Evaluation of Methods for Management of Bindweed in New York Vineyards

Project Leaders

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Objectives

The objectives of this project were as follows:

- Objective 1. Determine the carryover effects of the 2019 treatments on field bindweed (*Convolvulus arvensis*). Because of its perennial nature, it is important to understand not just how well the treatments worked in a given season, but also if they have any impact on regrowth of the weed in subsequent years.

- Objective 2. With one year of efficacy and economic data from several herbicide, non-chemical, and integrated treatments in both hedge bindweed (*Calystegia sepium*) and field bindweed, we aimed to replicate these trials to better gauge the variability between years.

- Objective 3. Disseminate our findings to New York growers.

Methods

Objective 1

Unfortunately, our assessment of weed density and ground coverage to evaluate carryover effects from 2019 treatments needed to occur in spring 2020 prior to weed maintenance operations at our on-farm trial site in Branchport, NY, but it was hindered by COVID-19 restrictions. To make up for this deficit, more in-depth assessments will be conducted by Co-PI Brown in 2021.

Objective 2

At the Finger Lakes Teaching & Demonstration Vineyard in Penn Yan, NY, we replicated the treatments applied in 2018 targeting *hedge* bindweed *(Calystegia sepium)*. The four treatments were as follows:

1. Untreated.
2. Three hoeing events – May 30, June 22, and July 22. Hoeing was conducted by hand, but in a manner representative of tractor hoeing.
3. Three applications of glyphosate (‘Makaze’, 2% v/v) – May 30, June 22, and July 22.

4. Two applications of rimsulfuron ('Matrix', 2 oz/A + AMS at 2.5% v/v) – May 30 and June 22. Rimsulfuron was not applied on the final date due to label restrictions.

At the on-farm trial in Branchport, NY, we replicated treatments applied in 2019 targeting *field* bindweed *(Convolvulus arvensis)*. The six treatments were as follows:

1. Untreated.
2. Three hoeing events – May 30, June 22, and July 22. Hoeing was conducted by hand, but in a manner representative of tractor hoeing.
3. Three applications of glyphosate ('Makaze', 2% v/v) – May 30, June 22, and July 22.
4. Two applications of rimsulfuron ('Matrix', 2 oz/A + AMS at 2.5% v/v) – May 30 and June 22. Rimsulfuron was not applied on the final date due to label restrictions.
5. An integrated treatment of cultivation on May 30, followed by an application of glyphosate ('Makaze', 2% v/v) on June 22, followed by an application of rimsulfuron ('Matrix', 4 oz/A + AMS at 2.5% v/v) on July 22.
6. A pre-emergence application of dichlobenil ('Casoron', 2.8 gal/A) on April 29 immediately following a hoeing event to ensure bare ground.

All treatments were replicated four times in a randomized complete block design. Weed groundcover and density in the under-vine strip was assessed using three 0.7 m^2 quadrats two weeks after treatments. Hedge or field bindweed was assessed specifically, whereas all other weeds were grouped into a separate category. Aboveground weed biomass was collected September 22, dried for 7 days at 38 degrees Celsius, and weighed.

Statistical analysis of efficacy based on aboveground weed biomass was conducted using nonparametric methods (Wilcoxon tests) due to one treatment resulting in zero weed biomass, which does not satisfy ANOVA assumptions of constant variance. Finally, we estimated the relative cost of each treatment through use of a partial budgeting analysis following Davis et al. (2020). Although our applications were made with a backpack sprayer, the economic modeling assumed the use of a tractor-drawn directed sprayer and a tractor-based glyphosate rate ('Roundup WeatherMax', 44 oz/A). Similarly, the modeling assumed the use of a tractor-drawn grape hoe, but our plots were hoed by hand in a manner to simulate mechanical cultivation.

Results

Objective 1

Visible carryover effects generally seemed to follow in-season effectiveness of treatments in 2019. More in-depth assessments will be conducted by Co-PI Brown in 2021.

Objective 2

HEDGE BINDWEED

At the Finger Lakes Teaching & Demonstration Vineyard in Penn Yan, NY, hedge bindweed groundcover generally increased through the season in untreated plots, while density remained relatively constant (Figure 1). Hoeing, rimsulfuron, and glyphosate were all effective on the hedge bindweed, with slight visual increases in efficacy in that order. Results were similar for

the other weeds present – mostly annual grasses – with the exception that in untreated plots groundcover and density increased as the season progressed.

Control efficacy based on aboveground hedge bindweed biomass was greatest in the glyphosate and rimsulfuron treatments (Figure 2), but due to sporadic emergence of the hedge bindweed, only glyphosate was significantly different than the untreated plots. For the other weeds, glyphosate and hoeing were most effective. Rimsulfuron treated plots did not statistically differ from the untreated plots. Many annual grasses are effectively controlled by rimsulfuron, but only when at the seed stage or when they have just recently emerged, so any escaped weeds may have grown past rimsulfuron effectiveness.

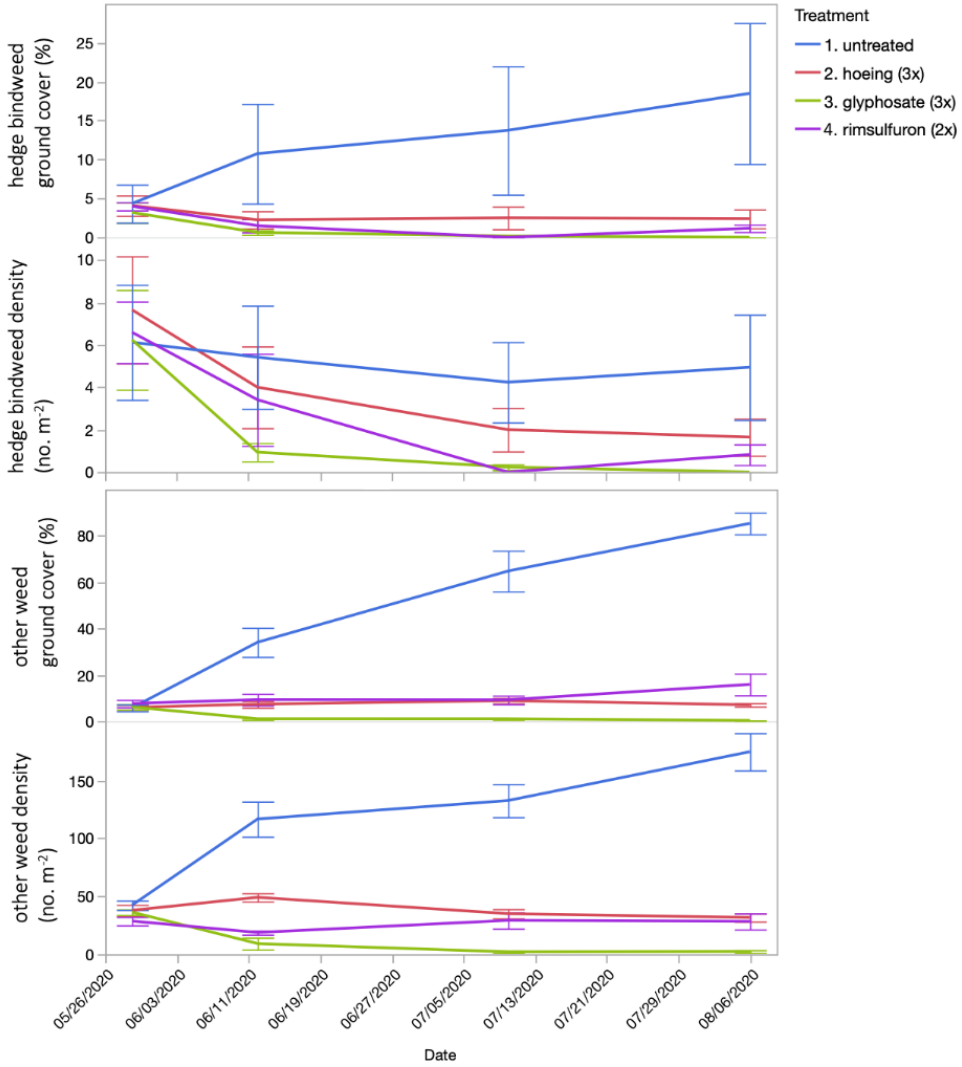

Figure 1. Effect of treatments on groundcover and density of hedge bindweed and other weeds over the course of the growing season at the Teaching and Demonstration Vineyard in Penn Yan, NY.

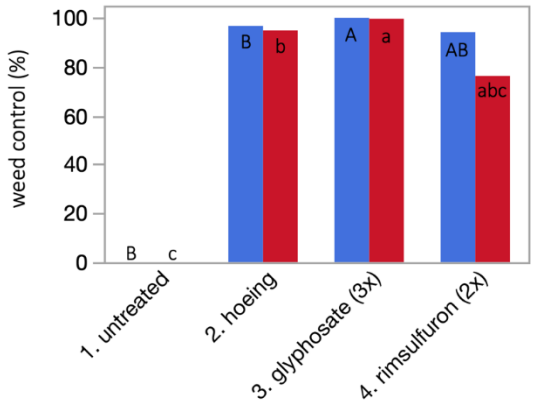

Figure 2. Effects of treatments on the aboveground biomass of hedge bindweed (blue) and all other weeds (red) at the end of the growing season at the Teaching and Demonstration Vineyard in Penn Yan, NY. Bars with the same letter are not significantly different (Wilcoxon Tests, $P > 0.05$). Capitalized letters should not be compared with uncapitalized letters.

FIELD BINDWEED

At our on-farm trial site in Branchport, NY, field bindweed densities remained relatively constant while ground coverage increased through the season in the untreated plots (Figure 3). Glyphosate, integrated treatment, and hoeing visually performed best, in that order, but interestingly, hoeing resulted in an increase in field bindweed density over the season. This likely reflects the extensive root reserves of field bindweed and its ability to send out new shoots in response to shoot removal efforts. Whereas the herbicides used have systemic activity to potentially target the root system. Unfortunately, despite a doubling of the rate of dichlobenil used compared to 2019, we did not see an improvement in control by this pre-emergence product. The other weeds present – primarily ground ivy (*Glechoma hederacea*), clover (*Trifolium* spp.), and smartweeds (*Polygonum* spp.) increased in groundcover over the season in the untreated and rimsulfuron treated plots. The other treatments satisfactorily suppressed these other weeds through the season, especially glyphosate and the integrated treatment.

Field bindweed control efficacy based on aboveground biomass was greatest in the glyphosate treatment, followed by the integrated treatment, followed by hoeing and rimsulfuron treatments (Figure 4). Dichlobenil had no effect at the time of biomass collection, and in fact, there was numerically more field bindweed than the untreated plots since dichlobenil controlled some of the other weeds and lessened the competition with field bindweed. The other weeds were best controlled by glyphosate and the integrated treatment. The other treatments had only moderate control.

While there was again in 2020 some grape leaf puckering from the glyphosate, there was no visible injury from the treatments that did not contain glyphosate. Due to the timing of applications, it is unlikely that the grape roots were injured by rimsulfuron since no injury was seen in aboveground tissues.

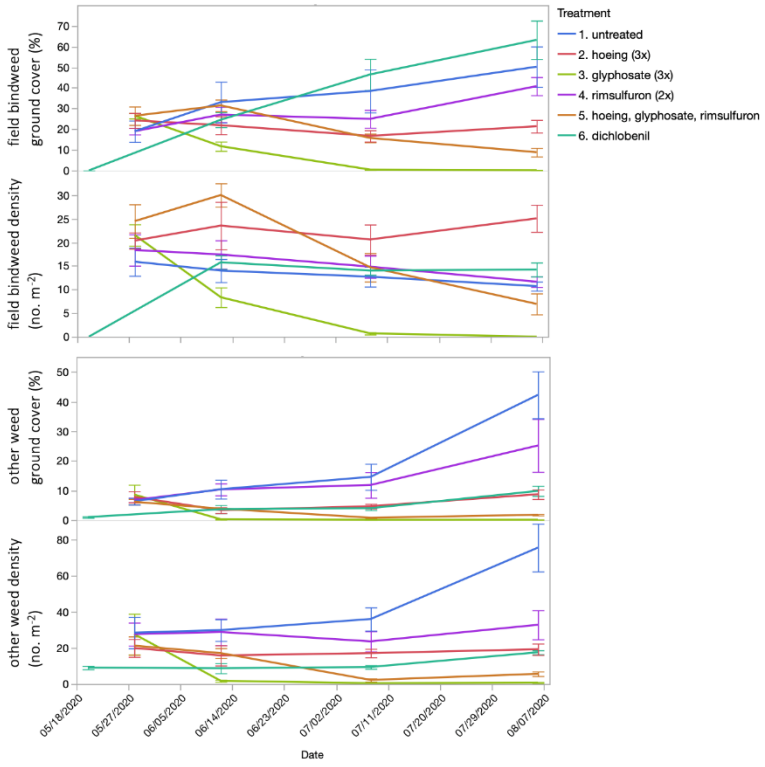

Figure 3. Effect of treatments on groundcover and density of field bindweed and other weeds over the course of the growing season our on-farm trial site in Branchport, NY.

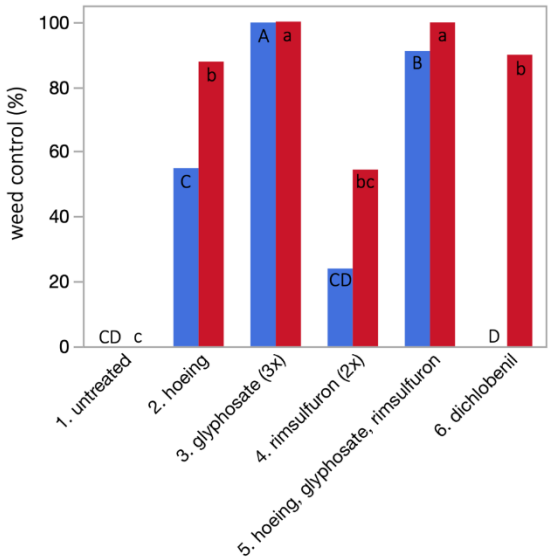

Figure 4. Effects of treatments on the aboveground biomass of field bindweed (blue) and all other weeds (red) at the end of the growing season at our on-farm trial site in Branchport, NY. Bars with the same letter are not significantly different (Wilcoxon Tests, $P > 0.05$). Capitalized letters should not be compared with uncapitalized letters.

COST COMPARISONS

Of all the treatments examined, the rimsulfuron application was substantially less expensive than all other treatments (Table 1). In this trial, however, rimsulfuron was shown to only be effective at controlling hedge bindweed and should not be considered for use to manage field bindweed. Dichlobenil had the lowest application costs because it is only applied once, but the material costs were 5 times higher than multiple applications of rimsulfuron or glyphosate. While it provided good control of other weed species, dichlobenil should not be used for management of field bindweed based on these results.

The glyphosate and the combination treatment (cultivation, glyphosate, rimsulfuron) both provided excellent control of field bindweed when compared to other treatments. While the combination treatment is about $20/acre more expensive than multiple glyphosate applications, it could be an attractive option for growers who want to reduce their use of glyphosate while still controlling field bindweed. It is possible that the rimsulfuron application in the combination treatment could be eliminated without any significant loss of control, based on its low effectiveness at controlling field bindweed on its own, and therefore reducing the cost even further.

Table 1. Partial budget analysis demonstrating total annual treatment costs for field bindweed treatments. Labor costs based on rate of $23/hour. Labor and equipment rates are taken from Davis et al. (2020). All costs are calculated on a per acre basis.

Treatment	Labor	Equipment	Herbicide	Total
Dichlobenil	$59.80	$29.54	$225.00	$314.34
Cultivation (3x)	$207.00	$143.76	$0.00	$350.76
Rimsulfuron (2x)	$119.60	$59.08	$45.76	$224.44
Glyphosate (3x)	$179.40	$88.62	$43.38	$311.40
Cultivation-glyphosate-rimsulfuron	$188.60	$107.00	$37.34	$332.94

Objective 3

Outreach opportunities were limited in 2020, but we are scheduled to present these results at the upcoming B.E.V. (Business, Enology, Viticulture) NY conference in March 2021. At that conference, we will use participant polling to better document the project impacts, including number of vineyards that utilized our results to inform their management, number of growers who utilized the 2(ee) exemption to use rimsulfuron to target hedge bindweed, and their approximate increase in profitability per acre due to this project.

We published our 2019 results to eCommons, titled "Field Bindweed Control Programs for New York Grape Production" available at https://ecommons.cornell.edu/handle/1813/69649, where it has been downloaded by 56 growers. A similar publication will be posted in February 2021.

We are also planning to work with Lynn Sosnoskie, Cornell University Assistant Professor of Weed Ecology in Specialty Crops, to publish our three years of results in a peer-reviewed journal such as HortTechnology, and in 'Appellation Cornell', which is distributed to industry members throughout New York and other states.

Conclusion

Over the three years of this project, we have found several effective alternatives to glyphosate, which is very important for herbicide resistance management. And since mid- to late-season control efforts are most effective on perennial weeds, such as bindweed species, it is important to find use products that do not injure vines as harvest approaches. These glyphosate alternatives did not visibly injure the grapes, whereas glyphosate caused injury to leaves lower in the canopy and on suckers.

For control of hedge bindweed, rimsulfuron and hoeing provided satisfactory results. For field bindweed, glyphosate and an integrated treatment of hoeing, glyphosate, and rimsulfuron remained the most effective, and rimsulfuron could be dropped from the sequence to decrease costs, likely without a weed control penalty. Dichlobenil was ineffective on field bindweed but very effective on the other weeds present. These results demonstrate that a mix of these alternatives to glyphosate can be used effectively if in conjunction with regular weed scouting and correct weed identification.

Literature cited

Davis T, Gómez M, Moss R, Walter-Peterson H (2020). COST OF ESTABLISHMENT AND PRODUCTION OF V. VINIFERA GRAPES IN THE FINGER LAKES REGION OF NEW YORK-2020. Cornell University. Ithaca, NY.

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