethalin formulations for efficacy, tolerance as well as handling and spraying characteristics.

Results from research trials conducted throughout the US, showed that AquaCap controlled crabgrass (*Digitaria* spp.) at a level equal to or better than other pendimethalin formulations. Pendulum AquaCap outperformed other pendimethalin formulations in 23 of 29 trials. Applications were made at rates of 1.5 lb ai/A or 2.0 lb ai/A in northern locations and 1.5 + 1.5 lb ai/A or 3.0 lb ai/A in transitional and southern locations. In locations where split application treatments (1.5 lb ai/A + 1.5 ai/A) were compared to single treatments (3.0 lb ai/A), crabgrass control was greatest with split applications. Turf and ornamental tolerance for AquaCap was found to be similar to other pendimethalin formulations.

Separate tests were also conducted to determine staining of off-target surfaces following application at labeled use rates. Comparisons were made between the Pendulum 3.3EC formulation and Pendulum AquaCap on a variety of surfaces, which included concrete, PVC fencing and vinyl siding. Intensity of stain and ability to rinse off at 1, 4 and 24 hours post treatment were evaluated. In all cases, Pendulum AquaCap displayed less initial staining and enhanced ability to wash off after initial treatment.

EFFECTS OF DAZOMET AND PLASTIC COVERING ON ESTABLISHMENT OF CREEPING BENTGRASS IN PUTTING GREENS. B.S. Park and P.J. Landschoot, Penn State Univ., University Park.

ABSTRACT

Dazomet (Basamid® Granular) is a soil fumigant that controls weeds, fungi, and nematodes in soils. Because residual biocide compounds remain in the soil following dazomet applications, a waiting period is required to avoid the inhibition of turfgrass seed germination. Previous research has shown that efficacy of dazomet for inhibiting annual bluegrass seedling emergence can be enhanced by covering dazomet treated areas with plastic. Specific information is needed regarding effective intervals for seeding turfgrasses following dazomet applications covered with plastic. The objective of this study was to determine the effects of surface applications of dazomet and use of plastic covering on seeding intervals of 'Penn G-6' creeping bentgrass on a putting green.

The entire test area, consisting of a 20-yr-old stand of 'Penncross' creeping bentgrass and annual bluegrass, was killed 8 weeks prior to the initiation of the test. The test area was core aerified, topdressed, and verticut for seedbed preparation (16 Aug 2001 and 20 Aug 2002). Eight plots in each replication were treated with dazomet at 347 lbs/A; the other eight plots were not treated (24 Aug 2001 and 22 Aug 2002). Four of the dazomet-treated and four of the non-treated controls were covered with clear plastic sheets; the remaining dazomet and control plots were not covered. Immediately following application, the entire test area received 0.5 inches of irrigation water and plastic sheets were placed over the four covered dazomet treatments and four covered non-treated controls. Plastic sheets were removed 7 days after treatment. Seeding treatments consisted of 'Penn G-6' creeping bentgrass seeded at 1.0 lb/1000 ft² to dazomet and control plots at 1, 3, 6, and 9, days after plastic sheets were removed. Visual estimates of percent ground cover were made 22 days after plots were seeded. Clippings were collected from each plot as a measure of yield (22 Nov 2001 and 28 Oct 2002). The treatments were arranged as a 4X2X2 factorial in a randomized complete block design with three replications per treatment.

Results showed that percent ground cover estimates did not differ between dazomet and control treatments (2001 and 2002). Creeping bentgrass clipping yields were greater for dazomet treated plots compared to controls when seeded at 1, 3, and 6 days after removal of plastic sheets in 2001. When plots were seeded 9 days after removal of plastic sheets in 2001, no clipping yield differences were found between control and dazomet treatments. Creeping bentgrass clipping yields were greater for dazomet treatments compared to the controls for all seeding intervals in 2002.

ABSTRACT

Creeping bentgrass (*Agrostis palustris* Huds.) is a self-sterile, wind pollinated perennial grass that is native to Eurasia but has become naturalized in North America. Creeping bentgrass is one of the most tolerant cool-season turfgrasses which can tolerate continuous, close mowing at heights as low as 0.2 inch. This species is widely used for putting greens and fairways on the golf courses of temperate climates around the world. The development of transgenic creeping bentgrass resistant to glyphosate has led to our research to identify alternative strategies for control of the *Agrostis* species. Field studies were conducted in 2002 with several modes of action of herbicides either on 1-year old or 4-year old creeping bentgrass stands. All treatments were applied POST to creeping bentgrass with a CO₂-backpack sprayer at a pressure of 22 psi in 50 gpa. Turfgrass was maintained at a 0.5 inch cutting height. Foliar injury to turfgrass species was visually estimated on a scale of 0 to 100% (0 = no injury and 100 = completely dead) over a 16-wk period.

Glyphosate at 1.5 lb/A controlled one-year old susceptible creeping bentgrass over 98% 1 week after treatment (WAT) and maintained its control up to 16 weeks. Fluazifop at 0.25 lb/A and sethoxydim at 0.25 lb/A controlled only 27 to 37% 1 WAT and 70 to 85% control 8 WAT, respectively. The sequential treatments of either of these herbicides 4 weeks after the initial application did not improve creeping bentgrass control. Clethodim at 0.25 lb/A applied once or applied in sequential applications 4 weeks after the initial application controlled creeping bentgrass (>97%) up to 16 WAT. Isoxaflutole at 0.25 lb/A controlled 50, 90 and 90% of creeping bentgrass sod 1, 2, 4 WAT, respectively, and the control declined with time. Only the sequential applications of isoxaflutole at 0.25 lb/A followed by an application of isoxaflutole at 0.25 lb/A 4 weeks after the initial application controlled creeping bentgrass (>97%) up to 16 WAT.

In another trial on a 4-year old creeping bentgrass stand, sequential applications of glyphosate at 1.5 lb/A, clethodim 0.375 lb/A, fluazifop at 0.25 lb/A and sethoxydim at 0.25 lb/A 4 and 8 weeks after the initial application resulted in excellent control (>99%) of creeping bentgrass 8 WAT. Isoxaflutole at 0.2 lb/A resulted in 93% control 2 WAT, while the control was only 79% 8 WAT. Sequential applications of 0.1 lb/A of isoxaflutole followed by an application of isoxaflutole at 0.1 lb/A 4 weeks later resulted in 87 and 53% control of creeping bentgrass 2 and 8 WAT, respectively. Mesotrione at 0.2 lb/A resulted in 87% control 2 WAT, while creeping bentgrass control was only 45% 8 WAT. Sequential applications of mesotrione at 0.1 lb/A followed by 0.1 lb/A 4 weeks later resulted in 91% control 2 WAT, although control of creeping bentgrass declined to 67% 8 WAT. These results indicate alternative management strategies to control creeping bentgrass under various environments.

ABSTRACT

Common reed [*Phragmites australis* (Cav.) Trin. ex Steud.] has overtaken wetland areas across the northeast. Studies were conducted in containers and at two field sites to evaluate mowing, with or without herbicide application, for phragmites control. Certain plots were mowed every 2, 4 or 8 weeks. One set of plots received an application of glyphosate at 2% V/V. Glyphosate was also applied either two weeks prior to a single mowing or at 4 weeks after one mowing. Experimental design was a randomized complete block with four replications.

In the container trials, phragmites was grown in 1-gallon pots of pine bark, with 3 pots per plot. Phragmites was 3 feet tall at initiation of the trial. At three months after study initiation, all treatments containing glyphosate gave complete control of phragmites. Phragmites shoot weight and shoot number decreased as mowing frequency increased. Cutting every 2 weeks gave excellent control of common reed. Cutting every 8 weeks did not provide acceptable control.

In the field trials, phragmites was four to nine feet tall at study initiation. Plots were mowed with a weedeater fitted with a saw blade. Percent control and phragmites shoot count were recorded on September 4, 2001, 4 months after initiation of the trial. Phragmites shoots were counted and weighed in May of 2002, one year after trial initiation.

In the field mowing trials, mowing every 2 weeks resulted in 90 to 95% control of giant reed in early September, with approximately 80% control seen with mowing every 4 weeks. Mowing every 8 weeks gave 70% control. For all mowing treatments, however, viable phragmites stems were observed at the end of the growing season. When evaluated the following May, considerable regrowth was observed in mowed plots. Reduction in phragmites shoot weight in May ranged from 35 to 77% with the mowing treatments that did not receive a glyphosate application.

When evaluated in early September, glyphosate applied in combination with a single mowing provided good to excellent control of phragmites. Applying glyphosate prior to mowing provided similar control compared to applications made one month after mowing.

Addition of mowing appeared to improve control over glyphosate applied without mowing when evaluated in September. Glyphosate applied alone provided 75 to 88% control of common reed, while combining mowing with glyphosate resulted in 84 to 96% control, depending upon location, at this time. However, when evaluated in the following May, glyphosate applied alone appeared to give slightly greater control than when applied with mowing, although the results were not statistically different. Glyphosate applied without mowing gave 93 to 95% reduction in phragmites shoot weight the following May. Glyphosate applied in conjunction with mowing gave 87 to 93% reduction in phragmites shoot weight in May.

Glyphosate, applied with or without mowing, provides excellent but not complete phragmites control one year after a single application. Mowing frequently will suppress this weed. However, maintaining a regular mowing schedule for one growing season will not provide acceptable control of phragmites the following season.

ABSTRACT

Kudzu (*Pueraria montana* var. *lobata* (Ohwi) Maesen) was introduced to the United States during middle of the 19th century as an ornamental. During first half of the 20th century, approximately 134760 ha were planted to feed livestock and for erosion control. Presently, extension agents report more than 404280 ha of kudzu distributed among approximately 700 counties. Estimates suggest 10% of some lands administered by the Army Corps of Engineers are occupied by kudzu. Although the largest and most dense infestations have been documented in the Southeast, small infestations have appeared recently in the Pacific North West, the Great Plains, and the Northeast. This development supports predictions concerning the range to which kudzu may expand as a function of increased carbon dioxide concentration and of increased winter temperatures resulting from global climate change.

Kudzu kills trees by climbing up their boles and into their canopies, out-competing them for light. Infestations cost commercial forests approximately US\$119.00 per ha annually and compromise the integrity of valuable natural resources. Recently, dense infestations of kudzu have been reported to interfere with military exercises in North Carolina, South Carolina, and Virginia.

Herbicides generally are used to manage small, isolated populations of kudzu, but obstacles exist to their application. The most important are concerns for applicator safety and cost. Evaluating potential hazards for application equipment and operators on land occupied by kudzu is difficult. Also, repeated application over several years is required to kill the large corms, which can weigh up to 75 kg. Use of expensive herbicides against infestations on land of marginal economic value is generally not cost effective. Furthermore, application of herbicides over large areas threatens contamination of water resources.

In response to these obstacles, an integrated approach to managing kudzu, including biological control, is being studied. The goal of a biological control program is balance between kudzu and its new habitat. Natural enemies are the means by which this goal may be achieved and they may be found either in the habitat to which kudzu is native or its new habitat. Presently, the USDA (United States Department of Agriculture) Forest Service is sponsoring exploration for biological control agents through cooperative agreements with the Chinese Academy of Sciences and three universities: Anhui Agricultural Univ., South China Agricultural Univ., and the South China Institute of Botany. Eleven sites in three provinces, including Shaanxi, Guahgdong, and Anhui, have been surveyed for natural enemies. China is a vast country, and kudzu occupies a large area within its borders. To optimize use of limited resources and increase chances of encountering potential biological control agents at our sites, important parameters like defoliation, seed damage, and stem and root boring were monitored continuously to identify the best opportunity for comprehensive surveys.

So far, approximately 240 insects associated with kudzu have been identified. Among them are defoliators, root and stem borers, and gall makers. Only a few, however, satisfy the important criterion of host-specificity in preliminary experiments. So far, the most promising potential biological control agent encountered during surveys of kudzu in China is a sawfly, which appears to complete its life cycle only on kudzu.

Pathogens also can be used against populations of an invasive/exotic plant. Bioherbicides generally cost as much as chemical herbicides to formulate and apply, but they are less likely to contaminate important water resources. One pathogen encountered during surveys of kudzu in China is an imitation rust, which interferes with translocation of water and nutrients throughout a plant. Impact of this fungus on kudzu is being studied.

Systematic resolution has been an obstacle to developing integrated management programs for many invasive, exotic plants, including hoary cress, leafy spurge, and spotted knapweed. Distinction between kudzu and some related taxa in the field by their morphology is unreliable. For this reason, molecular tools are being developed to distinguish among specimens. So far, results of preliminary experiments support the use of randomly amplified polymorphic DNA's (RAPDs). Continued study of this tool is necessary before it may be used to evaluate the composition of populations in China and in the United States. More convenient and reliable distinction among kudzu and related taxa in the field will expedite surveys of for biological control agents by allowing professionals to reconcile identity of potential agents with identity of their targets.

Over the next three years the completion of host testing against leguminous crop plants in China is anticipated. Rearing methods will be developed for those insects with some promise as biological control agents, and their study will continue in quarantine facilities in the United States.

NATURE AND DISTRIBUTION OF GIANT HOGWEED: AN INVASIVE SPECIES. P. C. Bhowmik, C.S. Hollingsworth and J. Levasseur, University of Massachusetts, Amherst.

ABSTRACT

The invasive species, giant hogweed, *Heracleum mantegazzianum* Sommier & Levier, is a member of the parsley or carrot family, Umbelliferae (Apiaceae). Giant hogweed is a perennial with tuberous root stalks which generate perennating buds each year. It colonizes a wide variety of habitats but is most common along roadsides, other rights-of-way, vacant lots, streams and rivers.

Giant hogweed is currently listed as noxious weed under the federal noxious weed list. A native to the Caucasian mountains and southwestern Asia, it was introduced as an ornamental plant to Europe, the United Kingdom, Canada and the United States. Because of its tenacious growth habit, the species escaped and became a weed species. It is found in Connecticut, New York, Oregon, Pennsylvania, Maine, and Washington State. In 2002, giant hogweed was found in 23 sites in seven counties in Massachusetts.

Giant hogweed takes several years from germination to produce the first flowering stalk. Plants die after first flowering and seed (monocarpic) set. Seed longevity is known to be greater than seven years. Reproduction is through seed and perennating buds formed on the crown and tuberous root stalk. It may grow from 15 to 20 feet in height. Stalks and stems have sturdy bristles. It has compound leaves that may expand to 5 feet in breadth and each leaflet is deeply serrated. The inflorescence is a broad flat-topped umbel composed of many small white florets: each inflorescence may attain a diameter of 2.5 feet. It produces large elliptic dry fruits marked with brown swollen resin canals. Identification of this weed is vital. Giant hogweed closely resembles the cow parsnip, *Heracleum lanatum*, with a similar leaf and flower, a native plant to the maritime Pacific Northwest. Giant hogweed is distinguished by a stout dark reddish-purple stem and spotted leaf stalks. The hollow stems of giant hogweed can be 2 to 4 inches in diameter. Cow parsnip generally reaches a maximum height of 6 feet, far shorter than giant hogweed.

This species represents an increasing public health hazard. The plant exudes a clear watery sap that which sensitizes the skin to ultraviolet radiation, resulting in severe burns to the affected areas and severe blistering and painful dermatitis. These blisters can develop into purplish or blackened scars.

Control measures must be taken in order to prevent its further infestations. The primary measure is public education to dissuade gardeners from planting this striking but noxious plant in their gardens. Plants may be dug-out or mowed prior to seeding to prevent seed dispersal, however, the toxicity of the plant sap limits the desirability of mechanical control. Chemical control options include post-emergence application of 2, 4-D, dicamba or glyphosate, although limited information on its control is available. Finally, this species should be watched carefully for its future infestation as an invasive weed.

THE OCCURRENCE OF COMMON GROUNDSEL RUST ON THE EAST COAST OF THE UNITED STATES. W. L. Bruckart, III, USDA-ARS-FDWSRU, Ft. Detrick, MD, J. C. Neal, North Carolina State Univ., Raleigh; A. Senesac, Cornell Univ., Riverhead, NY; and M. Travis, Maryland Dept. Agr., Annapolis

ABSTRACT

A British isolate of the rust fungus, *Puccinia lagenophorae*, has been under evaluation for biological control of common groundsel (*Senecio vulgaris*) in the U.S. The fungus has been studied extensively in Europe, where it may have caused significant reductions of *S. vulgaris* populations. Research in Europe and Australia indicate *P. lagenophorae* is not limited to *S. vulgaris*; susceptibility of English daisy (*Bellis perennis*), pot marigold (*Calendula officinalis*), and at least two other species of *Senecio* has been noted [1]. A limited host range determination in the present study showed that English daisy also could be infected but not damaged by the British acquisition of *P. lagenophorae*. Pot marigold was not infected in these tests. No other plant has been tested, including any of the nearly 100 species of *Senecio* native to North America.

In 2001, there were two reports that *P. lagenophorae* was discovered in the U.S. on *S. vulgaris* [2] and on English daisy [3]. This information was shared at both the 2002 NEWSS and APS Potomac Division meetings, with the specific request for specimens, if they were found on the East Coast. As a result, accessions were sent from three states, widely separated, on the East Coast. The first sample was collected near Riverhead, NY on January 18, 2002. Two samples were collected in North Carolina on April 4 and again on August 13, 2002, and another sample came from Calvert County, Maryland, collected on May 21, 2002. All three samples were found in nurseries. Thus far, only the isolate from Maryland caused infections on groundsel plants, but all have characteristic aeciospores and aecia for *P. lagenophorae*. The issues raised in 2002 concerning the discovery of *P. lagenophorae* remain, and may be more critical in light of the discovery of *P. lagenophorae* on the East Coast of the United States. We are still interested in knowing how much damage the disease will cause to common groundsel and, more specifically, will it cause reduction in stand density throughout the range of common groundsel in North America? Of greater concern is whether North American species of *Senecio* and plants in related genera are susceptible and will be damaged by infections from *P. lagenophorae*

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A *PHOMA* SP. THAT KILLS COMMON CRUPINA (*CRUPINA VULGARIS*). F. Eskandari, M. McMahon, D. G. Luster, and W. L. Bruckart, III, USDA-ARS-FDWSRU, Ft. Detrick, MD.

ABSTRACT

Recently, a wilt disease was discovered on common crupina in the containment greenhouse at Ft. Detrick. Infected plants had blackened, necrotic stems and were wilting, at first only on half of the top. Because of the damage, it was of interest to isolate, identify, and evaluate this pathogen for biological control of crupina. A fungal causal agent was isolated and Koch's postulates were satisfied using a wound inoculation procedure. The pathogen grows easily on acidified potato dextrose agar (APDA) under room conditions. After 20 days on APDA, dark, ostiolate pycnidia developed that contain one-celled hyaline conidia. DNA sequence analysis of the ribosomal RNA gene Internal Transcribed Spacer regions 1 and 2 (ITS1 and ITS2) demonstrated 100% identity to several *P. exigua* Desm. isolates.

Several approaches were used in testing pathogenicity, including: 1) wounding plants with a contaminated needle, 2) drenching crupina plants with inoculum (a mixture of conidia and mycelium), 3) spraying foliage of test plants with inoculum in an atomizer, 4) spraying test plants with a mixture of inoculum and abrasives (either silica gel or carborundum), and 5) immersing seedlings in inoculum for one minute before transplanting. All inoculated plants were placed under constant light in a 23 °C dew chamber for 48 hours. Typical symptoms of stem blight and wilting occurred only when plants were wounded on the stem with a contaminated needle, wounded with spray inoculations that included abrasives, or when seedlings were dipped into inoculum before transplanting. From this, we conclude that infection by *P. exigua* requires a wound.

Symptoms usually appeared quickly, often within 2 days, but occasionally as long as 15 days. Wound inoculation of 4-wk-old plants and dipping seedlings resulted in 100% and 85% wilting, respectively, within 48 hours. Plants 6- to 8- wk-old were less susceptible, with 65% wilting between 4 to 10 days after wounding. Use of abrasives for inoculation of 3-5 wk-old plants caused only 20% infection after 10 days.

Symptoms of disease developed only above the portion of the plant that was wounded; roots were always white and healthy, except when seedlings were inoculated. The pathogen seems to be host specific, considering that none of the close relatives, two *Centaurea* sp., *Acroptilon repens*, *Cynara scolymus*, *Carthamus tinctorius*, *Carduus acanthoides*, or *Cirsium vulgare*, developed symptoms after wound inoculations.

Phoma exigua remains of interest as a candidate for biological control of crupina, but the requirement of a wound for infection poses major challenges to practical development.

ABSTRACT

The potential of two invasive herbaceous vines black swallow-wort (*Vincetoxicum nigrum* (L.) Moench.) and pale swallow-wort (*V. rossicum* (Kleo.) Barb.) to reduce monarch butterfly (*Danaus plexippus* L.) populations was investigated by evaluating oviposition selection in adult monarch butterflies and larval feeding preference in choice tests comparing the native host plant of monarch butterflies, common milkweed (*Asclepias syriaca* L.), and the two non-indigenous *Vincetoxicum* species. Both *Vincetoxicum* species are members of the Asclepiadaceae family and are associated with disturbed and waste areas such as quarries and transportation corridors in many regions of the Northeastern United States. However, once established, these aggressive species readily move into nearby, less disturbed forest understories, Christmas tree plantations, or reduced tillage agricultural fields, often forming monospecific stands and displacing resident vegetation, including common milkweed. In both choice and no-choice tests, no eggs were oviposited on either of the two *Vincetoxicum* species whereas over 100 eggs were oviposited on common milkweed plants. All larvae feeding on common milkweed for 48 h survived while a significantly lower proportion survived on *V. rossicum* and *V. nigrum*. Mean weight of larvae that did survive on the *Vincetoxicum* species was significantly lower than the mean weight of larvae that fed on common milkweed. The mean proportion of leaves consumed by larvae feeding on common milkweed leaves was significantly greater than the mean proportion of leaves consumed by larvae feeding on either *Vincetoxicum* species. Findings from this research suggest that *V. rossicum* and *V. nigrum* are not viable hosts of monarch butterflies and are likely to pose little direct threat to this native Lepidopteran. However, the ability of these highly aggressive introduced plants to outcompete and displace the native host of monarchs, common milkweed, may pose a more serious threat.

SPATIAL HETEROGENEITY OF EDAPHIC VARIABLES AND SEDGE POPULATIONS IN GOLF COURSE FAIRWAYS. J. S. McElroy, F. H. Yelverton, and M. G. Burton, North Carolina State Univ., Raleigh.

ABSTRACT

No information is available regarding the spatial heterogeneity of soil fertility, and moisture characteristics or weed populations in managed turfgrass systems. Greater understanding of the spatial variability of soil characteristics and weed populations is necessary for the development of effective integrated pest management practices. Therefore, three golf courses in North Carolina were selected to investigate the spatial relationship of topography to soil characteristics and green kyllinga (*Kyllinga brevifolia*) populations in golf course fairways. The three golf courses selected were Fairfield Harbour CC (New Bern, NC), The Cape CC (Wilmington, NC), and Echo Farms GC (Wilmington, NC). All three sites have green kyllinga infested bermudagrass (*Cynodon* spp.) fairways and success in controlling green kyllinga with herbicides has been poor. Parallel transects spaced 2 to 3 meters apart were positioned along the major topographic gradient within a green kyllinga infested fairway. Quadrats (0.09 m²) were spaced evenly along each transect every 0.6 or 0.7 meters, with 30 to 40 quadrats per transect. At each quadrat, soil samples, a measurement volumetric water content of the soil, and a rating green kyllinga %cover were taken. In all situations, variations in soil fertility, moisture, and green kyllinga % cover were observed along the topographic gradient. At all sites, more green kyllinga was observed at lower elevations. Additionally, all sites had greater soil volumetric water content at the lower elevations, while greater soil humic matter concentrations were observed at higher elevations. At Echo Farms and Fairfield Harbour, higher base saturation concentrations, and higher pH was observed at lower elevations, with a pH change >1.0 unit over both surveyed areas. However, at The Cape, higher pH was observed at higher elevations, but this was attributed to increased management of the sloped golf course putting green approach area located at the higher elevations of our surveyed area. The spatial structure of soil K and P concentrations was not consistently correlated with topography. These data indicate spatial heterogeneity of soil edaphic characteristics and weed populations do exist. Thus, management of turfgrass systems that reflects the spatial heterogeneity of weed populations, and soil fertility and moisture variables of the system could be both economically and environmentally beneficial.

INFLUENCE OF SEED PRETREATMENT WITH SODIUM HYPOCHLORITE ON SEED GERMINATION AND RADICLE ELONGATION IN THREE ANNUAL WEED SPECIES.
R.E. Nurse and A. DiTommaso, Cornell Univ., Ithaca, NY.

ABSTRACT

This study examined the effect of pre-soaking seeds of three annual weed species in sodium hypochlorite on germination and radicle elongation. Seeds of *Amaranthus retroflexus*, *Setaria faberi*, and *Abutilon theophrasti* collected in a single location near Aurora, NY were subjected to 0, 0.6, and 6.0% v/v concentrations of sodium hypochlorite for 0, 5, 10, 30 and 60 seconds. We hypothesized that the sodium hypochlorite seed pre-treatment would alter the proportion of seeds germinating and also influence radicle elongation of seedlings. After 14 days, *Amaranthus retroflexus* seed germination was highest in the 6.0% sodium hypochlorite treatment (80%) and lowest in the control treatment (distilled water) (10%). Germination increased in *A. retroflexus* as the soaking period increased, but declined for seeds pre-soaking for more than 30 sec. Alternatively, germination of *Setaria faberi* seeds was negatively affected by the pre-soaking treatment with seeds in the control treatment exhibiting 80% germination and seeds pre-soaked in the sodium hypochlorite treatments having only 20% germination. Increases in duration of exposure to sodium hypochlorite decreased overall seed germination in *S. faberi*. Finally, *Abutilon theophrasti* exhibited no discernable effect of the pre-soaking treatment on seed germination as the control treatment did not differ significantly ($p>0.05$) from the 6.0% sodium hypochlorite solution. However, prolonged exposure times (i.e. 30 sec and 60 sec) did result in a decrease in germinability. For all three species, radicle elongation of seedlings produced from seeds exposed to the sodium hypochlorite treatments was greater than for seeds exposed only to distilled water. The findings of this study suggest that caution should be used when interpreting seed germination and seedling vigor studies where seeds have been pre-soaked in sodium hypochlorite solution for extended periods.

PERIODICITY OF WEED EMERGENCE AND THE IMPLICATIONS FOR WEED MANAGEMENT IN CORN. M. W. Myers, W. S. Curran, D. A. Mortensen, D. D. Calvin, Penn State Univ., University Park; M. J. VanGessel, B. Scott, Univ. of Delaware, Georgetown; B. A. Majek and A. O. Ayeni, Rutgers Univ., Bridgeton, NJ.

ABSTRACT

Integrated weed management (IWM) systems have become an important component in modern agriculture. The main goal of IWM is to use herbicides more efficiently and effectively without sacrificing profitable crop yields. In order to achieve this objective, understanding the relationship between crop and weed competition is essential. One step in understanding this association between crops and weeds is to explore the emergence periodicity of weed species. Having knowledge of weed emergence characteristics could help with crop management decisions such as time of crop planting, soil tillage, and herbicide application.

An experiment was conducted in 2001 and 2002 at four locations in the Northeast to determine the effect of geography and soil disturbance on weed species emergence. The locations included two Pennsylvania sites (Rock Springs and Landisville) and one site in both Delaware and New Jersey. The experimental sites were sown with multiple weed species or left fallow in the fall prior to the start of the experiments. Individual plots were either tilled or left undisturbed in the spring of 2001 and 2002. During the course of the season, weed emergence, by species, was monitored every 14 days by counting two 0.5 m² areas per plot. Following each monitoring interval, weeds were removed using a 1.12 kg ai/ha paraquat rate. All four experimental sites were supplemented with irrigation, as needed.

A total of 20 weed species were identified across all locations and years. The most prevalent weed species were common lambsquarters (*Chenopodium album* L.), smooth (*Amaranthus hybridus* L.) or redroot pigweed (*Amaranthus retroflexus* L.), eastern black nightshade (*Solanum ptycanthum* Dun.), large crabgrass (*Digitaria sanguinalis* (L.) Scop.), giant foxtail (*Setaria faberi* Herrm.), and yellow foxtail (*Setaria glauca* (L.) Beauv.). Each of these species were found at four or more site-years. The impact of soil disturbance was quite variable across years and locations. Soil disturbance either had no effect or decreased emergence with all the weed species except common lambsquarters. Common lambsquarters had similar results apart from the 2002 Delaware site where soil disturbance increased emergence. Common lambsquarters also had a unique emergence pattern, emerging at three different stages throughout the season. The first occurred in early April, the second in mid-May, and a third in early July. The other weed species exhibited a bimodal emergence pattern. Pigweed, eastern black nightshade, large crabgrass, and both foxtail species had peak periods of emergence in mid-May and mid-June. In the case of all the weed species, soil disturbance had little effect on the emergence pattern, only impacting the number of emerged plants. The results from this experiment demonstrate that these weed species have distinct emergence patterns. The influence of soil disturbance proved to be more variable, and further investigation is needed. The integration of emergence periodicity and the response to soil disturbance with IWM systems can prove to be a valuable and practical tool.

IDENTIFICATION AND CHARACTERIZATION OF ALLELOPATHIC VOLATILES
FROM MUGWORT. J. N. Barney and L. A. Weston, Cornell Univ., Ithaca, NY.

ABSTRACT

The increasingly problematic perennial weed, mugwort (*Artemisia vulgaris*) has demonstrated allelopathic potential in several laboratory and field studies. Two morphologically distinct mugwort populations were examined for their inhibitory potential on several test species. The volatile bioassay consisted of suspending freshly harvested crushed foliage over test species. Both populations demonstrated significant inhibition of curly cress (*Lepidium sativum* L.) and foxtail millet (*Setaria italica* (L.) Beauv.) test species. Volatiles were elucidated using gas chromatography-mass spectrometry (GC/MS). Twelve terpenoid compounds were identified, with Santolina triene, α -pinene, β -pinene, camphene, cineole, and camphor comprising the major peaks. Major differences in terpene quantity were observed between the two mugwort populations, which could possibly account for their discrepancy in phytotoxicity. Some of these terpenes were tested as pure compounds (α -pinene, β -pinene, camphene, cineole, caryophyllene oxide, and camphor); however, camphor consistently showed the greatest inhibitory effect on germinating seeds (> 85% inhibition) of the test species evaluated. GC/MS data showed that mugwort population 1 contained nearly six times greater quantities of camphor in comparison to mugwort population 2, and was subsequently also more phytotoxic to test species. Both populations also showed significant differences in growth rates and morphology in a two-year field experiment. Therefore, it is theorized that the presence of camphor and other volatile terpenes that are released over time from mugwort foliage may be related to mugwort's ability to spread by forming dense monocultures.

WEED MANAGEMENT OPTIONS FOR ACCELERATING AGRICULTURAL PRODUCTIVITY IN NEPAL. J. D. Ranjit, Nepal Agricultural Research Council, Lalitpur, Khumaltar, Nepal. e-mail: nepaljdr@yahoo.com

ABSTRACT

Improving agricultural production is important for improving the economic situation in Nepal. Besides many abiotic and biotic factors, weeds play an important role in their agriculture. Because most inputs are imported at high cost, an integrated weed control approach is needed. Integrated weed management including all possible options are discussed in this paper including hand weeding, preventive measures, cultural practices, tillage and crop establishment, rotation, mechanical, cultivars, water, mulches, and chemicals. Training and linkages with international and regional weed groups is also important to meet the needs of future food production in Nepal.

Keywords; Weed, crops, management, productivity, integrated weed management

INTRODUCTION

Nepal lies between China in the north and India in the east, south and west. The area of the country is 147181 sq. km and is 800 km east-west and 140 km north-south. Its altitude varies from 60 meters in the south to above 8500 m in the north. The area under mountains, hills and *Terai* are 35, 42 and 23 %, respectively. Nepal is divided into 5 physiographic regions; (a) High Himal (b) High Mountains (c) Middle Mountains (d) Siwaliks and (e) *Terai* which represent well-defined geographic areas with distinct bedrock geology, geo-morphology, climatic and hydrologic characteristics. The population of Nepal is just over 20 million with a diverse array of ethnic groups and is predominantly Hindu.

The annual rainfall ranges from 263 mm to 5228 mm with eastern Nepal receiving more rainfall than western Nepal. Rainfall in summer accounts for more than 75 % of the total rainfall with less than 25% in the winter. Western Nepal gets more winter rainfall than eastern Nepal (Pokhrel 1996).

The most suitable land for agriculture is found in the Middle mountains and the *Tarai* belt. The Middle Mountains (Mid-Hills) lie between 800 m to 2400 m and occupy about 41% of cultivated land. The climate is warm temperate but subtropical in lower river valleys and cool temperate on high ridges. The dominant crop of the Mid-hills is maize and the cropping system is maize-based. Maize is grown as a rainfed crop, often mixed with other crops on sloping terraces in summer. It covers 65 % of the cultivated area in the mid-hills. Upland rice is also grown in the Mid-hills on sloping terraces like maize, often mixed with maize. Lowland rice is also an important crop in the mid-hills and is grown in the valleys and lower slopes on bunded terraces (*Khet*) in summer either as an irrigated or a rainfed crop depending upon the availability of water. Double rice cropping (spring and summer) occurs up to an elevation of 700-900 masl where assured irrigation exists. In the warm temperate areas under lowland conditions, rice-wheat-fallow and rice-wheat+mustard-fallow are the most common cropping patterns (Pokhrel 1996). Potato is becoming a profitable crop in lowland areas if irrigation is available. The Siwaliks are also mid-hill areas that lie between 200-1500 m altitudes. The climate is subtropical and rice-based rotations occur in the lowlands and maize-

based rotations predominate in upland areas. Mustard, vegetables, wheat and soybeans are rotation crops following both rice and mixed with maize.

The *Terai* region is the southern most region of Nepal, lying in the Indo-Gangetic Plain and is the granary of the country. Although it constitutes only 14 % of the total area of Nepal, it accounts for 42 % of the total cultivated land in the country. The elevation of this region is from 60 to 330 m and the climate is subtropical. The *Terai* is an extension of the Gangetic plain and forms alluvial deposits along the border with India. Rice occupies more than a million ha of land in summer, mostly under rainfed conditions. Wheat is grown in winter with partial irrigation. Legumes, oilseeds and fodders are also important winter crops. Ninety-six percent of the country's sugarcane is also produced in this region. Potato, coriander, and rapeseed are commonly intercropped in sugarcane. However, the rice-wheat cropping pattern predominates.

WEED MANAGEMENT IN NEPAL'S AGRICULTURE

The main objective of weed management is to decrease weed density below critical threshold levels. Eradication is not the aim. Management strategies will vary depending on the size of the farm, culture, crops and economic status of the farmers.

There are many weeds associated with different crops. Some common summer and winter crop weeds are given in the Table 1.

Table 1. Common weeds of summer and winter crops

Summer Narrow leaved weeds	Winter Narrow leaved weeds
<i>Echinochloa colona</i> , <i>E. crusgalli</i> , <i>E. glabrescens</i>	<i>Phalaris minor</i> , <i>Alopecurus</i> sp, <i>Polypogon</i> sp
<i>Digitaria</i> sp, <i>Panicum</i> sp., <i>Paspalum disticum</i>	<i>Poa annua</i> , <i>Cynodon dactylon</i> , <i>Cyperus rotundus</i>
<i>Setaria</i> sp., <i>Ischaemum rugosum</i> , <i>Eleusine indica</i>	
<i>Cyperus iria</i> , <i>C. rotundus</i> , <i>C. difformis</i> <i>Scirpus</i> sp.	
<i>Fimbritylis littoralis</i> , <i>F. dichotoma</i>	
Broadleaved weeds	Broadleaved weeds
<i>Ageratum conyzoides</i> , <i>Amaranthus</i> sps	<i>Chenopodium album</i> , <i>Anagalis arvensis</i>
<i>Alternanthera sessilis</i> , <i>Commelina diffusa</i>	<i>Argemone mexicana</i> , <i>Cirsium arvense</i>
<i>C. benghalensis</i> , <i>Caesulia axillaris</i> , <i>Eclipta alba</i>	<i>Cypsella -bursa - pastories</i> , <i>Coronopus didynamus</i>
<i>Ipomoea aquatica</i> , <i>Ludwigia prostrata</i>	<i>Lathyrus aphaca</i> , <i>Melilotus parviflora</i>
<i>Monochoria vaginalis</i> , <i>M. hastata</i>	<i>Medicago denticulatus</i> , <i>Fumaria</i> sp.,
<i>Marsilia quadrifolia</i> , <i>Polygonum</i> sp	<i>Polygonum hydropiper</i> , <i>Rumex crispus</i> , <i>Soliva</i> sp
<i>Potamogeton</i> sp, <i>Pistia stratimoides</i>	<i>Stellaria</i> sps, <i>Xanthium</i> sps.
<i>Sagittaria sagittifolia</i> , <i>Sphenoclea zelanica</i>	
<i>Oxalis latifolia</i>	
Parasitic weeds include <i>Cuscuta</i> sps. <i>Orobanche aegyptiaca</i> , <i>O. ramosa</i> , <i>O. solmsii</i>	

Phalaris minor, a grassy weed, is spreading in almost all the wheat growing areas of the Mid-hills, inner *Terai* and *Terai* of Nepal. The intensity of this weed is higher where the rice-wheat system has been continuously practiced for many years.

Yield losses due to weeds depend on the type and severity of weed species; sometimes a single species may cause heavy yield loss such as *Polygonum hydropiper* (*Pire*) that reduced wheat yield 50 % in the mid-hill khet area of Kavre district

(Harrington et al. 1992). Yield reductions due to uncontrolled weeds from studies in different crops are given in Table 2.

Table 2. Yield losses due to uncontrolled weeds

Crop	Average yield loss (%)
Direct seeded rice	14-93
Transplanted rice	10-47
Wheat	9-36
Barley	7-11
Maize	11-64
Finger millet	23-43
Soybean	6-50
Groundnut	55-75
Lentil/chickpea	5-34

There are many factors that govern production and productivity of agricultural commodities. Both biotic and abiotic factors play an important role. Among the pests, weeds are an important factor in terms of competing for inputs and other resources from the beginning of crop growth. Weeds are also alternate hosts for many diseases and insects, and impede agricultural operations. There are many weeds which are becoming widespread problems, and annually Nepal imports costly chemical fertilizers and pesticides. Integrated Weed Management (IWM) can play an important role in Nepalese agriculture by reducing the costs of inputs, minimizing weed populations and species shifts, and encourage the use of cultivation implements. Combined with other management, IWM will potentially reduce soil degradation, and yield losses. By integrating all crop management strategies with essential government policies, the expected increase in demand for major cereal crops may be achieved.

COMPONENTS OF INTEGRATED WEED MANAGEMENT IN NEPAL

Integrated weed management uses all available knowledge to manage weeds without causing economic loss and adversely effecting the environment. However, adoption of IWM depends on farmers understanding their weeds, techniques, experiences, and resources in their specific crop production systems. Hence, active participation of farmers in IWM development is essential in successful adoption (Ho et al., 1994). Farmers manage weeds in their own traditional ways. Most farmers intercrop during winter and summer for weed suppression and to avoid the risk of crop failure. High seeding rates are also used to suppress weeds in many crops. Another important aspect that should be considered is herbicide-resistance in weeds. Although this problem has not been recorded in Nepal yet, care should be taken to prevent it from happening since it is found in Indian States adjacent to Nepal (Malik et al., 1998). Many weeds have developed herbicide-resistance such as *Echinochloa colona* to propanil, *Cyperus difformis* to bensulfuron, *Fimbristylis miliacea* and *Sphenoclea zeylanica* to 2,4-D, *Phalaris minor* to isoproturon, and *Monochoria vaginalis* to sulfonylureas (Graham et al., 1994; Pappas-Fader et al., 1993; Fisher et al., 1993; Watanabe et al., 1997; Koarai 2000; and Itoh, 1991). Integration of more than one option of weed management could minimize the weed densities and reduce the chance of developing

herbicide resistance. Some of the options that could be incorporated to IWM are given below.

1. Manual weeding is the most common and traditional weed control practice in rice and other crops throughout Nepal. One or more weeding may be done. The weeding should be done early before the critical period of competition. With the introduction of modern technology and the use of fertilizer weed problems have increased. At the same time labor is becoming expensive and scarce as young people migrate to urban centers looking for employment and to get away from the drudgery of agriculture. This makes this system less sustainable for the future.

2. Preventive methods comprise all possible measures taken to prevent the spread of weeds in new areas and include:

- a. Produce weed free crop seed.
- b. Clean crop seeds during processing.
- c. Adoption of field standards for seed certification.
- d. Strengthen quarantine and weed laws to stop the movement of noxious weeds.
- e. Use of decomposed manure as it helps check the spread of weed seeds.

It is well known in Nepal that crop seed is a primary source of weed seeds. One study showed that the number of weed seeds ranged from 4 to 151 at harvest and 1 to 94 at seed bed preparation from rice sample sizes of 50 to 500 gm collected from 54 households (Ranjit 1995/96). Most of the weed seeds were *Echinochloa colona*, *E. crusgalli*, *Cyperus spp.* and *Fimbristylis spp.* Many weed seeds can be separated from crop seed by using sieves of different sizes.

3. Crop cultivars also play an important role in suppressing weeds. Tall rice varieties have more competitive ability than short statured, modern ones. Some important characteristics include earliness, rapid canopy closure, increased plant height, and early root growth and need to be incorporated into competitive crops (Mansor et al., 1997). One preliminary study in Nepal showed that medium tall rice cultivars had some weed suppressing ability when compared to a dwarf cultivar (Annual Report 1999/2000).

4. Cultural practices and nutrient management affect weed flora and density. Weed populations are less in transplanted than in direct-sown rice. *Caesulia axillaris*, *Ischaemum rugosum* and *Echinochloa sp.* were more common in direct-sown rice. *Fimbristylis littoralis* and *Cyperus iria* were less, but were more problematic in transplanted rice (Ranjit and Srivastav, 1998). Judicious use of fertilizer, especially after weed removal, will certainly favor the crop rather than the weeds. Weed severity is a greater problem in rainfed rice than in irrigated, transplanted rice if water stands but, even here weeds still reduce yields.

Many weeds in transplanted rice are controlled by a combination of hand weeding, herbicides, and water management. Transplanting is the most predominant method of planting rice in Nepal with very little dry-seeding occurring. Weeds are the most constraining factor in direct-seeded rice when compared to transplanting. However, weeds could be minimized with the application of both pre- and post-emergence herbicides and result in increased grain yield (Ranjit and Bellinder, 2002).

Direct-seeding of rice cultivars with a Chinese seed drill that rototilled and sowed seeds in rows in one operation coupled with butachlor @ 2l/ha suppressed weeds in rice and resulted in yields comparable to those of transplanting rice. This reduced, dry tillage system reduced the cost of rice production significantly although there existed a cultivar by tillage interaction Table 3.

Table 3. Effect of Chinese Seed Drill and Transplanting on Rice Yield (Annual Report 99/00)

	Yield kg/ha
A. Planting methods	
Chinese Seed Drill	4531
Transplanting	4202
B. Variety	
Khumal-4	4974
Chainung-242	3760

Tillage systems performed differently in suppressing weeds in wheat. Weeds like *Phalaris minor*, *Alopecurus spp.* and *Chenopodium* were less in wheat planted with a Chinese seed drill than conventional tillage. *Alopecurus* and *Soliva anthemifolia* populations were very low in normal tillage compared to no-tillage (Fig. 1). Seeding method not only affected weeds but also wheat yields. The highest yield was recorded with the Chinese seed drill (Fig. 2).

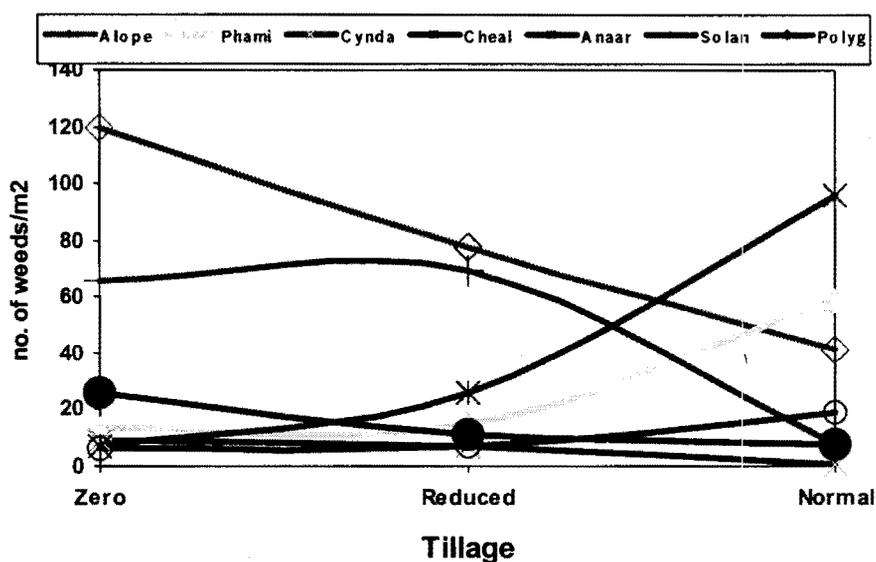


Fig: 1 Effect of planting methods to weed species in wheat (Ranjit, 1999)

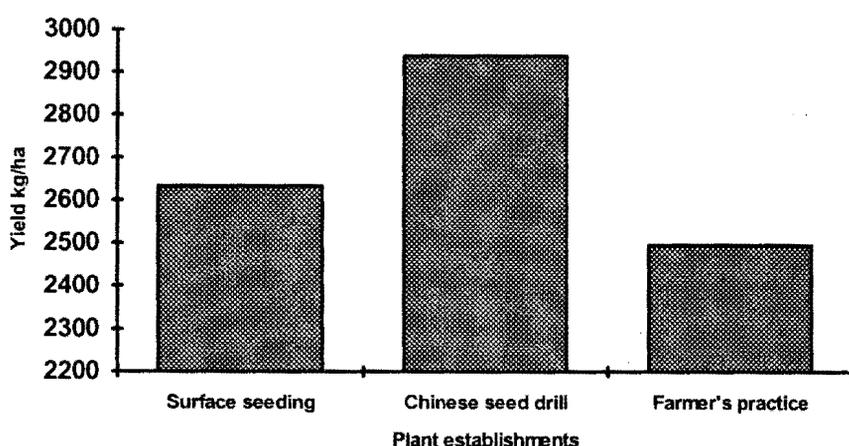


Fig. 2 Wheat yield as affected by wheat seeding techniques 1993-1997 (Giri et al., 1997).

Planting row crops and wheat with a bed planter has been gaining popularity in many countries in South Asia. The reasons behind this are more efficient use of irrigation water, easier hand weeding, reduced herbicide use, less lodging, and ease of planting other row crops after wheat harvest (Hobbs et al., 1997). Bed planting is now being introduced in some research farms and stations in Nepal. However, planting wheat in a traditional ridge and furrow system is very popular in the Kathmandu valley.

5. Mulching with rice straw alone as well as with post-emergence herbicides suppressed grassy weeds like *Phalaris minor* and *Alopecurus* and increased wheat grain yield (Table 4). Many early season weeds could be minimized in direct-seeded rice by using straw mulch. Use of cultural or chemical methods later, would control later-emerging weeds.

Table 4. Effect of treatments on weed in wheat at Khumaltar (Ranjit, 2002)

Treatments	Weed count at 5 WAS /0.50m ²				Weed count at 12 WAS /0.50m ²				Yield	
	Broadleaf		Narrowleaf		Broadleaf		Narrowleaf		Kg/ha	
	No mulch	Mulch	No mulch	Mulch	No mulch	Mulch	No mulch	Mulch	No mulch	Mulch
Unweeded Check	125	78	106	47	166	98	86	67	1684	2819
Hand weeding one	140	90	99	47	35	37	19	21	3478	3770
Sulfosulfuron @ 28 gm/ha	118	88	93	50	54	44	11	17	3878	4104
NPK placement (10DAE)	82	59	51	28	126	104	70	57	1886	3018
LSD- 0.05	24		44		29		21		344	

DAE= Days After Emergence

6. Water management is used to control many terrestrial weeds. Maintaining water levels between 5-10 cm controls most grass weeds, however, a few sedges and broadleaf weeds remain. Combining with other weed control practices could enhance weed suppression in rice.

7. Crop rotation is an alternate approach to minimize the seed bank of weeds like *Phalaris minor*, *Echinochloa* sp. and many other competitive weeds in rice- and maize-based cropping systems. A rainfed ecosystem will also be benefited with diversification.

Inclusion of potato, lentil or berseem in the rice-wheat system helps control weeds like *P. minor*. A rice-soybean rotation is practiced in the southern USA to control weeds such as *Alternanthera philoxeroides*, red rice, and *Leptochloa* spp. (Eastin, 1991). *A. philoxeroides* is becoming an important species in many summer crop growing areas of Nepal due to its fast propagating habit.

8. Mechanical weeding using rotary weeders is effective in controlling weeds in transplanted rice. However, they require soft, moist soil to operate best and row spacing must be accurate. The integration of mechanical rice transplanters and weeders can enhance weed control and increase yields in rice. Tools for winter crops are also needed. Mechanical weeding in bed planted crops also is a possibility.

9. Chemical weed control with herbicides is greater in developed countries than in developing and less-developed countries. The use of herbicides in Nepal is still very low. But, in many intensive production areas, more herbicides are used in both summer and winter crops. In many parts of the country, labor is becoming scarce. Most farm operations are carried out by women, especially rice transplanting and hand weeding. More herbicides are used in rice than in other crops. However, accurate data are not available on actual herbicide use in Nepal

Although herbicides save labor, the continuous use of the same herbicide leads to a build up of weeds, especially the perennials, which are not controlled by the herbicides, weed flora shifts, and development of resistance. Lessons should be learned from neighboring countries where *Phalaris minor* developed resistance to isoproturon. Crop and herbicide rotation should be practiced. Use of minimum doses of herbicide plus hand weeding can also help prevent weed build up and minimize the weed seed bank in the soil. There are many constraints in herbicide use in Nepal. It needs technical skill and special equipment and training on proper application is essential. Careful and judicious use of herbicides, together with cultural practices did increase yields in rice (Ranjit and Sivastav 1998, wheat (Ranjit, 1998, 1999; Annual Report 1998/99) and soybeans (Ranjit, 1997). Cultural methods combined with herbicides suppressed weeds and increased soybean yields.

10. Weed quarantine laws are important in reducing the spread of weeds. They help in protecting farmers from using mislabeled or contaminated seed and also in legally prohibiting seeds of noxious weeds from entering the country. Plant quarantine rules must be strict regarding weeds, insects and diseases and are used in Nepal.

11. Training farmers to identify weeds is important for sound IWM implementation. Training in proper application techniques for herbicides is also critical. Stressing the importance of this, training workshops for application techniques were conducted for the past two years in collaboration with Nepal Agriculture Research Council (NARC), Cornell Univ. and CIMMYT for researchers, extension agents and farmers. Almost all the farmers who participated in the training programs left feeling it was very useful. The training manual on "Herbicide Application Using a Knapsack Sprayer" by A. Miller and R. Bellinder was translated into Nepali and distributed to the participants.

12. Linkage among research scientists, extension agents, and farmers is essential for effective implementation of IWM. Collaborative work in different aspects of weed science with international institutes such as CIMMYT, IRRI, the Rice–Wheat Consortium, Cornell Univ. and others are essential and should be continued in the future.

Future research emphasis should be focused on ecological aspects of weed biology, selecting competitive crop genotypes, weed seed bank dynamics, promoting plant quarantine, cultural/mechanical strategies, tillage, environmentally compatible herbicides having no residues, safety to wildlife, living mulches, bio- herbicides, and farmer training.

ACKNOWLEDGEMENTS

The author is thankful to Prof. Robin Bellinder, Cornell Univ., USA/organizer for support to participate in the Northeastern Weed Science Society Symposium. I'm very thankful to Nepal Agriculture Research Council (NARC) and Dr P. R. Hobbs, Regional Director, CIMMYT/South Asia for their support and encouragement for strengthening the weed science program in Nepal.

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ABSTRACT

Weed science and associated technology were successful in increasing food production in developed world, but inefficient in reducing malnutrition and hunger in developing world. According to the FAO there are almost 840 million malnourished people in the developing countries. Population growth, desertification, drought and low agricultural output are the most important factors contributed to this malnourished massive population. Studies show that population growth will be the most important factor influencing the global increase in food production in the coming years. To help in solving this dilemma, food production, citizen's purchasing power and international aid programs must increase in developing countries. Food supply and crop production in the Middle East have improved in the last decade, but water and land are becoming the most limiting resources for food production in this region. Present research has identified available technologies and management strategies for improving crop production systems. But implementation of such technologies has been slow. Recent socioeconomic changes, and recent market reforms (Globalization), negatively affected the investment and management strategies of small farmers in this region. One way to help in solving this dilemma is by transferring a feasible integrated package of technologies to the farmers. Technologies include GM crops (biotechnology), pesticide application techniques, water saving irrigation systems, GIS and post harvest technologies. Transfer of GM crops is the most powerful tool to enhance food production. However, to be transferable, GM companies must publicize the "nutritional value" of their GM crops, rather than stressing on reduction in production cost and economical benefit. The integrated package of technologies can be effectively transferred via a proper mechanism that will include: funds integrated with research, education and training and the development of regional and international information network and partnership. Evidence shows that integrating technology with research, education and extension can improve the overall performance of agricultural technology systems. The key players in transferring technologies are public and private sectors in collaboration with non-profit NGOs and universities. This collaboration could provide assistance and speed up in choosing the appropriate technology to be transferred. However, implementation of an integrated package of technologies has to be carefully planned, technically feasible to the farmer's conditions, economically feasible, relevant to the local needs of the farmers and environmentally sustainable.

INTEGRATED WEED MANAGEMENT AND CONSERVATION AGRICULTURE IN THE INDIAN RICE-WHEAT CROPPING SYSTEM. R.K. Malik and A. Yadav, Haryana Agricultural Univ., Hisar, India; P.R. Hobbs, CIMMYT and Cornell Univ., Ithaca, NY; G. Gill, Univ. of Adelaide, Australia; P.K. Sardana, Haryana Agricultural Univ., Hisar, India; and R. Bellinder Cornell Univ, Ithaca, NY

ABSTRACT

Indian agriculture has been able to keep pace with population growth and food demand the past 30 years using "Green Revolution" technology. Today, second generation problems including natural resource degradation and increase in pest and weed problems have started to appear. *Phalaris minor* resistance to herbicide is cited as an example of one of these problems and how resource conserving technologies (RTC) and new herbicides were used to overcome this problem. These RCT's also resulted in many other natural resource, environment and socio-economic benefits. These would be even greater if the entire system could use RCT's. Weed control in rice is one area that still needs attention for this to happen. GMO's are discussed in relation to further improving the efficiency of agriculture and the rice-wheat system. The paper finishes with a list of issues for further attention that would enable this green technology to be adopted by the majority of farmers in India and lead to the many benefits listed in the paper and achieve sustainable food security in the region.

INTRODUCTION

Developments in Indian Agriculture in the past 30 years have been conducive to economic development and allowed production levels to match population growth with current grain stocks exceeding 70 million tons. The rice-wheat cropping system practiced on 10.5 million hectares in India is a strategic component of this Indian food security. The population of India will stabilize around 1.5 billion in 2020. At that time, the annual demand for food grains will reach 343 million tons. India may have to import 14 million tons of food grain by 2010 and then imports may stabilize at the rate of 2% every year. To meet the domestic demand by 2010, India needs to increase rice yield by 32.7% and wheat yield by 35.1 %. The production during the last decade has stagnated with a decline in total factor productivity (Hobbs and Morris, 1996). Second generation problems related to soil productivity and increased problems of pests and weeds also affect India's ability to meet the above production goals. Also, with globalization in agriculture and free market economies, more focus on system profitability and quality will be needed. It is also important to understand that the per capita land availability is only 0.15 ha, which is expected to reduce further, that India has more than 110 million farmers in about 70 million villages, that 36% of the Indian population live below the poverty line, and that average per capita income varies from US\$550-600 in Punjab and Haryana to \$400 in India as a whole. This paper looks at the role of weed science and integrated weed management in rice-wheat systems in maintaining sustainable crop production in the region.

THE RESOURCE BASE

Farm holdings in India are classified as marginal (<1 ha), small (1-2 ha), semi-medium (2-4 ha), medium (4-10 ha) and large (> 10 ha). About 1/3 of the land is cultivated by marginal and small farmers (78% of total farming population) while 2/3 is cultivated by the remaining 22% farmers (P. Singh, 2002). Average farm size in Punjab and Haryana is about 3 ha compared to an Indian average of 1.6 ha (Yadav *et al.*, 1998).

The country has 2.6 million tractors, which is less than 2% of the total farmers, although many farmers are able to contract services for plowing. Most tractors are found in high productivity zones of the rice-wheat cropping system with about 70 tractors per thousand ha in Punjab and Haryana States. Average unit farm power in these states is 3.55 kW ha⁻¹ compared to 1kW ha⁻¹ in India on average (G. Singh, 2002). Combine harvesting of rice and wheat is very common in Punjab, Haryana and Western UP. It is also spreading fast in other parts of India.

The use of certified seed by farmers is about 0.9 million tons and fertilizer consumption is about 95.3 kg/ha. The fertilizer nutrient (N, P and K) consumption in both rice and wheat in Punjab and Haryana states is around 350 kg/ha. The pesticide demand in 2000-01 was estimated at 50,464 tons. Herbicides sales, especially in the rice-wheat cropping system are about 13% of the total pesticides sold and are increasing.

Irrigated agriculture accounts for 37% of the 142 million hectare net sown area and provides 55% of the total agricultural production. Per capita availability of water in the country has dropped from 5300 m³ in 1955 to 2200 m³ recently. This compares to 7420 m³ in the world and 3240 m³ on average in Asia (G.B. Singh, 2000). The large scale development of surface water resources have resulted in problems associated with water logging and secondary salinization in about 5.6 million hectare. More than 90% of the ground water resources have been tapped in Punjab and Haryana. These states are now facing a serious problem of ground water depletion. Today India has a more complex research agenda than ever. India is spending about 0.3% of its agricultural GDP in research and development compared to 2.8% in US and 4.0% in Australia (P. Singh, 2002).

THE PHALARIS MINOR PROBLEM

After the green revolution, India witnessed an appreciable growth in the production and acreage of the rice-wheat cropping system (RWCS). By the early 1990s, however, decreased rates of yield growth were noted as a result of degradation of the natural resource base, declining organic matter, falling water tables and build up of weeds, pathogens and pest populations.

Having consolidated the dominant RWCS position through modern varieties and increased input use, this cropping system, especially in the high productivity zones of India, identified new second generation problems in the 1990's including weed resistance to herbicides. Until the early 1990s, *Phalaris minor* could be effectively controlled by isoproturon (a substituted urea compound). After continuous use of this herbicide, along with poor application techniques, evidence of resistance in this weed was reported in Haryana in 1993 (Malik and Singh, 1995). Farmers became concerned due to lost productivity and increased prices for the new wheat herbicides. In some

cases the entire crop had to be harvested for fodder. This added to decline in total factor productivity of the RWCS already reported by Harrington *et al.* (1993). Solutions were not easy and required that the research model change from a top down to a bottom up approach. Introduction to farmers of new resource conserving technologies in addition to a paradigm shift to a more efficient participatory approach of extension using an expanded number of stakeholders was key to present success.

In Punjab, Haryana and the *tarai* belt of Uttar Pradesh in India, most farmers use herbicides for control of weeds in rice and wheat. Over the past 6 years, use of new herbicides (sulfosulfuron (34%), clodinofofop (29%) and fenoxypop (8%)) in wheat has increased from 0% to 74% but in rice farmers continued to use the same herbicides as before (butachlor (47%), anilophos (34%) and pretilachlor (19%)). Costs of these new herbicides were 4 times higher than isoproturon. Some farmers were reluctant to use these herbicides and instead decided to experiment with no-tillage wheat on their farms.

RESOURCE CONSERVING TECHNOLOGIES

No-tillage was first tried to overcome this problem of weeds when it was suggested that savings obtained by less land preparation would help farmer's incomes and so allow him to afford the new, more expensive herbicides. No-tillage soon showed a positive impact on grain yield of wheat. During the last 5 years, the yield advantages of no-tillage have been maintained at permanent sites with a yield advantage for no-tillage in all years (Malik *et al.*, 2002). It turned out that *Phalaris minor* populations were also significantly reduced in no-tillage since the soil was less disturbed and this winter annual weed germinated less (Figure 1).

Other benefits of no-tillage identified by farmers and scientists soon became evident; higher yields were obtained at less cost resulting in better incomes; less water (15-20%) was needed to grow a wheat crop; diesel use and therefore greenhouse gas emissions were significantly reduced; fertilizer efficiency was increased; the farmers could leave the loose residues on the soil surface as mulch and so reduce the air pollution resulting from burning; and beneficial insects and a higher soil biological diversity were found.

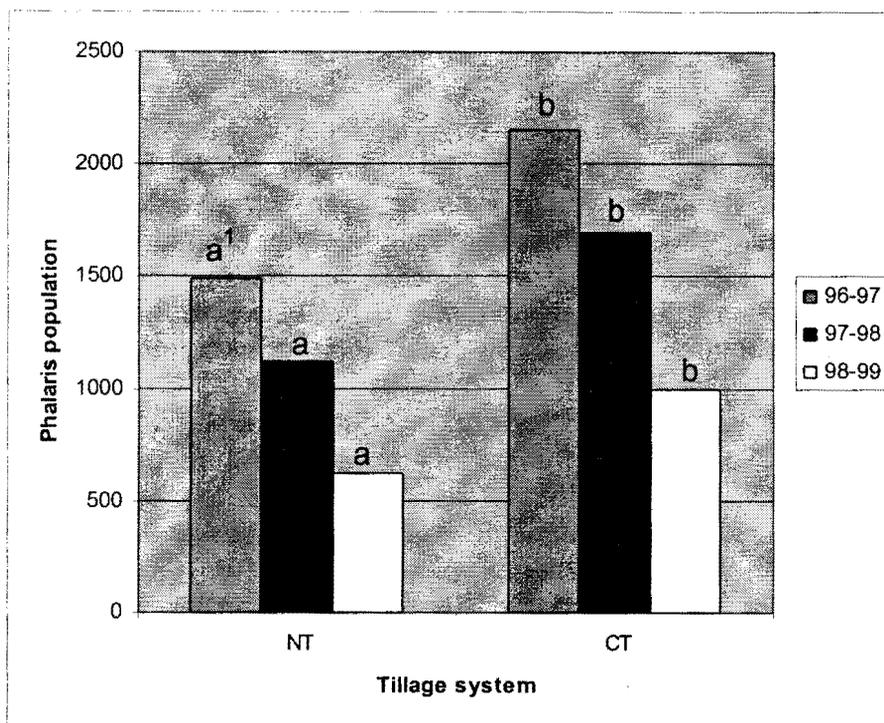


Figure 1. Phalaris minor population in No-tillage and conventional tillage sampled from permanent benchmark sites in Karnal District, Haryana, India. (Based on data from Malik et al., 2002).

A report by the Center of International Economics, Canberra, Australia calculated a gain to the Indian economy of around A\$1800 million in net present value terms over the next 30 years from the adoption of this package of herbicides and no tillage (Vincent and Quirke, 2002). India has embarked on an ambitious plan to accelerate no tillage and other resource conservation technologies including bed planting in all the RWCS areas in India.

However, early work concentrated on no-tillage for the wheat phase of the system. In order for farmers to gain the maximum benefits of no-tillage the entire system, including the rice phase, needs to be included. At the moment farmers grow rice by puddling soils (to restrict water infiltration) and then transplant rice seedlings into this soil. The puddling process destroys soil physical properties and has a large influence on other soil properties. However, by puddling, water can be ponded and used to control weeds in rice. For non-puddled or even no-tillage rice to be successful, solutions to this rice weed problem are needed. Work has started on this issue and initial results are encouraging. Zero tillage transplanted rice in Haryana and zero tillage direct drilling of rice in Bihar have been successfully demonstrated in farmer fields. Once this problem is resolved, all the benefits mentioned for the natural resource base, the environment and the socio-economic livelihoods of farmers can be dramatically improved. Even the drudgery of farming can be reduced. The same applies to another innovative RCT called permanent bed planting that really combines no-tillage with a bed system of planting crops. This new RCT has even more benefits than no-tillage with greater savings in water, more input efficiency, easier weed control and higher yields.

GENETICALLY MODIFIED CROPS

It has been forecast that the use of cereals for livestock feed will be 12 times greater in 2020 than it was in 1993 (Bhalla et al., 1999). Lloyd Evans (2001) stated that the increase in genetic yield potential has so far come almost entirely from gains in harvest index and not from genetic enhancement of photosynthesis or crop growth rates. Crop management practices including fertilizers substantially increase crop growth but plant breeding has not been able to achieve this alone. However, he does state that direct genetic modification through the "Gene Revolution" can change the face of agriculture.

The 40% loss in crop yields by pests, diseases and weeds remains extremely high in the World (Cramer, 1967; Oerke et al., 1994). Biotechnology and the use of "Genetically Modified" (GM) crops may prove effective in reducing these losses. Concerns over the consequences of GM crops have caused uncertainties and ignorance in India. Due to such concerns investment in biotechnology has been moderate and the availability of technologies and materials useful for farmers is low. During this process of adjustment, scientists in India need to better define the development needs for these technologies so that they can help reduce the losses caused by biotic or abiotic stresses or to improve the quality of crops so they have greater export potential.

Herbicide resistant rice would dramatically help overcome the issue of weed control in direct seeded, non-puddled, bed planted and no-tillage rice and allow RCT's to be used on the whole system. Of course it would mean that the needed genes would have to be incorporated into the background quality of rice presently being grown and preferred by farmers. The benefits in terms of the increased efficiency of natural resources, the environment, the improved livelihoods of farmers and the reduction in drudgery all listed above would far outweigh any possible negative issues this technology would have, although these possible problems would need to be carefully monitored. Another example is found with Bt cotton. At present, farmers apply excessive amounts of toxic pesticides to control the boll weevil and other insect pests of cotton. Bt cotton would allow cotton to be grown without application of toxic chemicals and would have a much greater positive impact on the environment than not using Bt cotton. The economic benefits of farmers and the improved health of agricultural workers who presently apply these insecticides with poor technique would also add to the benefits.

FUTURE DIRECTIONS

Resource conserving technologies are innovative techniques that can make a big positive difference in the way food is grown in the next decade. The following is a list of some issues that still need to be resolved in order to make this technology better still and available to more farmers:

1. Effective weed control for the entire rice-wheat system. An integrated approach is needed that combines all possible control mechanisms:

- a. Use of new herbicides that effectively control weeds but have the minimum effect on the environment (soil, water, etc.)
 - b. Use of surface mulch that is now available in no-tillage systems to help control and smother weeds. This should lead to less burning and less air pollution.
 - c. Development of bed planting systems and machinery that allows intercultural, mechanical weeding.
 - d. Development of varieties of crops for the system that grow better under no-tillage and bed planting, but are also more competitive against weeds.
 - e. Diversification of the cropping system to allow crop rotation to help control weeds. At present, fodder crops like berseem clover are very effective at reducing *Phalaris minor* numbers.
 - f. Development of herbicide resistant crop varieties.
 - g. Use of stale seedbed and other techniques to control weeds between crops in the system.
 - h. Use of cover crops and green manures to help control weeds.
2. Development of low cost machinery for the various resource conserving technologies. This includes:
- a. Machinery that can plant into loose residues, so that the residue mulch does not create a problem at planting
 - b. Combines that can chop and spread straw evenly during harvest
 - c. Suitable implements on a tool bar to do efficient weeding.
 - d. A multi-crop planter so a diversity of crops can be grown.
 - e. Development of low cost sprayers from local materials that can be used to effectively spray herbicides.
 - f. Human Resource Development
 - g. Herbicide application training for all partners
 - h. Introduction of a conservation agriculture curriculum into Universities and colleges.
 - i. Training of users and service providers on proper use, repair and maintenance of equipment including no-till drills and spray equipment.
 - j. Introduction of CA into the extension training programs, both private and public.
 - k. A need to upgrade the management, communication and information system through various types of collaborations and short term projects with international organizations.
3. Monitoring of the long term consequences of RCT's on physical, socio-economic and biotic factors in order to document benefits scientifically and head off possible problems.
4. Introduction of pertinent policy issues to help stimulate the adoption and use of RCT's.

By following this set of proposals, farmers will be able to benefit from this green technology while at the same time providing food to keep pace with population growth and improve farmer livelihoods and subsequently help reduce poverty.

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ABSTRACT

Farmers in developing countries act and have similar aspirations as farmers in the United States, Canada and other developed countries. The typical farmer in a developing country farms 0.25 to 2 hectares of land, plants a mix of annual crops and essentially all aspects of crop production, land preparation through harvest is done with manual labor. Limited family financial resources requires that most farmers have to use credit to purchase both crop inputs as well as living necessities during the cropping cycle. Limited access to government regulated credit sources exposes the farmers to unregulated credit sources, which do not give the farmer the opportunity to be rewarded for the risks, associated with the adoption of newer agricultural technology. Tradition, government regulations/guidelines and risk aversion at the family as well as at village level also slow the adoption of new technology. The lack of infrastructure and reduced funding of extension programs limits the communication of improved or new technology to farm villages and traditional cultures in some countries slows the adoption of technology. The lack of basic infrastructure to transport crop yield to market centers and the lack of market standards results in many cases in higher market prices for commodities that do not meet minimum international standards. The resulting poor quality grains and other commodities limits the ability of the farmer to market his or her commodities for a fair price. These factors plus suggested options will be discussed in the paper.

ABSTRACT

GRAMOXONE® (active ingredient: paraquat) is used by millions of smallholder farmers in a wide range of crops including maize, fruits and nuts, coffee, bananas, rubber, oil palm, vegetables and rice. After more than 40 years of use, it remains one of the world's most widely used herbicides. In many uses, GRAMOXONE® has no effective alternative.

GRAMOXONE® offers many advantages to the smallholder farmer. It controls a wide range of weeds, acts very quickly, and its effectiveness is not reduced by rainfall, even when it occurs within minutes of application. GRAMOXONE® contributes to the production of safe food through yield protection and farming efficiency. It eliminates the need for arduous and costly hand weeding, and in some cases plowing. By replacing mechanical weeding, GRAMOXONE® helps to avoid soil erosion, particularly in hilly terrain. Today, GRAMOXONE® remains an herbicide with unique benefits and it has a continuing essential role in the future of sustainable agriculture in developing countries.

Selling any product in developing countries requires that labeled uses are appropriate to local conditions and that safety precautions can be implemented in practice. Use of GRAMOXONE® in developing countries is no different, and Syngenta takes a responsible approach to steward safe and effective use.

Stewarding any agricultural chemical in developing countries presents challenges not found in the developed world. Numbers of farmers are great, technical backgrounds may be limited, and literacy may be an issue.

As with all chemicals, it is necessary to follow the use recommendations of GRAMOXONE® to avoid risks. Training programs in developing countries teach farmers and their families how to handle and apply agricultural chemicals safely. These training programs often run in conjunction with government agencies or local associations, and the distribution channel. Given that GRAMOXONE® is similar to other pesticides in terms of risk, Syngenta's stewardship activities focus on the safe use of all pesticides: farmers are taught how to store transport, mix and load sprayers, how to check for leaky spray equipment, what type of clothing to wear to prevent skin contact and appropriate first aid in response to accidents. Farmers are also trained in best farming practice techniques, such as integrated crop and pest management, that minimize adverse environmental effects and maximize productivity.

Many such programs, above and beyond those required by regulations, have been held in different regions and countries of the developing world. These have included programs which taken place in Brazil, covering over 200,000 farmers in 2001, in Vietnam, with village based training schemes, in Malaysia, with small holder training on safe use, in Guatemala, with train the trainer programs, and in Costa Rica, with training and certification for small holders and their families in conjunction with the Ministry of Health.

Agriculture is essential in addressing the needs of a growing global population. Sustainable agriculture addresses present and future needs and requires the use of the best available technologies, including agricultural chemicals, to produce sufficient, affordable, safe, quality food, feed and fiber.

INTRODUCTION

It gives me great pleasure to be invited to this important meeting of weed scientists in the North east of USA to talk about this important topic. In the 1950's, South Asia was plagued by problems of providing sufficient food to feed its population. Famine was a common term used and the traditional farming techniques, germplasm and inputs used were at the mercy of the vagaries of poor weather (drought, floods, high temperatures etc.) and biotic factors such as disease epidemics, weeds, and insects. Added to this was immense drudgery and hard work needed to maintain a living from agriculture under trying conditions. In the 1960's new improved wheat and rice germplasm was developed and introduced to farmers. This technology was based on the principle that the improved plant type could withstand lodging when more nutrients and moisture were provided. Better genetic resistance to diseases and insects was also bred into the new varieties making them less susceptible to biotic stresses. The result was a rapid increase in productivity in South Asia both in terms of area covered but also yield increase. This led to coining the term "The Green Revolution". Today, famines are not mentioned, countries are self sufficient in food production and in fact countries like India have huge surpluses of grain stored for food security reasons. However, this doesn't mean that everyone is well fed. There are still many people in South Asia who do not get sufficient food or calories each day. This is more of a distribution problem than an agricultural production issue. It is an issue that needs to be addressed by the national program governments.

Although, the "Green Revolution" was very successful at averting famine and improving regional food security, the issue of controlling population growth was not as successful, so that today the region (Bangladesh, India, Nepal and Pakistan) has a population of 1.3 billion people that is growing at a 2% growth rate. That means 26 million more mouths to feed every year. That is more than the population of New York and Massachusetts combined. At the same time weather patterns are changing either because of normal cycles or through the influence of global warming on creating greater extremes in climate as the World tries to buffer the effects of increased temperature. Pakistan and Afghanistan are in the 5th year of a severe drought. India experienced a failure of the 2002 monsoon in NW States that has led to a very poor rice harvest. This presentation will attempt to discuss the needs of this region for technology development and adoption for the next decade.

The Rice-Wheat areas of the Indo-Gangetic Plains

The rice-wheat cropping system is one of the most important cropping systems in South Asia and is grown on 13.5 million hectares of land (Ladha et al., 2000) in some of the most densely populated parts of Asia (Figure 1). It is estimated that 280 million people live within the RW system boundaries with a population density of 517 per sq km. Just for comparison this is close to the population of USA that has a population density of 31 per sq km. This area has fertile soils, a climate that allows two or more crops to be grown in any calendar month (Figure 3) and a good system of surface canal and groundwater for irrigation. Potential cereal production ranges from 10-15 t/ha from a rice and wheat crop grown per year. 42% of the wheat in South Asia is grown following

rice and 32% of the rice follows wheat (Hobbs and Morris, 1996). The system not only grows rice and wheat, but an array of other crops including oilseeds, legumes, fodder crops, sugarcane, potatoes and vegetables. Minor changes in soil types and topography, markets and family needs determine what cropping pattern the farmer adopts.

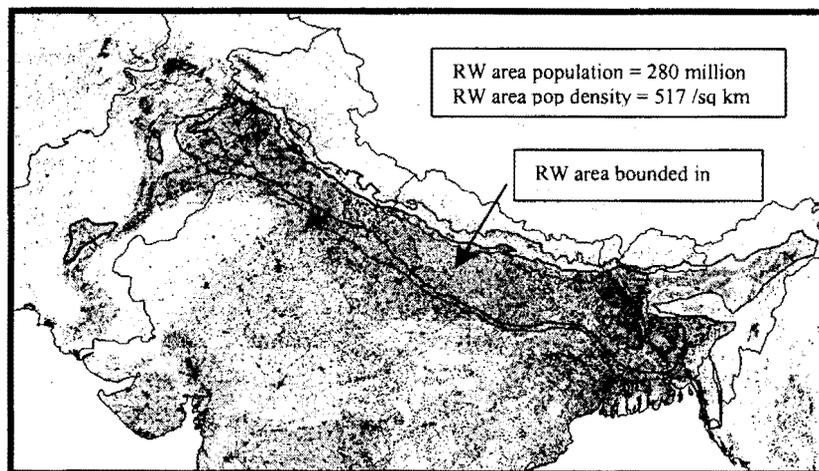


Figure 1: Population density in the rice-wheat areas of South Asia

Rice is grown in the wet and warm summer monsoon season followed by wheat in the cool dry winter season. Rice is traditionally grown by transplanting rice seedlings into a field that has been puddled (plowed when wet). Puddling is done to reduce water percolation so that the standing water can be used to control weeds. This practice creates problems with timely establishment of the succeeding wheat crop because of the need for multiple passes of the plow to prepare a good seedbed. Late planting of wheat is a common feature in this system leading to yields below potential.

Weed control varies in the region. In eastern areas, hand weeding (1 or 2 times) is the most common practice but in the more developed western areas herbicides are used for weed control in rice and wheat. The most common rice herbicide is *Butachlor* (an acetamide) and for wheat, *Isoproturon* (a substituted urea). Both are commonly applied by broadcasting although single nozzle backpack sprayers are also used. 2,4 D is another herbicide used on both crops for broadleaf weed control. Herbicide spraying techniques are faulty and this is an issue for future consideration.

THE RICE-WHEAT CONSORTIUM (RWC) AND RESOURCE CONSERVING TECHNOLOGIES (RCT's)

The RWC is an eco-regional program of the CGIAR (Consultative Group on International Agricultural Research) convened by CIMMYT (International Maize and Wheat Improvement Center – a CGIAR member). The RWC is a partnership between the national agricultural research systems of Bangladesh, India, Nepal and Pakistan; several International Centers of the CGIAR (CIMMYT, IRRI, ICRISAT, CIP and IWMI); and various advanced Institutions (Cornell, IACR, Rothamsted, IAC, Wageningen, CABI-UK, and others) aimed at sustainably increasing the productivity of the rice-wheat

systems in South Asia by conserving and improving the efficiency of use of natural resources, improving livelihoods and reducing poverty.

Food production growth in South Asia needs to increase at 2.5% per year in order to keep pace with food demands in the next decade and maintain food security. This will have to come from yield growth, since area growth is assumed to be nil or negative, using technologies other than the traditional growth technologies of the "Green Revolution" (varieties, fertilizer and irrigation) since these are already being used. The RWC through its partners has been promoting resource conserving technologies as a way to achieve the above goal of sustainably maintaining food security in the "post Green Revolution era". A basket of options is being promoted for farmer experimentation in different parts of the IGP. A description of all of these different technologies can be found in Hobbs and Gupta, 2002. They are all based on using reduced and no-tillage crop establishment combined with input (fertilizer, water, crop protection chemicals) use efficiency techniques. They result in more production at less cost, improve profits and farmer livelihoods and result in several environmental benefits including a reduction in greenhouse gas emissions and better biodiversity of soil biology organisms and beneficial insects.

The first problem encountered while promoting this technology was the mindsets of the people associated with agricultural production (farmers, scientists, extension agents, administrators and others). The belief that "the more you till, the higher the yield" was a very difficult concept to overcome. Although it took 10 years to overcome this bias, no-tillage establishment of wheat after rice has since grown to more than 200,000 hectares in the IGP in 2001-02 compared to just a few hectares 5 years before as more and more farmers accelerate the adoption of this innovative technology. Other technologies such as permanent bed planting, reduced tillage systems and surface seeding are also gaining popularity. The RWC is now promoting this technology for the entire system meaning that rice and other crops are also grown using these RCT's. In this way, the benefits of these RCT's are multiplied and not lost through puddling or excess tillage in other phases of the system. Obviously, this creates new problems that need to be resolved. Equipment design and manufacture is a major issue to enable farmers to experiment. Weed control also becomes a major stumbling block especially since weed control in rice is more difficult when puddling soil and ponding water is stopped. An important principle for these conservation agriculture techniques is leaving residue mulch on the surface. This helps with improving soil surface physical and biological properties, aids in weed control but does create a problem of seeding into loose residues. Research is underway to resolve these issues.

TECHNOLOGY DISSEMINATION CONCERNS

The traditional extension system in South Asia is a linear one and not very effective, especially with the new knowledge intensive needs of modern technology. The traditional system is shown in Figure 2. The technology is developed by scientists, usually on experiment stations (many of which do not represent the farmer situations); they are then tested in adaptive trials on farmer fields (usually researcher managed); and then given to extension for onward transmission to farmers.

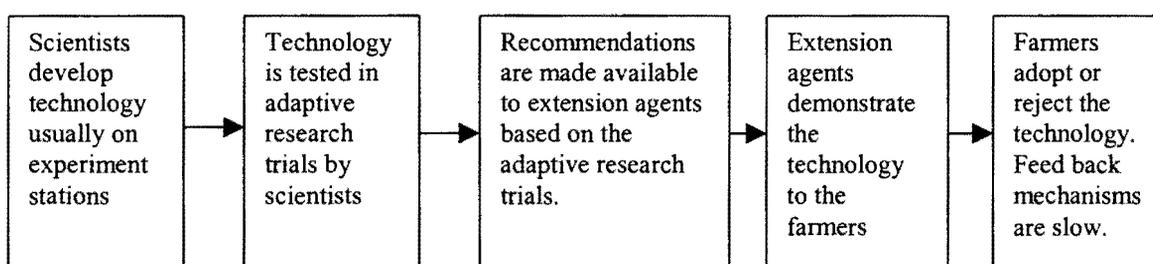


Figure 2: The traditional linear approach to extension.

Today, and in the future, a better approach, where farmers are participating and experimenting with the technology along with other partners, is needed. This innovation network is shown in a simplistic way in figure 3. The main change suggested is a much more participatory approach and an expanded number of stakeholders. Feed back mechanisms are also a key component.

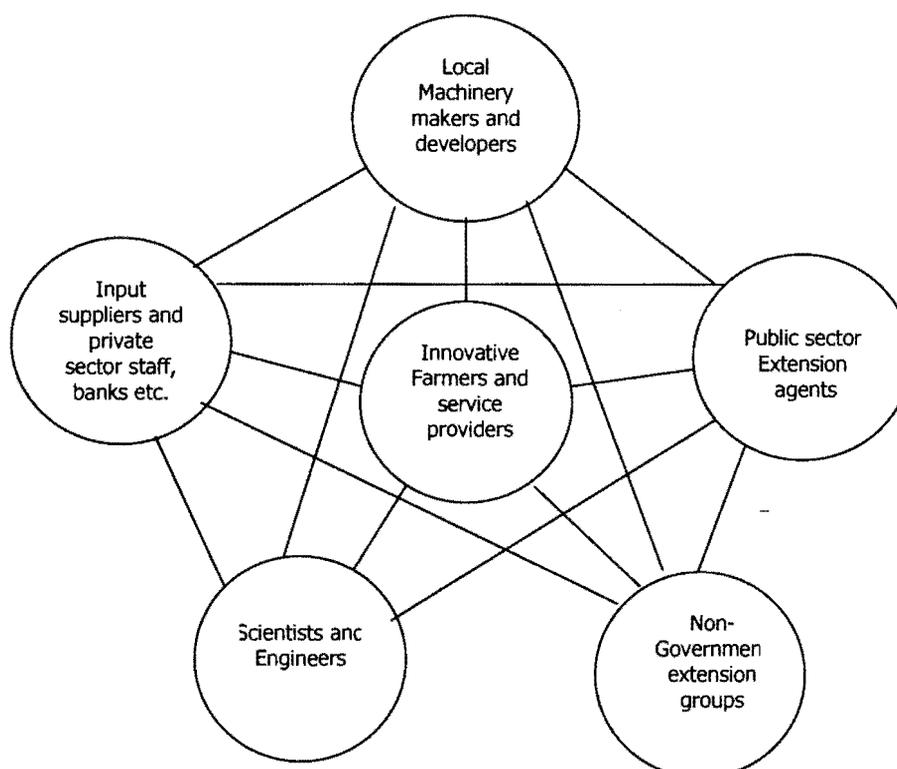


Figure 3: An innovation network for improved and accelerated technology adoption in developing countries. (Based on Ekboir, 2002; Wall et al., 2002)

A good example of this change in paradigm can be seen in the difference in uptake of no-tillage in the two adjoining States of Haryana and Punjab in India. In Haryana, RK Malik (paper to be presented later on) was able to marshal his staff, obtain locally made no-tillage drills and interact directly with innovative farmers. He left the machinery with the farmers so they could experiment with the technology after training

in proper drill use. There are many stories about how some of these innovative farmers were ridiculed by his neighbors when he first started to experiment. But as soon as the crop emerged, his neighbors wanted to borrow the machinery and get their own land planted this way. Adoption accelerated from a few hectares the first year to 100,000 ha last year. After three years it was made a recommendation of the State Agriculture department. In Punjab State, the University administration insisted on following the linear approach to "make sure the technology was correct" before recommending the technology. Only 5,000 ha were covered last year and much of that close to the Haryana border.

Malik also involved other stakeholders in the process. Local manufacturers started making the drill in Punjab and were invited to participate in the planting and get immediate feedback on improving the drill. The extension service was encouraged to help expand the coverage and get some of the recognition for the introduction of this technology. Herbicide companies were also encouraged to view the work and help with accelerating its adoption. In order to allow resource poor farmers who didn't have tractors or equipment to also benefit from this technology, service providers were encouraged to make it available on a rental basis. In fact, many farmers in South Asia use this system to get their land plowed, renting tractor time instead of owning their own tractor and plow. The service provider is an obvious choice for targeting training.

ISSUES OF *PHALARIS MINOR* CONTROL

One of the major issues that convinced Malik to try this no-tillage and also bed planting technology was the appearance of herbicide resistant *Phalaris minor* (little seed canary grass) to the commonly used herbicide, *Isoproturon*, in NW India in the early 1990's (Malik and Singh, 1995). This was the number one weed problem in wheat in rice-wheat areas. As populations increased, many farmers were forced to harvest their wheat for fodder, with no grain production possible. Malik's original concept was that money saved in reducing plowing costs could be used to pay for the more expensive alternative herbicides (*Fenoxaprop*, *Clodinofof*, *Sulfosulfuron*, *Tralkoxydim* etc.) (Vincent and Quirke, 2002). In fact, data soon became available that *P. minor* populations were significantly lower in no-tillage compared to conventional tillage plots (figure 4). Also by using a combination of no-tillage and the new herbicides, the problem of *P. minor* was resolved in 3-4 years to the point where farmers could grow wheat without using herbicide (Malik et al., 2002). The reason for the reduction in *P. minor* populations with no-tillage is simply that with less soil disturbance, this weed, that only germinates in the cool winter season, has less emergence than when soils are fully plowed. Also, wheat is planted earlier and can cover the ground and shade out the *P. minor* when it does germinate.

Another RCT being promoted is the use of permanent beds. Wheat (usually 2-rows) and other crops are planted on top of a 70 cm bed. This allows mechanical weeding in the furrows to control *P. minor* without herbicide use. The *P. minor* also dislikes the drier bed top and does not compete as well with wheat in that situation. Also, with 2-rows planted per bed, inter-cultivation can also occur on the bed top as well as placement of topdress nitrogen fertilizer.

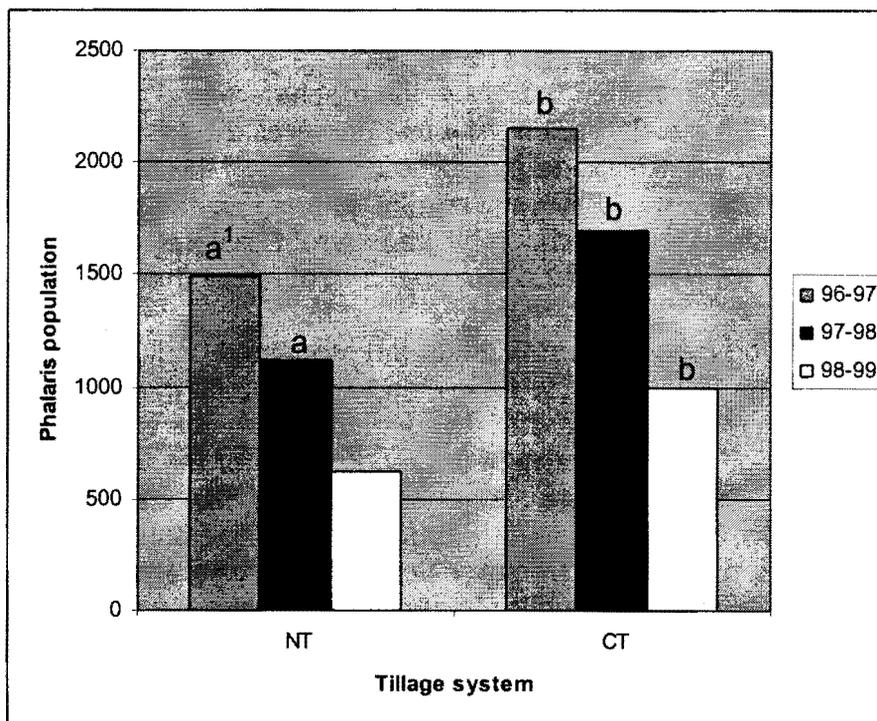


Figure 4: Phalaris minor population in No-tillage and conventional tillage sampled from permanent benchmark sites in Karnal District, Haryana, India. (Based on data from Malik et al., 2002).

Many farmers who used *Isoproturon* for controlling *P. minor* could apply the herbicide by mixing with sand or urea and broadcasting. Many farmers didn't have sprayers or the proper training to apply herbicides uniformly for maximum control. With the introduction of the new herbicides, spraying was not an option and farmers were forced to use backpack sprayers. Obviously, training in proper herbicide use became a priority issue and Malik with the assistance of Robin Bellinder and Andrew Miller at Cornell, developed a simple one-day course to be administered to scientists, extension agents and farmers directly in the field (Bellinder and Miller, 2002). This was done with the help of herbicide companies and local sprayer manufacturers. The response was tremendous with hundreds of farmers showing up for the training. In addition to training in proper herbicide application, farmers were given the option of buying a 2-3 nozzle boom made out of local materials with the proper T-fan tips and an inexpensive pressure regulator. They are also promoting the training of service providers who can provide this service in an efficient way to farmers and to farmers in other parts of the IGP.

CONCLUSION

Food security in South Asia and increasing food production sustainably is crucial for the densely populated areas of South Asia. Food production increases will have to come from yield growth and will have to use technology in addition to the yield growth

factors of the "Green Revolution" since these are already being used. Natural resource use efficiency and consideration of the impact on the environment must also be taken into consideration. Resource conserving technologies like no-tillage and bed planting are being promoted by the RWC to achieve this difficult goal. The results are very encouraging with farmers obtaining more yields at less cost through these RCT's. Even resource poor farmers as well as the larger commercial farmers (who produce cheap food for the urban poor) can use this technology through hiring service providers. The future will see this technology being extended to the whole system as scientists working in participatory network mode help partners to find solutions to key problems. Weed science will be a major player in this work since effective integrated weed management will be needed to replace the traditional system of plowing for weed control. Conservation agriculture, a term coined by FAO to include RCT's is gaining popularity throughout the World and does provide a mechanism for a more efficient, greener food production system to meet the needs of an expanding population that will hopefully start to slow in the next half century.

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ABSTRACT

Previous and current studies detail control of the invasive Eurasian watermilfoil (*Myriophyllum spicatum*) growth through small-scale control experiments. Control studies using laboratory containers and field enclosures in Vermont, Minnesota, and New York show significant decreases in the growth of the submersed aquatic plant watermilfoil caused by herbivory from the aquatic weevil (*Euhrychiopsis lecontei*) and/or the moth (*Acentria ephemerella*). Analysis of long-term field monitoring of watermilfoil growth in lakes continues to implicate insect herbivory, by indigenous populations of the weevil, moth and a midge (*Cricotopus myriophylli*), as a major reason for seasonal and long-term plant damage limiting watermilfoil growth. The importance of a potential robust native plant community able to compete with damaged watermilfoil appears to be a requirement in documented natural declines of watermilfoil in Vermont, Minnesota, and New York. Insect populations feeding on watermilfoil need to be enormous and feed early in the growing cycle of watermilfoil to cause substantial plant damage necessary to allow native plant species to increase.

Data from Minnesota and New York suggest that important factors influencing the density of insects includes not only the insects' abilities to successfully hibernate, mate and avoid predation, but also the host plant abundance and quality. Limiting of any of these factors can negatively influence the potential of these biological control agents to slow watermilfoil growth and may explain the failure to achieve the high populations of insects required to limit watermilfoil growth. The few herbivore augmentation studies attempted to date have shown no success in increasing the indigenous herbivore populations over the long term. The major factor limiting the high herbivore population densities necessary to control watermilfoil growth appears to be predation on invertebrates by small fish. The future of using or aiding these potential biological control agents to provide consistent control of watermilfoil growth may require control of small fish populations, suggesting fishery management as a key player in Eurasian watermilfoil control.

ABSTRACT

If weeds are defined simply as unwanted plants, algae are among our worst weed problems. Although mostly invisible to the naked eye as individual plants, high concentrations of algae form unsightly blooms that disrupt lake and river ecology and impair human uses of water. Beyond aesthetic considerations, algal toxins and taste and odor have become significant issues in water supply, and algal-induced fluctuations in oxygen, pH and other water quality features affect habitat quality and water treatment needs. Nearly all algal groups can cause problems at high enough concentrations, but the primary offending groups are blue-greens (Cyanophytes, or more properly cyanobacteria) and greens (Chlorophyta). Problem growths may be dense aqueous solutions (the "pea-soup" phenomenon) or macrophytic mats on the bottom or surface. While water quality will affect which species of algae occur, some forms are invasive and we are seeing shifts in geographic occurrences that may reflect climatic changes or human-aided distribution. Various government assessments place the portion of lakes suffering from algal blooms at about 40%.

Algal control is facilitated by an understanding of algal growth and loss processes. Major growth processes include photosynthesis, facultative heterotrophy, and recruitment from resting stages in the sediment or upstream waters. Primary loss processes include cellular death, consumption by primary consumers, wash out, and sedimentation. By far the most desirable algal control approach involves limiting nutrient availability to minimize photosynthetic production, with phosphorus most often targeted. Watershed management is usually involved, and is often a difficult, expensive, and prolonged effort, although major successes have been documented. In-lake approaches include dredging or phosphorus inactivation to reduce nutrients, dyes or surface covers to restrict light, food web manipulation to enhance consumption, flushing to increase washout, and algaecides for direct kills. Each method has advantages and drawbacks, and a substantial amount of system specific information is needed for proper application for maximum effectiveness. Short-term control usually involves algaecides, which can be an integral part of algal control, but are more often used as a last resort and in a manner inappropriate to maximizing benefits and longevity. Longer term control normally requires nutrient management, while alteration of the biological structure of the lake can be effective on a more intermediate term. A combination of techniques is usually necessary for effective, long-term control of algae.

ABSTRACT

Japanese knotweed (*Polygonum cuspidatum* Sieb. & Zucc.) is an invasive, herbaceous, rhizomatous, perennial. Introduced from Asia as an ornamental and fodder plant, Japanese knotweed has spread across the United States and into Canada where it has colonized riparian zones, surface mines, roadways, and rights-of-way. Due to its rapid growth and stand-forming habit, Japanese knotweed forms dense canopies that few other species can survive beneath, thus threatening native biodiversity.

Mechanical control of Japanese knotweed can be very expensive and is largely ineffective. The purpose of this study was to find a more efficient and effective method of chemical control. Based on previous studies, which showed that glyphosate and imazapyr limited Japanese knotweed growth, the effectiveness of foliar applied imazapyr (Arsenal AC[®]) and glyphosate (Accord[®]) was tested and evaluated at different rates, combinations, and dates of application. Five herbicide treatments were tested (glyphosate 4 kg ai/ha, imazapyr 0.25 kg ai/ha and 0.5 kg ai/ha, glyphosate 4 kg ai/ha + imazapyr 0.25 kg ai/ha, and glyphosate 4 kg ai/ha + imazapyr 0.5 kg ai/ha) on four dates of application, May, June, July, and August at two locations. In addition, a two-time application of each treatment, May and August, was tested. Japanese knotweed biomass, the average height of the tallest three stems, the number of new Japanese knotweed seedlings, the number of stems (ramets), and the percent cover of volunteer species were collected from sample plots (4 m²) and evaluated one year following treatment application. In addition, fresh vegetation samples were collected from both sites and sent to the University of Massachusetts-Boston for examination of morphological micro-characteristics.

Compared to the control, results indicated that a one-time application of all treatments reduced the number of Japanese knotweed stems and re-growth one year following treatment. Late season application seemed to improve treatment efficacy and provide better control of Japanese knotweed. A two-time application of all herbicide treatments in one growing season significantly reduced Japanese knotweed dry weight by approximately 93 percent across all treatments, compared to a one-time treatment. The imazapyr (0.5 kg/ha) and glyphosate plus imazapyr (4 + 0.5 kg/ha) treatments were most effective in controlling Japanese knotweed, but severely limited establishment of desirable volunteer species. The glyphosate treatment applied two times within the same growing season was not as effective as the two-time imazapyr (0.5 kg/ha) and glyphosate plus imazapyr (4 + 0.5 kg/ha) treatments, but permitted the establishment of the most volunteer species. In addition, samples of knotweed from both site locations in Pennsylvania exhibited macro-and micro-morphological characteristics associated with hybridization between Japanese knotweed and giant knotweed (*P. sachalinense*) and Japanese knotweed and the horticultural variety *P. cuspidatum* var. 'Crimson Beauty.'

Due to the chemical characteristics of glyphosate and imazapyr, relating the treatment to the environment is crucial to effectively controlling Japanese knotweed, while protecting the health of surrounding ecosystems. The Accord[®] formulation of glyphosate, with an approved surfactant is recommended to control Japanese knotweed in areas containing desirable hardwood trees and where water is present.

ABSTRACT

Clopyralid (3,6-dichloro-2-pyridinecarboxylic acid) has been widely used against difficult to control broadleaf weeds in turf since the early 1990's. Incidents have been reported where clopyralid residue was detected in compost material at levels sufficient enough to cause damage to sensitive plants grown in compost medium. Laboratory and field studies were undertaken by Dow AgroSciences to understand the fate of clopyralid in turf and remediation options available to reduce levels in compost. A brief summary of the findings will be reported along with an update on label changes in commercial herbicide products containing clopyralid.

Oxyfluorfen (2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene) is a highly effective broadleaf herbicide widely used in container and field grown ornamental production systems. Oxyfluorfen recently went through the Reregistration Eligibility Documentation (RED) process required by the US EPA. The RED was completed in August 2002 and the Federal Register Notice was published in the fall of 2002. A brief summary of label changes in commercial herbicide products containing oxyfluorfen will be made.

Supplement
of the
56th Annual Meeting of the
Northeastern Weed Science Society

Loews Hotel
Philadelphia, PA

January 7-10, 2002

Mark VanGessel, Editor
University of Delaware
Georgetown

**Northeastern Weed Science Society
56th Annual Meeting**

January 8, 2002
Loews Hotel, Philadelphia, Pennsylvania

PRESIDENTIAL ADDRESS

The Status of Weed Science in the Northeast

JEFFREY F. DERR
Virginia Tech

The objective of my research for this presentation was threefold:

- Summarize faculty devoted to Weed Science at Universities in the Northeast
- Summarize Weed Science Classes taught
- Compare results to that for Entomology and Plant Pathology

My methods for collecting information were to survey websites for Virginia Tech, West Virginia University, Penn State, University of Maryland, University of Delaware, Rutgers University, Cornell University, SUNY-Cobleskill, University of Rhode Island, University of Connecticut, University of Massachusetts, University of Vermont, University of New Hampshire, and the University of Maine. I ignored cross-discipline courses, microbiology courses, independent study, and special topics courses.

Since I am a member of the Department of Plant Pathology, Physiology, and Weed Science at Virginia Tech, I have additional information on the status of Weed Science at this university. In terms of full time equivalents (1 FTE = one full time person), Virginia Tech has the following faculty positions:

Table 1. Virginia Tech Faculty full time equivalents.

	Teaching	Research	Extension	Total
Weed Science	0.5	3.5	3.0	7.0
Entomology				20.0
Plant Pathology	2.9	7.4	4.95	15.3

Table 2. Classes and graduate students at Virginia Tech.

	Undergraduate credits	Graduate credits	Undergraduate classes	Graduate classes	Graduate students
Weed Science	3	3	1	1	7
Entomology	20	29	9	9	26
Plant Pathology	4	14	1	6	10

Virginia Tech has twice as many Plant Pathologists and almost three times as many Entomologists as Weed Scientists. There are significantly more Entomology and Plant Pathology courses than Weed Science classes at Virginia Tech. Entomology has the most students, followed by Plant Pathology, with the fewest number of graduate students in Weed Science. Similar patterns in faculty numbers and classes are apparent at other universities in the northeast.

Table 3. University of Maryland faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	3	1	1
Entomology	18	8	3
Plant Pathology	2	1	1

Table 4. West Virginia University faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	1	1	0
Entomology	3	6	0
Plant Pathology	8	2	8

Table 5. Penn State faculty and classes.

	Faculty	Graduate students	Undergraduate classes	Graduate classes
Weed Science	4	7	3	0
Entomology	20	36	18	12
Plant Pathology	24	24	8	8

Table 6. University of Delaware faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	1	1	0
Entomology	8	12	14
Plant Pathology	2	4	4

Table 7. Rutgers University faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	2	1	0
Entomology	17	9	10
Plant Pathology	10	1	7

Table 8. Cornell - Ithaca plus Geneva plus Riverhead faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	5	1	1
Entomology	28	25	6
Plant Pathology	35	4	20

Table 9. Faculty at SUNY – Cobleskill.

Weed Science	1
Entomology	0.5
Plant Pathology	1.5

Table 10. University of Connecticut plus Connecticut Agricultural Experiment Station faculty and university classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	3	1	0
Entomology	13	0	0
Plant Pathology	8	1	0

Table 11. University of Rhode Island faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	1	1	0
Entomology	7	5	5
Plant Pathology	2	4	1

Table 12. University of Massachusetts faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	2	1	1
Entomology	13	7	11
Plant Pathology	5	2	8

Table 13. University of Vermont faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	0	1	0
Entomology	3	2	0
Plant Pathology	2	1	0

Table 14. University of New Hampshire faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	0	2	2
Entomology	7	0	0
Plant Pathology	4	1	0

Table 15. University of Maine faculty and classes.

	Faculty	Undergraduate classes	Graduate classes
Weed Science	3	1	0
Entomology	7	5	1
Plant Pathology	3	1	0

Table 16. Faculty Summary – 14 Institutions in the Northeast

Weed Science	33
Entomology	155
Plant Pathology	109

When the number of faculty at universities are summarized across the northeast, there are over three times as many Plant Pathologists and almost five times as many Entomologists as there are Weed Scientists. Since Weed Science is as important a discipline as Entomology and Plant Pathology, there exists a great need for additional

Weed Scientists at all universities. The current low faculty count results in few Weed Science classes taught in the northeast. For better training of our students, additional undergraduate and graduate classes are needed in Weed Science.

I would like to thank the members of the Executive Committee for all of their hard work this past year. Your assistance has made my job much easier. The society had a successful year, culminating in an excellent annual meeting. I enjoyed serving the society as president.

ABSTRACT

Common groundsel (*Senecio vulgaris*) has been the target of the biological control approach. Recently, the rust fungus, *Puccinia lagenophorae*, was acquired from the U.K., because it has played a significant role in reductions of *S. vulgaris* populations in Europe. Under containment greenhouse conditions, the rust fungus was very aggressive, causing reductions in plant biomass. In two experiments, dry weights of inoculated plants were less than controls by 29.0 and 30.5%.

Research in Europe and Australia indicate *P. lagenophorae* is not limited to *S. vulgaris*; susceptibility of English daisy (*Bellis perennis*), pot marigold (*Calendula officinalis*), and at least two other species of *Senecio* has been noted [1]. A limited host range determination in the present study showed that English daisy also could be infected but not damaged by the British acquisition of *P. lagenophorae*. Pot marigold was not infected in these tests. No other plant has been tested, including any of the nearly 100 species of *Senecio* native to North America.

Recently *P. lagenophorae* was discovered on *S. vulgaris* in the United States [2]. The fungus also has been discovered on English daisy [3]. Issues with the discovery of *P. lagenophorae* in the United States include: 1) how much damage will the disease cause to common groundsel, and 2) will it cause reduction in stand density throughout the range of common groundsel in North America? An issue of greater concern and for which there is no data concerns susceptibility of North American species of *Senecio* and plants in related genera.

Because the rust disease has been so effective in Europe and the pathogen can spread very quickly, it is of great interest to: 1) document the current distribution of infected *S. vulgaris*, 2) follow spread of the pathogen through the U.S., 3) document damage caused by *P. lagenophorae* to *S. vulgaris* in the field, and 4) determine if other species of native *Senecio* spp. and related Asteraceae are susceptible and damaged by infection. This is an appeal for help to document either the fact or the lack of infection of *S. vulgaris* by *P. lagenophorae* in the Northeast. If common groundsel is not infected, it should be documented so a clear time that the rust fungus arrives can be established. This is an invitation for anyone concerned or knowledgeable about common groundsel to participate in this process over the next few seasons. Participants are asked to record either: 1) the presence or lack of rust on common groundsel in the Northeast, or 2) the arrival of the rust in the Northeast. Samples of infected plants can be sent to me at the address above to confirm whether the infection is caused by *P. lagenophorae*.

1. Wilson, I.M. and D.F. Walshaw. 1965. The New Groundsel Rust in Britain and its Relationship to Certain Australian Rusts. *Trans. Brit. Mycol. Soc.*, 48:501-511.
2. Scholler, M. and S.T. Koike. 2001. First Occurrence of *Puccinia lagenophorae* Causing Rust Disease on Common Groundsel in North America. *Plant Disease* 85:335.
3. Koike, S.T. and M. Scholler. 2001. First occurrence of a rust fungus on English daisy (*Bellis perennis*) in North America. *Plant Disease* 85:562.

**Northeastern Weed Science Society
56th Annual Business Meeting Agenda
January 9, 2002**

1. Call to order – J. Derr
2. Acceptance of the Minutes from the 55th Annual Business Meeting
3. Necrology Report – D. Yarborough
4. Executive Committee Reports. Submitted reports are compiled in the handout.
 - a. President's Comments – J. Derr
 - b. Secretary/Treasurer Update – D. Yarborough
 - c. Audit Committee Report – D. Yarborough
 - d. Archives Committee – R. Bellinder
 - e. Awards – B. Olson
 - i. Distinguished Member
 - ii. Award of Merit
 - iii. Outstanding Educator
 - iv. Outstanding Researcher
 - v. Collegiate Weed Contest Winners
 - vi. Graduate Student Presentation awards
 - vii. Research Poster contest
 - viii. Photo contest
5. Old Business
 - NEWSS committee on change – J. Neal
 - NEWSS Collegiate Contest rules update – T. Mervosh
6. Officer Changeover and Presentation of the Gavel
7. New Business – D. Mayonado
 - a. Resolutions Committee – T. Bean
 - b. Nominating Committee report – A. Senesac
 - c. Election of the Vice President
 - d. Appointment (2) and Election (3) of the 2001 Nominating Committee
 - e. Resolution Committee appointments
 - f. Weed Contest 2002
 - g. Meeting Site 2003 – Hyatt Regency Baltimore, Baltimore, MD Monday – Thursday 1/6-1/9/2003
 - h. Other business
8. Presentation of the 2002 Executive Committee
9. Adjourn

NEWSS Financial Statement for 2001
November 1, 2000 to October 31, 2001

INCOME:

2000 Sustaining Membership and Coffee Break support.....	\$4,575.00
Individual Membership.....	\$4,100.00
Annual Meeting Registration.....	\$10,914.00
Proceedings.....	\$4,990.00
Annual Meeting Awards	\$ 300.00
Interest.....	\$1,788.97
NEASHS.....	\$1055.96
Other Income.....	\$ 55.71
Weeds Contest	\$6,100.00
Subtotal.....	\$33,879.64

EXPENSE:

Annual Meeting/Programs.....	\$8,827.57
Student Reimbursement	\$1,600.97
Administration	\$ 679.42
Proceedings.....	\$3,914.08
Newsletter	\$2,853.20
Annual Meeting Awards	\$1,075.00
CAST	\$1,285.67
NEASHS.....	\$ 148.40
WSSA Director of Science Policy	\$4,000.00
Weed Contest 2000	\$1,329.40
Weed Contest 2001	\$7,420.36
Refunds/bad check.....	\$ 217.00
Web site.....	\$ 499.00
Subtotal	\$33,850.07

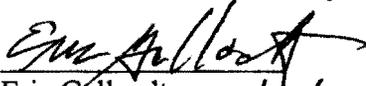
Total Income/Expenses

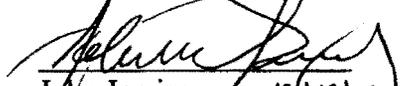
	\$ 29.57
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October 31, 2000 Savings Certificate Accounts (IDS-American Express)	\$19,450.58
October 31, 2000 UM Credit Union Savings	\$28,729.85
October 31, 2000 UM Credit Union Checking.	\$824.27
TOTAL NET WORTH	\$49,004.70

October 31, 2001 Savings Certificate Accounts (IDS-American Express)	\$20,531.99
October 31, 2001 UM Credit Union Savings	\$27,941.08
October 31, 2001 UM Credit Union Checking.	\$561.20
TOTAL NET WORTH	\$49,034.27

The Northeastern Weed Science Society Checking Account, Savings Account and Money Market accounts were reviewed by the undersigned and are in order


Eric Gallandt 12/19/01


John Jemison 12/19/01

Executive Committee Reports of the NORTHEASTERN WEED SCIENCE SOCIETY

Presented at the 56th Annual Business Meeting
Loews Philadelphia Hotel
January 9, 2002

PRESIDENT
Jeffrey F. Derr

The society started 2001 with another successful annual meeting at the Boston Cambridge Marriott, Cambridge, MA. This hotel, chosen by Brian Olson, was an excellent choice. Thanks to everyone on the Executive Committee for their time and effort developing and implementing the program. I am always amazed at the amount of work completed by our board, section chairs, and other volunteers in the society. Special thanks go out to Dave Mayonado for serving as program chair and to Rich Bonanno for his work as awards chair. The joint meeting with the Northeastern Branch of the American Society for Horticultural Science (NE-ASHS) was also beneficial to both organizations. I was pleased to hear from Carolyn DeMoranville that NE-ASHS will meet with us in 2002 and 2003. Both groups benefit from this cooperation. I would like to thank Carolyn for serving as liaison between the two groups.

We welcomed two new members to the Executive Committee, Tim Dutt as WSSA representative, and Carrie Judge as Graduate Student representative. Steve King, a PhD candidate in Weed Science at Virginia Tech, agreed to serve as webmaster for the society. Prasanta Bhowmik will replace Nate Hartwig as the NEWSS rep on the WSSA Outstanding Young Weed Scientist Award Committee. Tim Dutt agreed to replace Renee Keese as the NEWSS rep on the WSSA Industry Awards Subcommittee. I will serve as our rep on the WSSA membership committee. Jim Parochetti has been nominated as the NEWSS rep to the WSSA Fellows committee.

Dave Mayonado and I were able to participate in some of the activities for National Invasive Weeds Awareness Week in Washington D.C. Rob Hedberg, our representative in Washington, was an important part of the planning for this week. It is important for NEWSS and the other weed science societies to be involved in this effort. While in D.C., Rob arranged for Dave and I to meet with staffers for Senator Warner of Virginia, and Senators Sarbanes and Mikulski of Maryland. We discussed the importance of invasive plants in the Northeast, mentioned the activities that were occurring for Weed Awareness Week, and discussed how NEWSS can serve as a source of information on invasive plants. One item discussed that week was Senate bill 198, **Harmful Nonnative Weed Control Act of 2000**.

Scott Glenn, Betty Marose, Art Gover and I met with Kerrie Kyde and Faith Campbell, representatives of the Mid-Atlantic Chapter of the Exotic Pest Plant Council (MA-EPPC). We will have an invasive plants symposium at the 2002 meeting that will be co-sponsored by MA-EPPC. We will have an evening reception as part of that effort. I am hoping that we can expand upon our efforts with invasive plant societies, building on the program Dave Mayonado put together for Cambridge. Besides affecting forestry and noncrop areas, invasive plants are impacting turf and ornamental areas, and are

also infesting cropland. Pulling together native plant societies, horticulturists and weed scientists will benefit all of us as we all need to be part of the effort to address these weed species.

In continuing the theme of cooperation with other organizations, I have been discussing interaction between NEWSS and the Northeast chapter of the Aquatic Plant Management Society (NE-APMS) with officers of that group. Gerald Smith of Aquatic Control Technology in Sutton, MA is the current president of NE-APMS. This relatively young organization had their second annual meeting this past January. Hopefully we can develop closer ties with this group. There is an amazing amount of similarity between the 2 groups. Both work on weeds, are located in the Northeast, and meet in January. The issue of invasive plants also overlaps the 2 societies.

There will be a phragmites conference in New Jersey at the same time as our annual meeting in Philadelphia. I spoke with one of the organizers of the meeting, Michael P. Weinstein, Director, New Jersey Sea Grant College Program, New Jersey Marine Sciences Consortium, Sandy Hook Field Station, Fort Hancock, NJ. Mike said that if he had been aware of our meeting, we could have worked out a joint program. There may be potential in the future to interact with this and other groups that work on invasive plants.

Frank Himmelstein and Todd Mervosh hosted the 2001 Collegiate Weed Contest at the University of Connecticut Plant Science Research and Teaching Facility in Storrs, CT. A total of 60 students competed this year. Approximately 30 people volunteered to help with the contest. George Knocklein of NE-APMS set up an aquatic weed display at the contest. Hopefully we can make aquatic weeds a permanent part of the weed identification section of the contest. This is part of a larger goal of having more cooperation between NEWSS and NE-APMS. I would like to thank Frank, Todd, and the volunteers for putting on an excellent contest. After the contest, Carrie Judge led a group of students in a tour of the Monsanto Mystic Research facility. I thank Tim Dutt for setting up the tour with Jim O'Brien of the Monsanto facility. I have asked Todd Mervosh to serve as chair of a committee that reviews rules for the summer student contest.

Plans are finalized for the 2002 annual meeting at the Loews Philadelphia Hotel. Scott Glenn, program chair for the 56th meeting, has done an excellent job. The number of presentations is increased from the 2001 meeting. The General Symposium will address current issues in biotechnology. Carrie Judge has developed a tour of DuPont's Stein Haskell Research Facility for the students. I would like to thank Raymond Forney at Dupont for hosting this tour. Carolyn DeMoranville has arranged a tour of Longwood Gardens for Tuesday afternoon and evening. I would like to thank Art Gover for developing the invasive plants symposium.

Three members of the Executive Committee will be completing their terms at the meeting in Philadelphia – Brian Olson, Past President; Carroll Moseley, Sustaining Membership Chair, and Betty Marose, Research and Education Coordinator. I would like to thank them for their service to the society. I would also like to thank the entire board for all of their help this past year. We continue to be a strong organization due to the time and effort devoted to NEWSS by our volunteer board.

Finally, I would like to thank the society for the opportunity to serve as your president. It has been an enjoyable and rewarding experience.

PRESIDENT-ELECT
David J. Mayonado

At our meeting in Cambridge last year, we conducted a poll of the membership to determine if they would prefer to meet at a more southern location in 2003 or a northern location. The vote was strongly in favor of going south. Four hotels were considered for the site of the 2003 annual meeting. Two of the hotels were in Boston, the Cambridge Marriott and the Sheraton Boston, and 2 were in Baltimore, the Hyatt and the Baltimore Marriott Waterfront. Because of our previous experience with the Hyatt in Baltimore, and the society's general desire to meet in the south, I recommended to the board that we accept their contract offer of \$109/night for single occupancy and \$119/night for double occupancy along with the other standard concessions. The board voted to accept their contract. After several successful years of meeting jointly with the NE-ASHS, we will again meet jointly in Baltimore.

To date I have been unsuccessful in securing a location for the 2002 collegiate weed science contest. With the consolidation that has occurred in industry, we are becoming more dependent upon universities to host this event. While the number of potential locations is down, the size of the event and the number of students participating remains strong. This puts considerable burden on the host location and has made it difficult to get anyone to commit. I believe we will need to discuss this issue amongst the participating universities to determine if an annual contest remains do-able or should we consider other alternatives.

VICE PRESIDENT
Scott Glenn

The call for papers for the January 2002 NEWSS meeting went out in the August Newsletter. September 14, 2001 was the deadline for submission for the annual meeting. Section Chairs were asked to contact their colleagues and encourage participation in the meeting.

The theme for the annual meeting will be "Biotechnology: The Next Generation". There are four invited speakers that will address future concerns with use of herbicide resistant crops and possible solutions. The invited speakers are: Dr. Tom Vrabel with the Slater Center for Environmental Biotechnology; Dr. Mark VanGessel with the University of Delaware; Dr. Albert Kausch with Hybrigene; and Dr. David Heering with Monsanto. Dr. Albert Kausch will also present the keynote address in the General Symposium. We will also have a special mini-symposium in the Conservation, Forestry and Industrial section entitled "Invasive Plants".

There are 114 volunteered papers for the 2002 meeting, along with 7 invited papers. The invited papers include 1 in the General Session, 4 in the General Symposium, and 2 in the Invasive Plants Symposium. The volunteered papers can be broken down as follows: Poster - 25; Agronomy - 23; Conservation, Forestry, and Industrial - 17; Ornamentals - 15; Turfgrass and Plant Growth Regulators - 23; and Vegetables and Fruit - 10. There are 19 participants in the Graduate Student Contest. The Biologically-based Weed Control section was dropped due to lack of interest. The title for the Industrial, Forestry and Conservation section was changed to the Conservation, Forestry, and Industrial as noted earlier. We again will meet jointly with

the NE-ASHS as we have since 1999. The NE-ASHS program was coordinated by Carolyn DeMoranville. The final program was sent to the printer on November 6, 2001.

Steve King, a graduate student at Virginia Tech, was in charge of the NEWSS website. He received all electronically submitted titles and forwarded them to me. Directions for Abstract Submission and the Keyword Index Form were available on the website. These forms were sent to those who did not submit electronically or requested them. Instructions for preparing a Poster were sent to all participants in the Poster section.

Lists of e-mail addresses were provided to section chairs so that participants could be made aware of the availability of projection equipment. Lists of addresses were also compiled for the Graduate Student Contest participants so that they could receive judging instructions and information concerning the Graduate Student Mixer.

SECRETARY-TREASURER
David E. Yarborough

The annual meeting in Cambridge, MA was attended by 195 members, of which 153 preregistered. The total Membership for 2001 stands at 212. Below is the financial statement for the NEWSS for the fiscal year November 1, 2000 to October 31, 2001.

NEWSS Financial Statement for 2001
November 1, 2000 to October 31, 2001

INCOME:	
2001 Sustaining Membership and Coffee Break Support.....	\$4,575.00
Individual Membership.....	\$4,100.00
Annual Meeting Registration.....	\$10,914.00
Proceedings.....	\$4,990.00
Annual Meeting Awards.....	\$300.00
Interest.....	\$1,788.97
NEASHS.....	\$1055.96
Other Income.....	\$55.71
Weed Contest.....	\$6,100.00
Subtotal	\$33,879.64
EXPENSE:	
Annual Meeting/Programs	\$8,827.57
Student Reimbursement.....	\$1,600.97
Administration.....	\$679.42
Proceedings.....	\$3,914.08
Newsletter.....	\$2,853.20
Annual Meeting Awards.....	\$1,075.00
CAST	\$1,285.67
NEASHS.....	\$148.40
WSSA Director of Science Policy	\$4,000.00
Weed Contest 2000.....	\$1,329.40

Weed Contest 2001	\$7,420.36
Refunds/bad check	\$217.00
Web site	\$499.00
Subtotal	\$33,850.07

Total Income/Expenses \$29.57

Balance Forwarded Savings Certificate Accounts (IDS-American Express) ..	\$19,450.58
Balance Forwarded UM Credit Union Savings	\$28,729.85
Balance Forwarded UM Credit Union Checking	\$824.27
TOTAL NET WORTH October 2000	\$49,004.70

October 31, 2001 Savings Certificate Accounts (IDS-American Express)	\$20,531.99
October 31, 2001 UM Credit Union Savings	\$27,941.08
October 31, 2001 UM Credit Union Checking	\$561.20
TOTAL NET WORTH October 2001	\$49,034.27

**PAST PRESIDENT
Brian D. Olson**

In 2001, the Awards Committee (B. Olson, R. Bonanno, D. Vitolo, J. Neal, and T. Vrabel) reviewed nominations for all awards and submitted candidates for approval by the Executive Committee at the October EC meeting. Plaques were prepared for all award recipients and the Awards Presentation Brochure was prepared and printed. Recognition plaques were also prepared to honor the outgoing President as well as Steve King, for maintaining the NEWSS web site. The Graduate Student Paper contest award committee was established (A. R. Bonanno, Chair) and the judging schedule was coordinated with the program chair. The Photo Contest committee (G. Jordan, Chair) was established and an article was submitted to the Newsletter for the November edition requesting entries. The Poster Committee (Ted Bean, Chair) was established. BASF was contacted to financially support the Graduate Student Paper Contest and certificates were prepared for the contest winners. Archival materials from 2000 - 2001 were collected and sent to R. Bellinder (NEWSS archivist) for storage. Changes to the MOP were solicited from the executive committee. Work is continuing to create a MOP for the Collegiate Weed Contest. The 2002 NEWSS MOP and the NEWSS Constitution were prepared and printed for distribution at the annual meeting.

**CAST
Robert D. Sweet**

The year 2001 has been one of substantial changes of CAST. The highly successful Dr. Stuckey, EVP for 8 years, retired and was replaced by Dr. Teresa Gruber who has been working in the D.C. arena of agricultural matters for several years. She has an agricultural related Ph.D. as well as a J.D. in law. A second major change was moving the EVP office, not the operations, from Ames to D.C. This event had long been urged by some board members, but the change in EVP and the development of the

Internet made the change appropriate at this time. A third major change will be an amalgamation with ARI. This organization has similar goals to those of CAST but is supported primarily by Agriculture businesses. As they have consolidated, support for ARI has diminished so that their D.C. office is no longer economically feasible. Detailed plans are being worked on so that a fair amalgamation can take place. Plans should be ready for a vote at the March CAST Board meeting.

The result of these changes is red ink for the 2001 operation budget. However CAST has a strong competent budget committee and they assure us we will soon be back in the black.

CAST's reputation continues to climb, almost precipitously. Several well-heeled farm groups have offered to pay CAST very well for doing some work for them. The board is insisting these requests are scrutinized carefully and brought to us before any commitments are made. Credibility can be lost much more quickly than it can be earned.

Other groups, even including lawyers, are suggesting we work together. Also often CAST is asked to testify before congressional committees, etc.

It's great that NEWSS has been part of CAST's successful development.

EDITOR
Mark J. VanGessel

Instruction to Authors was further updated this year in an attempt to make the proceedings more consistent for all abstracts. NEWSS website was used for electronic submission of titles and source of Keyword Form submission. The process was modified to ensure that authors receive a confirmation note that included their title and complete list of authors. Abstracts with graphics were emailed to the editor in an MSOffice compatible program. Approximately 95% of those submitting abstracts used electronic submission.

Two publications were produced for the 2002 Annual Meeting. The program guide was 48 pages long and 650 were printed. Approximately 400 copies were mailed by the editor with first-class postage. The proceedings were 258 pages and 275 were printed. The number of programs and proceedings was lower this year than in previous years since there is a considerable amount of carryover from the past few years. One hundred and six abstracts and papers were published with an additional two abstracts and papers published as a supplement to the 55th Volume.

The cumulative index will be available by the 2003 meeting. This index will include papers and abstracts from 1998 to 2002.

GRADUATE STUDENT REPRESENTATIVE
Carrie A. Judge

The graduate student activities of the past year were as follows:

A graduate student resource list detailing contact information and specialty area of study of the NEWSS students was compiled by Ivan Morozov. This year it has been continually updated and modified with students from the 2001 annual meeting and attendees of the 2001 weed contest. Strides to maintain an accurate and

comprehensive list will continue to be made to ensure effective communication and networking opportunities.

The weed contest at the University of Connecticut was a big success in August. Both graduate and undergraduate students were well represented from many universities. The day after the weed contest, students had the opportunity to visit Monsanto's biotech facility in Mystic, CT. Approximately 50 students and coaches from nine universities attended. It was a 2-hour comprehensive tour in which students had the chance to see the transformation process group, the forward/reverse genetics group, yield group, quality trait group, quality control group, and the trait development group. It was an excellent educational opportunity.

During the 2002 annual meeting in Philadelphia, students will have the opportunity to tour DuPont's Stine-Haskell chemicals facility. The tour will include a look at the high throughput chemicals facility, the insecticide, fungicide and herbicide screening facilities and procedures, greenhouses, growth chambers, laboratories and offices. A workshop will follow that will discuss industry, assessment of the past, present and future of the crop protection chemicals business and discovery opportunities. In addition, they will discuss opportunities within the industry and the required and desired qualifications for employment. The annual Graduate Student mixer will be held the same evening.

PUBLIC RELATIONS **Todd Mervosh**

At the 55th NEWSS Annual Meeting in Cambridge, MA, I took photos of all award winners at the General Session and Business Meeting, people at the poster session, Past Presidents at their breakfast meeting, and speakers at the General Session, General Symposium and Graduate Student Mixer. I included these photos with an annual meeting report for the April 2001 issue of the NEWSS newsletter, and submitted an article and photos to the newsletter editors for WSSA and SWSS. The April newsletter included the nomination form for NEWSS awards.

The April 2001 newsletter was mailed on April 17 to all paid members and/or those who attended the annual meeting in January. Sir Speedy Printing printed 300 copies of the 16-page newsletter, folded, affixed mailing labels and first-class postage (\$0.55 for U.S.) to 270 newsletters. The total cost of printing and mailing the April newsletter was \$653.66. I sent Steve King the file containing the newsletter and additional photos that he posted on the NEWSS website.

Along with Frank Himmelstein of the University of Connecticut, I served as a co-organizer of the 2001 NEWSS Collegiate Weed Contest held in Storrs, CT at the UConn Plant Science Farm on July 31. Fifty-nine students from nine universities participated in this year's contest. More than 30 volunteers helped make the contest a success. Dave Yarborough took digital pictures at the contest and of the winners at the awards banquet, and he sent me jpeg files of these images. I also took several photos during the contest. A writer for *The Chronicle of Higher Education* interviewed me about the weed contest for an article she has written.

For the August 2001 newsletter, I included names of the top three teams and individuals for the undergraduate and graduate divisions in the weed contest. The call for papers, title submission form, and award nomination form were also included. Sir

Speedy printed 400 copies of the 12-page newsletter (including two inserts), folded, affixed mailing labels and first-class postage (\$0.57 for U.S.) to approximately 300 newsletters mailed on August 30. Also, 1000 copies of the green NEWSS masthead were printed on 11" x 17" paper for future newsletters. The total cost of these services was \$1027.60. I sent Steve King the file containing the newsletter, and he posted it on the NEWSS website.

In addition to the full report and photos from the Collegiate Weed Contest, the November 2001 newsletter contained annual meeting pre-registration and placement service forms, hotel room reservation information, condensed meeting program, and other important information for the upcoming annual meeting in Philadelphia. Sir Speedy printed 400 copies of the 16-page newsletter (including three inserts), folded, affixed mailing labels and first-class postage (\$0.80 for U.S.) to approximately 300 newsletters mailed on November 30 to people on our mailing list. The total cost of these services was \$1103.33. I mailed additional newsletters to invited speakers and non-member presenters at the 2002 annual meeting.

I sent a report and photos from the weed contest to the newsletter editors for WSSA and SWSS. To publicize the 56th NEWSS annual meeting in January 2002, I sent announcements to newspapers and relevant publications in the Philadelphia area.

SUSTAINING MEMBERSHIP
Carroll M. Moseley

The NEWSS received \$6100 in support of the 2001 summer contest.

Contributions to the 2001 NEWSS Contest University of Connecticut	
BASF	900
Bayer	750
Dow	750
DuPont	500
FMC	1000
Monsanto	1000
Syngenta	1000
Valent	300
Total	\$6100

Twenty one companies submitted sustaining membership funds for 2002 (listed below). This is the same number of members that the NEWSS had in 2001

2002 Sustaining Membership List Northeastern Weed Science Society	
ASPLUNDH Tree Expert Co.	Marbicon, Inc.
Aventis	McConnell Agronomics
BASF	Monsanto
Bayer	PBI Gordon Corp.
Crop Management Strategies, Inc.	Perfection Agronomics
Dow AgroSciences	Sprout-Less Vegetation
DuPont	Syngenta Crop Protection, Inc.
FMC Corporation	Uniroyal Chemical Co.
For-Shore Weed Control	USGA Mid-Atlantic Green Section
Gandy Company	Valent USA Corp.
J. C. Ehrlich Chemical Co.	\$125 per company = \$2625

Eight companies volunteered as coffee break sponsors for the 2002 meeting.

2002 Meeting – Coffee Sponsorship Northeastern Weed Science Society	
BASF	FMC Corp.
Bayer	Monsanto
Dow AgroSciences	Syngenta
DuPont	Valent
	\$200 per company = \$1600

As mergers and other consolidations continue to take place, we will need to evaluate our sustaining membership roster and payment situation.

WSSA
Timothy E. Dutt

As NEWSS Representative to the WSSA, I attended the WSSA annual meeting held February 11-14, 2001 in Greensboro, NC. I assumed my responsibilities by attending the WSSA Board of Directors (BOD) meeting on February 15. I also attended the summer BOD meeting held July 28-30 in Reno, NV. This is a summary of the year's highlights and activities.

2001 Meeting: The meeting in Greensboro went exceptionally well with a program of 247 papers, 97 posters, 6 symposiums, and a special session on New Developments from Industry. Symposiums were on Gene Flow Implications, Dormancy in Weed Seeds, Grower Forum on Sustainable Weed Management, Weed Science Extension and Outreach Methods, Role of Biotechnology in Minor Crops, and Invasive Plant Species. The attendance based on registration numbers totaled 643, which was similar to the previous years meeting in Toronto. A draft of the new WSSA Strategic plan (2001-2005) was made available for membership review at the meeting. The Strategic

Planning Committee utilized the input to revise the plan and present a final draft for BOD review at the summer meeting.

2001 WSSA Board of Directors:

Charlotte Eberlein – President
Brad Majek – President Elect
Al Hammill – Vice President
Dick Oliver – Past President
Laura Whatley – Secretary
Carol Mallory-Smith – Treasurer
Michael Foley – Director of Publications
Leslie Weston – Director of Education
Horace Skipper – Constitution and Operating Procedures Chair
David Shaw – Director-at-Large
Dale Shaner – Director-at-Large
Phil Westra – Director-at-Large
Doug Buhler – Director-at-Large
Greg MacDonald – Aquatic Plant Management Society (APMS) Representative
Robert Blackshaw – Expert Committee on Weeds (ECW - Canada) Representative
Kent Harrison – NCWSS Representative
Tim Dutt – NEWSS Representative
Barry Brecke – SWSS Representative
Steve Miller – WSWS Representative
Rob Hedberg – Director of Science Policy
Joyce Lancaster – Executive Secretary

Board of Directors Summer Meeting: The meeting was held at the Reno Hilton, site of the 2002 annual meeting. The Board participated in leadership training, and then discussed priorities for implementing the new WSSA Strategic Plan. Problems identified were having a clear mission statement and the lack of resources. Key priority areas in the plan were identified as 1.) promoting research with focus on trying to improve funding, 2.) promoting publications with focus on implementing electronic access and identifying avenues for popular/extension type articles, and 3.) promoting education with focus on improving the web site. The Board approved Strategic Plan was placed on the WSSA web site for members to access. The Finance Committee reported the society to be in good shape financially, but annual meeting expenses have been exceeding revenues now for several years. Therefore, the Board approved an increase in meeting registration rates, member dues, and subscription rates for 2002. Program and Local Arrangements committees presented workshop/symposium and tour proposals for the 2002 meeting in Reno. The Board approved several changes in the annual meeting format. LCD projectors will be used for presentations instead of slide projectors. The General Session on Sunday evening will include award presentations followed by an Awards Reception. The traditional Wednesday evening banquet will be replaced by a social event with food, refreshments and entertainment. In addition, meetings will be moved away from traditionally beginning on weekends to a Monday through Thursday schedule starting in 2003. The Director of Publications reported that the next edition of *The Herbicide Handbook* would be completed and available in early 2002. The BioOne site, an on-line research journal articles search vehicle, will also be available to members in early 2002. The Director of Education provided an overview of

the 2002 Invasive Species Workshop, and the proposal for a 2003 Invasive Plant Species Conference was discussed and approved by the Board. A need for a Director of Education mission statement was noted, and that additional development of the web site over the next several years would be necessary to improve the societies educational and outreach efforts. A Web Site Task Force will be appointed to develop recommendations and prepare a proposal for site management by Allen Marketing and Management.

WSSA Future Meeting Sites:

2002 – Reno, NV (February 10-13)

2003 – Jacksonville, FL

2004 – Kansas City, MO

2005 – Honolulu, HI

2006 – The 50th Anniversary Meeting to be held somewhere in the Northeast.

LEGISLATIVE COMMITTEE REPORT

Jerry Baron

Pesticides and the Food Quality Protection Act

- The goals of the new administration in regulating pesticides are partnerships, innovations and results. The key EPA program areas are FQPA implementation, New product (especially Reduced Risk) registrations, methyl bromide alternatives, worker protection, inert labeling and decision on whether human study data should be used in risk assessment.
- EPA has proposed a new mechanism to expediting the review of Experimental Use Permit (EUP's). There are very specific requirements to be considered under this new policy.
- EPA has prepared a Minor Use Report (http://www.epa.gov/opp00001/minoruse/minor_use_rpt.pdf.) The report describes actions taken by EPA to increase communication with minor use stakeholders and expedite registrations for minor use pesticides. To accomplish this, EPA has designated a minor crop advisor and a public health coordinator to increase responsiveness to minor use concerns. The report also describes the coordinated approach between EPA, United States Department of Agriculture (USDA) and the Department of Health and Human Services (DHHS) required by FQPA for dealing with minor use issues.
- EPA is creating opportunities for information sharing and stakeholder involvement in the development of a Critical Use Exemptions(CUE) Program under which methyl bromide (chemical name, bromomethane) may be obtained after the complete phaseout of this conventional pesticide in 2005. The exemption will permit users to obtain methyl bromide if they credibly demonstrate that there will be no technically or economically feasible alternatives available to them by the phaseout date. Applicants will be required to submit information on their current use of methyl bromide and data on the status of alternatives for their crops or end use.
- Due to the events of September 11, the Environmental Protection Agency has

issued an alert to all pesticide industry organizations, facilities, and handlers as a precaution during this heightened state of security awareness. The alert highlights some general security areas that companies may want to review to ensure that appropriate measures are being implemented. EPA's Office of Pesticide Programs has developed this tailored summary of the Agency's Chemical Safety Alert entitled, "Chemical Accident Prevention: Site Security," which outlines measures to ensure secure and accident-free operations. Published in February 2000, the more detailed Chemical Safety Alert is available on the Web at: www.epa.gov/swercepp/p-small.htm#alerts.

- Following up on USDA's issuance of guidance for organic crop and animal production, EPA has issued guidance on the steps required to request and EPA stamp for a label announcing a pest control products compliance with the National Organic Program.

Invasive Plants

- Rep. Joel Hefley (R-Col.), has introduced the "Harmful Nonnative Weed Control Act of 2001" (H.R. 1462) would establish a program to provide financial assistance through the states to eligible weed management entities. The Bill is seeking an authorization of \$100 million annually through 2006 to fight invasive weeds. It is proposed that resources will be used to assist eligible entities in carrying out projects to control or eradicate harmful, nonnative weeds on public or private land, to coordinate projects with existing weed management areas and districts, to stimulate the formation of new local or regional cooperative weed management entities, to leverage additional funds from public and private sources to control or eradicate weeds through local stakeholders, and to promote healthy, diverse and desirable plant communities by abating the treat posed by the invasive weeds.

Farm Bill

- The House Agriculture Committee's 2001 Farm Bill, " The Farm Security Act" (HR 2646) was approved on Friday, October 5, 2001 in a **291 to 120** vote by the U.S. House of Representatives. The House had defeated an earlier attempt to move crop support away from producers. This Bill provides farmers the voluntary choice to update their base acres and adding counter cyclical support based on target prices to the already established 2002 level of transition payments. The bill also allows for enlarged participation for soil and water conservation programs by nearly 80%. There are multiple proposals under consideration in the Senate version. The Senate is expected to take up review of the Farm Bill in early 2002.

Members of the
Northeastern Weed Science Society
As of October 2002

Tim Abbey
The Connecticut Agricultural
Experiment Station
153 Cook Hill Road, PO Box 248
Windsor, CT 06095
Tel: (860) 687-4763
Fax: (860) 683-4987
Email: abbey6@mindspring.com

Michael Agnew
Syngenta Professional Products
302 Rose Glen Lane
Kennett Square, PA 19348
Tel: (610) 444-2063
Fax: (610) 444-2093
Email:
michael.agnew@syngenta.com

John Ahrens
Conn. Ag. Exp. Station (former)
PO Box 248
Windsor, CT 06095
Tel: (860) 683-4985
Fax: (860) 683-4987
Email: jpahrens@worldnet.att.net

Jennifer Allaire
Cornell University
Horticulture Department
20 Plant Sciences Bldg
Ithaca, NY 14853
Tel: (607) 387-6410
Fax: (607) 255-9998

Greg Armel
ESAREC - Virginia Polytechnic
Institute
33446 Research Drive
Painter, VA 23420
Tel: (757) 414-0724
Fax: (757) 414-0730
Email: garmel@vt.edu

Marija Arsenovic
IR-4 Project, Center for Minor Crop
Pest Mgmt
681 US Highway No 1, South
North Brunswick, NJ 08902-3390
Tel: (732) 932-9575
Fax: (732) 932-8481
Email: arsenovic@actb.rutgers.edu

James Ashley
Ashgrow Crop Management
11913 Simsbury Place
Glen Allen, VA 23059
Tel: (804) 747-7148
Fax: (804) 747-7249
Email: jeashley@ashgrow.com

Richard Ashley
University of Connecticut
Dept. of Plant Science, Unit 4067
Storrs, CT 06269-4067
Tel: (860) 486-3438
Fax: (860) 486-0682
Email: richard.ashley@uconn.edu

Shawn Askew
Virginia Polytechnic Institute
Glade Road Research Facility
Box 0330
Blacksburg, VA 24061-0330
Tel: (540) 231-5807
Email: saskew@vt.edu

David Austin
PBI / Gordon Corp.
PO Box 014090
Kansas City, MO 64101-0090
Tel: (816) 421-4070
Fax: (816) 460-3781
Email: daustin@pbigarden.com

Albert Ayeni
Rutgers University
RAREC
121 Northville Road
Bridgton, NJ 08302
Tel: (856) 455-3100
Fax: (856) 455-3133
Email: ayeni@aesop.rutgers.com

Richard Bailey
Fallbrook Research Group
16049 Robinson Road
Plain City, OH 43064
Tel: (614) 873-5449
Fax: (614) 873-2348
Email: rbaileyconsult@cs.com

William Bailey
Virginia Polytechnic Institute -
Eastern Shore Area
33446 Research Drive
33446 Research Dr.
Painter, VA 23420-2826
Tel: (757) 414-0724
Fax: (757) 414-0730
Email: wabailey@vt.edu

Jacob Barney
Cornell University
20 Plant Sciences Bldg
Horticulture Department
Ithaca, NY 14853
Tel: (607) 255-0884
Fax: (607) 255-9998

Jerry Baron
Cook College / New Jersey Ag. Exp.
Station
Rutgers University
88 Lipman Drive
N. Brunswick, NJ 08902-3390
Tel: 732-932-9000x501
Fax: 732-932-8481
Email: jbaron@aesop.rutgers.edu

Rick Bates
Penn State University
303 Tyson Bldg
1 Dept. of Horticulture
University Park, PA 16802
Tel: (814) 863-2198
Fax: (814) 863-6139
Email: rmb30@psu.edu

Josh Beam
Virginia Polytechnic Institute
0330 Glade Road Research Facility
Blacksburg, VA 24061-0330
Tel: (540) 231-5807
Email: jbeam@vt.edu

Ted Bean
Valent USA Corporation
PO Box 309
Franklin, PA 16323
Tel: (814) 432-2349
Fax: (814) 437-0717
Email: ted.bean@valent.com

Chris Becker
BASF Corp
6374 Rt 89
Romulus, NY 14541
Tel: (607) 869-9511
Fax: (607) 869-9515
Email: beckerc@basf.com

Robin Bellinder
Cornell University
Dept. of Horticulture
164 Plant Science Bldg
Ithaca, NY 14853
Tel: (607) 255-7890
Fax: (607) 255-0599
Email: rrh3@cornell.edu

Diane Benoit
Agriculture & AgroAlimentaire Canada
430 Govin Blvd
Saint-Jean-sur-Richelieu, Quebec J3B
3E6 Canada
Tel: (450) 346-4494
Fax: (450) 346-7740
Email: benoitdl@em.agr.ca

**Members of the
Northeastern Weed Science Society
As of October 2002**

Wayne Berman
Cornell University
49C Plant Sciences Bldg
Horticulture Department
Ithaca, NY 14853
Tel: (607) 387-6410
Fax: (607) 255-9998
Email: wmb22@cornell.edu

Dana Berner
USDA ARS FDWSRU
1301 Ditto Avenue
Fort Detrick, MD 21702
Tel: (301) 619-7316
Fax: (301) 619-2880
Email: d.berner@fdwsr.ars.usda.gov

Cecile Bertin
Cornell University, Horticulture Dept.
20 Plant Sciences Bldg
Ithaca, NY 14853
Tel: (607) 387-6410
Fax: (607) 255-9998
Email: cb97@cornell.edu

C. Edward Beste
University of Maryland
27664 Nanticoke Road
Salisbury, MD 21801
Tel: (410) 742-8788
Fax: (410) 742-1922
Email: cb20@umail.umd.edu

Prasanta Bhowmik
University of Massachusetts -
Amherst
Stockbridge Hall Box 37245
Plant & Soil Sciences
Amherst, MA 01003-7245
Tel: (413) 545-5223
Fax: (413) 545-3958
Email: pbhowmik@pssa.umass.edu

Clifford Blessing
Delaware Dept. of Agriculture
2320 S. Dupont Highway
Dover, DE 19901-5515
Tel: (302) 698-4500
Fax: (302) 698-4468
Email: Paul.Blessing@state.de.us

Cynthia Boettner
Silvio O Conte National Fish &
Wildlife Refuge
38 Avenue A
Turners Falls, MA 01376
Tel: (413) 863-0209
Fax: (413) 863-3070
Email: cynthia_boettner@fws.gov

A. Richard Bonanno
University of Massachusetts
255 Merrimack Street
Methuen, MA 01844
Tel: (978) 682-9563
Fax: (978) 685-6691
Email: rbonanno@umext.umass.edu

Jeffrey Borger
Valentine Turf Grass Research Ctr.
University Drive Extension
University Park, PA 16802
Tel: (814) 865-3005
Fax: (814) 863-1613
Email: jab267@psu.edu

Kevin Bradley
Virginia Polytechnic Institute
Dept. of Plant Path., Phys., & Weed
Science
Glade Road Research Center
Blacksburg, VA 24060
Tel: (540) 231-2463
Email: kebradle@vt.edu

Daniel Brainard
Cornell University
155 Plant Sciences Bldg
Horticulture Department
Ithaca, NY 14853
Tel: (607) 273-9495
Email: dcb15@cornell.edu

Melissa Bravo
Penn State University
RD5 Box 17A
Wellsboro, PA 16901
Tel: (570) 723-8429

William Bruckart
USDA-ARS-FDWSRU
1301 Ditto Avenue
Ft. Detrick, MD 21702
Tel: 301-619-2846
Fax: 301-619-2880
Email: bruckart@asrr.arsusda.gov

Michael Burton
NCSU Crop Science Dept.
Campus Box 7620
Raleigh, NC 27695
Tel: (919) 513-2860
Fax: (919) 515-5315
Email: mike_burton@ncsu.edu

Nancy Cain
Cain Vegetation Inc.
5 Kingham Road
Acton, ON L7J 1S3
Canada
Tel: (519) 853-3081
Fax: (519) 853-1395
Email: cainvegetation@sympatico.ca

J. Boyd Carey
Monsanto
800 North Lindbergh Blvd-F2EA
St. Louis, MO 63167
Tel: (314) 694-8684
Fax: (314) 694-4249
Email: boyd.j.carey@monsanto.com

Luke Case
Ohio State University
2001 Fyffe CT
Columbus, OH 43210
Tel: (614) 292-0209
Fax: (614) 292-3505
Email: case.49@osu.edu

Rakesh Chandran
West Virginia University
1076 Agricultural Sciences Bldg
Morgantown, WV 26506
Tel: (304) 293-6131
Fax: (304) 293-6954
Email: rschandran@mail.wvu.edu

Ken Chisholm
Nichino America
4550 New Linden Hill Road, Suite 501
Wilmington, DE 19808
Tel: (302) 636-9001
Fax: (302) 636-9122
Email: kchiz@nichino.net

William Chism
EPA
PO Box 258
Point of Rocks, MD 21777
Tel: (301) 874-6390
Fax: (301) 874-6380
Email: foxtail-farm@mindspring.com

Brian Clark
116 ASI
University Park, PA 16802
Tel: (814) 863-7607
Fax:
Email: bic159@psu.edu

Members of the
Northeastern Weed Science Society
As of October 2002

Benjamin Coffman
USDA-ARS
10300 Baltimore Blvd
Bldg 001 Rm 124
Beltsville, MD 20705
Tel: (301) 504-5398
Fax: (301) 504-6491
Email: coffmanc@ba.ars.usda.gov

John Cranmer
Valent USA Corporation
110 Iowa Lane
Suite 201
Cary, NC 27511-2400
Tel: (919) 467-6293
Fax: (919) 481-3599
Email: jcran@valent.com

William Curran
Penn State University, 116 ASI
Dept. Crop & Soil Sciences
University Park, PA 16802
Tel: (814) 863-1014
Fax: (814) 863-7043
Email: wsc2@psu.edu

Mark Czarnota
University of Georgia
1109 Experiment Street
Griffin, GA 30223
Tel: (770) 228-7398
Fax: (770) 412-4764
Email: mac@griffin.peachnet.edu

Jeffery Darden
NCSU, Dept. Horticulture Science
Box 7609 Dept of Horticulture
Science
Raleigh, NC 27695-7609
Tel: (919) 515-7747

Paul David
Gowan Company
343 Rumford Road
Lititz, PA 17543
Tel: 717-560-8352
Fax: 717-560-9796
Email: pdavid@gowanco.com

Todd Davis
Delaware Dept. of Agriculture
2320 S. Dupont Highway
Dover, DE 19901-5515
Tel: (302) 698-4500
Fax: (302) 698-4468
Email: todd@dda.state.de.us

Stephan Dennis
Syngenta Ag Products
6105 Bay Hill Circle
Jamesville, NY 13078
Tel: (716) 385-5621
Fax: (716) 385-2764
Email: Steve.Dennis@syngenta.com

Peter Dernoeden
University of Maryland
Dept. of Natural Resource Sciences
& LA
1112 H.J. Petersen Hall
College Park, MD 20742
Tel: (301) 405-1337
Fax: (301) 314-9041
Email: pdg@umail.umd.edu

Jeffrey Derr
Virginia Polytechnic Institute
Hampton Roads AREC
1444 Diamond Springs Road
Virginia Beach, VA 23455
Tel: (757) 363-3912
Fax: (757) 363-3950
Email: jderr@vt.edu

Robert Devlin
University of Massachusetts
Cranberry Experiment Station
Box 569
East Wareham, MA 02538
Tel: 508-295-2213
Fax: 508-295-6387
Email: rdevlin@umext.umass.edu

Robert DeWaine
Monsanto
505 W. Noyes Blvd
Sherrill, NY 13461
Tel: (315) 363-3903
Fax: (315) 363-3903
Email: bob.dewaine@monsanto.com

Antonio DiTommaso
Cornell University
903 Bradfield Hall
Dept. of Crop & Soil Sciences
Ithaca, NY 14853
Tel: (607) 254-4702
Fax: (607) 255-8615
Email: ad97@cornell.edu

John Dobson
American Cyanamid (Retired)
2815 Lake Road
Williamson, NY 14589
Tel: (315) 589-8940
Email: crispjack@aol.com

Richard Dunst
Cornell University
Vineyard Research Lab
412 East Main Street
Fredonia, NY 14063
Tel: (716) 672-6464
Fax: (716) 679-3122
Email: rmof@cornell.edu

Tim Durham
Deer Run Farm
35 Bieselin Road
Bellport, NY 11713
Tel: 631-286-2584
Email: tcd8@cornell.edu

Timothy Dutt
Monsanto Company
8482 Redhaven Street
Fogelsville, PA 18051
Tel: (610) 285-2006
Fax: (610) 285-2007
Email: timothy.e.dutt@monsanto.com

Donna Ellis
University of Connecticut
Dept. of Plant Science-Unit 4163
Storrs, CT 06269
Tel: (860) 486-6448
Fax: (860) 486-0534
Email: donna.ellis@uconn.edu

Michael Elston
University of Massachusetts - Amherst
11 Colrain Street
Greenfield, MA 01301
Tel: (413) 775-0055
Email: gmelston@pssci.umass.edu

Seok Eom
Cornell University
20 Plant Sciences Bldg
Horticulture Department
Ithaca, NY 14853
Email: se43@cornell.edu

Jason Fausey
Valent USA Corp.
Office Park West
530 South Creyts, Suit C
Lansing, MI 48917
Tel: 517-321-7380
Fax: 577-321-7216
Email: jason.fausey@valent.com

Stanford Fertig, (Retired)
Rutgers University
16919 Melbourne Drive
Laurel, MD 20707
Tel: 301-776-2527

Members of the
Northeastern Weed Science Society
As of October 2002

Mike Fidanza
Penn State University
Berks Campus
Tulpehocken Road
Reading, PA 19610
Tel: (610) 396-6330
Fax: (610) 396-6024
Email: maf100@psu.edu

Michael Fleming
BASF Corporation
536 Wood View Drive
Lititz, PA 17543
Tel: (717) 627-0661
Fax: (717) 626-1827
Email: fleminma@basf.com

J. Ray Frank
IR-4
6916 Boyers Mill Road
New Market, MD 21774
Tel: (301) 898-5332
Fax: (301) 898-5937

Jim Gaffney
BASF
3206 Co Road 1100 North
Seymour, IL 61875
Tel: (217) 687-4156
Fax: (217) 687-4157
Email: gaffneyj@basf.com

Donald Ganske
DuPont Co.
125 Cotton Ridge Road
Winchester, VA 22603
Tel: (540) 662-6011
Fax: (540) 662-6011
Email:
donald.d.ganske@usa.dupont.com

Scott Glenn
University of Maryland
Natural Resources Sciences Dept
0115 HJ Patterson Hall
College Park, MD 20742
Tel: 301-405-1331
Fax: 301-314-9041
Email: dg11@umail.umd.edu

Art Gover
Penn State University
Landscape Management Res Ctr
Orchard Road
University Park, PA 16802
Tel: 814-863-1184
Fax: 814-863-1184
Email: aeg2@psu.edu

James Graham
12381 Country Glen Lane
Creve Coeur, MO 63141-7438
Tel: 314-878-9815
Fax: 314-469-5951
Email: jgraham@i1.net

Art Graves
2237 West Fulton Road
Warnerville, NY 12187
Tel: (518) 673-3053
Email: gravesas@cobleskill.edu

Scott Guiser
Penn State University
Bucks County Cooperative Ext.
1282 Almshouse Road
Doylestown, PA 18901
Tel: (215) 345-3283
Fax: (215) 343-1653
Email: sxq6@psu.edu

Howard Guscar
FMC Corporation - APG
4270 W. Charleston
Tipp City, OH 45371
Tel: 937-667-5162
Fax: 937-667-5939
Email: howard_guscar@fmc.com

Todd Hagenbuch
Alenza
100 North Conahan Drive
Hazelton, PA 18201
Tel: (570) 459-5048
Fax: (570) 459-5500
Email: thagenbuch@dbiservices.com

Russell Hahn
Cornell University
SCAS
147 Emerson Hall
Ithaca, NY 14853
Tel: 607-255-1759
Fax: 607-255-6143
Email: rrh4@cornell.edu

Jim Haldeman
Monsanto
269 Pine View Lane
York, PA 17403
Tel: (717) 474-9923
Fax: (717) 747-9844
Email:
jim.haldeman@monsanto.com

Kevin Handwerk
116 ASI Bldg
University Park, PA 16802
Tel: (814) 865-2242
Fax: (814) 863-7043
Email: kxh136@psu.edu

Ralph Hansen
Longwood Gardens
2304 Marlyn Drive
Wilmington, DE 19808
Tel: 302-994-1843

Tracey Harpster
Penn State University
102 Tyson Road
University Park, PA 16802
Tel: (814) 865-3190
Fax: (814) 863-6139
Email: tlh8@psu.edu

Scott Harrison
Consultant
2223 Marengo Road
Warriors Mark, PA 16877
Tel: (814) 692-7353
Fax: (814) 692-4881
Email: saharris1@earthlink.net

Stephen Hart
Rutgers University
Plant Science Dept. Furan Hall
59 Dudley Road
New Brunswick, NJ 08901
Tel: 732-932-9711X166
Fax: 732-932-9441
Email: hart@aesop.rutgers.edu

Brian Hearn
University of Delaware
23127 Asbury Road
Georgetown, DE 19947
Tel: 302-856-1997
Fax: 302-856-1994
Email: bhearn@udel.edu

Robert Hedberg
National & Regional Weed Science
Societies
Director of Science Policy
900 Second Street, N.E., Suite 205
Washington, DC 20002
Tel: 202-408-5388
Fax: 202-408-5385
Email: robhedberg@erols.com

Members of the
Northeastern Weed Science Society
As of October 2002

David Heering
Monsanto Company
800 N. Lindbergh Blvd. C35F
St. Louis, MO 63167
Tel: (314) 694-6698
Fax: (314) 694-2687
Email:
david.c.heering@monsanto.com

Lane Heimer
Maryland Dept. of Agriculture, Weed
Control
50 Harry S. Truman Parkway
Annapolis, MD 21401
Tel: (410) 841-5920
Fax: (410) 841-5835
Email: notfoot60@aol.com

Gerald Henry
Rutgers University
59 Dudley Road
New Brunswick, NJ 08816
Tel: (732) 932-9711
Email: gmh26@eden.rutgers.edu

Robert Herrick
United Agri Products
11 Wolfpack Court
Hamilton, NJ 08619-1156
Tel: (609) 586-8843
Fax: (609) 586-6252
Email: bob.herrick@uap.com

Edward Higgins
Syngenta
3511 Normandy Hills Circle
Greensboro, NC 27410
Tel: 336-632-2043
Fax: 336-547-0632
Email: ed.higgins@syngenta.com

Gideon Hill
6634 N. Seedescorb Dr.
Fresno, CA 93711
Tel: (559) 261-9637

Frank Himmelstein
University of Connecticut, Storrs
24 Hyde Avenue
Cooperative Extension System
Vernon, CT 06066
Tel: 860-870-6932
Fax: 860-875-0220
Email:
fhimmels@canr1.cag.uconn.edu

Thomas Hines
Eastern Shore AREC VPI/SU
33446 Research Drive
Painter, VA 23420
Tel: (757) 414-0724
Fax: (757) 414-0730
Email: thhines@vt.edu

Leslie Huffman
Ontario Ministry of Agriculture,
Research Center
2585 Country Road 20
Harrow, ON N0R 1G0 CANADA
Tel: 519-738-2251x499
Fax: 519-738-4564
Email:
leslie.huffman@omafra.gov.on.ca

Richard Ilnicke
Rutgers University
403 Georges Rd
Dayton, NJ 08810
Tel: 732-329-2858

Mark Isaacs
University of Delaware
Research & Education Center
RD 6, Box 48
Georgetown, DE 19947
Tel: 302-856-1997
Fax: 302-856-1994
Email: isaacs@udel.edu

John Isgrigg III
Bayer Professional Care
12001 Hadden Hall Drive
Chesterfield, VA 23838
Tel: (804) 796-5982
Fax: (804) 796-5986
Email: trey.isgrigg.8@bayer.com

Jerry A. Ivany
Agriculture & Agri-Food Canada
Crops & Livestock Research Centre
440 University Avenue
Charlottetown, PEI C1A 4N6 Canada
Tel: (902) 566-6835
Fax: (902) 566-6821
Email: ivanyj@em.agr.ca

John Jemison
University of Maine Cooperative
Extension
495 College Avenue
Orono, ME 04473-1294
Tel: 207-581-3241
Fax: 207-581-1301
Email: jjemison@umext.maine.edu

Quintin Johnson
University of Delaware
Research & Education Center
16684 County Seat Hwy
Georgetown, DE 19947
Tel: (302) 856-7303
Fax: (302) 856-1845
Email: quintin@udel.edu

Roy Johnson
Waldrum Specialties, Inc.
4050A Skyron Drive
Doylestown, PA 18901
Tel: (215) 348-5535
Fax: (215) 348-5541
Email: rjoh834880@aol.com

Jon Johnson
Penn State University
Landscape Mgmt. Research Center
Orchard Road
University Park, PA 16802
Tel: 814-863-1184
Fax: 814-863-1184
Email: jmj5@psu.edu

Grant Jordan
A.C.D.S. Research, Inc.
9813 Glenmark Road
North Rose, NY 14516
Tel: (315) 587-2140
Fax: (315) 587-2145
Email: acdsgj@computer-conntion.net

Caren Judge
North Carolina State University
Box 7609
Raleigh, NC 27695-7609
Tel: (919) 515-3178
Fax: (919) 515-2505
Email: cuschmid@nity.ncsu.edu

Kathie Kalmowitz
BASF Corporation
26 Davis Drive
Research Triangle Park, NC 27709
Tel: (919) 547-2642
Email: kalmowk@basf.com

Gordon Kauffman III
Penn State University
116 ASI Building
University Park, PA 17522
Tel: (814) 863-7607

Members of the
Northeastern Weed Science Society
As of October 2002

Renee Keese
Syngenta
985 Arrowwood Drive
Carmel, IN 46033
Tel: (317) 846-8812
Fax: (317) 846-8832
Email: renee.keese@syngenta.com

Larry Kuhns
Penn State University
103 Tyson Bldg
University Park, PA 16803
Tel: (814) 863-2197
Fax: (814) 863-6139
Email: lj@psu.edu

Kerrie Kyde
ARS-USDA
1301 Ditto Avenue
Ft. Detrick, MD 21702
Tel: 3016197211
Email: kkylde@naa.ars.usda.gov

Brent Lackey
Syngenta Crop Protection
6128 Eddy Ridge Road
Williamson, NY 14589
Tel: (315) 589-4880
Fax: (315) 589-4999
Email: brent.lackey@syngenta.com

David Lamore
Aventis Crop Service
107 Sunrise Lane
Bryan, OH 43506
Tel: (419) 630-0138
Fax: (419) 630-0449
Email: david.lamore@aventis.com

Scott Lawson
Syngenta Crop Protection
410 Swing Road
Greensboro, NC 27409
Tel: (336) 632-6345
Fax: (336) 632-6950

Dwight Lingenfelter
Penn State University
Dept. of Crop & Soil Sciences
116 ASI Bldg
University Park, PA 16802
Tel: (814) 865-2242
Fax: (814) 863-7043
Email: dxl18@psu.edu

Dean Linscott
USDA-ARS/Cornell University
179 Lexington Drive
Ithaca, NY 14850
Tel: 607-257-5984

Henry Lohmann
PO Box 22
Bellport, NY 1173-0022
Tel: (631) 286-1078

Daniel Loughner
Dow AgroSciences, LLC
497 Leonard Road
Huntington Valley, PA 19006
Tel: (215) 947-0721
Fax: (215) 947-1921
Email: dloughner@dowagro.com

Edith Lurvey
IR-4, Food Science - NYSAES
630 West North St.
Geneva, NY 14456
Tel: (315) 787-2308
Fax: (315) 787-2397

Darren Lycan
Rutgers University
Plant & Science Dept.
59 Dudley Road, Foran Hall
New Brunswick, NJ 08879
Tel: 732-932-9711 EXT 116
Fax: 732-932-9441
Email: lycan@aesop.rutgers.edu

Matthew Mahoney
Bayer Corporation
4773 Sailers Retreat Road
Oxford, MD 21654
Tel: (410) 822-5215
Fax: (410) 819-0286
Email: matt.mahone.b@bayer.com

Brad Majek
Rutger University
Rutgers A.R.E.C.
121 Northville Road
Bridgeton, NJ 08302
Tel: (856) 455-3100
Fax: (856) 455-3133
Email: majek@aesop.rutgers.edu

Brian Manley
Syngenta Crop Protection
Eastern Regional Technical Center
67 Pinewood Road
Hudson, NY 12534
Tel: 518-851-2122
Fax: 518-851-9790
Email: brian.manley@syngenta.com

Betty Marose
University of Maryland
Dept. of Entomology
3140 Plant Science Bldg
College Park, MD 20742
Tel: 301-405-3929
Fax: 301-314-9290
Email: bm7@umail.umd.edu

Richard Marrese
Consultant
101 Haverhill Place
Somerset, NJ 08873-4773
Tel: 732-271-8619
Fax: 732-563-0003

Hannah Mathers
The Ohio State University
2001 Fyffe Ct., 248C Howlett Hall
Columbus, OH 43210
Tel: (614) 247-6195
Fax: (614) 292-3505
Email: mathers.7@osu.edu

David Mayonado
Monsanto Company
6075 Westbrooke Drive
Salisbury, MD 21801
Tel: 410-726-4222
Fax: 410-219-3202
Email: david.j.mayonado@monsanto.com

Maxwell McCormack
PO Box 644
Deer Isle, ME 04627-0644
Tel: 207-348-5243
Fax: 207-348-2818
Email: maxweldime@aol.com

Hiwot Menbere
University of Maryland
H.J. Paterson Hall Rm 1112
College Park, MD 20742
Tel: 301-405-1334
Fax: 301-314-9041
Email: hm22@umail.umd.edu

Todd Mervosh
Connecticut Ag. Exp. Station
PO Box 248
153 Cook Hill Road
Windsor, CT 06095
Tel: 860-683-4984
Fax: 860-683-4987
Email: tmervosh@caes.state.ct.us

Members of the
Northeastern Weed Science Society
As of October 2002

David Messersmith
Penn State University
925 Court Street
Honesdale, PA 18431-1996
Tel: 570-253-5970
Fax: 570-253-9478
Email: dtm101@psu.edu

Ivan V. Morozov
Virginia Polytechnic
410 Price Hall
Blacksburg, VA 24061-0331
Tel: 540-231-7176
Fax: 540-231-7477
Email: imorozov@vt.edu

David Mortensen
Pennsylvania State University
Department of Crop and Soil
Sciences
215 ASI Building
University Park, PA 16802
Tel: 814-865-1906
Fax: 814-836-74003
Email: dmortensen@psu.edu

Carroll Moseley
Syngenta
PO Box 18300
Greensboro, NC 27419
Tel: 336-632-7754
Fax: (336) 632-7837
Email:
carroll.moseley@syngenta.com

Wilbur Mountain
Pennsylvania Dept. of Agriculture
2301 N. Cameron Street
Harrisburg, PA 17110
Tel: 717-772-5209
Fax: 717-783-3275
Email: wmountain@state.pa.us

Aboud Mubareka
Sprout-Less Vegetation Control
Systems
1125 Power Road
St. Joseph de Madawaska, NB E7B
2M3 CANADA
Tel: 506-739-6447
Fax: 506-735-7033
Email: samco@nbnet.nb.ca

Chris Munsterman
Syngenta Crop Protection
102 Larkspur Lane
Martinsburg, WV 25401
Tel: (304) 754-6247
Email:
chris-munsterman@syngenta.com

Matt Myers
Penn State University
Dept. of Agronomy
116 ASI Bldg
University Park, PA 16802
Tel: (814) 867-6172
Fax: (814) 863-7043
Email: mwm133@hotmail.com

Joseph Neal
North Carolina State University
Dept. of Horticultural Sci., Nox 7609
Raleigh, NC 27695-7609
Tel: 919-515-9379
Fax: 919-515-7747
Email: joe_neal@ncsu.edu

C. David Nelson
Penn DOT 2-0
1924 Daisy Street
Clearfield, PA 16830
Tel: (814) 765-0409
Email: nelsonc@state.pa.us

Larry Norton
Aventis - Chipco
739 Blair Road
Bethlehem, PA 18017
Tel: (610) 814-6220
Fax: (610) 814-6221
Email: larry.norton@aventis.com

Robert Nurse
Cornell University
Dept. of Crops & Soil Sciences
901 Bradfield Hall
Ithaca, NY 14850
Tel: 607-255-4747
Email: ren8@cornell.edu

Brian Olson
Dow AgroSciences LLC
PO Box 753
Geneva, NY 14456-0753
Tel: 315-781-0140
Fax: 315-781-0387
Email: bdolson@dowagro.com

Brian Oneill
Weeds Inc.
250 Bodley Road
Aston, PA 19014
Tel: (610) 358-9430
Fax: (610) 358-9438

Marc Pacchioli
Crop Management Strategies, Inc.
PO Box 510
Hereford, PA 18056
Tel: 610-767-1944
Fax: 610-767-1925
Email: cms1@fast.net

Eric Palmer
Syngenta
67 Pinewood Road
Hudson, NY 12534
Tel: (518) 851-2122
Fax: (518) 851-9790
Email: eric.palmer@syngenta.com

Philip Pannill
Maryland Dept. of Natural Resources
Forest Service
1260 Maryland Avenue
Hagerstown, MD 21740
Tel: (301) 791-4010
Email: ppannill@dnr.state.md.us

Brad Park
Penn State University
116 ASI Building
University Park, PA 16802
Tel: (814) 466-3443
Email: bsp109@psu.edu

James Parochetti
USDA-CSREES, Mail Stop 2220
14th & Independence Avenue
Washington, DC 20250-2220
Tel: 202-401-4354
Fax: 202-401-4888
Email: jparochetti@reeusda.gov

Annamarie Pennucci
Northeast Turf & Ornamental
Research
4 Englewood Drive
Raymond, NH 03077
Tel: 603-895-8480
Fax: 603-672-6332

Robert Peters (Retired)
Connecticut University
238 Maple Road
Storrs, CT 06268
Tel: 860-429-4065

Florence Peterson
USDA Forest Service
PO Box 640
Durham, NH 03824
Tel: 603-868-7714
Fax: 603-868-7604
Email: fpeterson@fs.fed.us

**Members of the
Northeastern Weed Science Society
As of October 2002**

Ross Phillips
J.C. Ehrlich Chemical Company, Inc.
500 Spring Ridge Drive
Reading, PA 19612-3848
Tel: 610-372-9700 X 239
Fax: 610-378-9744
Email: ross.phillips@jcehrlich.com

Randall Probstak
University of Massachusetts
Dept. of Plant & Soil Sciences
French Hall
Amherst, MA 01033
Tel: 413-577-1738
Fax: 413-545-3075
Email: rprobstak@pssci.umass.edu

Stanley Pruss
ARMS, Inc.
443 Moniger Road
Washington, PA 15301
Tel: 724-222-4831
Fax: 724-222-9347
Email: stan@wped.com

Randy Ratliff
Syngenta Crop Protection, Inc.
PO Box 18300
Greensboro, NC 27419
Tel: (336) 632-2549
Fax: (336) 632-6950
Email: randy.ratliff@syngenta.com

Robert Richardson
Virginia Polytechnic Institute Eastern
Shore AREC
33446 Research Drive
Painter, VA 23420
Tel: 757-414-0724
Fax: 757-414-0724
Email: roricher@vt.edu

Susan Rick
DuPont
2021 Gardenbrook Drive
Raleigh, NC 27606
Tel: (919) 854-0806
Fax: (919) 854-0806
Email: susan.k.rick@usa.dupont.com

Domingo Riego
Monsanto Company
1307 Cottonwood Ct
Carmel, IN 46033
Tel: (317) 575-8769
Fax: (317) 574-9157
Email:
domingo.c.riego@monsanto.com

Ronald Ritter
University of Maryland
12901 North Point Lane
Laurel, MD 20708-2343
Tel: 301-405-1329
Fax: 301-405-3754
Email: rr24@umail.umd.edu

Don Robbins
Maryland Dept. of Agriculture
50 Harry S. Truman Parkway
Annapolis, MD 21401
Tel: (410) 841-5920
Fax: (410) 841-5835
Email: robbindr@mda.state.md.us

Bridget Robinson
North Carolina State University
Crop Science Department
Box 7620
Raleigh, NC 27695-7620
Tel: (919) 515-5654
Email: big_robinb@hotmail.com

Joe Rodrigues
Harris Agriscience and Tech Ctr
Huckleberry Lane
Bloomfield, CT
Tel: 860-242-0331
Email: jrod1@carthlink.net

David Ross
Syngenta Professional Products
41- Swing Road
Greensboro, NC 27409
Tel: (336) 632-6411
Fax: (302) 698-1638
Email: david.ross@syngenta.com

John Roy
RWC, Inc.
PO Box 876
248 Lockhouse Rd
Westfield, MA 01085
Tel: 413-562-5681
Fax: 413-568-5584

James Saik
Perfection Agronomics Consulting
Services
15 South Wayne Street
Phelps, NY 14532
Tel: (315) 548-7607
Fax: (315) 548-7607
Email: saikj@aol.com

Sujatha Sankula
NCFAP
1616 P Street NW 1st Flr
Washington, DC 20036
Tel: (202) 328-5057
Fax: (202) 328-5133
Email: sankula@ncfap.org

Rick Schmenk
Syngenta Crop Protection, Inc.
14 Baldwin Drive
Lancaster, PA 17602-1643
Tel: 717-464-9660
Fax: 717-464-9715
Email: rick.schmenk@syngenta.com

M. G. Schnappinger
930 Starr Road
Centreville, MD 21617
Tel: 410-758-1419
Fax: 410-758-0656
Email: schnappg@toadmail.com

William Sciarappa
Rutgers University
Cooperative Extension
20 Court Street
Freehold, NJ 07728
Tel: 732-431-7260
Fax: (732) 431-4813
Email: sciarappa@aesop.rutgers.edu

Rene Scoresby
The Scotts Company
1411 Scottslawn Road
Marysville, OH 43041
Tel: 937-644-7563
Fax: 937-644-7153
Email: rene.scoresby@scottscsco.com

Barbara Scott
University of Delaware
Research & Education Center
16684 County Seat Hwy
Georgetown, DE 19947
Tel: 302-856-7303
Fax: 302-856-1845
Email: bascoh@udel.edu

Leroy Sellman
Maryland Dept. of Agriculture
50 Harry S. Truman Parkway
Annapolis, MD 21401
Tel: (410) 841-5920

Members of the
Northeastern Weed Science Society
As of October 2002

Jim Sellmer
Penn State University
Dept. of Horticulture
102 Tyson Bldg
University Park, PA 16802
Tel: (814) 863-2250
Fax: (814) 363-6139
Email: jcs32@psu.edu

Andrew Senesac
Cornell Cooperative Extension
Long Island Hort. Res. Lab
3059 Sound Avenue
Riverhead, NY 11901
Tel: 631-727-3595
Fax: 631-727-3611
Email: afs2@cornell.edu

Sandra Shinn
Syngenta
67 Pinewood Road
Hudson, NY 12534
Tel: (518) 851-2122
Fax: (518) 851-9790
Email: sandra.shinn@syngenta.com

Edward Skurkay
Monsanto Co.
219 Constance Drive
McKees Rocks, PA 15136
Tel: 412-788-4950
Fax: 412-788-4960

Mark Smith
Maryland Dept. of Agriculture
50 Harry S. Truman Parkway
Annapolis, MD 21401
Tel: (410) 841-5920
Fax: (410) 841-5835
Email: www.mda.state.md.us

Catherine Smith
383 Olde House Lane
Media, PA 19063
Tel: (610) 565-0382
Email: catheris@mindspring.com

Dan Smith
Syngenta Crop Protection
21 Chatham Drive
Bedford, NH 03110
Tel: (603) 582-8135
Fax: (603) 759-6627
Email: dan.smith@syngenta.com

David Spak
Aventis Environmental Science
113 Willow Ridge
New Holland, PA 17557
Tel: 717-355-2822
Fax: 717-355-0990
Email: david.spak@aventis.com

Neal Spencer
USDA - Agriculture Research Service
Plant Soil & Nutrition Lab
Tower Road
Ithaca, NY 14853
Tel: (607) 255-2179
Fax: (607) 255-2459
Email: nrs23@cornell.edu

Paul Stachowski
Cornell University
Dept. of CSS, Leland Field House
Caldwell Road
Ithaca, NY 14853
Tel: 607-255-7701
Fax: 607-255-6143
Email: pjs16@cornell.edu

Richard Stalter
St. John's University
Dept. of Biology
8000 Utopia Parkway
Jamaica, NY 11439
Tel: 718-990-6288
Fax: 718-990-5958
Email: biosju@stjohns.edu

James Steffel
LABServices
342 South Third Street
Hamburg, PA 19526
Tel: 610-562-5055
Fax: 610-562-5066
Email: labs@labservices.com

Jennifer Stingelin-Keefer
Pennsylvania State University
248 Toftrees Ave.
Apt. 108
State College, PA 16803
Tel: (814) 867-6242
Email: jls227@psu.edu

Amy Suggars
Trugreen Chemlawn
135 Winter Road
Delaware, OH 43015
Tel: 740-548-7330
Fax: 740-548-4860
Email: amysuggars@trugreen.mail

Robert Sweet
Cornell Univ. (Retired)
Dept. of Fruit and Vegetable Science
167 Plant Science Bldg.
Ithaca, NY 14853
Tel: 607-255-5428
Fax: 607-255-0599

Raymond Taylorson
University of Rhode Island
Department of Plant Sciences
Kingston, RI 02881
Tel: 401-874-2106
Fax: (401) 874-2494
Email: rtaylorson@aol.com

Gar Thomas
BASF
1002 Bethel Road
Chesapeake City, MD 21915
Tel: 410-885-5920
Fax: 410-885-5975
Email: thomasgig@basf.com

Prescott Towle
9 Meadow Lark Lane
Epsom, NH 03234
Tel: 603-736-6045
Fax: 603-736-6046
Email: sprays@metrocast.met

Brian Trader
Virginia Polytechnic Institute
VA Tech
836 Clayton Square
Blacksburg, VA 24060
Tel: 540-552-7663
Email: btrader@vt.edu

Tateshi Tsujikawa
NISSO America Inc.
220 East 42nd Street, Suite 3002
New York, NY 10017
Tel: 212-490-0350
Fax: 212-972-9361

Nathan Tuttle
Ohio State University
2001 Fyffe Ct., 264B Howlett Hall
Columbus, OH 43210
Tel: (614) 292-0209
Fax: (614) 292-3505
Email: tuttle.36@osu.edu

**Members of the
Northeastern Weed Science Society
As of October 2002**

Mark Van Gessel
University of Delaware
Research & Education Center
16684 County Seat Hwy
Georgetown, DE 19947
Tel: 302-856-7303
Fax: 302-856-1845
Email: mjv@udel.edu

Terry Van Horn
Delaware Dept. of Agriculture
2320 S. Dupont Highway
Dover, DE 19901-5515
Tel: (302) 698-4500
Fax: (302) 698-4468
Email: terry.vanhorn@state.de.us

David Vitolo
Novartis Crop Protection, Inc.
67 Pinewood Road
Hudson, NY 12534
Tel: 518-851-2122
Fax: 518-851-9790
Email: david.vitolo@cp.novartis.com

Eric Vorodi
Penn State University
25 Sheeley Lane
Boiling Springs, PA 17007
Tel: (717) 921-8803
Fax: (717) 921-0135
Email: vorodi@paonline.com

Thomas Vrabel
Slater Center of Environmental Tech.
222 Richmond Street
Suite 202
Providence, RI 02816
Tel: (401) 490-6860
Fax: (401) 273-2048
Email: tvrabel@slaterenvirotech.com

Thomas Watschke
Penn State University
405 ASI Bldg
University Park, PA 16802
Tel: (814) 863-7633
Fax: (814) 863-7043
Email: tlw3@psu.edu

Williams Welker
USDA - ARS
282 Tuscowilla Hills
Charlestown, WV 25414
Tel: 304-725-2140

Tim Wenskus
NYC Parks - Natural Resources
Group
1234 Fifth Avenue Rm 233
New York, NY 10029
Tel: (212) 360-1427
Email: timberwolf@parks.nyc.org

Edward Werner
Agriliance, LLC
PO Box 349
Kinderhook, NY 12106
Tel: (518) 758-2030
Fax: (518) 758-2035
Email: elwerner@agriliance.com

Jeff Westendoup
Walters Garden Inc.
PO Box 137
Zeeland, MI 49464
Tel: 616-772-4697
Fax: 616-772-5803
Email: jaw@waltersgardens.com

Leslie Weston
Cornell University
20 Plant Sciences Bldg
Horticulture Department
Ithaca, NY 14853
Tel: (607) 387-6410
Fax: (607) 255-9998
Email: law20@cornell.edu

Cory Whaley
Virginia Polytechnic Institute
26558 Kaye Road
Seaford, DE 19973
Tel: 757-414-0724
Email: cwhaley@vt.edu

Mark White
Aventis Crop Science
4030 Parkside Ct
Mt. Joy, PA 17552
Tel: (717) 684-2600
Email: mark.white@aventis.com

Henry Wilson
Virginia Polytechnic Institute
Eastern Shore AREC
33446 Research Drive
Painter, VA 23420-2827
Tel: 757-414-0724 X13
Fax: 757-414-0730
Email: hwilson@vt.edu

E. C. Wittmeyer
Ohio State University (Retired)
Dept. of Horticulture
2001 Fyffe Court
Columbus, OH 43220-1096
Tel: 614-292-3873
Fax: 614-292-3505

Robert Wooten
North Carolina State University
Dept. of Horticulture Science
Box 7609
Raleigh, NC 27695-7609
Tel: 919-515-2650
Fax: (919) 515-7747
Email: rob_wooten@ncsu.edu

David Yarborough
University of Maine
5722 Deering Hall Rm 414
Orono, ME 04469-5722
Tel: 207-581-2923
Fax: 207-581-2941
Email: davidy@maine.edu

John Yocum
Penn State
PO Box 308
Landisville, PA 17538
Tel: 717-653-4728
Fax: 717-653-1052

Roger Young, Prof. Emeritus
West Virginia University
PO Box 128 Cottage 302-D
Quincy, MA 17247
Tel: 717-749-3979
Email: rsyoung@mail.cvn.net

Jeffrey Zelna
Syngenta Crop Protection
4598 Reliant Road
Jamesville, NY 13078
Tel: (315) 498-4259
Fax: (315) 498-4259
Email: jeff.zelna@syngenta.com

Chaoxian Zhang
Institute of Plant Protection, CAAS
No. 2 West Yuanmingyuan Road
Haidian, Beijing 100094 China
Tel: 86 10 628-15908
Fax: 86 10 628-15908
Email: cxzhang@public.east.net.cn

Members of the
Northeastern Weed Science Society
As of October 2002

Stanley Zontek
USGA Mid Atlantic Green Section
PO Box 2105
West Chester, PA 19382
Tel: 610-696-4747
Fax: 610-696-4810
Email: szontek@usga.org

Members of the
Northeastern Weed Science Society
 By Affiliation

A.C.D.S. Research, Inc.
 Grant Jordan

Agriculture & Agri-Food Canada
 Jerry A. Ivany

**Agriculture & AgroAlimentaire
 Canada**
 Diane Benoit

Agrilience, LLC
 Edward Werner

Agway, Inc.
 George Bayer

Alenze
 Todd Hagenbuch

Amchem Products, Inc.
 Robert Beatty

American Cyanamid
 John Dobson (Retired)

ARMS, Inc.
 Stanley Pruss

ARS-USDA
 Kerrie Kyde

Aventis
 David Lamore
 Larry Norton
 David Spak
 Mark White

BASF
 Chris Becker
 Michael Fleming
 Jim Gaffney
 Kathie Kalmowitz
 Gar Thomas

Bayer
 John Isgrigg III
 Matthew Mahoney

Cain Vegetation, Inc.
 Nancy Cain

**Connecticut Agriculture
 Experiment Station**
 Tim Abbey
 John Ahrens
 Todd Mervosh

**Cook College/New Jersey
 Agriculture Experiment Station**
 Jerry Baron

Cornell University
 Jennifer Allaire
 Jacob Barney
 Robin Bellinder
 Wayne Berman
 Cecile Bertin
 Daniel Brainard
 Antonio DiTommaso
 Richard Dunst
 Seok Eom
 Russell Hahn
 Robert Nurse
 Andrew Senesac
 Paul Stachowski
 Leslie Weston

**Crop Management Strategies,
 Inc.**
 Marc Pacchioli

Deer Run Farm
 Tim Durhman

**Delaware Department of
 Agriculture**
 Clifford Blessing
 Todd Davis
 Terry Van Horn

Dow AgroSciences LLC
 Daniel Loughner
 Brian Olson

DowElanco
 Raymond Wright

DuPont
 Donald Ganske
 Susan Rick

EPA
 William Chism

Fallbrook Research Group
 Richard Bailey

FMC Corporation – APG
 Howard Guscar

Gowan Company
 Paul David

**Harris Agriscience & Tech
 Center**
 Joe Rodrigues

**Institute of Plant Protection,
 CAAS**
 Chaoxian Zang

IR-4
 Marija Arsenovic
 J. Ray Frank
 Edith Lurvey

**J.C. Ehrlich Chemical Company,
 Inc.**
 Ross Phillips

LABServices
 James Steffel

**Maryland Department of
 Agriculture**
 Lane Heimer
 Don Robbins
 Leroy Sellman
 Mark Smith

**Maryland Dept. of Natural
 Resources**
 Philip Pannill

Monsanto

J. Boyd Carey
 Robert DeWaine
 Timothy Dutt
 Jim Haldeman
 David Heering
 David Mayonado
 Domingo Riego
 Edward Skurkay

National & Regional Weed Science Societies

Robert Hedberg

NDFAP

Sujatha Sankula

Nichino America

Ken Chisholm

NISSO America Inc.

Tateshi Tsujikawa

North Carolina University

Michael Burton
 Jeffery Darden
 Caren Judge
 Joseph Neal
 Bridget Robinson
 Robert Wooten

Northeast Turf & Ornamental Research

Annamarie Pennucci

NYC Parks – Natural Resources Group

Tim Wenskus

Ohio State University

Luke Case
 Hannah Mathers
 Nathan Tuttle
 E.C. Wittmeyer (Retired)

Ontario Ministry of Agriculture, Research Center

Leslie Huffman

PBI/Gordon Corporation

David Austin

Penn State University

Rick Bates
 Melissa Bravo
 William Curran
 Mike Fidanza
 Art Gover
 Scott Guiser
 Chiko Haramki
 Tracey Harpster
 Jon Johnson
 Gordon Kauffman III
 Larry Kuhns
 Dwight Lingenfelter
 David Messersmith
 David Mortensen
 Matt Myers
 C. David Nelson
 Brad Park
 Jim Sellmer
 Jennifer Stingelin-Keefer
 Eric Vorodi
 Thomas Watschke
 John Yocum

Pennsylvania Dept. of Agriculture

Wilbur Mountain

Perfection Agronomics

James Saik
 Consulting Services

Rutger Unviersity

Albert Ayeni
 Stanford Fertig (Retired)
 Stephen Hart
 Gerald Henry
 Richard Ilnicke
 Darren Lycan
 Brad Majek
 John Meade
 William Sciarappa

RWC, INC

John Roy

Silvio O Conte National Fish and Wildlife Refuge

Cynthia Boettner

Slater Center of Environmental Tech.

Thomas Vrabel

Sprout-Less Vegetation Control Systems

Aboud Mubareka

St. John's University

Richard Stalter

Syngenta

Michael Agnew
 Stephan Dennis
 Edward Higgins
 Renee Keese
 Brent Lackey
 Scott Lawson
 Brian Manley
 Carroll Moseley
 Chris Munsterman
 Eric Palmer
 Randy Ratliff
 David Ross
 Rick Schmenk
 Sandra Shinn
 Dan Smith
 David Vitolo
 Jeffrey Zelna

The Scotts Company

Rene Scoresby

Trugreen Chemlawn

Amy Suggars

Union Carbide Agriculture Products

Barbara Emerson
 John Gallagher

United Agriculture Products

Robert Herrick

University of Connecticut

Richard Ashely
 Donna Ellis
 Frank Himmelstein
 Robert Peters (Retired)

University of Delaware

Brian Hearn
 Mark Isaacs
 Quintin Johnson
 Barbara Scott
 Mark Van Gessel

University of Georgia

Mark Czarnota

University of Maine

John Jemison
David Yarborough

University of Maryland

C. Edward Beste
Peter Dernoeden
Scott Glenn
Betty Marose
Hiwot Menbere
Ronald Ritter

University of Massachusetts

A. Richard Boanno
Prasanta Bhowmik
Robert Devlin
Michael Elston
Randall Prostack

University of Rhode Island

Raymond Taylorson

USDA

Dana Berner
William Brucket
Benjamin Coffman
Walter Gentner
Dean Linscott
James Parochetti
Florence Peterson
Neal Spencer
Williams Welker

USGA

Stanley Zontek

Valent USA Corporation

Ted Bean
John Cranmer
Jason Fausey

**Valentine Turf Grass Research
Center**

Jeffrey Borger

Virginia Polytechnic

Greg Armel
Shawn Askew
William Bailey
Josh Beam
Kevin Bradley
Jeffrey Derr
Thomas Hines
Ivan V. Morozov
Robert Richardson
Brian Trader
Cory Whaley
Henry Wilson

Waldrum Specialities, Inc

Roy Johnson

Walters Garden, Inc

Jeff Westendoup

Weeds, Inc

Brian Oneill

West Virginia University

Rakesh Chandran
Roger Young (Prof. Emeritus)

NEWSS PAST PRESIDENTS

Gilbert H. Ahlgren	1947-49	Henry P. Wilson	1975-76
Robert D. Sweet	1949-50	Richard J. Marrese	1976-77
Howard L. Yowell	1950-51	C. Edward Beste	1977-78
Stephen M. Raleigh	1951-52	James D. Riggelman	1978-79
Charles E. Minarik	1952-53	James V. Parochetti	1979-80
Robert H. Beatty	1953-54	M. Garry Schnappinger	1980-81
Albin O. Kuhn	1954-55	Raymond B. Taylorson	1981-82
John Van Geluwe	1955-56	Stephan Dennis	1982-83
L. Danielson	1956-57	Thomas L. Watschke	1983-84
Charles L. Hovey	1957-58	James C. Graham	1984-85
Stanford N. Fertig	1958-59	Russell R. Hahn	1985-86
Gordon Utter	1959-60	Edward R. Higgins	1986-87
E. M. Rahn	1960-61	Maxwell L. McCormack	1987-88
Lawrence Southwick	1961-62	Roy R. Johnson	1988-89
Donald A. Shallock	1962-63	Stanley F. Gorski	1989-90
Anthony J. Tafuro	1963-64	John B. Dobson	1990-91
Robert A. Peters	1964-65	Prasanta C. Bhowmik	1991-92
Gideon D. Hill	1965-66	Stanley W. Pruss	1992-93
Richard D. Ilnicki	1966-67	Ronald L. Ritter	1993-94
John E. Gallagher	1967-68	Wayne G. Wright	1994-95
John A. Meade	1968-69	Bradley A. Majek	1995-96
Homer M. Lebaron	1969-70	Thomas E. Vrabel	1996-97
John F. Ahrens	1970-71	Joseph C. Neal	1997-98
George H. Bayer	1971-72	David B. Vitolo	1998-99
Arthur Bing	1972-73	A. Richard Bonanno	1999-00
Ralph Hansen	1973-74	Brian D. Olson	2000-01
Walter A. Gentner	1974-75	Jeffrey F. Derr	2001-02

AWARD OF MERIT

1971	Gilbert H. Ahlgren Homer Neville Claude E. Phillips M. S. Pridham Stephen A. Raleigh	Rutgers University L.I. Ag. & Tech, Farmingdale, NY University of Delaware Cornell University Penn State University
1972	Robert Bell Stuart Dunn Alfred Fletcher Frank N. Hewetson Madelene E. Pierce Collins Veatch Howard L. Yowell	University of Rhode Island University of New Hampshire NJ State Dept. of Health Penn Fruit Res. Lab. Vassar College West Virginia University Esso Research Lab.
1973	Moody F. Trevett	University of Maine
1974	Robert H. Beatty Arthur Hawkins	Amchem Products, Inc. University of Connecticut
1975	Philip Gorlin Herb Pass Robert D. Sweet	NY City Environ. Cont. CIBA-GEIGY Corp. Cornell University
1976	C. E. Langer Charles E. Minarik Herb Pass	University of New Hampshire US Dept. of Agriculture-ARS CIBA-GEIGY Corp.
1977	L. L. Danielson Madelene E. Pierce Lawrence Southwick John Stennis	US Dept. of Agriculture-ARS Vassar College Dow Chemical Company US Bureau of Fish & Wildlife
1978	None Awarded	
1979	Carl M. Monroe Charles Joseph Noll Jonas Vengris	Shell Chemical Company Penn State University University of Massachusetts
1980	Otis F. Curtis, Jr. Theodore R. Flanagan Oscar E. Shubert	NY Agricultural Experiment Sta. University of Vermont Virginia University
1981	Dayton L. Klingman Hugh J. Murphy John Van Geluwe	US Dept. of Agriculture-ARS University of Maine CIBA-GEIGY Corp.
1982	Robert D. Shipman	Penn State University
1983	Arthur Bing William E. Chappel Barbara H. Emerson	Cornell University Virginia Tech Union Carbide Agricultural Prod.
1984	William H. Mitchell Roger S. Young	University of Delaware West Virginia University
1985	John A. Jagschitz	University of Rhode Island
1986	John R. Havis	University of Massachusetts
1987	None Awarded	

1988	J. Lincoln Pearson	University of Rhode Island
1989	Robert A. Peter	University of Connecticut
1990	Bryant L. Walworth	American Cyanamid Co.
1991	Don Warholic	Cornell University
1992	Robert Duel	Rutgers University
	Richard Ilnicki	Rutgers University
	William V. Welker	USDA/ARS
1993	None Awarded	
1994	John F. Ahrens	CT Agricultural Experiment Sta.
	John B. Dobson	American Cyanamid
	J. Ray Frank	USDA-ARS/IR-4
1995	Francis J. Webb	University of Delaware
1996	Robert M. Devlin	University of Massachusetts
	Wilber F. Evans	Rhone-Poulenc Ag. Co.
	Raymond B. Taylorson	University of Rhode Island
	S. Wayne Bingham	Virginia Tech
1997	Jean P. Cartier	Rhone-Poulenc Ag. Co.
1998	Stan Pruss	Novartis Crop Protection
	Max McCormack, Jr.	University of Maine
1999	None Awarded	
2000	Richard J. Marrese	Hoechst-NorAm
2001	Nathan L. Hartwig	Penn State University
	Edward R. Higgins	Novartis Crop University
2002	Garry Schnappinger	Syngenta Crop Protection

DISTINGUISHED MEMBERS

1979	George H. Bayer Robert A. Peters Robert D. Sweet	Agway, Inc. University of Connecticut Cornell University
1980	John F. Ahrens John E. Gallagher Richard Ilnicki	CT Agricultural Experiment Sta. Union Carbide Agric. Prod. Rutgers University
1981	Robert H. Beatty Arthur Bing John A. Meade	Amchem Products, Inc. Cornell University Rutgers University
1982	Walter A. Gentner Hugh J. Murphy	US Dept. of Agriculture-ARS University of Maine
1983	L. L. Danielson	US Dept. of Agriculture-ARS
1984	Barbara H. Emerson Henry P. Wilson	Union Carbide Agric. Prod. Virginia Tech
1985	None Awarded	
1986	Chiko Haramaki Dean L. Linscott	Penn State University USDA-ARS/Cornell University
1987	Gideon D. Hill Williams V. Welker	E. I. DuPont DeNemours US Dept. of Agric-ARS
1988	Wendell R. Mullison James V. Parochetti	Dow Chemical US Dept. of Agriculture-CSRS
1989	None Awarded	
1990	Robert M. Devlin	University of Massachusetts
1991	John (Jack) B. Dobson Robert D. Shipman	American Cyanamid Penn State University
1992	Gary Schnappinger	Ciba-Geigy Corp.
1993	Steve Dennis James Graham	Zeneca Ag. Products Monsanto Ag. Co.
1994	Russell Hahn Maxwell McCormick	Cornell University University of Maine
1995	Richard Ashly Richard Marrese	University of Connecticut Hoechst-NorAm
1996	Roy R. Johnson Edward R. Higgins	Waldrum Specialist Inc. Ciba Crop Protection
1997	Raymond B. Taylorson Wayne G. Wright Stanley F. Gorski	UDSA-ARS DowElanco Ohio State University
1998	Prasanta Bhowmik	University of Massachusetts
1999	C. Edward Beste	University of Maryland
2000	J. Ray Frank Stanley W. Pruss	IR-4 Project Ciba Crop Protection
2001	Ronald L. Ritter	University of Maryland
2002	Bradley A. Majek Thomas L. Watschke	Rutgers University Penn State University

OUTSTANDING RESEARCHER AWARD

1999	Garry Schnappinger	Novartis Crop Protection
2000	Prasanta C. Bhowmik	University of Massachusetts
2001	Robin Bellinder	Cornell University
2002	Jerry J. Baron	IR-4 Project, Rutgers University

OUTSTANDING EDUCATOR AWARD

1999	Douglas Goodale	SUNY Cobleskill
2000	Thomas L. Watschke	Penn State University
2001	C. Edward Beste	University of Maryland
2002	E. Scott Hagood	Virginia Tech University

OUTSTANDING GRADUATE STUDENT PAPER CONTEST

1979	1	Bradley Majek	Cornell University
	2	Betty J. Hughes	Cornell University
1980	1	John Cardi	Penn State University
	2	Timothy Malefyt	Cornell University
1981	1	A. Douglas Brede	Penn State University
	2	Ann S. McCue	Cornell University
1982	1	Thomas C. Harris	University of Maryland
	2	Barbara J. Hook	University of Maryland
	HM	L. K. Thompson	Virginia Tech
	HM	Timothy Malefyt	Cornell University
1983	1	Anna M. Pennucci	University of Rhode Island
	2	Michael A. Ruizzo	Ohio State University
	HM	I. M. Detlefson	Rutgers University
1984	1	Robert S. Peregoy	University of Maryland
	2	Ralph E. DeGregorio	University of Connecticut
1985	1	Stephan Reiners	Ohio State University
	2	Erin Hynes	Penn State University
1986	1	Elizabeth Hirsh	University of Maryland
	2 (tie)	Ralph E. DeGregorio	University of Connecticut
	2 (tie)	Avraham Y. Teitz	Ohio State University
1987	1	Russell W. Wallace	Cornell University
	2 (tie)	Daniel E. Edwards	Penn State University
	2 (tie)	Frank J. Himmelstein	University of Massachusetts
1988	1	William K. Vencill	Virginia Tech
	2	Lewis K. Walker	Virginia Tech
	HM	Scott Guiser	Penn State University
	HM	Frank J. Himmelstein	University of Massachusetts
1989	1	Frank S. Rossi	Cornell University
	1	Amy E. Stowe	Cornell University
1990	1	William J. Chism	Virginia Tech
	2	Russell W. Wallace	Cornell University

1991	1	Elizabeth Maynard	Cornell University
	2	Daniel A. Kunkle	Cornell University
1992	1	J. DeCastro	Rutgers University
	2	Ted Blomgren	Cornell University
	3	Fred Katz	Rutgers University
1993	1	Eric D. Wilkens	Cornell University
	2	Henry C. Wetzel	University of Maryland
1994	1	Jed B. Colquhoun	Cornell University
	2	Eric D. Wilkins	Cornell University
1995	1	Sydha Salihu	Virginia Tech
	2	John A. Ackley	Virginia Tech
	HM	Jed B. Colquhoun	Cornell University
1996	1	Dwight Lingenfelter	Penn State University
	2	Mark Issacs	University of Delaware
	HM	Jed B. Colquhoun	Cornell University
1997	1	David Messersmith	Penn State University
	2	Sowmya Mitra	University of Massachusetts
	HM	Mark Issacs	University of Delaware
1998	1	Dan Poston	Virginia Tech
	2	Travis Frye	Penn State University
	3	David B. Lowe	Clemson University
1999	1	Hennen Cummings	North Carolina State University
	2	John Isgrigg	North Carolina State University
2000	1	Matthew Fagerness	North Carolina State University
	2	Steven King	Virginia Tech
	3	Gina Penny	North Carolina State University
2001	1	Robert Nurse	University of Guelph
	2 (tie)	W. Andrew Bailey	Virginia Tech
	2 (tie)	Steven King	Virginia Tech
2002	1.	G. Michael Elston	University of Massachusetts
	2.	Caren A. Judge	North Carolina State University

COLLEGIATE WEED CONTEST WINNERS

1983 - Wye Research Center, Maryland

Graduate Team: University of Guelph
Undergraduate Team: Penn State University
Graduate Individual: Mike Donnelly, University of Guelph
Undergraduate Individual: Bob Annet, University of Guelph

1984 - Rutgers Research and Development Center, Bridgeton, New Jersey

Graduate Team: University of Guelph
Undergraduate Individual: D. Wright, University of Guelph
Graduate Individual: N. Harker, University of Guelph

1985 - Rhom and Haas, Spring House, Pennsylvania

Graduate Team: University of Maryland
Undergraduate Individual: Finlay Buchanan, University of Guelph
Graduate Individual: David Vitolo, Rutgers University

1986 - FMC, Princeton, New Jersey

Graduate Team:
Undergraduate Team: University of Guelph
Graduate Individual: R. Jain, Virginia Tech
Undergraduate Individual: Bill Litwin, University of Guelph

1987 - DuPont, Newark, Delaware

Graduate Team: University of Guelph
Undergraduate Team: University of Guelph
Graduate Individual: Lewis Walker, Virginia Tech
Undergraduate Individual: Allen Eadie, University of Guelph

1988 - Ciba-Geigy Corp., Hudson, New York

Graduate Team: Virginia Tech
Undergraduate Team: University of Guelph
Undergraduate Individual: Del Voight, Penn State University
Graduate Individual: Carol Moseley, Virginia Tech

1989 - American Cyanamid, Princeton, New Jersey

Graduate Team: Cornell University
Undergraduate Team: SUNY Cobleskill
Graduate Individual: Paul Stachowski, Cornell University
Undergraduate Individual: Anita Dielman, University of Guelph

1990 - Agway Farm Research Center, Tully, New York

Graduate Team: Virginia Tech
Undergraduate Team: SUNY Cobleskill
Graduate Individual: Brian Manley, Virginia Tech
Undergraduate Individual: Dwight Lingenfelder, Penn State University

1991 - Rutgers University, New Brunswick, New Jersey

Graduate Team: Virginia Tech
Undergraduate Team: University of Guelph
Graduate Individual: Carol Moseley, Virginia Tech
Undergraduate Individual: Tim Borro, University of Guelph

1992 - Ridgetown College, Ridgetown, Ontario, CANADA

Graduate Team: Michigan State University
Undergraduate Team: Ohio State
Graduate Individual: Troy Bauer, Michigan State University
Undergraduate Individual: Jeff Stackler, Ohio State University

1993 - Virginia Tech, Blacksburg, Virginia

Graduate Team: Virginia Tech
Undergraduate Team: SUNY Cobleskill
Graduate Individual: Brian Manley, Virginia Tech
Undergraduate Individual: Brian Cook, University of Guelph

1994 - Lower Eastern Shore Research and Education Center, Salisbury, Maryland

Graduate Team: Virginia Tech
Undergraduate Team: University of Guelph
Graduate Individual: Brian Manley, Virginia Tech
Undergraduate Individual: Robert Maloney, University of Guelph

1995 - Thompson Vegetable Research Farm, Freeville, New York

Graduate Team: Virginia Tech
Undergraduate Team: University of Guelph
Graduate Individual: Dwight Lingenfelter, Penn State University
Undergraduate Individual: Jimmy Summerlin, North Carolina State University

1996 - Penn State Agronomy Farm, Rock Springs, Pennsylvania

Graduate Team: Michigan State University
Undergraduate Team: SUNY, Cobleskill
Graduate Individual: John Isgrigg, North Carolina State University
Undergraduate Individual: Mark Brock, University of Guelph

1997 - North Carolina State University, Raleigh, North Carolina

Graduate Team: Michigan State University
Undergraduate Team: University of Guelph
Graduate Individual: Brett Thorpe, Michigan State University

1998 - University of Delaware, Georgetown, Delaware

Graduate Team: Virginia Tech
Undergraduate Team: University of Guelph
Graduate Individual: Shawn Askew, North Carolina State University
Undergraduate Individual: Kevin Ego, University of Guelph

1999 - Virginia Tech, Blacksburg, Virginia

Graduate Team: North Carolina State University
Undergraduate Team: Nova Scotia Agricultural College
Graduate Individual: Rob Richardson, Virginia Tech
Undergraduate Individual: Keith Burnell, North Carolina State University

2000 - University of Guelph, Guelph, Ontario, CANADA

Graduate Team: Virginia Tech
Undergraduate Team: Ohio State University
Graduate Individual: Shawn Askew, North Carolina State University
Undergraduate Individual: Luke Case, Ohio State University

2001 - University of Connecticut, Storrs, Connecticut

Graduate Team: North Carolina State University
Undergraduate Team: Penn State University
Graduate Individual: Matt Myers, Penn State University
Undergraduate Individual: Shawn Heinbaugh, Penn State University

2002 - ACDS Research Facility, North Rose, New York

Graduate Team: North Carolina State University
Undergraduate Team: North Carolina State University
Graduate Individual: Scott McElroy, North Carolina State University
Undergraduate Individual: Sarah Hans, North Carolina State University

RESEARCH POSTER AWARDS

- 1983 1. Herbicide Impregnated Fertilizer of Weed Control in No-Tillage Corn - R. Uruatowski and W. H. Mitchell, Univ. of Delaware, Newark
2. Effect of Wiper Application of Several Herbicides and Cutting on Black Chokeberry - D. E. Yarborough and A. A. Ismail, Univ. of Maine, Orono
HM. Corn Chamomile Control in Winter Wheat - R. R. Hahn, Cornell Univ., Ithaca, New York and P. W. Kanouse, New York State Cooperative Extension, Mt. Morris
- 1984 1. Herbicide Programs and Tillage Systems for Cabbage - R. R. Bellinder, Virginia Tech, Blacksburg, and T. E. Hines and H. P. Wilson, Virginia Truck and Ornamental Res. Station, Painter
2. Triazine Resistant Weeds in New York State - R. R. Hahn, Cornell Univ., Ithaca, NY
HM. A Roller for Applying Herbicides at Ground Level - W. V. Welker and D. L. Peterson, USDA-ARS, Kearneysville, WV
- 1985 1. No-Tillage Cropping Systems in a Crown Vetch Living Mulch - N. L. Hartwig, Penn State Univ., University Park
2. Anesthetic Release of Dormancy in *Amaranthus retroflexus* Seeds - R. B. Taylorson, USDA-ARS, Beltsville, MD and K. Hanyadi, Univ. of Agricultural Science, Keszthely, Hungary
2. Triazine Resistant Weed Survey in Maryland - B. H. Marose, Univ. of Maryland, College Park
HM. Wild Proso Millet in New York State - R. R. Hahn, Cornell Univ., Ithaca, NY
- 1986 1. Discharge Rate of Metolachlor from Slow Release Tablets - S. F. Gorski, M. K. Wertz and S. Refiners, Ohio State Univ., Columbus
2. Glyphosate and Wildlife Habitat in Maine - D. Santillo, Univ. of Maine, Orono
- 1987 1. Mycorrhiza and Transfer of Glyphosate Between Plants - M. A. Kaps and L. J. Khuns, Penn State Univ., University Park
2. Redroot Pigweed Competition Study in No-Till Potatoes - R. W. Wallace, R. R. Bellinder, and D. T. Warholic, Cornell Univ., Ithaca, NY
- 1988 1. Growth Suppression of Peach Trees With Competition - W. V. Welker and D. M. Glenn, USDA-ARS, Kearneysville, WV
2. Smooth Bedstraw Control in Pastures and Hayfields - R. R. Hahn, Cornell Univ., Ithaca, NY

- 1989 1. Burcucumber Responses to Sulfonylurea Herbicides - H. P. Wilson and T. E. Hines, Virginia Tech, Painter, VA
 2. Water Conservation in the Orchard Environment Through Management - W. V. Welker, Jr., USDA-ARS Appalachian Fruit Res. Sta., Kearneysville, WV
- 1990 1. Reduced Rates of Postemergence Soybean Herbicides - E. Prostko, J. A. Meade, and J. Ingerson-Mahar, Rutgers Coop. Ext. Mt. Holly, NJ
 2. The Tolerance of Fraxinus, Juglans, and Quercus Seedlings to Imazaquin and Imazethapyr - L. J. Kuhns and J. Loose, Penn State Univ., University Park
- 1991 1. Johnsongrass Recovery from Sulfonylurea Herbicides - T. E. Hines and H. P. Wilson, Virginia Tech, Painter, VA
 2. Growth Response to Young Peach Trees to Competition With Several Grass Species - W. V. Welker and D. M. Glenn, USDA-ARS, Kearneysville, WV
- 1992 1. Teaching Weed Identification with Videotape - B. Marose, N. Anderson, L. Kauffman-Alfera, and T. Patten, Univ. of Maryland, College Park
 2. Biological Control of Annual Bluegrass (*Poa annua* L. *Reptans*) with *Xanthomonas campestris* (MYX-7148) Under Field Conditions - N. D. Webber and J. C. Neal, Cornell Univ., Ithaca, NY
- 1993 1. Development of an Identification Manual for Weeds of the Northeastern United States - R H. Uva and J. C. Neal, Cornell Univ., Ithaca, NY
 2. Optimum Time of Cultivation for Weed Control in Corn - Jane Mt. Pleasant, R. Burt and J. Frisch, Cornell Univ., Ithaca, NY
- 1994 1. Herbicide Contaminant Injury Symptoms on Greenhouse Grown Poinsettia and Geranium - M. Macksel and A. Senesac, Long Island Horticultural Res. Lab, Riverhead, NY and J. Neal, Cornell Univ., Ithaca, NY
 2. Mow-kill Regulation of Winter Cereals Grown for Spring No-till Crop Production - E. D. Wilkins and R R Bellinder, Cornell Univ., Ithaca, NY
- 1995 1. A Comparison of Broadleaf and Blackseed Plantains Identification and Control - J. C. Neal and C. C. Morse, Cornell Univ., Ithaca, NY
 2. Using the Economic Threshold Concept as a Determinant for Velvetleaf Control in Field Corn - E. L. Werner and W. S. Curran, Penn State Univ., University Park
- 1996 1. Preemergence and Postemergence Weed Management in 38 and 76 cm Corn - C. B. Coffman, USDA-ARS, Beltsville, MD
 2. Common Cocklebur Response to Chlorimuron and Imazaquin - B. S. Manley, H. P. Wilson and T. E. Hines, Virginia Tech, Blacksburg, VA

- 1997 None Awarded
- 1998 1. Weed Control Studies with *Rorippa sylvestris* - L. J. Kuhns and T. Harpster, Penn State Univ., University Park, PA
 2. Postemergence Selectivity and Safety of Isoxaflutole in Cool Season Turfgrass - P. C. Bhowmik and J. A. Drohen, Univ. of Massachusetts, Amherst, MA
- 1999 1. Winter Squash Cultivars Differ in Response to Weed Competition - E. T. Maynard, Purdue Univ., Hammond, IN
 2. Effectiveness of Row Spacing, Herbicide Rate, and Application Method on Harvest Efficiency of Lima Beans - S. Sankula, M. J. VanGessel, W. E. Kee, and J. L. Glancey, Univ. of Delaware, Georgetown, DE
- 2000 1. Weed Control and Nutrient Release With Composted Poultry Litter Mulch in a Peach Orchard - P. L. Preusch, Hood College, Frederick, MD; and T. J. Tworkoski, USDA-ARS, Hearneysville, WV
 2 (tie). The Effect of Total Postemergence Herbicide Timings on Corn Yield - D. B. Vitolo, C. Pearson, M. G. Schnappinger, and R. Schmenk, Novartis Crop Protection, Hudson, NY
 2 (tie). Pollen Transport From Genetically Modified Corn - J. M. Jemison and M. Vayda, Univ. of Maine, Orono, ME
- 2001 1. Evaluation of methyl bromide alternatives for yellow nutsedge control in plasticulture tomato - W. A. Bailey, H. P. Wilson, and T. E. Hines, Virginia Tech, Painter, VA.
 2. Evaluation of alternative control methods for annual ryegrass in typical Virginia crop rotations - S. R. King and E. S. Hagood, Virginia Tech, Blacksburg, VA.
- 2002 1. Effectiveness of mesotrione to control weeds in sweet corn. J. M. Jemison, Jr. and A. Nejako, Univ. Maine, Orono.
 2. Flufenacet plus metribuzin for italian ryegrass control in Virginia wheat. W. A. Bailey, H. P. Wilson, and T. E. Hines, Virginia Tech, Painter.

INNOVATOR OF THE YEAR

1986	Nathan Hartwig	Penn State University
1987	Thomas Welker	USDA/ARS Appl. Fruit Res. Sta.
1988	None Awarded	
1989	John E. Waldrum	Union Carbide Agric. Prod.
1990	None Awarded	
1991	Thomas L. Watschke	Penn State University
1992	E. Scott Hagood	Virginia Tech
	Ronald L. Ritter	University of Maryland
1993	None Awarded	
1994	George Hamilton	Penn State University
1995	Kent D. Redding	DowElanco
1996	James Orr	Asplundh Tree Expert Co.
1997	George Hamilton	Penn State University
1998	None Awarded	
1999	Award Discontinued	

OUTSTANDING APPLIED RESEARCH IN FOOD AND FEED CROPS

1991	Russell R. Hahn	Cornell University
1992	Henry P. Wilson	Virginia Tech
1993	None Awarded	
1994	Robin Bellinder	Cornell University
1995	None Awarded	
1996	E. Scott Hagood	Virginia Tech
1997	Ronald L. Ritter	University of Maryland
1998	None Awarded	
1999	Award Discontinued	

OUTSTANDING APPLIED RESEARCH IN TURF, ORNAMENTALS, AND VEGETATION MANAGEMENT

1991	Wayne Bingham	Virginia Tech
1992	John F. Ahrens	CT Agricultural Experiment Sta.
1993	Joseph C. Neal	Cornell University
1994	Prasanta C. Bhowmik	University of Massachusetts
1995	Andrew F. Senesac	Long Island Hort. Research Lab
1996	Larry J. Kuhns	Penn State University
1997	Jeffrey F. Derr	Virginia Tech
1998	None Awarded	
1999	Award Discontinued	

OUTSTANDING PAPER AWARDS

- 1954 Studies on Entry of 2,4-D into Leaves - J. N. Yeatman, J. W. Brown, J. A. Thorne and J. R. Conover, Camp Detrick, Frederick, MD
- The Effect of Soil Organic Matter Levels on Several Herbicides - S. L. Dallyn, Long Island Vegetable Research Farm, Riverhead, NY
- Experimental Use of Herbicides Impregnated on Clay Granules for Control of Weeds in Certain Vegetable Crops - L. L. Danielson, Virginia Truck Expt. Station, Norfolk, VA
- Cultural vs. Chemical Weed Control in Soybeans - W. E. Chappell, Virginia Polytechnical Institute, Blacksburg, VA
- Public Health Significance of Ragweed Control Demonstrated in Detroit - J. H. Ruskin, Department of Health, Detroit, MI
- 1955 A Comparison of MCP and 2,4-D for Weed Control in Forage Legumes - M. M. Schreiber, Cornell Univ., Ithaca, NY
- 1956 None Awarded
- 1957 Herbicidal Effectiveness of 2,4-D, MCPB, Neburon and Others as Measured by Weed Control and Yields of Seedling Alfalfa and Birdsfoot Trefoil - A. J. Kerkin and R. A. Peters, Univ. of Connecticut, Storrs
- Progress Report #4 - Effects of Certain Common Brush Control Techniques and Material on Game Food and Cover on a Power Line Right-of-Way - W. C. Bramble, W. R. Byrnes, and D. P. Worley, Penn State Univ., University Park
- 1958 Effects of 2,4-D on Turnips - C. M. Switzer, Ontario Agricultural College, Guelph, Canada
- Ragweed Free Areas in Quebec and the Maritimes - E. E. Compagna, Universite Laval at Ste-Anne-de-la-Pocatiere, Quebec, Canada
- 1959 Yields of Legume-Forage Grass Mixtures as Affected by Several Herbicides Applied Alone or in a Combination During Establishment - W. G. Wells and R. A. Peters, Univ. of Connecticut, Storrs
- Influence of Soil Moisture on Activity of EPTC, CDEC and CIPC - J. R. Havis, R. L. Ticknor and P. F. Boblua, Univ. of Massachusetts, Amherst

- 1960 The Influence of Cultivation on Corn Yields When Weeds are Controlled by Herbicides - W. F. Meggitt, Rutgers Univ., New Brunswick, NJ
- 1961 Preliminary Investigation of a Growth Inhibitor Found in Yellow Foxtail (*Setaria glauca* L.) - H. C. Yokum, M. J. Jutras, and R. A. Peters, Univ. of Connecticut, Storrs
- 1962 The Effects of Chemical and Cultural Treatment on the Survival of Rhizomes and on the Yield of Underground Food Reserves of Quackgrass - H. M. LeBaron and S. N. Gertig, Cornell Univ., Ithaca, NY
- Observations on Distribution and Control of Eurasian Watermilfoil in Chesapeake Bay, 1961 - V. D. Stotts and C. R. Gillette, Annapolis, MD
- 1963 The Relation of Certain Environmental Conditions to the Effectiveness of DNBP of Post-Emergence Weed Control in Peas - G. R. Hamilton and E. M. Rahn, Univ. of Delaware, Newark
- The Influence of Soil Surface and Granular Carrier Moisture on the Activity of EPTC - J. C. Cialone and R. D. Sweet, Cornell Univ., Ithaca, NY
- The Determination of Residues of Kuron in Birdsfoot Trefoil and Grasses - M. G. Merkle and S. N. Fertig, Cornell Univ., Ithaca, NY
- 1964 Control of Riparian Vegetation with Phenoxy Herbicides and the Effect on Streamflow Quality - I. C. Reigner, USDA-Forest Service, New Lisbon, NJ; W. E. Sopper, Penn State Univ., University Park; and R. R. Johnson, Amchem Products, Inc., Ambler, PA
- EPTC Incorporation by Band Placement and Standard Methods in Establishment of Birdsfoot Trefoil - D. L. Linscott and R. D. Hagin, Cornell Univ., Ithaca, NY
- 1965 1. Corn Chamomile (*Anthemis arvensis* L.) Responses to Some Benzoic Acid Derivatives - Barbara M. Metzger, Judith K. Baldwin and R. D. Ilnicki, Rutgers Univ., New Brunswick, NJ
2. The Physical Properties of Viscous Sprays for Reduction of Herbicide Drift - J. W. Suggitt, The Hydro-Electric Power Commission of Ontario, Canada

- 1966 1. Weed Control Under Clear Plastic Mulch - Carl Bucholz, Cornell Univ., Ithaca, NY
2. A Chemical Team For Aerial Brush Control on Right-of-Way - B. C. Byrd and C. A. Reimer, Dow Chemical Co
- 1967 1. Influence of Time of Seeding on the Effectiveness of Several Herbicides Used for Establishing an Alfalfa-Bromegrass Mixture - R. T. Leonard and R. C. Wakefield, Univ. of New Hampshire, Durham
2. Weed Competition in Soybeans - L. E. Wheatley and R. H. Cole, Univ. of Delaware, Newark
- 1968 None Awarded
- 1969 1. Weed and Crop Responses in Cucumbers and Watermelons - H. P. Wilson and R. L. Waterfield, Virginia Truck and Orn. Res. Sta., Painter
2. Effect of Several Combinations of Herbicides on the Weight and Development of Midway Strawberry Plants in the Greenhouse - O. E. Schubert, West Virginia Univ., Morgantown
- 1970 1. Effects of RH-315 on Quackgrass and Established Alfalfa - W. B. Duke, Cornell Univ., Ithaca, NY
- 1971 1. Activity of Nitratin, Trifluralin and ER-5461 on Transplant Tomato and Eggplant - D. E. Broaden and J. C. Cialone, Rutgers Univ., New Brunswick, NJ
2. Field Investigations of the Activities of Several Herbicides for the Control of Yellow Nutsedge - H. P. Wilson, R. L. Waterfield, Jr., and C. P. Savage, Jr., Virginia Truck and Orn. Res. Sta., Painter
- 1972 1. Study of Organisms Living in the Heated Effluent of a Power Plant - M. E. Pierce, Vassar College and D. Alessandrello, Marist College
2. Effect of Pre-treatment Environment on Herbicide Response and Morphological Variation of Three Species - A. R. Templeton and W. Hurtt, USDA-ARS, Fort Detrick, MD

- 1973 1. A Simple Method of Expressing the Relative Efficacy of Plant Growth Regulators - A. R. Templeton and W. Hurtt, USDA-ARS, Fort Detrick, MD
2. Agronomic Factors Influencing the Effectiveness of Glyphosate for Quackgrass Control - F. E. Brockman, W. B. Duke, and J. F. Hunt, Cornell Univ., Ithaca, NY
- 1974 1. Weed Control in Peach Nurseries - O. F. Curtis, Cornell Univ., Ithaca, NY
2. Persistence of Napropamide and U-267 in a Sandy Loam Soil - R. C. Henne, Campbell Institute for Agr. Res., Napoleon, OH
- 1975 1. Control of Jimsonweed and Three Broadleaf Weeds in Soybeans - J. V. Parochetti, Univ. of Maryland, College Park
- HM. The Influence of Norflurazon on Chlorophyll Content and Growth of *Potamogeton pectinatus* - R. M. Devlin and S. J. Karczyk, Univ. of Massachusetts, East Wareham
- HM. Germination, Growth, and Flowering of Shepherdspurse - E. K. Stillwell and R. D. Sweet, Cornell Univ., Ithaca, NY
- 1976 1. Top Growth and Root Response of Red Fescue to Growth Retardants - S. L. Fales, A. P. Nielson and R. C. Wakefield, Univ. of Rhode Island, Kingston
- HM. Selective Control of *Poa annua* in Kentucky Bluegrass - P. J. Jacquemin, O. M. Scott and Sons, and P. R. Henderlong, Ohio State Univ., Columbus
- HM. Effects of DCPA on Growth of Dodder - L. L. Danielson, USDA ARS, Beltsville, MD
- 1977 1. The Effects of Stress on Stand and Yield of Metribuzin Treated Tomato Plants - E. H. Nelson and R. A. Ashley, Univ. of Connecticut, Storrs
- HM. The Influence of Growth Regulators on the Absorption of Mineral Elements - R. M. Devlin and S. J. Karczyk, Univ. of Massachusetts, East Wareham.
- HM. Quantification of S-triazine Losses in Surface Runoff: A Summary - J. K. Hall, Penn State Univ., University Park
- 1978 1. Annual Weedy Grass Competition in Field Corn - Jonas Vengris, Univ. of Massachusetts, Amherst
- HM. Metribuzin Utilization with Transplanted Tomatoes - R. C. Henne, Campbell Institute of Agr. Res., Napoleon, OH

- 1979 1. Herbicides for Ground Cover Plantings - J. F. Ahrens, Connecticut Agric. Expt. Station, Windsor
2. Weed Control Systems in Transplanted Tomatoes - R. C. Henne, Campbell Institute of Agr. Res. Napoleon, OH
- 1980 1. Integrated Weed Control Programs for Carrots and Tomatoes - R. C. Henne and T. L. Poulson, Campbell Institute of Agr. Res. Napoleon, OH
2. Suppression of Crownvetch for No-Tillage Corn - J. Carina and N. L. Hartwig, Penn State Univ., University Park
- HM. Effect of Planting Equipment and Time of Application on Injury to No-tillage Corn from Pendimethalin-Triazine Mixtures - N. L. Hartwig, Penn State Univ., University Park
- 1981 1. Weed Control in Cucumbers in Northwest Ohio - R. C. Henne and T. L. Poulson, Campbell Institute of Agr. Res. Napoleon, OH
2. Prostrate Spurge Control in Turfgrass Using Herbicides - J. A. Jagschitz, Univ. of Rhode Island, Kingston
- HM. Some Ecological Observations of Hempstead Plains, Long Island - R. Stalter, St. John's Univ., Jamaica, NY
- 1982 1. Differential Growth Responses to Temperature Between Two Biotypes of *Chenopodium album* - P. C. Bhowmik, Univ. of Massachusetts, Amherst
2. Chemical Control of Spurge and Other Broadleaf Weeds in Turfgrass - J. S. Ebdon and J. A. Jagschitz, Univ. of Rhode Island, Kingston
- HM. Influence of Norflurazon on the Light Activation of Oxyfluorfen - R. M. Devlin, S. J. Karczmarczyk, I. I. Zbiec and C. N. Saras, Univ. of Massachusetts, East Wareham
- HM. Analysis of Weed Control Components for Conventional, Wide-row Soybeans in Delaware - D. K. Regehr, Univ. of Delaware, Newark

- 1983 1. Comparisons of Non-Selective Herbicides for Reduced Tillage Systems - R. R. Bellinder, Virginia Tech, Blacksburg and H. P. Wilson, Virginia Truck and Orn. Res. Station, Painter
2. The Plant Communities Along the Long Island Expressway, Long Island, New York - R. Stalter, St. John's Univ., Jamaica, NY
- HM. Effect of Morning, Midday and Evening Applications on Control of Large Crabgrass by Several Postemergence Herbicides - B. G. Ennis and R. A. Ashley, Univ. of Connecticut, Storrs
- 1984 1. Pre-transplant Oxyfluoufen for Cabbage - J. R. Teasdale, USDA-ARS, Beltsville, MD
2. Herbicide Programs and Tillage Systems for Cabbage - R. R. Bellinder, Virginia Tech, Blacksburg and T. E. Hines and H. P. Wilson, Virginia Truck and Orn. Res. Station, Painter
- 1985 1. Peach Response to Several Postemergence Translocated Herbicides - B. A. Majek, Rutgers Univ., Bridgeton, NJ
- 1986 1. Influence of Mefluidide Timing and Rate on *Poa annua* Quality Under Golf Course Conditions - R. J. Cooper, Univ. of Massachusetts, Amherst; K. J. Karriok, Univ. of Georgia, Athens, and P. R. Henderlong and J. R. Street, Ohio State Univ., Columbus
2. The Small Mammal Community in a Glyphosate Conifer Release Treatment in Maine - P. D'Anieri, Virginia Tech, Blacksburg; M. L. McCormack, Jr., Univ. of Maine, Orono; and D. M. Leslie, Oklahoma State Univ., Stillwater
- HM. Field Evaluation of a Proposed IPM Approach for Weed Control in Potatoes - D. P. Kain and J. B. Sieczka, Cornell Univ., Long Island Horticultural Research Laboratory, Riverhead, NY and R. D. Sweet, Cornell Univ., Ithaca, NY
- 1987 None Awarded

- 1988 1. Bentazon and Bentazon-MCPB Tank-mixes for Weed Control in English Pea - G. A. Porter, Univ. of Maine, Orono; A. Ashley, Univ. of Connecticut, Storrs; R. R. Bellinder and D. T. Warholic, Cornell Univ., Ithaca, NY; M. P. Mascianica, BASF Corp., Parsippany, NJ; and L. S. Morrow, Univ. of Maine, Orono
2. Effects of Herbicide Residues on Germination and Early Survival of Red Oak Acorns - R. D. Shipman and T. J. Prunty, Penn State Univ., University Park
2. Watershed Losses of Triclopyr after Aerial Application to Release Spruce Fir - C. T. Smith, Univ. of New Hampshire, Durham and M. L. McCormack, Jr., Univ. of Maine, Orono
- 1989 None Awarded
- 1990 None Awarded
- 1991 Award Discontinued

HERBICIDE NAMES: COMMON, TRADE, AND CHEMICAL

Common And Chemical Names Of Herbicides Approved By The Weed Science Society Of America

<u>Common Name</u>	<u>Trade Name</u>	<u>Chemical Name</u>
acetochlor	Harness, Surpass, Topnotch	2-chloro-N-(ethoxymethyl)-N-(2-ethyl-6-methylphenyl)acetamide
acifluorfen	Blazer, Status	5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoic acid
alachlor	Lasso, MicroTech, Partner, many	2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl) acetamide
ametryn	Evik	N-ethyl-N'-(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
amicarbozone	Dinamic	4-amino-N-(1,1-dimethylethyl)-4,5-dihydro-3-(1-methylethyl)-5-oxo-1H-1,2,4-triazole-1-carboxamide
asulam	Asulox	methyl[(4-aminophenyl)sulfonyl]carbamate
atrazine	Aatrex, many	6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine
azimsulfuron	Gulliver	N-[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-1-methyl-4-(2-methyl-2H-tetrazol-5-yl)-1H-pyrazole-5-sulfonamide
benefin	Balan	N-butyl-N-ethyl-2,6-dinitro-4-(trifluoromethyl) benzenamine
bensulfuron	Londax	2-[[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]methyl]benzoic acid
bensulide	Bensumec, Betason, Prefar, Lescosan	O,O-bis(1-methylethyl)S-[2-[(phenylsulfonyl)amino]ethyl]phosphorodithioate
bentazon	Basagran	3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide
benzfendizone		methyl 2-[2-[[4-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2H)pyrimidinyl]phenoxy]methyl]-5-ethylphenoxy]propanoic acid
bromacil	Hyvar	5-bromo-6-methyl-3-(1-methylpropyl)-2,4(1H,3H)pyrimidinedione
bromoxynil	Brominal, Bucril, Moxly	3,5-dibromo-4-hydroxybenzotrile
butralin	AMEX-820, TAMEX	4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzenamine
butylate	Sutan+, Genate Plus	S-ethyl bis(2-methylpropyl)carbamothioate
cacodylic acid	Cotton-aide, Montar, Phytar 560	dimethyl arsenic acid
carfentrazone	Aim, Affinity	α ,2-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]-4-fluorobenzenepropanoic acid
chlorflurenol	Maintain, CF 125	2-chloro-9-hydroxy-9H-fluorene-9-carboxylic acid
chlorimuron	Classic	2-[[[[[(4-chloro-6-methoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoic acid
chlorsulfuron	Glean, Telar	2-chloro-N-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl] benzenesulfonamide
clethodim	Prism, Select	(E,E)-(±)-2-[1-[[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one
clomazone	Command	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone

<u>Common Name</u>	<u>Trade Name</u>	<u>Chemical Name</u>
clopyralid	Reclaim, Stinger, Transline	3,6-dichloro-2-pyridinecarboxylic acid
cloransulam	FirstRate	3-chloro-2-[[[(5-ethoxy-7-fluoro[1,2,4]triazolo[1,5-c]pyrimidin-2yl)sulfonyl]amino]benzoic acid
copper sulfate	Copper Sulfate	copper sulfate
cyanazine	Bladex, Cy-Pro	2-[[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl]amino]-2-methylpropanenitrile
cycloate	Ro-Neet	S-ethyl cyclohexylethylcarbamothioate
cyclosulfamuron	Ichiyonmaru, Nebiros	N-[[[2-(cyclopropylcarbonyl)phenyl]amino]sulfonyl]-N'-(4,6-dimethoxy-2-pyrimidinyl)urea
cyhalofop	Clincher	(R)-2-[4-(4-cyano-2-fluorophenoxy)phenoxy]propanoic acid
2,4-D	many	(2,4-dichlorophenoxy)acetic acid
dazomet	Basamid	tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione
2,4-DB	Butoxone, Butyrac	4-(2,4-dichlorophenoxy)butanoic acid
DCPA	Dacthal	dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate
desmedipham	Betanex	ethyl[3-[[[(phenylamino)carbonyl]oxy]phenyl]carbamate
dicamba	Banvel, Clarity, Vanquish	3,6-dichloro-2-methoxybenzoic acid
dichlobenil	Casoron, Dyclomec, Norosac	2,6-dichlorobenzonitrile
dichlorprop	Weedone 2,4-DP	(±)-2-(2,4-dichlorophenoxy)propanoic acid
diethatyl	Antor	N-(chloroacetyl)-N-(2,6-diethylphenyl)glycine
diclofop	Hoelon, Illoxan	(±)-2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid
diclosulam	Strongarm	N-(2,6-dichlorophenyl)-5-ethoxy-7-fluoro[1,2,4]triazolo[1,5-c]pyrimidine-2-sulfonamide
difenzoquat	Avenge	1,2-dimethyl-3,5-diphenyl-1H-pyrazolium
dimethanamid	Frontier	2-chloro-N-(2,4-dimethyl-3-thienyl)-N-(2-methoxy-1-methylethyl)acetamide
dimethanamid-P	Frontier X-2, Outlook	(S)-2-chloro-N-(2,4-dimethyl-3-thienyl)-N-(2-methoxy-1-methylethyl)acetamide
diphenamid	Enide	N,N-dimethyl-a-phenyl benzeneacetamide
diquat	Diquat, Reglone, Reward	6,7-dihydrodipyrido[1,2-a:2',1'-c]pyrazinediiumion
dithiopyr	Dimension, Stakeout	S,S-dimethyl 2-(difluoromethyl)-4-(2-methylpropyl)-6-trifluoromethyl)- 3,5-pyridinedicarbothioate
diuron	Karmex, Direx	N'-(3,4-dichlorophenyl)-N,N-dimethylurea
DSMA	Ansar, many	disodium salt of MAA
endothall	Aquathol, Accelerate, Desicate, H-273	7-oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
EPTC	Eptam, Genep	S-ethyl dipropyl carbamothioate
ethalfuralin	Sonalan, Curbit, Edge	N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)benzenamine
ethametsulfuron	Muster	2-[[[[[4-ethoxy-6-(methylamino)-1,3,5-triazin-2-yl]amino]carbonyl]amino]sulfonyl]benzoic acid

<u>Common Name</u>	<u>Trade Name</u>	<u>Chemical Name</u>
ethofumesate	Nortron, Progress	(±)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate
fenoxaprop	Acclaim, Horizon, Puma, Whip	(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoic acid
florasulam	Primus, Boxer	N-(2,6-difluorophenyl)-8-fluoro-5-ethoxy[1,2,4]triazolo[1,5-c]pyrimidine-2-sulfonamide
fluazifop	Fusilade, Horizon, Ornamec, Tornado	(R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid
flucarbazone	Everest	4,5-dihydro-3-methoxy-4-methyl-5-oxo-N-[[2-(trifluoromethoxy)phenyl]sulfonyl]-1H-1,2,4-triazole-1-carboxamide
flufenacet	Define	N-(4-fluorophenyl)-N-(1-methylethyl)-2-[[5-(trifluoromethyl)-1,3,4-thiadiazol-2-yl]oxy]acetamide
flumetsulam	Python	N-(2,6-difluorophenyl)-5-methyl[1,2,4]triazolo[1,5-a]pyrimidine-2-sulfonamide
flumiclorac	Resource	[2-chloro-4-fluoro-5-(1,3,4,5,6,7-hexahydro-1,3-dioxo-2H-isoindol-2-yl)phenoxy]acetic acid
flumioxazin	Broadstar, Flumizin, Sumisoya, Valor	2-[7-fluoro-3,4-dihydro-3-oxo-4-(2-propynyl)-2H-1,4-benzoxazin-6-yl]-4,5,6,7-tetrahydro-1H-isoindole-1,3(2H)-dione
fluometuron	Cotoran	N,N-dimethyl-N'-[3-(trifluoromethyl)phenyl]urea
flupoxam		1-[4-chloro-3-[(2,2,3,3,3-pentafluoropropoxy)methyl]-phenyl]-5-phenyl-1H-1,2,4-triazole-3-carboxamide
flupropacil		1-methylethyl 2-chloro-5-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2H)-pyrimidinyl]benzoate
fluridone	Sonar	1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4(1H)-pyridinone
fluroxypyr	Starane, Tomahawk, Vista	[(4-amino-3,5-dichloro-6-fluoro-2-pyridinyl)oxy]acetic acid
fomesafen	Reflex, Flexstar	5-[2-chloro-4-(trifluoromethyl)phenoxy]-N-(methylsulfonyl)-2-nitrobenzamide
fosamine	Krenite	ethyl hydrogen (aminocarbonyl)phosphonate
glufosinate	Finale, Liberty, Rely	2-amino-4-(hydroxymethylphosphinyl)butanoic acid
glyphosate	Accord, Honcho, Ranger, Rodeo, Roundup, Touchdown	N-(phosphonomethyl)glycine
halosulfuron	Manage, Permit, Sandea, Sempra	3-chloro-5-[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-1-methyl-1H-pyrazole-4-carboxylic acid
hexazinone	Pronone, Velpar	3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione
imazamethabenz	Assert	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-4-(and 5)-methylbenzoic acid (3:2)
imazamox	Raptor, Odessey	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imiazol-2-yl]-5-(methoxymethyl)-3-pyridinecarboxylic acid
imazapyc	Cadre, Plateau	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid

Common Name	Trade Name	Chemical Name
imazapyr	Arsenal, Chopper, Stalker	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid
imazaquin	Scepter, Image	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-quinolinecarboxylic acid
imazethapyr	Pursuit	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid
isoproturon		N,N-dimethyl-N'-[4-(1-methylethyl)phenyl]urea
isoxaben	Gallery	N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide
isoxaflutole	Balance, Balance Pro	(5-cyclopropyl-4-isoxazolyl)[2-(methylsulfonyl)-4-(trifluoromethyl)-phenyl]methanone
ketospiradox		2-[[2,3dihydro-5,8-dimethyl-1,1-dioxidospiro[4H-1-benzothiopyran-4,2'-[1,3]dioxolan]-6-yl]carbonyl]-1,3-cyclohexanedione ion(1-)
lactofen	Cobra	(±)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate
linuron	Lorox, Linex, Afolan	N'-(3,4-dichlorophenyl)-N-methoxy-N-methylurea
maleic hydrazide	Royal MH30, Royal Slo-Gro	1,2-dihydro-3,6-pyridazinedione
MCPA	many	(4-chloro-2-methylphenoxy)acetic acid
MCPB	Cantrol, Thistrol	4-(4-chloro-2-methylphenoxy)butanoic acid
mecoprop	Mecomec, Super Chickweed Killer	(±)-2-(4-chloro-2-methylphenoxy)propanoic acid
mefluidide	Embark, Vistar	N-[2,4-dimethyl-5-[[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide
mesotrione	Callisto	2-(4-mesy-2-nitrobenzoyl)-3-hydroxycyclohex-2-enone
metamifop		(R)-2-[4-(6-chloro-1,3-benzoxazol-2-yloxy)phenoxy]-2-fluoro-N-methylpropionanilide
metham	Vapam	methylcarbamodithioic acid
metolachlor	Dual, Pennant	2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide
s-metolachlor	Cinch, Dual Magnum Pennant Magnum	2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide, S-enantiomer
metosulam		N-(2,6-dichloro-3-methylphenyl)-5,7-dimethoxy[1,2,4]triazolo[1,5-a]pyrimidine-2-sulfonamide
metribuzin	Sencor	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one
metsulfuron	Ally, Cimarron, Escort	2-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoic acid
molinate	Ordram	S-ethyl hexahydro-1H-azepine-1-carbothioate
MSMA	Ansar, Arsonate Liquid, Bueno, Daconate	monosodium salt of MAA
napropamide	Devrinol	N,N-diethyl-2-(1-naphthalenyloxy)propanamide
naptalam	Alanap	2-[(1-naphthalenylamino)carbonyl]benzoic acid

Common Name	Trade Name	Chemical Name
nicosulfuron	Accent	2-[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-N,N-dimethyl-3-pyridinecarboxamide
norflurazon	Evital, Solicam, Predict, Zorial	4-chloro-5-(methylamino)-2-(3-(trifluoromethyl)phenyl)-3(2H)-pyridazinone
oryzalin	Surflan	4-(dipropylamino)-3,5-dinitrobenzenesulfonamide
oxadiazon	Ronstar	3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one
oxyfluorfen	Goal	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene
paraquat	Boa, Cyclone, Gramoxone Extra, Gramoxone Max, Starfire	1,1'-dimethyl-4,4'-bipyridinium ion
pebulate	Tillam	S-propyl butylethylcarbamoithioate
pelargonic acid	Scythe	nonanoic acid
pendimethalin	Pentagon, Pendulum, Prowl	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine
phenmedipham	Spin-Aid	3-[(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate
picloram	Tordon, Grazon	4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid
primisulfuron	Beacon, Rifle	2-[[[(4,6-bis(difluoromethoxy)-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoic acid
prodiamine	Barricade, Factor, RegalKade	2,4 dinitro-N3,N3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine
prometon	Pramitol	6-methoxy-N,N'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine
prometryn	Caparol, Cotton Pro	N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
pronamide	Kerb	3,5-dichloro (N-1,1-dimethyl-2-propynyl)benzamide
propachlor	Ramrod	2-chloro-N-(1-methylethyl)-N-phenylacetamide
propanil	Propanil, Stam, Superwham	N-(3,4-dichlorophenyl)propanamide
pyrazon	Pyramin	5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone
pyridate	Lentagran, Tough	O-(6-chloro-3-phenyl-4-pyridazinyl) S-octyl carbonothioate
pyrithiobac	Staple	2-chloro-6-[(4,6-dimethoxy-2-pyrimidinyl)thio]benzoic acid
quinclorac	Drive, Facet, Impact	3,7-dichloro-8-quinolinecarboxylic acid
quizalofop	Assure II	(±)-2-[4-[(6-chloro-2-quinoxalanyl)oxy]phenoxy]propanoic acid
rimsulfuron	Matrix	N-[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-3-(ethylsulfonyl)-2-pyridinesulfonamide
sethoxydim	Poast, Vantage	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one
siduron	Tupersan	N-(2-methylcyclohexyl)-N'-phenylurea
simazine	Aquazine, Princep, many	6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine
sodium chlorate	Defol	sodium chlorate

<u>Common Name</u>	<u>Trade Name</u>	<u>Chemical Name</u>
sulfentrazone	Authority, Spartan	N-[2,4-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]phenyl]methanesulfonamide
sulfometuron	Oust	2-[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoic acid
tebuthiuron	Spike	N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea
terbacil	Sinbar	5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H,3H)-pyrimidinedione
thiazafluron	Dropp	N,N'-dimethyl-N-[5-(trifluoromethyl)-1,3,4-thiadiazol-2-yl] urea
thiazopyr	Mandate, Visor	methyl 2-(difluoromethyl)-5-(4,5-dihydro-2-thiazolyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-3-pyridinecarboxylate
thifensulfuron	Cheyenne, Harmony	3-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]-2-thiophenecarboxylic acid
thiobencarb	Bolero	S-[(4-chlorophenyl)methyl]diethylcarbamoate
trallate	Far-Go, Avadex, Showdown	S-(2,3,3-trichloro-2-propenyl) bis(1-methylethyl) carbamoate
triasulfuron	Amber	2-(2-chloroethoxy)-N-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl] benzenesulfonamide
tribenuron	Express	2-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)methylamino]carbonyl]amino]sulfonyl]benzoic acid
triclopyr	Garlon, Grandstand, Pathfinder, Remedy, Turflon	[(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid
trifluralin	Treflan, Tri-4, Trilin, many	2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine
triflusulfuron	UpBeet	2-[[[(4-(dimethylamino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]-3-methylbenzoic acid
vernolate	Vernam	S-propyl dipropylcarbamoate

COMMON PRE-PACKAGED HERBICIDES

Common Pre-packaged Herbicides and Common Name of the Component Chemicals

Trade Name	Common Name of Individual Herbicides
Accent Gold	clopyralid + flumetsulam + nicosulfuron + rimsulfuron
Axiom	flufenacet + metribuzin
Backdraft	glyphosate + imazaquin
Basis	rimsulfuron + thifensulfuron
Basis Gold	atrazine + nicosulfuron + rimsulfuron
Betamix	desmedipham + phenmedipham
Bicep II Magnum	atrazine + s-metolachlor
Bicep Lite II Magnum	atrazine + s-metolachlor
Bison	bromoxynil + MCPA
Boundary	s-metolachlor + metribuzin
Bronate	bromoxynil + MCPA
Brushmaster	dicamba + 2,4-D + 2,4-DP
Buckle	triallate + trifluralin
Bullet	alachlor + atrazine
Canopy	chlorimuron + metribuzin
Canopy XL	chlorimuron + sulfentrazone
Celebrity	dicamba + nicosulfuron
Chaser	triclopyr + 2,4-D
Cheyenne	fenoxapropethyl + MCPA + thifensulfuron + tribenuron
Cimarron Max	dicamba + metsulfuron + 2,4-D
Cinch ATZ	atrazine + s-metolachlor
Comman Xtra	clomazone + sulfentrazone
Confront	clopyralid + triclopyr
Cool Power	dicamba + MCPA + triclopyr
Crossbow	triclopyr + 2,4-D
Curtail	clopyralid + 2,4-D
Dakota	fenoxaprop + MCPA
Degree Xtra	acetachlor + atrazine
Dissolve	mecoprop + 2,4-D + 2,4-DP
Distinct	dicamba + diflufenzopyr
Domain	FOE5043 + metribuzin
Eclipse	clopyralid + MCPA + 2,4-DP
Epic	FOE5043 + isoxaflutole
Eradicane	dichlormid + EPTC
Eradicane Extra	EPTC + dichlormid + dietholate
Event	imazapyr + imazethapyr
Exceed	primisulfuron + prosulfuron
Extreme	glyphosate + imazethapyr
FieldMaster	acetochlor + atrazine + glyphosate
Finesse	chlorsulfuron + metsulfuron
Fire Power	glyphosate + oxyfluorfen
Fuego	dicamba + triasulfuron
FulTime	acetochlor + atrazine
Fusion	fenoxaprop + fluazifop
Gauntlet	cloransulam + sulfentrazone

Trade Name	Common Name of Individual Herbicides
Genep Plus	dichlormid + EPTC
Guardman Max	atrazine + dimethenamid
Harmony Extra	thifensulfuron + tribenuron
Grazon P+D	picloram + 2,4-D
Harness Xtra	acetochlor + atrazine
Horizon 2000	fenoxaprop + fluazifop
Hornet	clopyralid + flumetsulam
Horsepower	dicamba + triclopyr + 2,4-D
Kansel Plus	oxadiazon + pendimethalin
Keystone	acetachlor + atrazine
Krovar	bromacil + diuron
Laddok S-12	atrazine + bentazon
Landmaster	glyphosate + 2,4-D
Lariat	alachlor + atrazine
Liberty ATZ	atrazine + glufosinate
Lightning	imazapyr + imazethapyr
Marksman	atrazine + dicamba
Millennium Ultra	clopyralid + dicamba + 2,4-D
Millennium Ultra Plus	clopyralid + dicamba + 2,4-D + MSMA
Momentum	clopyralid + triclopyr + 2,4-D
NorthStar	dicamba + primisulfuron + prosulfuron
Oasis	imazapic + 2,4-D
OH2 (Ornamental Herbicide)	oxyfluorfen + pendimethalin
Oustar	hexainone + sulfometuron
Power Zone	carfentrazone + dicamba+ mecoprop + MCPA
PrePair	napropamide + oxadiazon
Preview	chlorimuron + metribuzin
Prompt	atrazine + bentazon
QuickPro	diquat + glyphosate
Ready Master ATZ	atrazine + glyphosate
Redeem	clopyralid + triclopyr
Regal O-O	oxadiazon + oxyfluorfen
RegalStar	oxadiazon + prodiamine
Resolve SG	dicamba + imazethapyr
Rhino	atrazine + butylate
Rout	oryzalin + oxyfluorfen
Sahara	diuron + imazapyr
Shotgun	atrazine + 2,4-D
Simazat	atrazine + simazine
Snapshot	isoxaben + trifluralin
Speed Zone	carfentrazone + dicamba + mecoprop + 2,4-D
Spirit	primisulfuron + prosulfuron
Squadron	imazaquin + pendimethalin
Stampede	MCPA + propanil
Steadfast	nicosulfuron + rimsulfuron
Steadfast + ATZ	atrazine + nicosulfuron + rimsulfuron
Steel	imazaquin + imazethapyr + pendimethalin
Stellar	flumiclorac + lactofen

Trade Name	Common Name of Individual Herbicides
Sterling Plus	atrazine + dicamba
Storm	acifluorfen + bentazon
Strategy	clomazone + ethafluralin
Stronghold	imazapyre + imazethapyr + mefluidide
Sutan+	butylate + dichlormid
Synchrony STS	chlorimuron + thifensulfuron
Team	benefin + trifluralin
Telone C17	chloropicrin + dichloropropene
Tiller	fenoxaprop + MCPA + 2,4-D
Total	bromacil + diruon + sodiumchlorate + sodium metaborate
Triamine	mecoprop + 2,4-D + 2,4-DP
Tri-Ester	mecoprop + 2,4-D + 2,4-DP
Trimec992	dicamba + mecoprop + 2,4-D
Trimec Classic	dicamba + mecoprop + 2,4-D
Trimec Super	dicamba + dichlorprop + 2,4-D
Tri-Scept	imazaquin + trifluralin
Trupower	clopyralid + dicamba + MCPA
Typhoon	fluazifop + fomesafen
Vengeance	dicamba + MCPA
WeedERad	CMA/MAA
Weedmaster	dicamba + 2,4-D
XL 2G	benefin + oryzalin
Yukon	dicamba + halosulfuron

EXPERIMENTAL HERBICIDES

<u>Experimental Number</u>	<u>Common Name (proposed)/Trade Name, Company Name</u>
AC-900001	picolinafen/Pico, BASF
AEF-115008	iodosulfuron/Husar, Bayer
AEF-130060	mesosulfuron/Falcon, Bayer
AEF-130360	foramsulfuron/Equip, Option, Bayer
BAS 620	tepraloxymid/Aramo, Equinox, Honest, BASF
BAS 654	diflufenopyr, BASF
BAY MKH 6561	propoxycarbazone/Attribute, Olympus, Bayer or Rapsol, Sumitomo
BK-800	Uniroyal
CGA-152005.....	prosulfuron/Peak, Syngenta
CGA-184927.....	clodinafop-propargyl/Discover, Syngenta
CGA-248757.....	fluthiacet/Action, Appeal, Syngenta
CGA-277476.....	oxasulfuron/Dynam, Syngenta
CGA-362622.....	trifloxysulfuran/Enfield, Syngenta
ICIA-0604	tralkoxydim/Achieve, Syngenta
ET-751.....	pyraflufen/Ecopart, Milan, Nihon Nohyaku
MON-13900.....	furilazole, Monsanto
MON-37500.....	sulfosulfuron/Maverick, Monsanto
S-3153.....	flufenapyr, Valent
UBH-820.....	beflubutamid, Ube Industries
V10029	bispyribac/Regiment, Kumiai/Valent
.....	alloxydim/Clout, Bayer
.....	cinidon/Lotus, Bingo, BASF
.....	flazasulfuron/Mission, Syngenta
.....	fluzolate (JV 485), Bayer, Monsanto
.....	fluthuacet/Appeal, Kumiai
.....	fluzasulfuron/Mission, Katana, Syngenta
.....	oxadiargyl/Top Star, Bayer
.....	pethoxamid/Koban, Successor 600, Tohonyama
.....	propoxycarbazone/Rapsol, Sumitomo
.....	sulcotrione/Galleon, Bayer
.....	tritosulfuron/Corto, BASF

COMMON AND TRADE NAMES OF PLANT GROWTH REGULATORS

<u>Common Name</u>	<u>Trade Name</u>
ammonium thiosulfate	
aviglycine (AVG).....	Retain
6-benzyl adenine	BAP-10
chlorflurecol	Maintain
chlormequat chloride	Cycocel
clofencet	Detasselor
copper ethylenediamine	Inferno
CPPU.....	
diethylamine	
diminozide	B-nine
diphenylamine	
1,2,6-DIPN.....	Amplify
ethephon	Florel
forchlorfenuron	
GA 4 7/G BA.....	Promalin, Rite Size
gibberellic acid.....	Release, Ryzup, Provide
glutamic acid.....	Auxigro
LPE 94T	
MBTA	Ecolyst
mepiquat chloride	Pix
NAA	
paclobutrazol	Bonzi, Clipper, Trimmet
prohexadione.....	Apogee
sodium nitrophenolate	Atonik
trinexapac.....	Palisade, Primo
uniconazole	Prunit, Sumagic
1-methyl cyclopropene (1-MCP).....	Ethyl Bloc

COMMON AND CHEMICAL NAMES OF HERBICIDE MODIFIERS

<u>Common name</u>	<u>Chemical name</u>
benoxacor.....	(RS)-4-dichloroacetyl-3,4-dihydro-3-methyl-2H-1,4-benzoxazine
cloquintocet	(5-chloroquinolin-8-yloxy)acetic acid
cyometrinil	(Z)- α -[(cyanomethoxy)imino]benzeneacetonitrile
dichlormid	2,2-dichloro-N,N-di-2-propenylacetamide
dicyclonon.....	1-(dichloroacetyl)hexahydro-3,3,8a-trimethylpyrrolo[1,2- α]pyrimidin-6(2H)-one
dietholate	O,O-diethyl O-phenyl phosphorothioate
fenchlorazole	1-(2,4-dichlorophenyl)-5-(trichloromethyl)-1H-1,2,4-triazole-3-carboxylic acid
fencloirim.....	4,6-dichloro-2-phenylpyrimidine
flurazole	phenylmethyl-chloro-4-(trifluoromethyl)-5-thiazolecarboxylate
fluxofenim	1-(4-chlorophenyl)-2,2,2-trifluoroethanone O-(1,3-dioxolan-2-ylmethyl)oxime
furilazole	3-(dichloroacetyl)-5-(2-furanyl)-2,2-dimethyloxazolidine
isoxadifen	4,5-dihydro-5,5-diphenyl-3-isoxazolecarboxylic acid
mefenpyr	1-(2,4-dichlorophenyl)-4,5-dihydro-5-methyl-1H-pyrazole-3,5-dicarboxylic acid
mephenate	4-chlorophenyl methylcarbamate
naphthalic anhydride	1H,3H-naphtho[1,8-cd]-pyran-1,3-dione
oxabetrinil	α -[(1,3-dioxolan-2-yl)methoxyimino]benzeneacetonitrile

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