Title: Opportunities and needs for biological control in New York

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Abstract:

Challenges, opportunities, and current and future needs to improve the use of biocontrol pest management strategies in New York were assessed through meetings with colleagues and stakeholders. Major challenges include: (1) lack of stakeholder understanding of what biocontrol is; (2) hesitancy to adopt biocontrol because stakeholders are unsure of the efficacy or cost effectiveness of biocontrol strategies; and (3) stakeholder uncertainty over how to implement biocontrol in their crop production or other pest management settings. Important opportunities include: (1) changing pest management settings which may make biocontrol strategies more desirable than they once were; and (2) pests for which insufficient control has been achieved through other management strategies. Current needs in the area of biocontrol outreach, extension, and research include both increased awareness of what biocontrol strategies are and how they work, and also increased knowledge of the efficacy of biocontrol products and how to use them successfully. A list of pests and pest control settings for which biocontrol solutions are especially needed or seem promising is included. Future opportunities to collaborate on biocontrol research or extend information on biocontrol solutions for these pests should be prioritized.

Background and Justification:

On June 1, 2017 I began my position as the Biocontrol Specialist with the New York State Integrated Pest Management Program. Unlike many other NYS IPM positions, responsibilities for this position focus on a type of pest management (biological control), but are unrestricted in terms of the setting in which this pest management might take place (i.e., any agricultural commodity and community settings). Also, since this was a new position for NYS IPM (not refilling an existing position), other NYS IPM staff are already supporting the use of biological control in their commodities (e.g., Abby Seaman and *Trichogramma ostriniae* in sweet corn, Betsy Lamb and greenhouse pest control, Keith Waldron and parasites of livestock flies). It is important that these efforts be built upon, rather than duplicated. Various Cornell faculty and CCE staff are also involved in research and extension on biocontrol, and industry professionals are either supplying biocontrol organisms and products to stakeholders, or making recommendations on the use of these organisms and products. Therefore, I was advised to start this position by learning about where biocontrol is already being used successfully in agricultural and community settings, and about the challenges and opportunities to enhancing use of biocontrol in pest management around NY.

Objectives:

(i) Identify challenges to improved use of biocontrol strategies in NY
(ii) Identify opportunities for improved use of biocontrol strategies in NY
(iii) Identify specific current and future needs for biocontrol outreach, extension, and research in NY

Procedures:

Beginning in June 2017 and continuing through the remainder of 2017, I attended producer and community stakeholder meetings and events and scheduled one-on-one or group meetings with colleagues. In addition to NYS IPM staff, I met with 8 Cornell faculty, 32 CCE education staff, and 3 industry professionals. I attended 15 stakeholder meetings or events (attended by a total of approximately 650 people).

What I learned:

Challenges to improved use of biocontrol in NY

1) Understanding

Many individuals are at least somewhat unfamiliar with the term "biocontrol" (including both agricultural and community stakeholders). In agricultural settings, the plethora of "biological" products currently on the market and the different terms used to describe them (e.g., biocontrol agent, biostimulant, biopesticide) is confusing. The fact that the beneficial organisms providing pest control can be arthropods, fungi, bacteria, or nematodes, and the fact that some are pesticides (and regulated as such), while others are not, increases the confusion. In addition, some people would like clear delineations of what constitutes "biocontrol" and what does not. For example, is mating disruption biocontrol? What about pheromone traps? If a bacterium induces plant defenses, is it a biocontrol agent? What if a fungus enables a plant to more effectively take up nutrients, making the plant healthier and better able to resist disease? I think that one of my challenges will be to provide clear answers about terminology where it helps the stakeholder to understand the product he or she is purchasing and how to apply it according to the law, while not getting bogged down in academic debates over definitions.

2) Adoption

Some stakeholders are simply hesitant to adopt biocontrols because they think they are not cost effective, or will not provide the desired level of pest control. There is a perception that using biocontrol means tolerating some damage or some pests. For crops or pest settings with very low pest or damage thresholds, biocontrol solutions may be perceived as insufficient to meet stakeholder standards. Meanwhile, other stakeholders are already using biocontrol products alongside (compatible) chemical products, without evidence that the biocontrols are improving the levels of control achieved (beyond the control provided by the chemicals). The general public has access to a wide array of home pest control products (including some biocontrols) through both online and brick-and-mortar stores, but may not be aware of which products work best, or under what conditions. Lack of efficacy data from reputable sources is likely limiting the adoption of biocontrol in some settings, and leading to ineffective application of biocontrol products in other settings. In some cases, this efficacy data may exist, but the stakeholders are unaware of it. In other cases, stakeholders may need to see demonstration trials of biocontrol agents providing sufficient (as defined by the stakeholder) pest or damage reduction.

3) Implementation

Stakeholders need to feel confident that they can incorporate biocontrols into their existing crop production or pest management strategies and schedules. In order for stakeholders to successfully implement biocontrol, they need information about the ways in which these living organisms may need to be handled, stored, and applied differently than chemicals. For example, optimal storage conditions and shelf life may be more limited, necessitating additional planning when purchasing products. Many biocontrol agents are likely to require earlier application than a chemical pest management strategy, so different pest thresholds or application timings may be required. Some biocontrols may be more sensitive to specific (or different) weather conditions than chemicals. To transition successfully from chemical to biological pest management, stakeholders will need clear information and support from extension staff and/or fellow growers.

Compatibility of biocontrol strategies with chemical pest management is an extremely important component of implementation, especially in settings where many chemicals are applied (e.g., apples, onions grown on muck soil). If one pest in a system requires even one chemical that is toxic to an important biocontrol agent, it can make the use of biocontrols in the system difficult or impossible. In such situations, the solution would be a novel pest management strategy (chemical, biological, mechanical, or cultural) for that single "problem pest". Identifying such a solution seems outside the scope of the NYS IPM biocontrol specialist position, or would require substantial collaboration (e.g., with faculty or industry professionals). In many cases, simply the gap in knowledge about the compatibility of biocontrol organisms with chemical pest control is a substantial challenge. Many companies provide information about the compatibility of their own biocontrol products with chemicals (e.g., BASF, BioBest, BioWorks, Koppert), but there are still gaps in this information, and sometimes the information is inconsistent among sources. Since the information is located in so many different places, locating it can may be a barrier to some stakeholders.

<u>Opportunities to improve use of biocontrol strategies in NY</u>

1) Changing pest management settings

In NY, changes are ongoing in crop production systems, regulations, available pest management strategies, and public perceptions. How well a biocontrol organism fits into an IPM strategy is impacted by changes in the chemicals that are labeled for use on specific crops and in specific settings, the impact these changes have on pest species present, the continued arrival of new invasive pest species, and consumer preferences for pesticide use on their food or in the spaces where they live, work, attend school, and enjoy leisure activities. The continued emphasis on pollinator protection also creates an opportunity to use biocontrol strategies that are safe for pollinators. Furthermore, suitable pollinator habitat (mixed species plantings of perennial flowers that bloom from early spring through fall and are protected from chemical pesticide applications) also provide excellent habitat for natural enemies, and could enhance conservation of biocontrol organisms already in the landscape. These changes have already and will likely continue to make biocontrol strategies more desirable and more cost-effective in a wide range of pest management settings. Meanwhile, the number of biocontrol products on the market (especially those that contain bacteria and fungi) seems to be increasing, and I have received positive feedback from multiple Cornell faculty about efficacy of these products in the field. What is especially

encouraging is that even some faculty who traditionally have been skeptical of biocontrol and work in crops that use a lot of chemical pesticides have expressed optimism about some of the new biocontrol products they have tested. Growth in specific crops in NY may also provide new opportunities for biocontrol implementation. For example, I have been told that new hops growers who do not come from farming backgrounds and are not used to spraying pesticides may feel more comfortable releasing natural enemies or applying microbial products with short re-entry intervals. Furthermore, in every commodity there seem to be innovative producers who "think outside the box" and are willing to try new strategies. Producers who are already effectively using biocontrols in their production systems can be great resources when trying to help others adopt these strategies.

2) Insufficient pest control

It seems that in every commodity there are at least some pests for which no truly satisfactory control strategy currently exists, or for which current control strategies are at risk. This may be due to existing resistance to available chemical options, or the speed with which certain pests are able to develop resistance. In other pest control settings, other pest management strategies may be either unavailable or undesirable. A list of specific examples is included in the next section.

<u>Current and future needs for biocontrol outreach, extension, and research in NY</u>

1) Increased awareness and understanding

Producers who are considering biocontrols could benefit from clarification about the differences between biostimulants, biopesticides, and non-pesticide biocontrol agents (especially as this impacts the legal use of these products). The general public could also benefit from increased awareness of what biocontrol is, and that biocontrol products are available for use in and around the spaces where they live.

2) Support for adoption and implementation

Both producers and the general public could benefit from data on efficacy, costs, and the correct way to store and use biocontrol products. Strategic extension efforts utilizing reliable efficacy data already available, and collaboration with Cornell faculty and Cooperative Extension staff to collect additional efficacy data will be important to efficiently meet this need. In some cases, extension resources have already been created (e.g., parasites of livestock flies, fact sheets summarizing product efficacy trials created by plant pathologists) and merely need to be redistributed with minimal modifications). On-farm demonstrations or new outreach materials (e.g., videos) may also be appropriate. In addition, stakeholders may need support in obtaining biocontrols from sources that have good quality control practices, or instructions on how to do their own quality control checks (where practical). Finally, it might be useful to create (and continue to update) a single source of information on biocontrol-chemical compatibility. Many people have asked about this, and currently multiple sources may need to be consulted to find the information. Putting this information all in one place might facilitate its use.

3) Priority pests/pest settings

During my conversations with colleagues and stakeholders, some pests were mentioned repeatedly (within or among pest management settings) as needing biocontrol solutions, either

because of the importance of the pest, or because other management strategies are ineffective or undesirable. In situations where new biocontrol agents need to be identified for these pests, I think I should wait for this work to be done by others, or collaborate with them on ongoing work. However, it will be important for me to stay informed on progress to discover and assess biocontrol solutions for these pests so that I am able to extend information to NY stakeholders as it becomes available. Following is a list of priorities (in no particular order):

- Schools and daycares – Pesticide usage is severely restricted on school grounds and at daycare facilities. Non-pesticide biocontrols are one of the few options available.
- Long Island – Some chemical pesticides allowed elsewhere in NY are not allowed on Long Island. Also, the market for agricultural products (many direct-marketed to consumers, often in agri-tourism settings) can potentially make even expensive biocontrols a more attractive and cost-effective option.
- Fusarium head blight (caused by *Fusarium graminearum*, and other species) – In small grains, fusarium and the toxins produced by the fungus cannot be completely controlled with chemicals during wet growing seasons. In general, there seems to be a need for more organic pest management products in small grains (a growing industry in NY).
- Bed bugs (*Cimex lectularius*) – In 2017, a new biocontrol product for bed bugs was registered with the EPA (containing the entomopathogenic fungus *Beauveria bassiana*). It could provide an attractive alternative to repeated chemical applications (and a solution to pesticide resistance) or expensive heat treatments, if it is registered in NY.
- Ticks (multiple species) – The Tick Project (run by the Cary Institute) is conducting an extensive 5-year study to determine whether a pesticide containing an entomopathogenic fungus (*Metarhizium anisopliae*) can reduce tick populations or Lyme disease incidence either alone or in combination with a chemical-based management strategy. The study will be completed in 2020. If the results suggest that biocontrol has a role to play in tick management, these results can be extended to NY stakeholders. This project is focused on tick management in suburban settings. The potential for biocontrol of ticks in agricultural settings may differ and could be worth exploring.
- Swallow-wort (*Cynanchum louiseae* and *C. rossicum*) – A moth (*Hypena opulenta*) was approved in August 2017 for release as a biocontrol agent of black swallow-wort and pale swallow-wort. Both swallow-worts are invasive species that are pests in both natural and agricultural ecosystems. If this moth proves to be effective at reducing populations, it could be an additional tool for management of these weeds.
- Intestinal parasites of small ruminants (including *Haemonchus contortus* and *Parelaphostrongylus tenuis*) – These parasites are prone to developing resistance to chemical controls, and can have acute health effects on sheep and goats.
- Powdery mildew (species depends on the crop affected) – This fungal pathogen is a ubiquitous pest on most crops, and is prone to developing resistance to chemical fungicides. It can be especially challenging to control in greenhouses (where other biocontrols are frequently used).
- Mealybugs (multiple species) – In greenhouses, mealybugs can be the "one problem pest" that requires a chemical pesticide, inhibiting the use of arthropod natural enemies in the entire system.
- Western bean cutworm (*Striacosta albicosta*) – Populations of this pest in both vegetable and field crops have been increasing over the last several years. Abby Seaman has done

preliminary work assessing the efficacy of the parasitic wasp *Trichogramma ostriniae* as a biocontrol.

- Spotted wing drosophila (*Drosophila suzukii*) – This invasive species requires either thorough exclusion (using fine netting and high tunnel-like structures) or numerous insecticide applications to crops which previously required very few sprays. For crops like blueberries or raspberries where this may be the only pest for which insecticides are required, there is a lot of potential for a biocontrol solution to be effective.
- Moving biocontrol solutions from the greenhouse to the field – Biocontrol of arthropod pests like aphids and thrips (multiple species of each) in the greenhouse has been extensively studied. Enabling producers to use these biocontrol solutions in the field would be very useful. In addition, some of these pests (e.g., thrips) are prone to developing resistance to chemical pesticides. One grower in Western NY has had a lot of success controlling thrips in solanaceous field vegetables (by starting with transplant production in the greenhouse), and could be a good resource.
- Potato leafhopper – I think that 2017 was an especially bad year for this pest, and it was mentioned in the context of multiple crops.

Project location(s):

This project spanned all of New York State and involved visits to 14 counties:

Albany
Columbia
Erie
Genesee
Greene
Livingston
Onondaga
Ontario
Rensselaer
Saratoga
St. Lawrence
Suffolk
Tompkins
Yates