

# Needs and Opportunities for Integrated Weed Management in New York State Agricultural Crops

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## **Abstract**

Integrated Weed Management (IWM) offers many potential benefits to growers, but IWM outreach should be tailored fit the context of the commodity and the individual growers in order to be utilized. Therefore, I assessed needs of growers in each commodity and evaluated the potential for IWM to address those needs. A multitude of needs and opportunities were identified, including herbicide resistance in field crops, improved use of cultivation in vegetables, methods to control perennial weeds in fruit, and ways to improve use of mulch in ornamentals. A key opportunity across commodities is to determine the most appropriate ways to diversify production and management - a key aspect of successful ecological weed control. I hope to build on this initial assessment and use it to guide my future research and extension efforts.

## **Background and justification**

Integrated Weed Management (IWM) involves "integrating" more weed control tactics into farm management. While IWM can simply improve weed management, it can also reduce the number of herbicide applications required to achieve adequate control, delay or prevent herbicide resistance, and benefit the overall farm agroecology.

IWM tactics include diversification of herbicide modes of action, improved crop rotation, increased use of cover crops, incorporation of mechanical and biocontrols, and targeted seed and seedling control of the weed species present.

Globally, adoption has been slow due to the increased knowledge and sometimes increased expense required to implement IWM practices. However, the knowledge gap may be addressed with education and the expense may be offset by herbicide savings as well as the agronomic benefits of IWM tactics. Furthermore, it has been suggested that adoption may be improved by tailoring management strategies based on the needs and skills of individual growers (Bastiaans et al. 2008). Therefore, by assessing the needs of growers in New York and determining the most feasible IWM practices for growers in each commodity area, future IWM projects, outreach, and adoption will likely be more successful.

Bastiaans, L., Paolini, R., & Baumann, D. T. (2008). Focus on ecological weed management: what is hindering adoption? *Weed Research*, 48(6), 481–491.

## **6. Objectives:**

- Objective 1. Assess the need for IWM in field crops, vegetables, fruit, and ornamentals.
- Objective 2. Find feasible opportunities for IWM in each commodity.

## **7. Procedures:**

Objectives 1 and 2: Bryan Brown met with growers, researchers, and Cornell Cooperative Extension personnel in the summer and fall of 2017 to discuss needs and opportunities related to

IWM. He also gained responses about IWM during his speaking engagements at several grower and extension meetings.

## **Results and discussion**

In this section, the needs and opportunities for IWM that I have identified are outlined by commodity group.

### **Field crops**

Due to scale and feasibility, field crops growers typically do the minimum weed control required to attain a viable yield. For conventional growers this often involves spraying one or two herbicides with the best combination of effectiveness and affordability. However, this can lead to the development of herbicide resistant weeds. Over the years, there have been several documented cases of resistance to photosystem II inhibitors in NY, but with increased use of glyphosate resistant crops, glyphosate resistant horseweed and waterhemp are becoming more problematic. Using crops with stacked resistance to 2,4-D, glufosinate, or dicamba may represent a solution but over-reliance on these herbicides would likely cause resistance to develop in a process known as the "resistance treadmill." Therefore, there is a need to effectively communicate to growers that the number of herbicide options is limited and that a diverse herbicide rotation is required to maintain the utility of herbicide resistant crops. Furthermore, since herbicide rotation alone is unlikely to prevent the development of resistance (HRAC 2017), there is a need for cost-effective alternatives.

A compounding problem that I observed in fields across the state that I brought up with Cornell Cooperative Extension personnel participating in the weekly field crops conference calls is the issue of growers knowingly allowing weeds to produce seed. This was especially apparent in 2017 due to the wet growing season and the larger than usual number of acres that were not able to be planted. I was able to produce educational talks and materials on preventing weed seed production as well as how to reduce the impact of weed seed production, but it remains a key need.

Cultivation may be another possible solution, but it usually only kills around 70% of the weeds. Thus, to achieve satisfactory control, more than one pass may be required. Furthermore, at a Certified Crop Advisors meeting of field crop specialists, the consensus was that it was not the low efficacy of cultivation that was the limiting factor, instead, it was the increased time required to cover all fields. For example, a 90-foot-wide sprayer can travel 10 miles per hour, whereas cultivators are usually the same width as planters – less than 30 feet wide – and can usually only travel 5 miles per hour. Other types of physical weed control may be preferable in certain circumstances. For example, conventional field corn growers at the Corn Plots Field Day were interested in flaming to control weeds in riparian areas where herbicides and tillage are discouraged.

A weed management opportunity in soybeans that I am pursuing in a collaboration with Matt Ryan and Sarah Pethybridge is the potential for roller-crimped rye cover crop residue to suppress weeds. The cost of this practice may be offset by the agronomic benefits as well as suppression of soil-borne pathogens such as white mold. Furthermore, the burgeoning technique of

terminating the cover crop and planting into it in one step, or "planting green," may further increase the viability of residue mulches.

An opportunity to make the agronomic and weed control benefits of cover cropping more feasible for field corn growers involves a new piece of equipment called an interseeder, which allows cover crops to be planted mid-season so that they provide late-season ground cover and can take off as soon as the corn dries down. I will be collaborating with Lewis County Soil & Water next season to demonstrate this tool to interested growers.

More growers are starting to use no-till practices in New York. While this production system has many benefits for soil health, control of perennial weeds becomes more challenging and may require more systemic herbicides. In hay crops, brown knapweed remains a challenge and I am looking to pursue additional management strategies to support the work of Aaron Gabriel.

Industrial hemp production has been approved in New York, but there are no registered herbicides. Therefore, there is a need for improved understanding of most effective physical and cultural weed control practices for this crop.

### **Vegetables**

With far fewer registered herbicides than field crops, weed control can be challenging in vegetable production. Use of pre-emergence herbicides, grass-weed post-emergence herbicides, and cultivation are more common in vegetable production. In a meeting of processing vegetable growers and consultants, summer annual broadleaf weeds were a top priority in each crop. They desired new chemicals to control these weeds as well as research on the optimal timing of existing herbicides and techniques to delay herbicide resistance.

For organic growers, in-row weed control is the main challenge since between-row weeds are controlled with cultivation. Organic weed control is heavily reliant on soil disturbance and more work is needed to find reduced tillage solutions. Mulching to suppress weeds is one such option. Farm visits with Amy Ivy and Judson Reid included several operations that relied on mulch, even in conventional systems. My conversations with organic growers Jean Paul Courtens and Klaas Martens also tended to veer in the direction of mulch. Indeed, it is effective and has benefits to soil quality, but a key need that remains is reducing the cost.

Ethan Grundberg and I hosted the Mechanical Cultivation Equipment Demonstration Field Day in an attempt to bring new technology to NY that could benefit growers. The event hosted a range of equipment appropriate for different sized farms and I presented ways to use cultivation in IWM. Evaluations showed that growers were evenly split in interest between the different cultivators and that 82% of respondents felt that their weed management will improve as a direct result of the event. The evaluation also found two main problems that growers face with cultivation - the expense and the lack of effectiveness - perhaps areas where future research can improve. The high price point of the most advanced cultivator showcased was not feasible for most growers but it was suggested by Jeff Miller that it might be feasible for large farmer cooperatives or large seeding/planting companies. Some of the newer, less expensive models will be tested in my research in 2018. These models will be used to address another need mentioned

by Crystal Stewart and Christy Hoepting, that we need to determine the optimal cultivation systems for the varied stony, clayey, or muck parts of NY.

Several growers mentioned a research need of assessing the potential for soil nutrients to affect the emergence and survival of weeds. For example, one grower had invested in calcium amendments for three years in an unsuccessful effort to reduce weed emergence. However, there has already been sufficient research to refute the somewhat common farmer belief that by creating the "ideal" nutrient ratio weeds will be hindered. Therefore, this represents an opportunity to educate growers and prevent costly mistakes.

Meg McGrath brought to my attention a possible synergy of using mustard cover crops as biofumigants as well as for their allelopathic effects on germinating weed seeds. This could represent a possible research opportunity in the future.

### **Fruit**

Due to reduced tillage, perennial fruit crops are often accompanied by perennial weeds. Growers are typically reliant on glyphosate to control perennials while crops are not actively growing. Efficacy is generally high but there is confusion among growers about the optimal timing of application. Hans Walter-Peterson and I have initiated a project to attempt to improve control of these perennial weeds in grape production using a mix of disturbance and herbicides. Similarly, mowing is usually used to control vegetation in the row middles but there is interest in finding ways to reduce the required frequency of mowing, possibly through improved timing.

Several growers, including Jim Bitner, have mentioned interest in mulching for in-row weed control but there is concern about the mulch providing rodent habitat and whether the upfront investment would be economically viable. I've spoken with Greg Peck and Art Agnello on this topic, possibly leading to a grant submission in future years.

Weed control in first-year strawberry plantings is a key challenge as there are few herbicide options and the first year determines the success of following years. Laura McDermott and I visited a strawberry grower to assist with his weed management and while meeting it occurred to the farmer that the weed problems started increasing when his father stopped cultivating - highlighting the need for education on how to use the old equipment, refurbish it, or replace it.

### **Ornamentals**

At a conference of eastern New York cut flower growers where I presented, weed management was the top challenge (Figure right) due to the lack of herbicide options or other obstacles to weed control. The group was very open to ecologically-based weed management and were especially interested in soil solarization to kill weed seeds. Most of the group use a synthetic mulch weed barrier to some extent and there are several opportunities to improve their use of mulch that I'll explore in future talks.



Perennial ornamentals are accompanied by perennial weeds and have similar weed management

needs as perennial fruit. Christmas trees represent one of the largest grower groups in perennial ornamentals and I received several requests for tips on how to reduce mowing frequency.

In greenhouses with ornamentals mulched or in containers, competition with crops is less of an issue but weeds do provide overwintering habitat for pests and there are very few herbicides labeled for use indoors, suggesting a potential need.

### **Across commodities**

A critical need that is present in each commodity is to assess the potential to increase the diversity of management. Speaking with John Wallace, we agreed that changing up the chemical and tillage regimes through use of crop rotation and cover cropping is one of the best ways to minimize weed success. However, growers prefer the simplest system possible because of the immense amount of knowledge, experience, and equipment required to diversify. One possible solution is for specialized growers to trade fields so that each section of ground receives a lengthened rotation. Another opportunity is to determine the actual costs and benefits of IWM tactics. For example, the costs of cover cropping per acre can be easily estimated but it is very difficult to estimate a monetary benefit to weed control. A meta-analysis of prior research could provide estimates in this regard.

Another opportunity to improve weed management in all commodities is through the use of weed emergence phenology data to predict the emergence timing of key species and allow for more

informed timing of management events. This is a project that has been initiated by the Cornell Weed Ecology group.

Overall there are far more weed management needs for one person or even a team to address, but over the coming years I will carefully choose to pursue the research and education projects that offer the greatest potential to benefit NY growers.

HRAC (Herbicide Resistance Action Committee) 2017. Guideline to the management of herbicide resistance. Accessed online at <http://hracglobal.com/files/Management-of-Herbicide-Resistance.pdf> (1/4/18).

### **Project location**

Statewide

### **Samples of resources developed**

Online articles:

Brown, Bryan. "Abandoned fields: Weedy disaster or IPM opportunity?" *ThinkIPM Blog*. New York State Integrated Pest Management, 1 August, 2017. Web. Accessed 25 September 2017.

Brown, Bryan. "IPM for weeds in unplanted fields." *Weekly Field Crops Pest Report*. New York State Integrated Pest Management, 4 August, 2017. Web. Accessed 25 September 2017.

Brown, Bryan. "Using "Many Little Hammers" to Combat Herbicide Resistance." Integrated Weed Management Resource Center, 20 December, 2017. Web. Accessed 20 December 2017.

Video:

NYSIPM (11/20/17) *Integrating Cultivation into Weed Management* [Video File]. Retrieved from <https://www.youtube.com/watch?v=hYyToq4qrZ0>

Selected quotes from the evaluation forms of the Mechanical Cultivation Equipment Demonstration Field Day:

"[I'll] add more precision cultivating system to the farm"

"[I'll] incorporate more advanced weed control in future farm planning"

"[I'll] combine more tactics and try to find more ways to control in-row weeds"



Photo: Herbicide resistant horseweed in a crop of soybeans in western New York.