

VIABLE OPTIONS FOR MANAGING ALLIUM LEAFMINER IN ORGANIC ONION PRODUCTION- YEAR 2

2019 – Final Report for the Pennsylvania Vegetable Marketing and Research Program

Principle Investigator:

Gladis Zinati, PhD: Director, Vegetable Systems Trial, Rodale Institute, 611 Siegfriedale Rd, Kutztown, PA 19530. Tel: 610-683-1402; Email: gladis.zinati@rodaleinstitute.org

Introduction

Allium leafminer (ALM), an invasive herbivore pest, infests plants in the allium family such as onion, leeks, and garlic. This pest was confirmed in Lancaster in December 2015 and expanded to many other counties in Pennsylvania and other states such New Jersey, Maryland, New York and Massachusetts, according to PSU extension report in 2019.

Adult and larvae growth stages cause economic damage directly by adults laying eggs on leaves where they tunnel through leaves until they reach allium bulbs to pupate, with yield loss due to culls or non-marketable products. In Pennsylvania, organic allium crop growers are interested in finding non-chemical and viable options to increase organic onion production and managing allium leaf miner (ALM) pest.

At Rodale Institute, Dr. Zinati conducted research field trials over two years (2017-2019) with the goal to **1)** assess the impact of integrated cultural and biological systems on reduction of ALM injury on organic yellow onion and marketable yield; and **2)** provide allium growers with tactics that are non-chemical but viable for managing ALM pest in organic onion.

Preliminary results from Year 1 (2018 growing season), showed that onion plants grown in bare-ground soil when preceded by mycorrhizal inducing-cover crop mixture (MYCO), had earlier signs and higher ALM injury damage than those preceded by non-inducing mycorrhizal (Brassica) cover crop mixture. Optimal onion yields were achieved when plants grown in either black or reflective silver plastic mulch and covered with row cover for one month. Funding by PVGA has allowed us to expand our data collection over more sampling dates during the allium growing season in 2019 (year 2). In this document, Dr. Zinati is reporting on the completed tasks, results, challenges and outreach activities.

Materials and Methods (Year 2)

A field experiment was set-up at Rodale Institute, for the second year, in fall 2018 to grow and assess yellow onions for ALM and yield. The experimental design was a split-split-split block design with four replications. The treatments included cover crop mixtures as main factor. In the fall of 2018, the field site was divided into two sections where one section was planted with mycorrhizal cover crop mixture (hairy vetch, sunflower, cereal rye, oats, and white Dutch clover), and compared to a section where non-mycorrhizal-mediated cover crop mixtures (rape, tillage radish and mustard) were planted. *The objective here was to confirm whether the tested cover crop systems play a role in early attraction of ALM adult and infection of onion plants when the latter are grown in bare-ground and plastic mulch beds.*

In spring of 2019, the site then was divided into plastic mulch and bare ground (sub-factors). In the plastic mulch area: the treatments included three plastic mulch colors (black, silver reflective, and red mulch, as sub-plot), three yellow onion varieties (Cortland, Talon, and Sedona, as sub-sub-plot), and row cover (0, 1, and 1.5 month as sub-sub-sub-plot). The bare ground included all same varieties used in the plastic section and two treatments of row cover (0, and 1 month) on Talon variety only. *The objective here was to determine whether the ALM damage would be greater or lower in the bare ground than plastic mulch.*

Onion seedlings were transplanted into 3-row, 6-ft center wide and 5-ft long beds per treatment in April 2019. At planting, onion seedlings were covered with row covers for periods described above. *The objective here was to assess the role of using row cover and duration, as a potential tool to deter ALM from damaging young onion plants and reducing onion crop losses.*

For about five weeks from the time of planting onion seedlings, yellow and blue sticky cards were used as a tool in the toolbox *to assess their use for early detection of the ALM adult.* *Onion seedlings were also assessed for ALM injury during the five week period.*

Soil samples were collected early in March before any field activities started (plowing, bed preparation, etc.) These samples were serially-diluted into containers (10^{-1} through 10^{-4}) and planted with Bahia grass in the greenhouse for 6 weeks. Dr. David Douds (volunteer) is currently working on finishing the assessment of root colonization and arbuscular mycorrhizal fungi propagule numbers (MPN) in bahia grass roots.

Onion bulbs were harvested in August 2019 and cured in the greenhouse for about 3 weeks. From each treatment, onion bulb samples were processed (cutting, dehydrating, and grinding) at Rodale Institute research laboratory and sent out for determining macro and micro-nutrient concentrations at the PSU AASL. Fresh bulbs were shipped to Dr. Reddivari's laboratory at Purdue University to determine pungency (pyruvic acid concentration) per each treatment.

Results and Discussion

Our results in 2019 showed that number of ALM injury on onion seedlings was significantly greater in the MYCO than in the Brassica side of the bare ground. However, the number of plants that were showing ALM injury (less than eight) in 2019 was much less than those in 2018. *These results confirm that growing brassica cover crop mixture prior to planting onion crop will reduce the number of injured onion plants in bare ground.* However, the effect of cover crop type did not play a role in reducing the ALM injury on onion plants when grown in any of the tested plastic mulch. All plants did not show an injury except for two plants in black plastic (Talon and Cortland without row cover). However, the resulting injury did not affect the onion bulb marketable yield.

Onion marketable yield was significantly greater in the brassica side than in the myco side by a minimum of one fold. This observation confirms the first year's results. Onion yield in plastic mulch was much greater in 2019 than in 2018, possibly due to greater number of rainfall events. It is worth to note here that in 2019 we did not irrigate even once. There was no significant difference in onion yield (ranged between 16,000 to 21,000 kg/ha) among tested varieties in

plastic mulch, contrary to results from year 1, where Sedona variety had greater yield when grown in soils preceded with brassica cover crop than in myco cover crop. There was no significant effect of plastic mulch on onion yield in year 2019, contrary to those in 2018 where black and silver plastic mulch yielded more than red. *Thus, the effect of plastic mulch on yield may be more apparent under low rain fall events than in high rainfall events.* Onion yield was lower in bare ground plots in 2019 than those in 2018. *This could be due to heavy rain that affected the onion to be under stress.*

For the second year, the use of row cover for 1 and 1.5 months reduced ALM injury in bare-ground but did not play a role in plastic, as our results showed onion plants in plastic were not injured. However, covering plants in plastic mulch for 1 and 1.5 months increased their yield over those without cover. We found that there was no significant difference in yield when plants were covered for either 1 or 1.5 month. *Thus, using row cover for 1 month was optimal to produce high yields.*

Onion pungency varied with variety and was highest in Talon followed by Sedona and Cortland. Onion plants were also significantly pungent when grown in the brassica cover crop soils than those in the myco soil. *That could be attributed to the sulfur that is released from incorporating the brassica cover crop prior to planting onion.*

Challenges

There were many rain fall events in 2019. We have not irrigated the onion plants. Continuous rainy days throughout the growing season negatively impacted the crop yield and marketability. Plants that were grown on bare-ground were smaller in size than those of last year's. Rotted onion bulbs were seen in bare-ground and more than those in plastic mulch plots. *That could be attributed to the bed shape and depth of soil where the plants are growing in plastic mulch compared to those in bare ground (flat soil).*

Training/education and Outreach

Training/education: During the growing season *a total of nine individuals were trained and participated in this project:*

1. Two research interns, five agriculture supported community interns and one volunteer were trained on a variety of tasks including bed preparation, planting, sampling, monitoring ALM injury, inspecting sticky cards under microscope for ALM, processing and staining bahia grass and onion roots for mycorrhizal determination, or harvesting.
2. A recently research intern from France joined our team and worked on processing onion samples (cutting and dehydrating) before sending out the samples for macro and micro-nutrient analyses.

Outreach:

1. Online tools and services such as streamline Facebook live and webinars are considered excellent tools to reach out to new audience and deliver research information. This year, Dr. Zinati introduced and discussed the project on July 11, 2019 via Facebook live. The session has been viewed by 739, as of today.

2. Dr. Zinati gave a webinar titled: “Organic Management Options for Allium Leaf Miner Pest in Onion” on December 11, 2019, where she communicated her latest research information, generated from this project, to growers and the public at large.
3. Dr. Zinati shared her research results and recommendations on viable options for managing ALM, in a power point presentation, at the 2020 Mid-Atlantic Fruit and Vegetable Grower Convention in February 2020. Pre- and post-surveys were used to assess pre-presentation current practices and knowledge and post-presentation gain in knowledge. Results will be written and published in a web article in May 2020.
4. Dr. Zinati gave a 90 minutes workshop on Management of Allium Leaf Miner in Organic Onion at the 2020 PASA conference in Lancaster, PA, February 6, 2020. She provided step by step information on the viable and useful tools that can be adopted to reduce ALM and increase organic onion yield with scientific-based information from the two-year results. Pre- and post-surveys were also used to assess pre-presentation knowledge and current practices and post-presentation gain in knowledge. Results will be written and published in conjunction of item #3 in a web article in May 2020.
5. Preliminary results from the surveys, collected at the last two conferences, showed that the attendees:
 - a. learned about the pest and its life cycle (many did not know how the pest looks like and when does it appear), the injury damage that it causes
 - b. gained knowledge on tools that are viable to increase marketable onion yield and reduce losses to ALM pest by using:
 - i. Yellow traps for detection,
 - ii. Brassica cover crops (many replied that they will use this mixture to minimize the impact of ALM),
 - iii. Row cover for one month will be sufficient for mid-season onion plants to increase yield, reduce spraying of pesticides, and minimize ALM attack.
 - iv. Many recommended Dr. Zinati to continue working on the project and include garlic and leeks in future work.