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Editor: Linda Chalker-Scott

Zoller, C.[1], Barker, J.[2], Nye, T.[3]

[1]Associate Professor & Extension Educator ANR, Ohio State University Extension - Tuscarawas County, Ohio, 44663
[2]Extension Educator, ANR, Ohio State University Extension - Knox County, Ohio, 43050
[3]Extension Educator, ANR, Ohio State University Extension - Clinton County, Ohio, 45177

Teaching Farmers to Be on the Cutting Edge of Weed Management

Abstract

Weed management is part of any sound crop management program. Left uncontrolled, weeds can cause crop yield loss resulting in reduced income. Knowing how to properly identify weeds and understanding control methods, including timing and control practices, is essential. Herbicide application timing for optimum control is critical for success. To improve the knowledge and skills of farmers and crop consultants, a group of Ohio State University Extension Educators developed the “2022 Weed University,” in a hybrid model using Zoom to deliver the program. Retrospective evaluations indicate knowledge gain in all areas and intention to institute management changes.

Introduction

Weed management is part of any sound crop management program. Left uncontrolled, weeds can cause crop yield loss resulting in reduced income. Knowing how to properly identify weeds and understanding control methods, including timing and control practices, is essential.

Herbicide application timing for optimum control is critical for success. Weeds are best controlled when small, preferably less than six inches tall. According to research conducted by Hartzler (2020) through Iowa State University Extension, herbicide applications to weeds that were 10 inches tall resulted in 15% yield loss. Additional experiments controlling weeds that were six inches tall resulted in yield loss between zero and 25%.

In discussing the need for increased global food production, Chauhan (2020) notes that herbicides are an integral part of weed management and correct application techniques are required. Ozkan (2020) recommends selecting the appropriate type and size of nozzle as important for pest control. In addition to providing chemical recommendations, the Weed Control Guide for Ohio, Indiana, and Illinois (Loux et al., 2020) discusses the use and importance non-chemical control strategies. These strategies include crop rotation, mechanical control, and Integrated Pest Management (IPM) practices that promote crop growth, including fertility, planting date, insect and disease control, the use of resistant varieties, and soil drainage.

Proper timing of herbicide applications can help with costs. According to Ohio State University Extension Enterprise Budgets (2022), herbicide costs represent approximately nine percent of the variable cost of production for corn and approximately 21 percent of the variable cost of production for soybeans.

Herbicide resistance is becoming an increasingly greater management concern. Clay (2021) notes there are 521 unique cases of herbicide resistance in 94 crops across the globe. Resistance is an issue in grain, vineyard, orchard, and vegetable crops. Herbicide resistance is an issue in many states, including Ohio. Loux (2021) reported waterhemp populations in the state have developed resistance to seven sites of action. Heap (2022) maintains an herbicide resistant database. A search of this database reveals 19 different weed species considered resistant in Ohio.

Extension Educators across Ohio conducted a Fall Soybean Weed Survey in September and October of 2021. The survey is conducted by Extension Educators traveling approximately 100 miles across each participating county to assess weed

pressure in 80 to 100 separate fields. Educators observe and record the presence of marestail, giant ragweed, volunteer corn, common lambsquarters, common ragweed, giant foxtail/grasses, velvetleaf, redroot pigweed, waterhemp, and pokeweed. The presence of these weeds is recorded on an Excel spreadsheet using a scale of "1" for occasional, "2" for moderate, and "3" for widespread. Of Ohio's 88 counties, 36 counties participated in the survey, observing 3,625 fields with an average field size of 56 acres. The results are provided in Table 1.

Table 1. Summary of fall soybean weed survey results, Ohio 2021

Ohio Region	**No. of Counties**	**No. of Fields**	**Ave. Field Size (acres)**
Northwest	9	1,279	63
Northeast	5	432	26
West Central	7	623	57
Central	5	451	100
East Central	3	243	28
Southwest	5	450	48
Southeast	1	104	23
South Central	1	43	29
Statewide	**36**	**3,625**	**56**

Statewide in 2021, 51%, on average, of observed fields were classified as weed-free. The percentage considered weed-free varied across Ohio with a low of 34% to a high of 87% weed-free. A summary is provided in Table 2.

Table 2. Percentage of fields in fall soybean weed survey considered weed-free, Ohio 2021

Ohio Region	**Fields Classified as Weed-Free (%)**
Southeast	87
Central	55
Southwest	53
South Central	51
West Central	47
East Central	44
Northwest	37
Northeast	34
Average	**51**

The top five weeds reported in the survey included volunteer corn, marestail, giant ragweed, giant foxtail/grasses, and waterhemp. A summary is provided in Table 3. There was variation across Ohio in the percentage of fields observed to have the top five weeds identified. Figure 1 describes the percentage observation by Ohio region.

Table 3. Top five weeds reported in fall soybean weed survey, Ohio 2021

Weed	**Percentage**
Volunteer corn	18
Marestail	17
Giant ragweed	17
Giant foxtail/grasses	9
Waterhemp	8

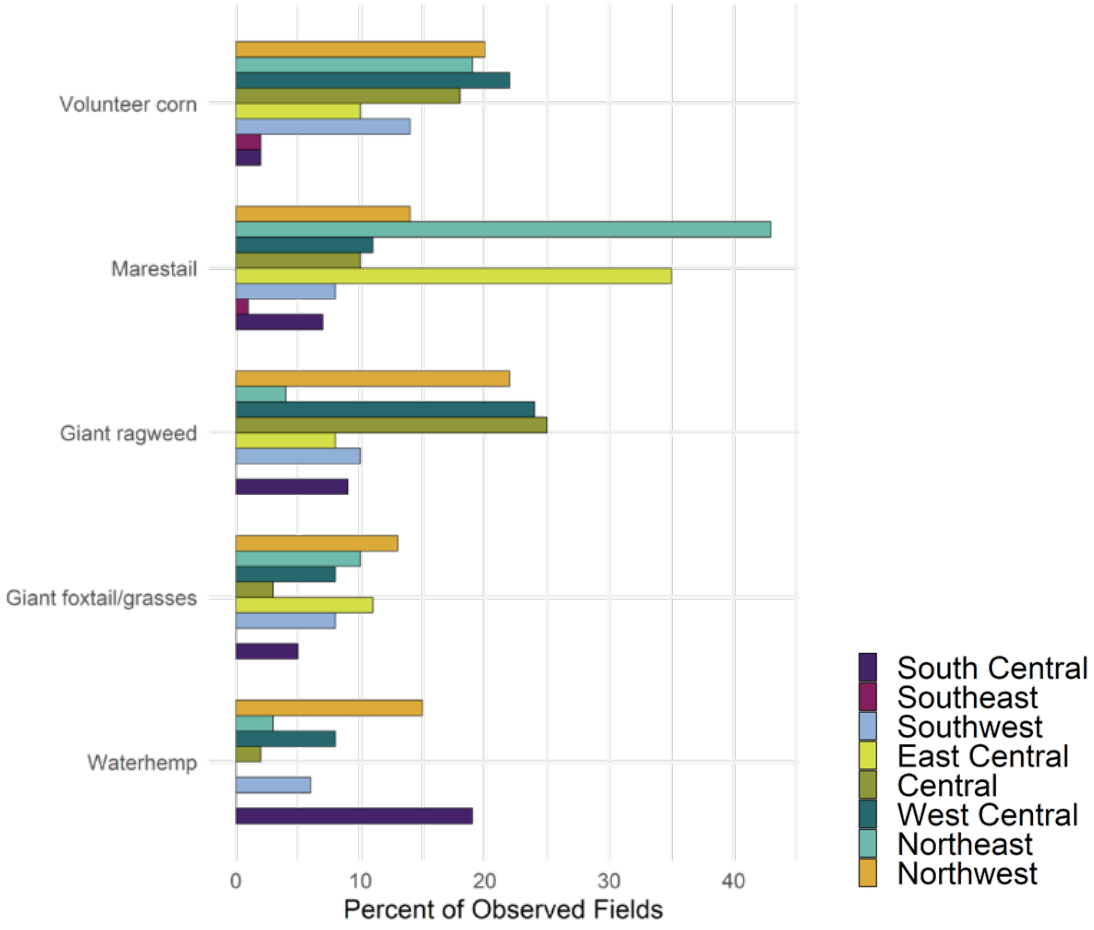

Figure 1. Percent of observed fields by Ohio region, fall soybean weed survey, Ohio 2021

To improve the knowledge and skills of farmers and crop consultants, a group of Ohio State University Extension Educators developed the “2022 Weed University” as a hybrid model using Zoom. The Zoom platform was used to allow presentations by Extension specialists to be broadcast to multiple locations simultaneously. The program was held over a two-day period in six Ohio counties and attracted farmers, crop consultants, and Extension professionals from 24 Ohio counties.

Program topics

Each location began with the host Educator presenting results of the soybean weed survey conducted the previous fall in their region. Other presentations included trending topics in weed control, weed biology and control methods, and using live specimens to properly identify grasses and broadleaf weeds. Farmers were encouraged by host Educators to submit prior to the event the herbicide program (products and rates applied) typically used in corn and/or soybeans. These were reviewed and discussed by our Extension Weed Specialist.

Methods

A planning committee of county Extension Educators and Specialists met regularly to identify topics, presenters, and meeting locations. Six counties across Ohio were identified as host sites, using a combination of in-person and Zoom teaching. Each location began with a presentation by the host Extension Educator of the results of the soybean weed survey conducted in the region. This was followed by Zoom presentations with Extension State Specialists discussing weed biology and control and trending topics in weed control.

Hands-on teaching demonstrations have been shown to be the most effective teaching strategies in other Extension training events (Kane, 2002; Strong et al., 2010). Incorporating hands-on activities was an integral part of this program. Three hands-on teaching activities were included in the afternoon sessions to supplement the Zoom programs offered in the morning sessions:

1. Utilizing live plants to teach weed identification – Producers were able to touch, feel and dissect plants to learn about important identifying characteristics of each species.
2. Learning to properly mix herbicides – Various herbicide products were used to demonstrate proper mixing sequence and utilizing appropriate Personal Protective Equipment (PPE) based upon label requirements of each product demonstrated.
3. Proper nozzle selection and calibration – A spray table was utilized to demonstrate various commonly used nozzles. A nozzle patternator was demonstrated to view nozzle performance. A box fan was used to emulate various wind speeds and participants held water-sensitive paper at various intervals in the classroom to analyze drift at different wind speeds.

The program concluded with a Zoom presentation by Extension Weed Specialists reviewing and evaluating herbicide control programs used by farmers attending the workshops. During this final session participants shared their herbicide program, and the Extension Specialist critiqued the program based on weed type and pressure, weed resistance strategies and herbicide cost.

Results and Discussion

The use of retrospective post-then-pre instruments is popular for measuring self-reported changes in knowledge and other variables (University of Wisconsin Extension-Madison, 2021). Two evaluation models common in Extension programming are pretest-posttest and retrospective pretest (O'Leary and Israel, 2022). A retrospective pre-test workshop evaluation was conducted at each site. Participants were asked to rate their level of knowledge about each program topic prior to and following their involvement in the workshop. The Likert-type scale of 1 (low) to 5 (high) was used. Results are summarized in Table 4.

Table 4. Summary of 2022 weed university program evaluation

Pre-Workshop Knowledge	Topic	Post-Workshop Knowledge
2.43	Regional Weed Survey Results	4.25
2.85	Weed Control Trending Topics	4.18
2.78	Weed Biology & Control	3.98
3.07	Weed Identification	4.18
3.13	Hands-On Activities	4.03
3.08	What Does Your Herbicide Program Look Like?	3.88

Knowledge gain was documented in all areas assessed. Those topics with the highest knowledge gain, shown in parentheses, were the regional weed survey results (1.82); trending topics in weed control (1.33); weed biology and control (1.20); and identification of grasses and broadleaf weeds (1.11). We believe the topics of highest knowledge gain were the result of topics of interest, the knowledge of presenters, and the use of live plants to teach weed identification.

Participants were asked to provide one to three management changes they would adopt because of attending the workshop. While too numerous to list all the comments here, we have provided a few common responses:

- Scout fields more regularly to identify weeds
- Examine spray nozzle types and select better nozzles
- Consider changes to herbicide programs

Conclusions

Based on pre and post knowledge assessment, the program was successful in communicating new knowledge. The Zoom technology presents challenges for many who prefer an in-person presenter. We are planning another round of Weed University programs in 2023 using a similar format, including a topic about alternative weed control strategies, and varying program topics based on geographic location.

Weed control will continue to be an area that requires education and management. It is likely resistance will continue to be an issue needing addressed through research and Extension work. Educational programs like the Weed University provide an opportunity to educate using hands-on instruction.

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