

## Michigan Wheat Program Final Report

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**Title:** *Winter Wheat Herbicide Effects on Cover Crop Establishment - Year 3*  
**MWP Project #:** 20-08-06-CS  
**MSU PD#:** 46812  
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**PROJECT GOALS AND VALUES FOR MICHIGAN WHEAT GROWERS:** This research is being used to develop recommendations on what cover crops can be safely planted following applications of herbicides commonly used in Michigan winter wheat production. These recommendations will help ensure the successful establishment of cover crops that can be used to improve soil health, organic matter, and fertility, while reducing soil erosion, disease, and insect pressure, suppressing weeds, that ultimately lead to increases in crop yield. This project fits with the Michigan Wheat Program's priorities to:

- study the use and benefits of cover crops.
- evaluate opportunities for double cropping (i.e., cover crops).
- evaluate the efficacy of fungicides, herbicides, and insecticides.

### RESULTS OF PROJECT:

Cover crops have been shown to benefit cropping systems through erosion protection, nutrient mineralization, increased nitrogen availability (legume covers), suppression of plant pathogens and weeds, improved soil health, and beneficial insect attraction. Planting cover crops after wheat harvest provides farmers with an excellent opportunity to include cover crops in their crop rotation. One of the areas of cover crop information that is currently lacking is the tolerance of cover crops to herbicides. If a cover crop is sensitive to herbicide residues from applications in the previous crop the cost to a grower can be high, including seed costs and the benefits that the cover crop would have provided to the cropping system. Additionally, prior to cover crop planting some growers may want to clean up weedy fields with herbicide applications. These herbicides may also affect cover crop establishment and growth. Therefore, the **objectives** of this research were two-fold: 1) *Evaluate the effects of commonly used spring-applied winter wheat herbicides on cover crop establishment and growth following winter wheat harvest, and 2) Evaluate cover crop tolerance to burndown herbicide applications applied after winter wheat harvest.*

1) *Spring-applied herbicides.* A field experiment was established by planting winter wheat in the falls of 2020, 2021, and 2022 at the MSU Agronomy Farm (MSUEL) and the Kellogg Biological Station (KBS), and at the Saginaw Valley Research and Extension Center (SVREC) in 2020 and 2021. In the spring, wheat was sprayed in April when wheat was between Feekes stages 4 and 5, with nine different herbicide treatments, including a no herbicide control. Throughout the growing season wheat was evaluated to determine if there are any unforeseen injury issues with any of the herbicide treatments. Wheat was harvested from studies where injury was significant. After harvest, nine different cover crop species were no-till drilled into winter wheat stubble in late-July between 85-118 d after application of nine different spring wheat herbicides. These cover crops

were evaluated for establishment (cover crop counts) and injury. The soil types at the different locations were a sandy clay loam, loam, and clay loam soils. Precipitation ranged between 4.78 to 11.4-inches between herbicide application and cover crop planting. In late fall, prior to the first frost, cover crops were evaluated for late-season herbicide injury and two 0.25 m<sup>2</sup> samples of each cover crop plot were harvested for above ground biomass.

Although not the major objective of this experiment, in 2021 significant wheat injury was present at MSUEL, with the greatest injury from a spring application of Osprey Xtra of 25%, 14 DAT. This injury persisted throughout the growing season. Wheat injury from Affinity BroadSpec, PowerFlex HL, and Axial Bold was also present at MSUEL, even though it was 10% or less and it did not persist. Wheat injury at this location was likely significant due to low day/night temperatures (<50° F) around application at MSUEL. Wheat injury from Osprey Xtra at MSUEL resulted in 23.4 bushel per acre lower yields (34%) compared with the untreated control (Figure 1). Yield was also lower with PowerFlex HL compared with the untreated control due to the cold temperatures at application.

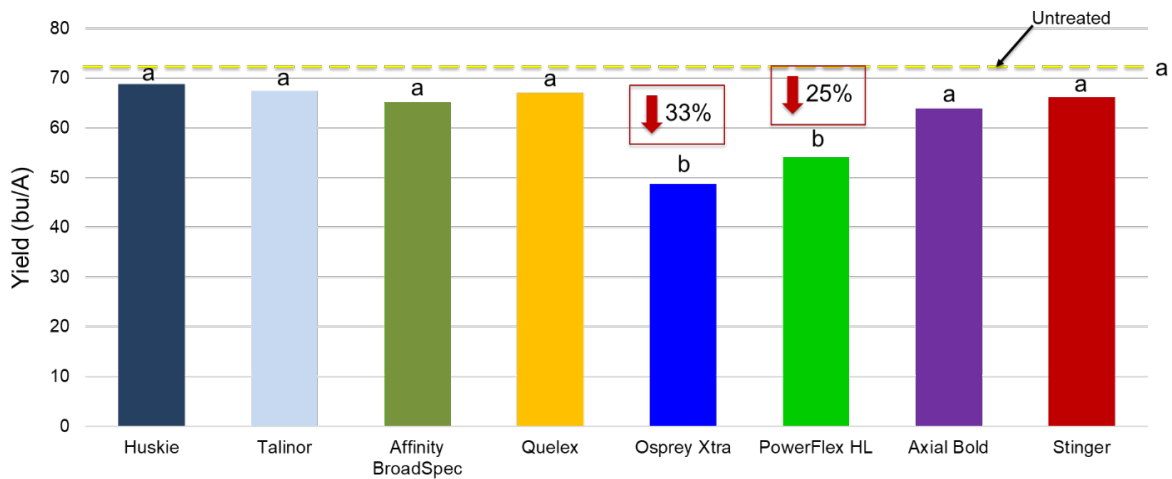


Figure 1. Wheat yield at MSUEL compared with the untreated control. Temperatures less than 50° F were present at herbicide application.

All cover crops established well at all locations by 28 days after planting (DAP) (Figure 2).



Figure 2. Establishment of 9 different cover crops, 28 DAP.

Across the 8 site-years there was less than 15% injury, no reductions in stand, or end of the season biomass for annual ryegrass, oat, cereal rye, mustard, radish, dwarf Essex rapeseed, and crimson clover. Huskie injury to red clover, 4 weeks after seeding, ranged from 0 to 40% across the 8 site-years, but most injury was less than 15%. Injury consisted of bleaching around the outer leaf edges (Figure 3). This injury did not result in any reductions in stand or final biomass. Huskie, Talinor, and Affinity BroadSpec applications caused injury to winter pea 4 weeks after seeding, but there was no an effect on final pea biomass.



**Figure 3.** Clover injury 28 d after planting from Huskie (Group 27) herbicide.

Table 1 provides our current recommendations for planting cover crops following a spring application of winter wheat herbicides after three years of research.

**Table 1.** Cover crops that can be safely planted after wheat harvest when various herbicides are spring-applied. Data is from eight site-years.

Herbicide	Annual ryegrass	Cereal rye	Oats	Crimson clover	Red clover	Oilseed radish	Mustard Caliente	Dwarf Essex rapeseed	Austrian winter pea
Affinity BroadSpec	Y <sup>1</sup>	Y	Y	Y	Y	Y	Y	Y	C
Talinor	Y	Y	Y	Y	Y	Y	Y	Y	C
Huskie	Y	Y	Y	Y	C	Y	Y	Y	C
Axial Bold	Y	Y	Y	Y	Y	Y	Y	Y	Y
Osprey <sup>2</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y
Osprey Xtra	Y	Y	Y	Y	Y	Y	Y	Y	Y
PowerFlex HL	Y	Y	Y	Y	Y	Y	Y	Y	Y
Quelex	Y	Y	Y	Y	Y	Y	Y	Y	Y
Stinger	Y	Y	Y	Y	Y	Y	Y	Y	Y

<sup>1</sup> Y = Yes cover crop can be seeded with injury less than 15% and no impact on counts or biomass; C = Caution should be taken with seeding (early season injury between 16-50%; but no impact on biomass); N = No do not seed (injury >50% or significant biomass reduction).

<sup>2</sup> Osprey data is only from 2022 and 2023.

2) *Post-harvest herbicides.* After wheat harvest at MSUEL and KBS in 2022 and 2023 and at SVREC22 five burndown herbicides were applied. Cover crops were planted immediately after herbicide application. Rainfall during the cover crop growing season ranged from 5.7 to 8.8-inches. Cover crop establishment with counts and injury was evaluated 28 DAP and final cover crop injury and biomass was collected prior to the first frost.

Across the five site-years, the various cover crops responded differently to the five different herbicides. Applications of Roundup PowerMax and Liberty did not affect initial cover crop establishment (28 d after planting) or final cover crop biomass. Enlist One caused initial injury or a reduction in stand for crimson clover, red clover, dwarf Essex rapeseed, mustard caliente, and oilseed radish. However, there was no reduction in final cover crop biomass for these species. Caution should be taken when using Enlist One as part of a burndown program prior to planting these cover crops (Table 2). Sharpen at the 1 and 2 fl oz/A rate had more of a significant effect on the clovers, *Brassica* species, and Austrian winter pea. While final biomass may not have been significantly affected in some cases, reductions in stand and cover crop injury at the end of the season would suggest not using Sharpen to control horseweed prior to planting oilseed

radish, mustard Caliente, or dwarf Essex rapeseed. While we are asking growers to take precautions when using Sharpen prior to planting crimson and red clover and Austrian winter pea and would suggest not using more than the 1 fl oz/A rate of Sharpen.

**Table 2.** Cover crops that can be safely planted after wheat harvest when various herbicides are applied post-harvest. Data is from five site-years.

Herbicide	Annual ryegrass	Cereal rye	Oats	Crimson clover	Red clover	Oilseed radish	Mustard Caliente	Dwarf Essex rapeseed	Austrian winter pea
Roundup PowerMax	Y <sup>1</sup>	Y	Y	Y	Y	Y	Y	Y	Y
Liberty	Y	Y	Y	Y	Y	Y	Y	Y	Y
Enlist One (32 fl oz)	Y	Y	Y	C	C	C	C	C	Y
Sharpen (1 fl oz)	Y	Y	Y	C	C	N	N	N	C
Sharpen (2 fl oz)	Y	Y	Y	C	C	N	N	N	C

<sup>1</sup> **Y = Yes** cover crop can be seeded with injury less than 15% and no impact on counts or biomass; **C = Caution** should be taken with seeding (injury between 16-50%; cover crop counts may be lower, but no impact on biomass); **N = No** do not seed (injury or stand loss >50% or significant biomass reduction).

### SUMMARY OF PROJECT:

Planting cover crops after wheat harvest provides farmers with an excellent opportunity to include cover crops in their crop rotation and can also broaden the spectrum of cover crop species that can be seeded. Cover crops can improve soil health, organic matter, and fertility; reduce soil erosion; suppress weeds; reduce disease and insect pressure; and some cover crops can provide N credits for the following crop. All these benefits can ultimately lead to increased crop yields. Spring herbicide applications in winter wheat are commonly used to manage weeds. However, wheat herbicides applied in the spring may limit establishment and growth of different cover crop species. Currently, there is little to no information available on the tolerance of several of these cover crop species seeded after winter wheat harvest to spring applied wheat herbicides. This lack of information leads us to the question, “*If I apply ‘X’ wheat herbicide, what cover crops can I safely plant after wheat harvest?*”. Understanding the tolerance of various cover crop species to commonly applied wheat herbicides will benefit Michigan wheat farmers’ overall cropping system. To date, after three years of research over three locations with varying rainfall, temperatures, and soil types we have found that annual ryegrass, cereal rye, oats, crimson clover, oilseed radish, mustard Caliente, and dwarf Essex rapeseed are safe to plant after all nine of the spring applied winter wheat herbicides tested (85 d or more after applications). While final cover crop biomass was not affected growers may experience some initial injury to red clover, and Austrian winter pea when Huskie is applied in the spring, and also when Talinor or Affinity BroadSpec are applied in the spring prior planting cover crops after wheat harvest. Additionally, if growers are wanting to control weeds, such as glyphosate-resistant horseweed or volunteer winter wheat, prior to planting cover crops. Liberty and glyphosate can be safely applied without impacting any of the nine cover crops planted. Enlist One (2,4-D) can also be used prior to planting annual ryegrass, cereal rye, oats, and Austrian winter pea. There is some injury and stand loss but no effect on final cover crop biomass when Enlist One was used prior to planting crimson clover, red clover, oilseed radish, mustard Caliente, or dwarf Essex rapeseed, but caution should be taken. If Sharpen is applied we would only recommend the 1 fl oz/A rate and the three grass cover crop species were safe to plant, there is some injury and stand loss, but no affect on cover crop biomass for the clover species and Austrian winter pea. We do not recommend planting any radish, mustard, or radish if Sharpen is used.

These recommendations will help ensure the successful establishment of cover crops that can be used to improve soil health, organic matter, and fertility, while reducing soil erosion, disease, and insect pressure, suppressing weeds, ultimately leading to increases in crop yield. The results from this research will be added to the 2025 MSU Weed Control Guide for Field Crops (E-434), continue to be presented at extension meetings, and posted on [www.MSUweeds.com](http://www.MSUweeds.com).

**FUTURE WORK:**

Not applicable.

**PROJECT CHANGES:**

None requested.

**BUDGET NARRATIVE:**

On track.

**INTELLECTUAL PROPERTY:**

None developed.

**APPROACH TO DISSEMINATE RESEARCH:**

This research will continue to be used as a resource of recommendations on what cover crops can be safely planted following these wheat herbicide applications. These recommendations will continue to help ensure the successful establishment of cover crops that can be used to improve soil health, organic matter, and fertility, while reducing soil erosion, disease and insect pressure, suppressing weeds, ultimately leading to increases in crop yield. This information will continue to be shared with Michigan wheat farmers and will be included in the Michigan Weed Control Guide for Field Crops (E0434). Research data and resulting recommendations will be presented at extension meetings, MWP summer field day, in newsletter articles (i.e., Wheat Wisdom), and included in a factsheet on cover crop tolerance to winter wheat herbicides, and on the web at [www.msuweeds.com](http://www.msuweeds.com). Additionally, we are currently writing a peer-reviewed manuscript for Weed Technology to communicate with the Weed Science discipline.