

Effective Waterhemp Control Programs and Compatibility with Interseeding in Corn: 2019 Trials

Project Leaders

Bryan Brown, NYS IPM Program
Venancio Fernandez, Bayer Crop Sciences
Mike Hunter, Cornell Cooperative Extension
Jeff Miller, Oneida County Cooperative Extension
Mike Stanyard, Cornell Cooperative Extension

Collaborators

Derek Conway, Conway Farms
Jaime Cummings, NYS IPM Program
Quentin Good, Quentin Good Farms
Antonio DiTommaso, Cornell University
Michael Durant, Lewis County Soil and Water Conservation District
Kathleen Howard, Cornell University
Grace Marshall, NYS IPM Program
Scott Morris, Cornell University
Ali Nafchi, Cornell Cooperative Extension
Jodi Putman, Cornell Cooperative Extension
Joshua Putman, Cornell Cooperative Extension
Matthew Ryan, Cornell University
Lynn Sosnoskie, Cornell University
Ken Wise, NYS IPM Program

Summary

Herbicide resistant waterhemp has spread into New York and caused yield losses for corn farmers. This project aimed to find ways to regain control of this weed in corn and determine the compatibility of more extensive herbicide programs with interseeded annual ryegrass. Our field trial included several treatments that effectively controlled waterhemp. One of the most effective treatments was an integrated program utilizing a reduced rate herbicide, row cultivation, and interseeding. This treatment was slightly more expensive than the other two-pass treatments but the cost may be offset by the benefits of cover cropping. Of the several residual herbicides that were compatible with interseeded annual ryegrass, Callisto provided the most effective control of waterhemp.

Background and justification

In the past few years, herbicide resistant waterhemp has expanded into New York and is now present in 12 counties at the time of this publication. Corn farmers have reported yield losses of 20% due to this weed (Figure 1), even after herbicide applications. Our greenhouse spray chamber tests of waterhemp from three different locations in New York indicate that it is likely resistant to herbicides from WSSA groups 2, 5, and 9 (ALS inhibitors, photosystem II inhibitors, and EPSPS inhibitors, respectively). Effective control programs in other states have relied on herbicides from other groups as well as additional physical or cultural tactics. Pre-emergence applications of residual herbicides are often recommended in order to reduce both the burden placed on post-emergence applications.

However, residual herbicides can sometimes cause injury to succeeding crops. Cover crops interseeded into a corn crop are at particular risk of injury. Interseeding has grown in popularity as a way to include a winter cover crop, which can benefit soil health, reduce erosion, and provide weed suppressive residue. Interseeding typically

occurs at corn growth stage V5 rather than waiting until after corn harvest, when it is oftentimes too late. Several prominent New York farmers have bought or built their own interseeders. Additionally, the Lewis County Soil and Water Conservation District and the Genesee River Coalition of Conservation Districts each have interseeders available for custom application.



Figure 1. Waterhemp competing with corn at a farm in Seneca County, NY.

Objectives

Objective 1. Evaluate the effectiveness of several different programs in controlling waterhemp in corn.

Objective 2. Assess the compatibility of residual herbicides with an interseeded cover crop.

Procedures

Objective 1.

The trial site was in Seneca County, NY on a field of Odessa silt loam soil where waterhemp had survived various herbicide applications and produced seed in 2018. In 2019, the ground was prepared for planting with a field cultivator on June 4, and planted on June 7. Pre-emergence applications were made after planting on June 7. Cultivation and interseeding occurred on July 12, while the other post-emergence treatments were applied on July 15. All treatments are listed in Table 1. For fertilizer, muriate of potash (0-0-60, 125 lbs K₂O/A) was applied prior to tillage and urea nitrogen (46-0-0, 100 lbs N/A) was broadcast on July 12.

Plots were 25' long and 10' wide. Each treatment was replicated four times in a randomized complete block design. Spraying was conducted using a backpack CO₂ sprayer with a 10' boom. Spray volume was 20 gal/A

applied at 40 psi. Row cultivation was achieved using a Double Wheel Hoe (Hoss Tools) with two staggered 6” sweeps (12” effective width). Two passes were made per row so that 24” of the 30” rows were cultivated. For Objective 1, interseeding was established by hand broadcasting annual ryegrass (Mercury Brand, “Ribeye”) at 20 lb/A.

Weed control was assessed on August 15 by collecting all aboveground weed biomass within a 2 ft² quadrat. The quadrat was used four times per plot, placed randomly in the two middle rows of each plot. Weeds were placed in paper bags and dried at 113 degrees F for 7 days, then weighed. Control was calculated by subtracting the biomass of each treated plot from biomass of the untreated plots, dividing by the biomass of the untreated plots, and multiplying by 100. Waterhemp was the dominant species present in this trial. Other species did not provide enough data for comparison. All waterhemp was manually removed immediately after the weed control assessments in order to prevent it from producing seeds.

Table 1. A list of the treatments implemented to control of waterhemp in corn. Weed Science Society of America herbicide site of action group numbers are in parentheses following each herbicide.

Treatment	Pre-emergence	Post-emergence
1	–	–
2	ResolveQ (2, 2) 1.5oz	–
3	Atrazine (5) 4pt	–
4	Callisto (27) 7.7 fl oz	–
5	Acuron (5, 15, 27, 27) 2.5qt	–
6	HarnessMax (15, 27) 2qt + Atrazine (5) 2pt	–
7	–	Acuron (5, 15, 27, 27) 2.5qt
8	–	Status (4, 19) 10oz + ResolveQ (2, 2) 1.25oz + NIS 0.25% v/v
9	–	Atrazine (5) 4pt + Callisto (27) 3 fl oz
10	Acuron (5, 15, 27, 27) 2.5qt	Status (4, 19) 10oz + ResolveQ (2, 2) 1.25oz + NIS 0.25% v/v
11	Acuron (5, 15, 27, 27) 2.5qt	Row Cultivation
12	Callisto (27) 5.4 fl oz	Row Cultivation, Interseeding

Corn grain yield was measured by first harvesting and weighing all ears in 10’ of a middle row of each plot on October 25. Weights were then adjusted based on the ratio of total ear weight to grain weight and then adjusted to 15.5% moisture based on subsamples that were completely dried (25 days at 113 degrees F). To provide an economic basis for comparison of each treatment, costs were estimated based on personal communications with several local custom applicators.

Objective 2.

This objective was conducted in Lewis County, NY on a field that did not contain any waterhemp. The field (Homer silt loam soil) was tilled June 9 and planted with silage corn (Pioneer, 95 day) on June 10 with 3 gal/A starter fertilizer (7-21-7). Pre-emergence herbicides were applied on June 12 and post-emergence on July 8. All treatments are listed in Table 2. Interseeding was conducted on July 10 using a 15’ interseeder (Interseeder Technologies) with three drills between each corn row operating at 0.5” depth. Annual ryegrass (Mercury Brand, “Ribeye”) was interseeded at 20 lb/A.

Table 2. A list of the treatments to evaluate the compatibility of pre-emergence herbicides with interseeded annual ryegrass. Weed Science Society of America herbicide site of action group numbers are in parentheses following each herbicide.

Treatment	Pre-emergence	Post-emergence (before interseeding)
1	–	–
2	–	Roundup PowerMax (9) 22 fl oz + AMS 2.5 lb
3	Atrazine (5) 4pt	Roundup PowerMax (9) 22 fl oz + AMS 2.5 lb
4	Callisto (27) 5.4 fl oz	Roundup PowerMax (9) 22 fl oz + AMS 2.5 lb
5	ResolveQ (2, 2) 1.5oz	Roundup PowerMax (9) 22 fl oz + AMS 2.5 lb
6	Dual II Magnum (15) 1.67pt	Roundup PowerMax (9) 22 fl oz + AMS 2.5 lb
7	<i>Warrant (15) 2.33 qt*</i>	Roundup PowerMax (9) 22 fl oz + AMS 2.5 lb
8	Sharpen (14) 3 fl oz	ResolveQ (2, 2) 1.25oz + Status (4, 19) 3oz + COC 1% v/v + AMS 2 lb
9	Acuron (5, 15, 27, 27) 1.25 qt	Roundup PowerMax (9) 22 fl oz + AMS 2.5 lb
10	Acuron (5, 15, 27, 27) 1.25 qt	Row Cultivation

*not a labelled use in New York.

Weed control of the pre-emergence herbicides was evaluated on July 7 by visually estimating the percentage of the ground covered by the most prevalent species or categories – common lambsquarters, velvetleaf, other broadleaf species, and monocot species. This was done using the same quadrat system described above and control was calculated in a similar manner.

Performance of the annual ryegrass was assessed on September 20 by collecting the aboveground biomass using the quadrat system and drying samples at 113 degrees F for 7 days before weighing. Although there would have been more cover crop biomass later in the fall, silage harvest would likely have altered the results.

Results and discussion

Objective 1.

Waterhemp control was most effective in treatments that utilized herbicides from WSSA groups other than 2, 5, or 9, or treatments that integrated non-chemical tactics. The pre-emergence-only and two-pass treatments were more effective than the post-emergence-only treatments. It was unexpected that the treatment with a reduced rate of Callisto followed by row cultivation and interseeding would control 100% of the waterhemp since most in-row weeds would have been uncontrolled by cultivation and the competition from the interseeded annual ryegrass would have been minimal.

Table 3. Effectiveness and estimated total cost of each treatment.

Treatment	Pre-emergence	Post-emergence	Waterhemp control (%)	Cost (\$USD/A)
1	–	–	0	0
2	ResolveQ	–	40	23
3	Atrazine	–	76	18
4	Callisto	–	89	26
5	Acuron	–	99	46
6	HarnessMax, Atrazine	–	99	40
7	–	Acuron	92	46
8	–	Status, ResolveQ	92	52
9	–	Atrazine, Callisto	99	23
10	Acuron	Status, ResolveQ	100	84
11	Acuron	Row Cultivation	100	62
12	Callisto	Row Cultivation, Interseeding	100	85

Both the untreated control and the treatment of ResolveQ yielded 10% less than the treatments with more than one herbicide or tactic. Yield loss would likely have been greater in most treatments if waterhemp had not been manually removed in mid-August to prevent seed production. From personal communications with NY corn farmers who have waterhemp in their fields, a 20% yield loss can be expected in fields with poor control.

The two-pass programs were the most expensive, but were also the only treatments to offer 100% control of waterhemp. Several one-pass treatments offered 99% control with less expense, but the remaining 1% of uncontrolled waterhemp could likely produce enough seed to perpetuate the population.

Objective 2.

Early-season weed control was most effective for treatments containing Acuron or Callisto (Table 4) even though reduced rates were used. Weed control for the other treatments varied by weed species, which reflects their more common use in mixtures. Dual II Magnum and Warrant performed somewhat similarly, which was expected because they are both in WSSA group 15.

Annual ryegrass biomass of the grower standard (Treatment 2) was similar to several of the treatments containing residual herbicides (Table 4). Treatments with pre-emergence applications of Dual II Magnum, Sharpen, and Acuron affected annual ryegrass biomass, although the injury from Sharpen may have been confounded by the addition of ResolveQ in the post-emergence application. More injury to annual ryegrass was expected from Atrazine, but a heavy rain may have lessened its effect. A rainfall gage at the field showed that in the four weeks between the pre-emergence applications and the interseeding, the field received nearly 4” of rain, with 2” on June 20. Likewise, the post-emergence use of row cultivation in Treatment 10 may have

lessened the effect of Acuron on annual ryegrass. Overall, Callisto stood out as the residual product that did not injure the annual ryegrass but also controlled waterhemp effectively in Objective 1.

Table 4. Effectiveness of each treatment on early-season weed control

Early-season weed control							
Treatment	Pre-emergence	Lambsquarters Control (%)	Velvetleaf Control (%)	Other Broadleaf Control (%)	Monocot Control (%)	Post-emergence (before interseeding)	Late summer annual ryegrass biomass (lb/A)
1	–	–	–	–	–	–	221
2	–	–	–	–	–	Roundup	485
3	Atrazine	88	53	99	39	Roundup	445
4	Callisto	99	100	100	98	Roundup	513
5	ResolveQ	100	10	80	98	Roundup	472
6	Dual II Magnum	97	0	62	88	Roundup	100
7	<i>Warrant*</i>	66	0	94	76	Roundup	394
8	Sharpen	99	100	96	43	ResolveQ, Status	246
9	Acuron	100	100	100	100	Roundup	268
10	Acuron	100	100	100	94	Row Cultivation	347

*not a labelled use in New York.

Project location(s)

Northern, western, and central New York.

Samples of resources developed

Online articles:

Brown, B., DiTommaso, A., Howard, K., Hunter, M., Miller, J., Morris, S., Putman, J., Sikkema, P., Stanyard, M. Waterhemp Herbicide Resistance Tests: Preliminary Results. Cornell Field Crops Blog. May 15, 2019. <https://blogs.cornell.edu/ccefieldcropnews/2019/05/15/waterhemp-herbicide-resistance-tests-preliminary-results/>

Video:

Marshall, G., Brown, B. Waterhemp Control in Corn: 2019 Trials. NYSIPM. December 20, 2019. [video] Accessed December 28, 2019. <https://www.youtube.com/watch?v=8NQ6S39uQ-8&t=17s>

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