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# LIFE HISTORY STUDIES AS RELATED TO WEED CONTROL IN THE NORTHEAST

## 8. Common Ragweed

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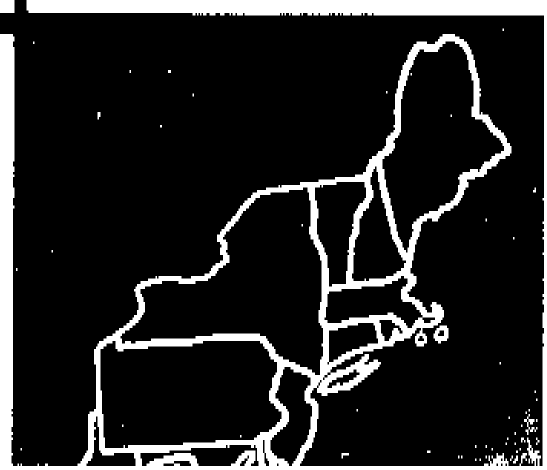

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This bulletin is one of a series pertaining to life history studies of weeds that are important in the Northeastern States. The series is being published by the Northeast Regional Weed Control Technical Committee (NE-42).

Bulletins previously published deal with the following weeds: **nutgrass** (Rhode Island Agr. Exp. Sta. Bul. 364, 1962), **quackgrass** (Rhode Island Agr. Exp. Sta. Bul. 365. 1962), **horsenettle** (Rhode Island Agr. Exp. Sta. Bul. 368, 1962), **yellow foxtail and giant foxtail** (Rhode Island Agr. Exp. Sta. Bul 369. 1963), **barnyardgrass** (Delaware Agr. Exp. Sta. Bul. 368, 1968), **large and small crabgrass** (Storrs [Conn.] Agr. Exp. Sta. Bul. 415. 1971), **common purslane**, (U. of Mass. Res. Bul. 598. 1972).

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# TABLE OF CONTENTS

# LIFE HISTORY STUDIES AS RELATED TO WEED CONTROL IN THE NORTHEAST

## 8 — Common Ragweed

## INTRODUCTION

Common ragweed (*Ambrosia artemisiifolia* L.), a member of the Compositae family, is a serious problem weed in the northeastern United States. Because it is an aeroallergin, probably no other weed has as great an effect on the population of the region. Estimates indicate that 3 to 5 percent of the population is sensitive to its pollen (Solomon 1967). If only 1 out of 10 of those persons sensitive to ragweed pollen is seriously hampered in his or her work, then value of lost time could easily reach $1 million per day during the 3- to 4-week period of peak flowering. The economic losses to the agriculture of the region are difficult to estimate. Ragweed is a known pest in small grains, in some forages, and in row crops. It can cause lowered crop yields and reduced quality and often interferes with harvest. However, the extent and frequency of these various losses have not been reported with any degree of accuracy. For certain high-value vegetables where no satisfactory controls exist, losses can be as much as $300 to $500 per acre. On the other hand, in crops such as corn, even severe infestations can be adequately controlled for only $6 to $10 an acre.

In 1966 the Technical Committee of the Northeastern Regional Research Project NE-42 began a cooperative study on the life cycle, ecology, and control of common ragweed. The states involved were New Hampshire, New York, and West Virginia. This publication sets forth their principal findings as well as pertinent information from other studies.

## CHARACTERISTICS OF RAGWEED

### Nomenclature, Description, and Habit

Common ragweed (*Ambrosia artemisiifolia* L.) is also known by several other common names such as small, short, and low ragweed; Roman wormweed; bitterweed; hogweed; wild pansy; Mayweed; hay fever weed; and blackweed. It is an annual, belonging to the Compositae family, and is one of 41 species of the genus *Ambrosia* (Fernald 1950; Payne 1966). Payne (1962) considered the following to be synonyms for *Ambrosia artemisiifolia* L.:

*A. artemisiifolia elatior* (L.) Descourtilz
*A. diversifolia* (Piper) Rydberg
*A. elatior* L.
*A. glandulosa* Rydberg
*A. maritima* L.
*A. media* Rydberg

Technical descriptions of common ragweed are available in many publications (Fernald 1950; Gleason 1963; Hitchock et al. 1955; Muenscher 1950; Wagner and Beals 1958; Payne 1962).

Dickerson (1968) chose to utilize the detailed description and terminology of Payne (1962) for common ragweed because of the latter's familiarity with both this species and its close relatives. Since Dickerson (1968, 1971) was a principal source for this bulletin, his summary of Payne's description and terminology is reprinted here:

> Annual, upright herb. Stem 0.5 to 19 dm high, pubescent, scabrous to villous, often marked or suffused with red; much branched from median or lower nodes when grown in the open, branches in northern forms often over-topping the terminal spike of the main shoot. Leaves opposite at lower nodes, alternate above; petiolate. Petioles from 2 to 6 cm long, usually somewhat ciliate; very narrowly winged by extension of the lamina to the stem. Lamina green on both sides, sometimes paler beneath; usually delicately scabrous-pubescent, minutely glandular with a resinous odor when crushed; broadly ovate to narrowly lanceolate in outline; median blades 5 to 20 cm long, 3 to 15 cm wide, rarely larger or smaller; unlobed to tripinnately lobed; margin remotely toothed, the distinction between ultimate lobes and teeth often obscure. Primary lobes linear or narrowly lanceolate to broadly lanceolate or ovate; secondary lobes usually present; tertiary lobes frequently present; small, subsidiary lobes occasionally present, inserted on midrib between primary lobes. Staminate heads in elongate spikes terminating primary, secondary and teritary branches; normally pedicellate, pedicels 0.5 to 3 mm long, rarely subsessile or over 10 mm. Staminate involucres 2 to 6 mm broad, broadly obconic to round, slightly scabrous, glandular, usually shallowly crenulate margined; outer surface uniformly green, center sometimes darkening upon drying. Staminate florets somewhat shorter than to over-topping the involucre, 10 to 60 per head. Paleae shorter than to as long as the florets, filiform. Pistillate involucres in small clusters in the axils of leaves and bracts subtending the male spike, occasionally occupying the male spike to the partial or complete exclusion of the staminate involucres; more or less obliquely turbinate, rugose, somewhat angled, 1.3 to 3.5 mm broad, 2.0 to 4.5 mm long, often marked with brown streaks or blotches. Spines of the fruiting involucre usually appearing as a single whorl of 5 to 10, terete, sharp emergences, 0.15 to 0.8 mm long.

Kummer (1951) described the seedlings of common ragweed as follows:

> Tap root prominent, adventitious and lateral roots sturdy. Hypocotyl splotched madder-purple or brownish purple above ground; rigid and tough. Seed leaves 2.5 × 7 – 4 × 13 mm; smooth; bases undiverged to form a very shallow cup, the stalks grooved; margins purple-dotted at first.

Germination is generally in the early spring, plants become 2–4 feet tall, flowers form as the daylength shortens, and the entire plant is killed by frost. Dickerson (1968) reported extreme variations in plant morphology within a seed lot collected at one site (Fig. 1). However, no controlled studies were done to determine if individual plants are relatively homogenous or heterogenous in regard to morphology.

## Distribution

Common ragweed is generally considered to be native to North America. Various reports show that it occurs in the Canadian provinces and throughout most of the United States except the Southwest, namely Arizona, New Mexico, Colorado, Utah, Nevada, southern California, and northwestern Texas. To a limited extent, common ragweed has been reported in Asia, Europe, and South America.

In the northern United States, common ragweed is widely distributed and often occurs in heavy infestations. In the vicinity of Washington, D.C., and on the Delaware, Maryland, and Virginia peninsula, it is especially prevalent in small grains. When the grains are harvested,

**Figure 1. Plants grown in the greenhouse from a single seed lot varied remarkably in height and foliage, as shown here.**

ragweed is released from the competition provided by the crop. It makes moderate vegetative growth and then flowers profusely, enormously contaminating the air with its pollen. Ragweed is also found in cultivated row crops such as corn, soybeans, dry beans, tomatoes, and potatoes unless an effective herbicide has been used. Recently abandoned cultivated fields are often heavily infested, but rarely for more than 3 years. Other important areas of infestation are along roadways where perennials have not become established, on freshly excavated earth spoil banks, and at entrances to rodent burrows. Common ragweed rarely grows where tight sod exists, even though viable seeds are present.

## Interspecific Crosses

Ragweeds have a remarkable ability to form interspecific hybrids. The first such hybrid to be described was that of *A. artemisiifolia* x *A. trifida* (Wylie 1915). Other hybrids that have been reported are:

*A. artemisiifolia* x *psilostachya* (Wagner and Beals 1958)
*A. artemisiifolia* x *peruviana* (Payne 1962)
*A. artemisiifolia* x *acanthicarpa* (Payne 1962)

Payne (1962) concluded that although interspecific crosses do occur with fair regularity, there is no evidence that these hybrids have had any major role in determining distribution, prevalence, or severity of infestation of ragweed in eastern North America.

## Anatomy

Holm (1917) published a detailed description of common ragweed. Esau (1960) illustrated a stem cross section with an endodermis having a Casparian strip. She pointed out that this is an unusual type of differentiation for stems of angiosperms. Dickerson (1968) confirmed this unusual characteristic and further noted a Casparian strip in the endodermis of the root. He also confirmed the report of Holm (1917) that secretory canals containing oil were present in the primary root. Dickerson (1968) stated that these canals apparently arise schizogenously and are formed by cortical cells adjacent to the endodermis and by endodermal cells. The secondary phloem contained sieve tube members with a simple perforation plate, companion cells, and paraenchyma. The xylem contained numerous vessels, tracheids, and paraenchyma. Staining with potassium iodide-iodine (IKI) did not indicate the presence of starch.

Dickerson (1968) reported that older stems contained an epidermis with thickened inner tangential walls and a distinct cuticle. Multi-cellular unbranched hairs were found on the surface. A hypodermis of lacunar collenchyma, 1 to 5 cells thick, was observed. A distinct endodermis with a Casparian strip was readily seen in longitudinal sections. In the mature stem, bundle caps of sclerenchyma fibers were found on each vascular bundle. The phloem was composed of parenchyma cells and sieve elements with companion cells. The xylem was composed of vessels, tracheids, and parenchyma cells. Many of the parenchymatic pith cells contained raphides. Holm (1917) reported that these "crystals" were calcium oxalate.

Holm (1917) described a transverse section of the leaf as being composed of 2 compact strata of high palisade cells on the ventral face, covering a pneumatic tissue of 3 layers, more open and of shorter cells; the hypodermal side frequently representing palisades, though shorter and less compact than the ventral. Dickerson (1968) found 1 compact continuous palisade layer and a second discontinuous layer. Holm (1917) reported that 3 systems of "oil ducts" could be observed in the midrib of the leaf. The first system was in the parenchyma outside the vascular bundles, the second in the periphery of the phloem, and the third in the "pith" inside the vascular bundles, which is the same arrangement as the stem. Dickerson (1968) found similar structures, but staining did not reveal any contents that could be identified.

## SEED INVESTIGATIONS

### Germination in the Field

Growers generally report that common ragweed emerges relatively early in the spring as compared with other broad-leaved weeds. A few report that their crops were "clean" at the time of last cultivation, but that ragweed was a problem at harvest time.

In New York several fields reported to be heavily infested with common ragweed were selected in central and western parts of the state. Observations were made as to initial and subsequent emergence. Most of the seedlings emerged in April and May, and, even with cultivation, rainfall, and sprinkler irrigation, subsequent flushes of common ragweed were quite minor. At time of last cultivation, so-called clean fields often had a stand of relatively inconspicuous seedlings some of which developed into prominent weeds at harvesttime.

Dickerson (1968) reported results of several field experiments on the time of emergence in natural as well as planted stands, the effects of different dates of seeding on emergence, and the influence of temperature on emergence. He conducted tests on both a gravelly loam and a silt loam near Ithaca, New York and, to examine the influence of aeration, he rototilled certain plots. By suspending clear and black polyethylene film about 14 inches above the soil, temperature differences of 16°C were obtained during the germination period.

TABLE 1. Number of ragweed seedlings per square meter as influenced by tillage and soil temperature

| Treatment | Date | | | |
|---|---|---|---|---|
| Sandy loam | June 6 | June 20 | July 20 | Oct. 6 |
| Undisturbed | 8,034 | 29 | 6 | 1 |
| Rototilled May 26 | 38 | 8 | 2 | 1 |
| Silt loam | June 8 | July 6 | Aug. 14 | Oct. 6 |
| Undisturbed | 1,898 | 162 | 37 | 10 |
| Rototilled May 26 | 310 | 201 | 13 | 7 |
| Rototilled+warmed† | 67 | 69 | 3 | 1 |
| Rototilled+cooled‡ | 272 | 259 | 2 | 1 |

†Clear plastic suspended 14 in. above soil surface.
‡Black plastic suspended 14 in. above soil surface.

The most striking data were obtained from undisturbed plots in a heavy natural infestation (Table 1). On the silt loam, more than 8000 seedlings per square meter had emerged by early June, and less than 50 additional seedlings emerged in the next 3 months. In plots rototilled in late May, only 38 seedlings emerged in early June, and only 9 more seedlings emerged in the next 3 months.

It is probable that in the undisturbed plots with a heavy natural stand, large numbers of seed were on the surface. In rototilled plots, seed were buried at all levels down to about 12 cm.—the depth of rototilling—but only those in the very shallowest layers germinated. Rototilling did not influence soil temperature; however, plastic covers caused great differences at a depth of 1 cm (Table 2).

In tests with seeds planted 1 cm deep in both sandy loam and silt loam soil on 6 different dates, at least 20 percent emergence was obtained in every treatment (Table 3). The fact that the temperature of the sandy soil averaged several degrees higher than that of the silt loam, may account for

TABLE 2. Influence of rototilling and plastic covers on temperatures °C of silt loam soil at 1 cm

| Treatment | °C | |
|---|---|---|
| | Maximum | Minimum |
| Not disturbed | 36 | 13 |
| Rototilled | 37 | 12 |
| Rototilled+clear plastic† | 41 | 16 |
| Rototilled+black plastic† | 25 | 13 |

†Plastic sheets suspended 14 in. above soil surface.

TABLE 3. Percentage emergence of common ragweed from 200 seeds planted at 1 cm depth as influenced by planting date and location

| Date of planting | Location and soil: Freeville Eel silt loam | Location and soil: Ithaca Arkport fine sandy loam |
|---|---|---|
| May 13 | | 48 |
| May 22 | 63 | |
| May 26 | 59 | 25 |
| June 9 | 44 | 29 |
| June 23 | 48 | 21 |
| July 8 | 32 | 21 |
| LSD,† .05 | 17.3 | 12.2 |
| .01 | NS‡ | 17.0 |

†Least significant differences.
‡Not significant.

the generally lower percentage of emergence on the sand. Moisture levels were not measured; however, it is likely this factor was more favorable on the silt loam.

Longevity of buried common ragweed has been studied over relatively long periods, about 80 years, by Beal (Darlington and Steinbauer 1961) at East Lansing, Michigan, and by DuVel (Toole and Brown 1946) near Baltimore, Maryland. The results of periodical germination tests do not show any consistent trends or patterns. Since little concern was shown for the specific conditions of light, temperature, and depth under which the tests were conducted, it is not likely that true viability was measured in every test. In one periodic test for example, seeds were sown in the greenhouse, and none sprouted. However, after being stored at 10°C for 2 months and retested, some lots germinated 22 percent. Despite these inconsistencies, since at least some seeds germinated even after 39 years, we must conclude that seed of common ragweed can be long-lived under field conditions.

## Germination in the Laboratory and Greenhouse

**Depth.** By studying depth of seeding in several soils in the greenhouse, Dickerson (1968) followed up his findings that rototilling decreases emergence. Emergence of seeds placed at depths greater than 1 cm was greatly reduced, regardless of the medium (Table 4).

The data in Table 4 suggest that rototilling a natural stand buried many seeds too deep for good germination. Subsequent tests over a range of temperatures and moisture levels confirm that seed germinates better on the surface or no more than 1 cm deep than at greater depths.

TABLE 4. Percentage of common ragweed emergence after 28 days from 200 seeds planted at several depths in 3 soils

| Depth (cm) | Hudson clay loam | Eel silt loam | Washed sand | Mean |
|---|---|---|---|---|
| 0 | 74.8 | 72.8 | 51.5 | 66.3 |
| 1 | 23.8 | 30.5 | 66.0 | 40.1 |
| 2 | 21.0 | 26.0 | 42.3 | 29.8 |
| 4 | 10.5 | 13.0 | 0.0 | 7.8 |
| 6 | 2.3 | 5.3 | 0.5 | 2.6 |
| 8 | 0.0 | 0.5 | 0.0 | 0.2 |

**Temperature.** Temperature under field conditions appeared to be important in the germination of common ragweed. Since successive flushes of new seedlings did not occur after the initial early flush, it can be postulated that high temperature prevents germination, perhaps by inducing dormancy. However, in the field, other factors such as lower soil moisture and poorer aeration often accompany the high temperatures of summer.

Dunn (1970)[1], in New Hampshire, investigated the need for a cold period to induce germination of common ragweed. Germination was not affected by a 2-week exposure of either soaked or dry seeds to 5°C. However, even the best results were only 20 percent germination. Since germination of some seed lots is known to be better than 80 percent, these results need to be viewed with caution. On the other hand, Bennett (1971) reported that germination was improved when either dry or moist seed had received a 5°C treatment. He found that a cold treatment lasting between 25 and 571 days had no significant influence. The average germination after cold treatments was about 90 percent, and after room temperature treatments, about 65 percent.

Dickerson (1968) compared alternating temperatures of 10°C-30°C and 20°C-30°C and obtained about 70 percent germination in the former case and only 26 percent germination in the latter. Constant temperatures of the same average, that is 20°C and 25°C, were inferior to the alternating ranges. Alternating temperatures of 30°C-40°C gave only 9 percent germination. These findings suggest that high temperatures in the top 1 cm of soil could readily inhibit germination.

In another test, gibberellic acid was used as a soak and as an imbibing solution, but no effects were observed. Dickerson (1968), working with $NO_3$, $PO_4$, $SO_4$, and Cl salts, reported few overall effects. However, in some specific instances, there was a benefit, particularly if temperature was not optimum.

[1] Dunn, S. Personal communication.

**Imbibing Solutions.** Dunn (1970) reported that imbibing solutions stimulated germination of common ragweed in certain instances. He placed the seeds in petri dishes with filter paper moistened with various concentrations of 4 different chemicals. During the course of the experiment, he added small amounts of distilled water to keep the paper moist. As shown, N, N-dimethyl formamide (N, N-DMF) appeared to be somewhat effective over a range of concentrations for seeds previously exposed to a cold treatment (Table 5).

Bennett (1971) found that presoaking treatments with distilled water increased germination substantially. There seemed to be a slight advantage for 0.3 percent hydrogen peroxide over distilled water. He suggested that further work with this treatment is warranted.

**Light.** Light did not influence germination of common ragweed according to Bennett (1971). However, Maguire and Overland (1959) reported striking beneficial effects on germination from light. Also Anderson (1968) stated that light may be beneficial in germinating common ragweed.

Dunn investigated light quality with several different fluorescent and mercury vapor lamps, making adjustments to insure uniform energy levels for all colors. Generally he found light to be more beneficial than darkness and mercury vapor lamps to be superior to fluorescent ones. Among the fluorescent types, yellow was superior to red, blue, green, or cool white. The standard clear and the gold mercury vapor lamps were

**TABLE 5. Germination of common ragweed following imbibition of 4 chemical solutions**

| Treatment | | 10 ppm | 250 ppm | 2500 ppm |
|---|---|---|---|---|
| | | | *percent* | |
| 2 weeks, 5° C | | | | |
| N,N-DMF† | | 70 | 69 | 66 |
| Ethrel‡ | | 47 | 42 | 46 |
| N-DSA§ | | 30 | 51 | 22 |
| DMSO‖ | | 30 | 31 | 35 |
| Distilled $H_2O$ | 40 | — | — | |
| 2 weeks, room temperature | | | | |
| Ethrel | | 49 | 52 | 53 |
| N-DSA | | 40 | 33 | 1 |
| DMSO | | 50 | 39 | 37 |
| Distilled $H_2O$ | 47 | — | — | — |

†N,N-DMF=N,N-dimethyl formamide.
‡Ethrel=2 chloro ethyl-phosphonic acid.
§N-DSA=n-decenyl succinic acid.
‖DSMO=dimethyl sulfoxide.

better than silver white or color improved ones, which were equal in effect to yellow fluorescent lamps. The significance of the findings on light quality under field conditions is not apparent at this writing. However, the presence of light could readily be a favorable factor for germination of seeds on or very close to the soil surface. Furthermore, this may, at least partly explain why ragweed is not prevalent in tight sod or where perennials are already established.

## GROWTH AND DEVELOPMENT

The objectives of the experiments and observations presented in this section were to define some of the environmental factors that influence the growth and development of common ragweed, to evaluate its competitive ability, and to determine the differences and similarities between populations of common ragweed collected from diverse locations.

Each plant species has environmental requirements that must be met, or it will not survive. When these are in the best balance, luxuriant growth occurs and seeds form abundantly. Often one can make guesses about requirements of a particular species by observing where it occurs. Obviously, if a species appears at a given site for several years, at least its minimum requirements are being met. On the other hand, just because a species grows in a particular place does not necessarily mean that it is the ideal location. Perhaps growth would be better elsewhere, but other, more competitive species may already occupy that site. Thus, one must not assume that locations given in certain data are the sites that provide the ideal conditions for all the species found in them.

Surveys show that ragweed is often located on roadsides, spoil banks, and well-worn playgrounds, as well as among field crops and vegetables. Obviously, great differences exist between these locations with regard to such factors as soil aeration, nutrient level, and moisture content. In fact, the differences are great enough for us to conclude that ragweed can survive over a wide range of soil conditions.

### Date of Planting

Although the germination studies reported earlier indicated that most common ragweed seedlings start early, nonetheless a few do continue to emerge throughout the growing season. Dickerson (1968) conducted several experiments on the dates when ragweed seeds in the field. He wanted to determine whether late- and early-emerging seedlings produce similar plants. This work was conducted near Ithaca and Riverhead, New York, locations about 250 miles apart but at similar latitudes. Detailed measurements were made on plants during the growing season as well as at harvesttime in September. As a means of showing relative reproductive development, he devised the following rating scale:

- 0 no visible staminate or pistillate influorescences
- 5 visible, but nondehiscing staminate heads on 75% of the branches
- 5 – visible florets without seed in 75% of the axils
- 10 staminate fluorescences on nearly all branches
- 10 – florets with seed in nearly all axils

Since the results from the various experiments on planting dates were remarkably similar, only one test – on a sandy soil in Ithaca in 1967 – will be reported (Table 6).

This work clearly indicates that when common ragweed is planted to emerge late in the growing season, the plants are small. Thus, under natural conditions, it is fairly certain that ragweed plants which sprout early and escape control will be relatively large at harvesttime, whereas those that emerge late are almost certain to be much smaller. However, as Table 6 shows, even these small plants produce more than 3000 seeds

**TABLE 6. Growth and development of common ragweed at Ithaca in 1967, as influenced by date of planting**

| Planting date | Parameter observed: Height | Spread | Fresh weight | Dry weight | Fr. wt./ dry wt. |
|---|---|---|---|---|---|
| | *cm* | *cm* | *g* | *g* | |
| May 12 | 97.8 | 134.8 | 1,075.0 | 329.4 | 3.30 |
| May 26 | 85.6 | 115.5 | 751.8 | 234.1 | 3.15 |
| June 9 | 83.6 | 107.9 | 564.6 | 180.3 | 3.06 |
| June 23 | 66.6 | 76.8 | 241.2 | 76.0 | 3.12 |
| July 8 | 50.4 | 48.8 | 94.7 | 28.2 | 3.34 |
| LSD: .05 | 10.5 | 16.9 | 269.2 | 81.1 | 0.24 |
| .01 | 14.8 | 23.7 | 377.5 | 113.6 | NS |

| Planting date | Primary branches | Stamin† inflor. | Pistil† inflor. | Seeds /plant |
|---|---|---|---|---|
| | *cm* | *rating* | *rating* | *no.* |
| May 12 | 30.3 | 10.0 | 10.0 | 32,485 |
| May 26 | 28.1 | 10.0 | 10.0 | 15,373 |
| June 9 | 28.4 | 10.0 | 10.0 | 8,828 |
| June 23 | 23.3 | 10.0 | 10.0 | 5,818 |
| July 8 | 18.8 | 10.0 | 10.0 | 3,135 |
| LSD: .05 | 3.9 | NS | NS | 15,533 |
| .01 | 5.4 | NS | NS | 21,778 |

†See scale at top of page for explanation.

each, which, while only 10 percent of the quantity produced by large plants, is sufficient to cause severe infestations.

## Light

**Photoperiod.** The above studies strongly imply that common ragweed is sensitive to photoperiod — a finding in agreement with early work by Garner and Allard (1920) and Allard (1943, 1945). Also, Salisbury (1963) classed common ragweed as a quantitative short-day plant, that is, one that flowers earlier under short days than most plants do. Dickerson (1968) studied certain aspects of photoperiod both in the field and in the greenhouse. In field experiments, he exposed the plants to 30 or 75 minutes of light during the night by means of frosted incandescent 100-watt bulbs which produced at least 52 footcandles at the upper part of the plant. Light-interruption treatments were started in late July and early August and continued until harvest in late September or early October. The data are presented in Table 7.

Table 7 shows that the relatively long period of light interruption (1 hr 15 min) in 1966 resulted in substantial increases in fresh weight of plants

**TABLE 7. Response of common ragweed to light interruption of the dark period**

| Parameter observed | Normal day length | Night interruption | LSD .05 | LSD .01 |
|---|---|---|---|---|
| | | *8:00 P.M. to 9:15 P.M. (1966)* | | |
| Height (cm) | 89.8 | 98.3 | NS | NS |
| Spread (cm) | 106.1 | 109.0 | NS | NS |
| Fr. weight (g) | 527.7 | 910.6 | 98.4 | 227.1 |
| Dry weight (g) | 144.7 | 183.0 | 22.5 | NS |
| Fr. wt./dry wt. | 3.7 | 5.3 | — | |
| Stamin inflor.† | 9.8 | 3.8 | 1.8 | 4.2 |
| Pistil inflor.† | 9.3 | 0.7 | 2.3 | 5.3 |
| | | *12 M to 12:30 A.M. (1967)* | | |
| Height (cm) | 84.1 | 92.4 | NS | NS |
| Spread (cm) | 124.8 | 133.2 | NS | NS |
| Fr. weight (g) | 1,308.6 | 2,070.5 | NS | NS |
| Dry weight (g) | 317.4 | 489.9 | NS | NS |
| Fr. wt./dry wt. | 3.5 | 4.2 | NS | NS |
| Stamin inflor.† | 10.0 | 8.8 | ‡ | ‡ |
| Pistil inflor.† | 10.0 | 8.6 | NS | NS |

†See text p. 12 for explanation of scale.
‡Experimental error is zero; therefore differences are highly significant, but of questionable practicality.

and significant reduction in flowering. However, the 30 minute light interruption in 1967 showed little significant difference. The large numerical difference in fresh weight was not significant in 1967 because the variability coefficient then was 29 percent, whereas in 1966 it was only 13 percent.

In greenhouse studies, Dickerson (1968) obtained additional evidence of ragweed response to a 30 minute interruption of the dark period by 30 footcandles of light from incandescent lamps. He further showed that flowering could be initiated with long days, 16.25 hours, but that it took much longer than with shorter days. He therefore concluded that Salisbury's classification (1963) of common ragweed as a quantitative short-day plant was correct.

**Light Intensity.** This factor could play a role in survival or competitive ability of a plant species. In noncrop situations, common ragweed is often the only species present in significant numbers. However, in row crops and small grains, common ragweed coexists with the agricultural crop, along with other weed species. Shade from another plant species may influence the growth and development of common ragweed.

Dickerson (1968) investigated this aspect under field conditions in several experiments. Saran shade cloth was laid over structures built of posts and wires to reduce sunlight either 30 or 73 percent. These shade structures were at two locations—on sandy loam and silt loam soils—and were of a size and height that permitted soil preparation by tractor. In some instances, plants were grown in large pots, so that water use and mineral nutrition could be controlled.

In an experiment on silt loam soil, seedling ragweed was transplanted at 30 days of age to 0, 30%, and 73% shade. Some of the data obtained are presented in Table 8.

It is readily apparent that ragweed is not harmed by moderate shade; in fact, both fresh and dry weight may be increased by moderate shade.

**TABLE 8. Response of common ragweed to 3 levels of shade**

| Shade | Height | Spread | Fresh weight | Dry weight | Stamin†. inflor. | Pistil† inflor |
|---|---|---|---|---|---|---|
| | *cm* | *cm* | *g* | *g* | | |
| None | 74.6 | 78.1 | 268 | 77 | 10.0 | 8.5 |
| 30% | 77.9 | 79.2 | 300 | 81 | 9.7 | 7.3 |
| 73% | 70.8 | 69.5 | 147** | 38** | 9.5 | 8.4 |
| | NS | NS | 99:1 | 99:1 | NS | NS |

†See text p. 12 for explanation of scale.

**Significant at .01.

In view of these results a more elaborate experiment was conducted with ragweed, sweet corn, and dry beans planted separately in pots and placed under similar levels of shade after 30 days. Some of the data obtained are presented in Table 9. It is again apparent that ragweed is not adversely affected by 30% shade, but rather, dry weight was actually increased. In Table 8, the data were obtained from plants watered only moderately by overhead irrigation. However, the data in Table 9 were obtained from pots with plants that were watered individually only when they wilted slightly. The authors are reluctant at this point to ascribe the response of ragweed to shade as a function of moisture and stomatal behavior. If this were so, beans and corn should also perform better under partial shade, but they did not. We believe that ragweed has some other efficiency factor that permits it to produce more dry matter under partial shade. Similar stimulation from 25% shade was reported with barnyardgrass (*Echinochloa crusgalli*) by Dickerson (1964); from 33% shade with wild radish (*Raphanus raphanistrum*) by Rahn and Feulner (1968); from 25% shade with common purslane (*Portulaca oleracea*) by Vengris and Livingston (1968).

**Light Quality.** Dunn studied this factor in New Hampshire. He worked with fluorescent lamps of 5 colors adjusted to provide an intensity of 800 $\mu w\ cm^2$ at plant level. The light qualities of each lamp have been described in detail (Dunn et al. 1968). He worked in air-conditioned growth chambers maintained at 21 C for a 16-hour light period and at 16 C for an 8-hour dark period. Several experiments were conducted under these conditions, and some of his data are presented in Table 10. He remarked on a good deal of variability among his plants, even though seed was obtained at only one site. He suggested that a wide range of genetic variability probably exists. Similar observations by Dickerson

**TABLE 9. Influence of shade on growth of common ragweed, dry beans, and sweet corn**

| Crop | Shade | Height | Spread | Fresh weight | Dry weight |
|---|---|---|---|---|---|
| | | *cm* | *cm* | *g* | *g* |
| Ragweed | None | 62.4 | 67.9 | 201 | 45.8 |
| | 30% | 66.7 | 76.2 | 275 | 54.3 |
| | 73% | 45.5 | 53.7 | 104 | 21.2 |
| Dry beans | None | 42.1 | 44.7 | 209 | 40.2 |
| | 30% | 42.8 | 46.9 | 212 | 37.4 |
| | 73% | 42.6 | 47.5 | 154 | 27.9 |
| Sweet corn | None | 126.3 | 16.9 | 421 | 81.1 |
| | 30% | 133.8 | 13.5 | 419 | 75.2 |
| | 73% | 116.0 | 9.3 | 281 | 44.2 |

TABLE 10. Response of common ragweed to 5 different light qualities†

| Plant character | Red | White | Yellow | Green | Blue |
|---|---|---|---|---|---|
| No. days for pollen shed | 32.0 | 35.7 | 42.3 | 37.4 | 32.2 |
| Height in cm | 26.8 | 24.4 | 24.2 | 21.0 | 19.5 |
| No. female flowers | 27.7 | 22.6 | 7.3 | 10.0 | 14.7 |
| No. male flowers | 9.2 | 10.3 | 6.5 | 6.0 | 6.6 |
| Fr. wt. (g), tops+roots | 61.8 | 47.7 | 48.9 | 42.3 | 31.3 |
| Dry wt. (g), tops+roots | 9.3[a] | 6.9[a,b] | 6.6[a,b] | 5.6[b] | 4.1[b] |

NOTE: Values in same line having same letter are not different at 5% significance level.
†See Dunn et al. (1968) for detailed description of light quality.

(1968) were mentioned in an earlier section. The effects of light quality were significant for dry weight only. Red light was superior to green and blue, and white and yellow were intermediate. Dunn summarized his study on light quality with common ragweed by stating that this species responded similarly to barnyardgrass (*Echinochloa crusgalli* L.) and crabgrass (*Digitaria sanguinalis* L.) as reported previously (Dunn et al. 1968).

## Water Use

It is well recognized that weeds can cause crop losses by competing for soil moisture and that generally the losses will be greater in seasons when rainfall is limiting. Also the larger the weeds and the smaller the crop plants, the more severe will be the competition. Another aspect of weed crop competition is the relative water use of each when grown separately under conditions where water is not limiting.

Dickerson (1968) carried out several greenhouse experiments with beans, sweet corn, and common ragweed, planted singly in large pots that were sealed in plastic bags. All water added was recorded, and entire containers were weighed periodically to determine fresh weight of plants. The results of two of his experiments are shown in Table 11. It is apparent that all plants used much more water in the October–January than in the July–October period, presumably because light values tend to be lower in the fall and winter than in the summer and early fall. However, relative water use by 2 of the 3 species was similar. Sweet corn used the least water per unit of either fresh or dry weight, whereas common ragweed used the most. Dry beans, however, had 3 times as much foliage in the second test, without a corresponding increase in dry weight, indicating a relatively inefficient use of water. It is difficult to interpret how these data characterize the ability of common ragweed to compete with crop plants for moisture. They could mean that it is a serious competitor; on the other hand, when water is extremely limiting, common ragweed may make little growth and thus, indirectly, be less competitive.

TABLE 11. Water use, fresh and dry weight of dry beans, sweet corn, and common ragweed

| Crop | $H_2O$ | Fr. wt. | Dry wt. | $H_2O$ per fr. wt. | $H_2O$ per dry wt. |
|---|---|---|---|---|---|
| | g | g | g | g | g |
| | | | July—October 1967 | | |
| Dry beans | 7,358 | 98.3 | 42.7 | 75.9 | 174.4 |
| Sweet corn | 7,413 | 236.2 | 88.4 | 32.6 | 85.1 |
| Ragweed | 12,600 | 140.6 | 45.4 | 95.7 | 312.2 |
| LSD .05 | 1,749 | 34.9 | 15.5 | 13.5 | 71.3 |
| | | | October—January 1968 | | |
| Dry beans | 17,549 | 301.5 | 41.9 | 58.8 | 421.3 |
| Sweet corn | 10,727 | 296.2 | 78.4 | 34.7 | 144.1 |
| Ragweed | 13,059 | 193.7 | 33.2 | 67.3 | 404.8 |
| LSD .05 | 1,623 | 54.2 | 9.1 | 21.3 | 76.8 |

## Ecotypes

Seed of common ragweed was obtained from 11 different locations in the United States from Florida to Maine and from 1 location in Ontario, Canada (Dickerson 1971). Experiments were conducted to determine the response of these 12 ecotypes to the day lengths prevailing at Ithaca, New York, during the normal growing season. Seed was sown May 21 in peat pots in the greenhouse, thinned to one seedling, and transplanted to the field June 30. A single plant was located in the center of a 3×3-foot plot. There were 13 replicates. Ratings were made of plant inflorescences 30 days later and again at harvest in late September.

The results, presented in Table 12, reveal several important trends. First, both vegetative growth and flowering were influenced by the latitude in which the ecotype originated. Generally speaking, those from more northerly latitudes produced smaller plants and flowered earlier than those from the more southerly places. The latter were approximately twice as tall and averaged about 3 times as much fresh weight and dry weight as the former. The Florida ecotype was not yet mature when the experiment was terminated. In another test, Florida plants that were potted in September and taken into the greenhouse did not produce substantial quantities of mature seed until mid-December.

Wide variability within an ecotype was apparent in leaf shape, plant height, stem branching, and length of internodes. However, time of reproductive development was relatively uniform within an ecotype. No genetic studies were conducted to determine whether the plant types within an ecotype were genetically fairly uniform and, therefore, would produce similar plants, or whether each plant type would segregate into a range of types in succeeding generations.

**TABLE 12. Growth and inflorescence ratings of common ragweed ecotypes from 12 North American areas, grown in Ithaca, N. Y., in 1967**

| Source of seed | Latitude | Height | Fresh weight | Dry weight | Inflorescence ratings* | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | July 31 | | Sept 20 and 25 | |
| | | | | | Stamin | Pistil | Stamin | Pist |
| | °N | cm | g | g | | | | |
| Prosser, Wash. | 46.1 | 68 | 834 | 307 | 4.5 | 0.2 | 10.0 | 10.0 |
| Orono, Maine | 44.8 | 75 | 1,037 | 345 | 4.9 | 0.2 | 10.0 | 10.0 |
| Durham, N. H. | 43.1 | 76 | 822 | 294 | 4.8 | 0.7 | 9.6 | 10.0 |
| London, Ontario | 42.8 | 85 | 1,001 | 318 | 3.9 | 0.2 | 10.0 | 10.0 |
| Freeville, N. Y. | 42.5 | 82 | 1,173 | 371 | 2.5 | 0.0 | 10.0 | 10.0 |
| Ithaca, N. Y. | 42.4 | 81 | 1,029 | 347 | 3.2 | 0.0 | 10.0 | 10.0 |
| University Park, Pa. | 40.7 | 90 | 1,444 | 445 | 2.6 | 0.0 | 10.0 | 10.0 |
| Lafayette, Ind. | 40.5 | 109 | 1,588 | 457 | 1.0 | 0.0 | 10.0 | 9.9 |
| Morgantown, W. Va. | 39.6 | 113 | 1,796 | 531 | 1.5 | 0.0 | 10.0 | 10.0 |
| Miami, Miss. | 39.3 | 112 | 2,214 | 632 | 0.2 | 0.0 | 9.6 | 9.5 |
| Painter, Va. | 37.5 | 145 | 2,513 | 625 | 0.0 | 0.0 | 9.2 | 9.2 |
| Belle Glade, Fla. | 26.7 | 179 | 3,707 | 873 | 0.0 | 0.0 | 5.2 | 2.3 |
| LSD: .05 | | 11 | 417 | 111 | 0.9 | 0.3 | 0.7 | 0.8 |
| .01 | | 14 | 549 | 145 | 1.2 | 0.4 | 0.9 | 1.1 |

*0=no visible inflorescences. 5=visible staminate heads or 75% of branches; also 5=visible florets without seed in 75% of axils. 10=staminate florescences on nearly all branches; also 10=well-developed seed in nearly every axil.

## RESPONSE TO HERBICIDES

Herbicides play an important role in the control of many weed species, including common ragweed. In waste places, phenoxy herbicides applied post-emergence are commonly used with good effectiveness. Triazine and substituted urea herbicides also are highly active against common ragweed, particularly when applied preemergence. Linuron, a substituted urea material that is active both post- and preemergence, is a standard treatment for controlling ragweed in carrots. Dinoseb is also effective both pre- and postemergence and is used in peas. In alfalfa, dinoseb is used postemergence.

On the other hand, the performance of several herbicides used in many vegetables and certain agronomic crops is only fair or poor against common ragweed. Chlorpropham, DCPA, EPTC, and trifluralin are examples of herbicides of this type. For a more detailed listing of chemicals and their relative activity on ragweed, readers are referred to *Herbicide Handbook of the Weed Science Society of America* (1967).

It is obvious that choice of herbicide is exceedingly important if chemicals are to be the principal method of control; however, Dickerson (1968) found in his growth-chamber studies that location influenced relative activity of herbicides. Eight of 9 chemicals were more active when placed 1 cm above the seed than when placed 2 cm below the seed (Table 13). Trifluralin was the one exception and was not effective at either location. This indicates that shallow incorporation is likely to be better than deep incorporation. In respiration studies, Bennett (1971) found that small seedlings were more influenced by herbicides than were larger plants, which suggests that early postemergence applications are likely to be more effective than are later sprays.

Although the dinitroaniline herbicides are generally poor in controlling ragweed, they do vary somewhat in physical and chemical characteristics such as solubility and volatility. Also, crop responses vary. Thus, although they generally are classed as highly active on annual grasses and much less active on annual broadleaves, there is a chance that one or more of them might be active against ragweed. Hatfield, Warholic, and Sweet (1978)[2] did a comprehensive study of 7 dinitroaniline herbicides on 3 soil types with 5 crops and 2 specific problem weeds, *Galinsoga* and ragweed. They used 3 rates of chemical, the recommended rate for a particular soil type and approximately ½ less and ½ more. All but 1 chemical was incorporated to a depth of 5-7 cm immediately after planting. In an experiment conducted on a Clarkson silty clay loam known to be heavily infested with ragweed, no crop was planted. Treatments, ratings of ragweed growth, counts of ragweed stand, and dry weights are given in

[2] In press.

TABLE 13. Effect of herbicide placement 2 cm above or below seed on emergence and growth of common ragweed

| Herbicide and placement | lb/A | Visual† rating | Number emerging | Total fresh wt. | Fresh wt. /plant |
|---|---|---|---|---|---|
| | | | | g | $g \times 10^{-2}$ |
| Atrazine | .75 | | | | |
| Above | | 5.0 | 29.3 | 1.40 | 4.79 |
| Below | | 5.5 | 32.7 | 2.33 | 7.30 |
| CP-50144 | 2 | | | | |
| Above | | 6.0 | 30.0 | 2.46 | 8.48 |
| Below | | 7.5 | 34.7 | 3.29 | 9.51 |
| DCPA | 20 | | | | |
| Above | | 6.5 | 32.3 | 2.56 | 8.27 |
| Below | | 7.5 | 39.0 | 3.03 | 7.78 |
| Diphenamid | 4 | | | | |
| Above | | 6.5 | 32.3 | 2.75 | 8.53 |
| Below | | 8.0 | 33.7 | 3.14 | 9.30 |
| DNBP | 2 | | | | |
| Above | | 3.0 | 7.7 | 0.43 | 5.68 |
| Below | | 5.5 | 28.3 | 2.21 | 8.13 |
| EPTC (10G) | 3 | | | | |
| Above | | 6.0 | 31.0 | 2.11 | 6.74 |
| Below | | 7.0 | 29.0 | 2.26 | 7.74 |
| Linuron | 1 | | | | |
| Above | | 4.0 | 29.7 | 1.57 | 5.26 |
| Below | | 6.0 | 38.3 | 2.92 | 7.76 |
| Propachlor | 3 | | | | |
| Above | | 3.5 | 21.3 | 1.62 | 7.60 |
| Below | | 5.5 | 25.7 | 2.08 | 8.29 |
| Trifluralin | 4 | | | | |
| Above | | 4.0 | 19.7 | 1.80 | 9.13 |
| Below | | 5.0 | 31.0 | 2.64 | 8.45 |
| Control | — | 8.8 | 39.2 | 3.31 | 8.52 |
| Mean | | | | | |
| Above | — | 5.3 | 27.0 | 1.97 | 7.28 |
| Below | | 6.7 | 33.4 | 2.76 | 8.30 |
| LSD: Placement | .05 | 0.7 | 2.5 | 0.26 | 0.58 |
| | .01 | 1.0 | 3.3 | 0.35 | 0.78 |
| Herbicide | .05 | 1.6 | 5.6 | 0.58 | 1.30 |
| | .01 | 2.2 | 7.5 | 0.78 | 1.74 |
| Interaction | .05 | NS | 7.9 | NS | NS |
| | .01 | NS | NS | NS | NS |

†9=no effect, 7=acceptable control, 1=complete kill.

Table 14. It is apparent that oryzalin was the only material that significantly affected ragweed. It reduced the stand sizably, and, most importantly, drastically stunted the plants that survived. The combination of these two effects resulted in acceptable control. In other

TABLE 14. Ragweed response to 7 dinitroaniline herbicides

| Herbicide | Rate | Incorpo-ration | Visual ratings† common ragweed | Plants per m² | Dry weight Per plant | Per m² as % untreated |
|---|---|---|---|---|---|---|
| | *lb/A* | | | *no.* | *g* | |
| Butralin | 1.500 | Inc. | 3.7 | 41 | 1.8 | 95 |
| (Amex) | 2.000 | Inc. | 3.3 | 40 | 1.7 | 88 |
| | 3.000 | Inc. | 4.0 | 25 | 1.7 | 55 |
| Dinitramine | 0.250 | Inc. | 3.7 | 40 | 1.5 | 78 |
| (Cobex) | 0.375 | Inc. | 4.7 | 36 | 1.5 | 70 |
| | 0.500 | Inc. | 5.0 | 33 | 1.2 | 51 |
| Fluchloralin | 1.000 | Inc. | 4.7 | 38 | 1.2 | 84 |
| (Basalin) | 1.500 | Inc. | 5.0 | 37 | 1.8 | 86 |
| | 2.000 | Inc. | 4.3 | 35 | 1.8 | 77 |
| Oryzalin | 1.000 | Inc. | 6.0 | 14 | 0.2 | 4 |
| (Surflan) | 1.500 | Inc. | 7.0 | 19 | 0.2 | 5 |
| | 2.000 | Inc. | 7.0 | 7 | 0.2 | 2 |
| Penoxalin | 1.000 | Surf. | 2.5 | 42 | 1.9 | 103 |
| (Prowl) | 1.500 | Surf. | 4.0 | 45 | 1.6 | 93 |
| | 2.000 | Surf. | 4.3 | 36 | 1.5 | 70 |
| Profluralin | 0.750 | Inc. | 2.7 | 58 | 1.7 | 127 |
| (Tolban) | 1.000 | Inc. | 3.3 | 50 | 1.7 | 110 |
| | 1.500 | Inc. | 4.0 | 40 | 1.6 | 83 |
| Trifluralin | 0.500 | Inc. | 3.0 | 38 | 1.7 | 83 |
| (Treflan) | 0.750 | Inc. | 3.5 | 36 | 1.9 | 88 |
| | 1.000 | Inc. | 2.5 | 47 | 1.7 | 103 |
| Untreated | | | 1.7 | 43 | 1.8 | 100 |

NOTE: All data represent averages of 3 replicates.
†7 or more acceptable control.

tests where crops were included, they found oryzalin was toxic to seeded tomatoes, seeded cabbage, and peas. However, snap and dry beans appeared to be commercially tolerant.

## SUGGESTIONS FOR CONTROL[3]

On lawns, playgrounds, parks, and graded roadsides and all similar places common ragweed can be successfully controlled by good management of native or planted vegetation. Fertilizing, mowing, and trimming should be done so as to encourage tight ground cover and heavy shading of the soil in spring and early summer. Common ragweed has a major flush of emergence when surface soil reaches 16°C–21°C during the day. Only a few seedlings emerge during the summer. Seedlings do not

[3]Consult local extension agents or other authorities for specific local recommendations on controlling common ragweed.

develop into plants if they are heavily shaded at time of emergence. A vigorous, dense sod is as effective as shrubs and broad-leaved weeds in providing shade. When ragweed is a problem in established lawns, it is a symptom of poor turf growth, but by correcting this problem, ragweed can be eliminated without any special treatment. In new seedings, however, light applications of 2,4-D may be needed for control.

When common ragweed is growing on spoil banks, highway cuts, rocky roadsides, and similar semi-barren places, control is best obtained by judicious use of herbicides. Such materials as simazine, 2,4-D, dicamba, and amitrole are effective. Choice of a particular chemical, however, depends on many factors, including the presence or absence of desirable vegetation, whether or not grasses should be encouraged, and the possibility of contaminating waterways and ponds.

In most row crops, common ragweed can be of potential economic disadvantage. It is most damaging in crop monoculture where neither the cultural practices nor the available herbicides are effective. For many years, early planted carrots were seriously infested because the crop was planted at a time favorable for ragweed, and was so slow in emergence and early growth that it offered little or no competition. However, with the development of linuron, postemergence sprays are now commonly used, and ragweed is readily controlled. In field-seeded tomatoes, much the same problem exists. Planting is done in early spring; seedlings emerge and grow slowly, and many of the registered herbicides are ineffective. Fortunately, newer chemicals such as metribuzin are active against ragweed. Research emphasizes special timing and low dosages to avoid crop injury.

Where crops can be rotated or planting time changed, nonchemical controls are practical. Plant forage or sod crops on heavily infested fields or, perhaps even better, plow and stir infested fields early. Rework the soil 2 or 3 times during the spring to destroy the early flushes of common ragweed and plant crops relatively late. Of course, choose crops wisely, keeping in mind that many vegetables and certain field crops can be planted late without decreasing yield or quality. However, field corn, tomatoes, and potatoes usually cannot be planted late without risk of serious losses. Cultivation between crop rows early in the season is usually an effective control, as are hoeing and hand pulling, which usually need to be done only once. In home gardens and high-value crops, these are feasible methods.

# SUMMARY

Much of the work reported in this bulletin was conducted in New York, New Hampshire, and West Virginia as a cooperative research effort under the sponsorship of the Northeastern Regional Technical Committee (NE-42). Studies were conducted on anatomical and morphological characteristics, seed germination, plant growth and development, ecotypes, and response to herbicides. However, to provide a more complete publication, additional findings were also included.

Common ragweed (*Ambrosia artemisiifolia* L.) is one of the few weeds of the northeastern United States that are economically detrimental to agriculture and also to the population of the region because of the allergenic properties of their pollens. The economic consequences of ragweed probably are greater in the public health sector than in agriculture. Dollar losses due to allergic reactions of humans have been estimated at about $1 million per day during the height of flowering, which lasts 3 to 4 weeks in most years. Agricultural losses have not been estimated accurately.

Some of the pertinent observations made in these studies were:

- Anatomical studies confirmed that the root, stem, and leaf have an elaborate system of secretory canals.
- Stomata are present on both upper and lower leaf surfaces.
- A major flush of seedlings emerged in early spring, late April, and May in Ithaca, New York. More than 90 percent of the season's total emerged by June 10.
- Under laboratory conditions, alternating temperatures of 10°C-30°C are the most beneficial for germination. Light aided germination in some studies, but not in others.
- Seed planted more than 2 cm in depth gave poor germination.
- Common ragweed ecotypes from Canada to Florida showed the same general response to photoperiod, namely, that of a quantitative short-day plant.
- Ecotypes from northern latitudes such as New York and Canada were smaller and flowered earlier than those from southern latitudes such as Florida.
- Seedlings that emerged in July produced relatively small plants and only about one tenth as many seeds per plant as those emerging in mid-May, 3,000 vs. 30,000.
- In greenhouse tests, water use per unit of dry weight produced was twice as high for common ragweed as for sweet corn.

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