Vision-Guided Herbicide Spraying: An Opportunity for Vineyard Automation

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On economic and social scales, the grape industry, valued at $66 million in 2017, is immensely important to New York's agricultural economy. However, weeds threaten crop yields by competing with vines for essential resources such as water, nutrients, and sunlight. They can also provide a habitat for harmful insects and may affect disease development.

Herbicides are the most used tool for managing weeds across cropping systems because of their low cost and high efficacy. However, many growers are interested in reducing spray applications due to rising consumer demand for minimal pesticide use, the continued evolution of herbicide resistance (127 unique cases (herbicide x species) in the United States alone), and herbicide shortages and their associated cost increases.

Precision herbicide applications, or targeted herbicide applications, are one strategy for reducing herbicide use in vineyards and other perennial crops. One spray system that we are investigating is the Weed-It. The Weed-It is a commercially available spray system from Rometron, based in The Netherlands. The Weed-It shines blue light towards the soil surface, which causes chlorophyll in under-vine vegetation to be detected. Sensors detect the chlorophyll signal and relay the information to solenoids, which turn on associated spray nozzles (Figure 1). This makes for a targeted application of herbicide to plant tissues, reducing chemical use, and in turn, lowering production costs. Weed-It units have been investigated and adopted in fallow dryland systems for pre-plant and post-harvest burndown purposes. However, we believe that there is opportunity for this technology to be applied outside of annual cropping systems on weeds under the canopy in tree and vine crops and for the control of water sprouts or suckers.

In 2021, results from our lab's research trials showed that precision sprays using the Weed-It were as effective as broadcast applications of Rely® 280 (active ingredient is glufosinate) at 1, 2, and 3 pints per acre, for controlling glyphosate-resistant horseweed (*Conyza canadensis*), which is a problem weed in New York apples and grapes. Both application systems reduced horseweed biomass by 90 to 97% at 14 days after treatment, relative to an untreated check (Figure 1). In 2022, we conducted a study in weed-free Concord grapes at the Cornell Lake Erie Research and Extension Laboratory to determine if the Weed-It system controlled grape suckers as well as continuous directed applications of Aim EC® (active ingredient is carfentrazone), a commonly used product for this purpose. Grape sucker removal is important for vineyard managers as they compete with productive fruiting vine for nutrients and water, which reduce crop yield. Suckers can be removed mechanically, but this can be damaging to the vines; hand-removal can be costly in terms of labor. In our trials, the Weed-It controlled grape suckers as well as a continuous banded application of Aim EC® at 2 ounces per acre. Both application systems reduced grape sucker biomass by 82 to 87% at 28 days after treatment (Figure 3). Furthermore, there was no statistical difference in sucker number reduction between both application systems. Additionally, plots treated with the Weed-It Quadro received 30 to 50% less herbicide to the bare ground between vines.

This study is an introduction for more work with the Weed-It and other vision-guided spray systems in future years. The overarching goal of this work is to integrate vision-guided sprayers into whole-vineyard mapping platforms that will facilitate the adoption of digital and precision agriculture for weed and crop management.

Figures

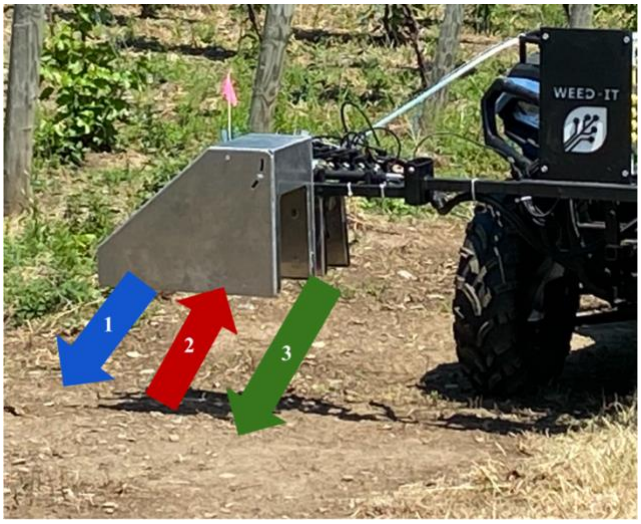

Figure 1: How the Weed-It Quadro operates. 1. The blue light shines from the machine. 2. Chlorophyll fluoresces and is detected by the sensor. 3. A specific nozzle is triggered to spray the plant tissue.

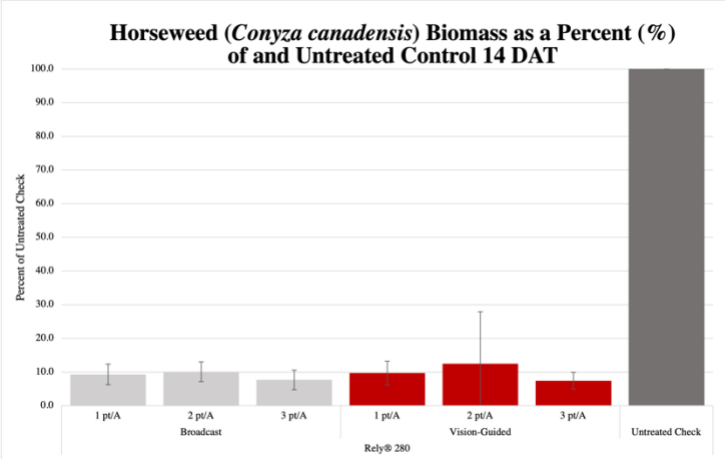

Figure 2: Horseweed (*Conyza canadensis*) Biomass (g) Treated with Rely® 280 12 Days After Treatment. There was no statistical difference (P > 0.05) in horseweed biomass plants treated with the Weed-It Quadro vision-guided sprayer compared to a standard broadcast application of herbicide. Error bars represent one standard deviation.

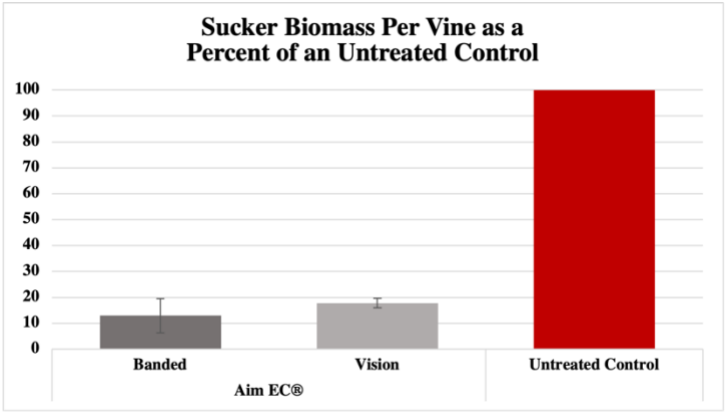

Figure 3: Sucker Biomass (g) per Vine as a Percent of an Untreated Control 28 Days after Application. There was no statistical difference (P > 0.05) in sucker biomass per vine in plots treated with the Weed-It Quadro vision-guided sprayer compared to a continuous banded application of herbicide. Error bars represent one standard deviation.

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