A New Pest for the New Year in Western New York: Allium Leafminer is Here to Stay

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Last fall, Allium leafminer (ALM) decimated leek crops in Orleans, Genesee, and Niagara Counties. After its first detection in North America near Lancaster, PA in 2015, this invasive insect pest originating from Europe quickly established itself in south-eastern New York, New Jersey, western Massachusetts, Delaware and Connecticut. It was only a matter of time that it would become established throughout New York. **We are now assuming that ALM will occur throughout the 14-county Cornell Vegetable Program region in 2024. And, unfortunately, it is here to stay.** Here is what Allium growers need to know.

Two Generations Per Year – ALM is Not Active in the Summer (Fig. 1).

- ALM has a bimodal lifecycle, with one generation occurring in early spring and the other in the fall.
- Damage is higher in the fall than in the spring.
- ALM is not active during summer months (mid-June through early September).
- ALM overwinters as pupae in the soil and in allium crop debris.
- Adults begin to emerge as flies in early to mid-April. The flies are active until late-May.
  - Fly activity includes mating, foraging and egg-laying.
  - Flies are relatively weak fliers and only disperse short distances.
  - Flies forage on the exudates that leak out of the leaves where females punch holes with their ovipositor (egg-laying apparatus). Very few of these holes contain eggs.
  - Egg-laying begins 10-14 days after emergence and continues for a period of about 6 weeks.
- Eggs hatch into larvae, which feed/mine between the upper and lower leaf surface until the end of their development, at which time they pupate within the mine, or drop to the soil.
- Adult flies emerge from the summer pupa beginning in early to mid-September through the end of October.
  - Egg-laying occurs from mid-September to late-October for a period of 6-8 weeks (longer in the fall than in the spring)
- In the fall, eggs hatch and larvae feed from late September through December.
- In the fall, larvae become pupae from late October to early-December and overwinter until they emerge as adults the following spring.

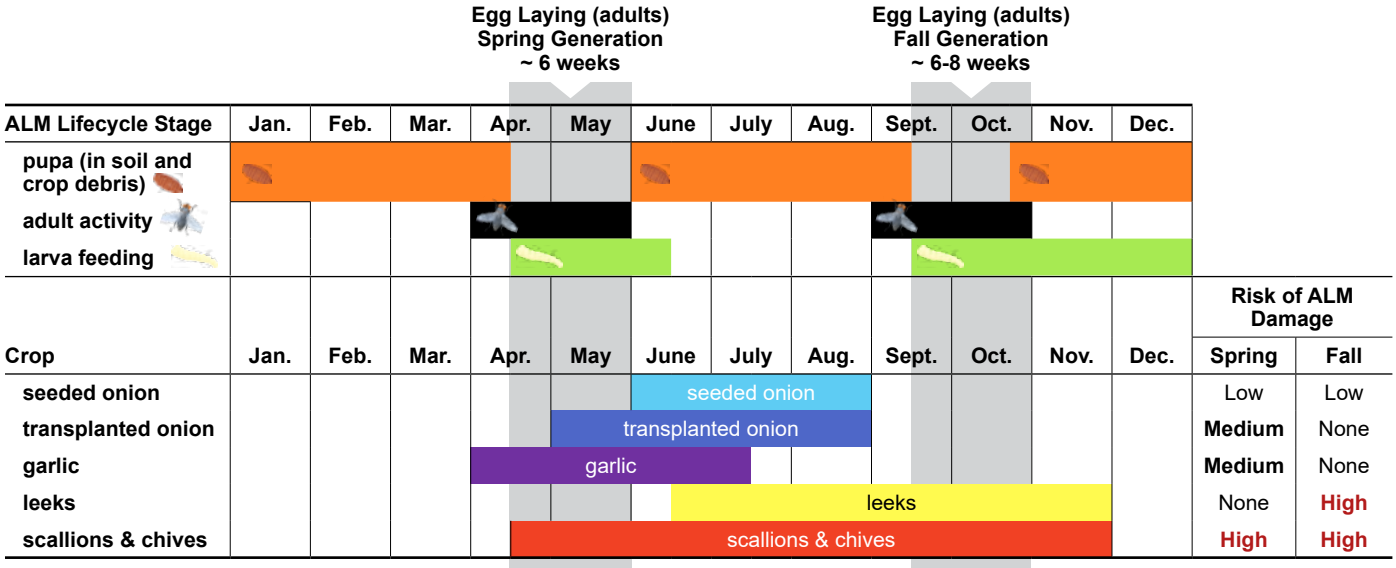

Figure 1. Lifecycle of Allium leafminer (ALM) in New York, overlaid with Allium crop exposure and relative risk of economic damage (adapted from Nault, 2019). Adult activity begins when flies emerge and includes mating, foraging and egg-laying. Egg-laying begins about 2 weeks after emergence. **During egg-laying is the most critical timing to protect Allium crops from ALM damage (gray vertical blocks).** Upon maturity, larvae transform into pupa, which occur in the feeding mines within the plant/bulb or drop to the soil. Pupa emerge into flies in early spring and late-summer.

Specialist of Alliums, Most Damaging to Fall Leeks (Fig. 1)

- ALM only targets Allium species including cultivated, ornamental and wild species.
- **ALM is most damaging to leeks and scallions in the fall, and to scallions in the spring.**
  - The feeding/mining injury to the leaves can deem the leaves of leeks and scallions/chives unmarketable (Fig. 2 & 3).

- ALM larvae and pupa squeeze between the leaves/scales and contaminate the marketable portions (Fig. 2).
- Mining injury may allow bacterial rot pathogens in to infect and rot ALM-infested plants.

- **ALM is the least damaging to direct seeded onions and shallots; these crops fall between the two ALM generations.**
- In the spring, garlic may sustain some feeding/mining injury and although rare, it is possible that pupa can be captured within the wrapper leaves of garlic bulbs.
  - Such pupal contamination is easily removed with the wrapper leaves.
  - ALM flies may emerge from pupae stowed away in wrapper leaves of garlic bulbs. Care must be taken to not ship ALM-contaminated garlic bulbs for seed prior to September (when the flies will emerge from pupa).
  - Losses due to ALM in garlic in NY have been very minor.
- Similarly, early-planted transplanted/set onions/shallots that have enough green foliage in early-May may sustain some ALM feeding/mining injury (Fig. 3).
  - ALM infestation of onion plants may cause leaf distortion and leaf splitting (Fig. 4), which only on rare occasions reduces bulb quality (marketable portion).
  - On very rare occasions, ALM larvae may survive long enough to be found in an onion bulb. However, when this does happen, the larvae and sometimes even pupae usually get squished between the scales and die. Dead ALM in onion bulbs are nearly impossible to see but would deem the bulb unmarketable.

Figure 2. ALM feeding/mining damage on leek, accompanied by larvae (pink) and pupa (green) contamination. ALM causes the most economic damage to leeks in the fall. *Photo: Ethan Grundberg, ENY Commercial Horticulture Program*

Figure 3. Oviposition (yellow dots) and early mining of ALM in scallion and early-planted onion transplants. *Photo: R. Harding*

Figure 4. Leaf twisting and distortion caused by ALM in onion transplants. Very rarely does this type of injury have a negative impact on marketability or yield. *Photo: Teresa Rusinek, CCE ENY Commercial Horticulture Program*

- ALM can also cause distorted growth in scallions, but to a lesser degree than it does in onion.

- ***Grower Experience:*** **By far, New York growers have experienced the most economic losses with ALM in fall leeks, followed by fall scallions** with only minor losses reported in garlic and early transplanted onion. ALM has not been detected in direct-seeded onion.

The most important time to protect Alliums from ALM is during egg-laying.

Crop Covers are the Most Effective Control Strategy for ALM

- Floating row cover or insect exclusion netting (e.g. ProtekNet 25 g) must be installed before ALM flies emerge:
  - third week of March for the spring generation
  - late-August/early September for the fall generation.

- Crop covers are not nearly as effective if they are applied after ALM egg-laying has started or if they are removed prior to finishing of egg-laying.
  - Remove in early-June for spring generation
  - Remove at end of October for fall generation
- It is imperative that the covers be well secured to prevent gaps where ALM flies may enter under the crop cover.
- It is imperative that covers not be used over top of ALM-infested ground that has pupae in it (e.g. same site as previous ALM-infested crop).
- Use of support hoops is highly recommended when using crop cover for leeks to minimize growth restrictions and improve aeration to reduce incidence of foliar diseases.
  - Leek stems can bend when their growth is restricted under a row cover (Fig. 5).
- Higher levels of diseases such as Botrytis leaf blight and poor weed control may occur under covers.

Figure 5. The stems of leeks can bend when they are grown under row covers that are not supported by hoops due to restricted growth. *Photo: Teresa Rusinek, CCE ENY Commercial Horticulture Program*


Figure 6. Allium leafminer adult fly leaving white oviposition marks in a relatively straight line. Note, the yellow head of the fly. *Photo: Ethan Grundberg, ENY Commercial Horticulture Program*

- ***Grower Experience:*** **Crop covers can provide close to 100% control of ALM.**
  - They have only been adopted by small-scale organic growers for fall leeks because they are more reliable than organic insecticides.
  - On a larger scale, crop covers are expensive and labor-intensive, especially when support hoops are used, and they come along with all of the other challenges associated with crop covers (e.g. weed control, too hot, etc.).

Control of ALM with Conventional Insecticides is Very Good

- Conventional insecticides are very effective (90-100% control) at reducing damage from ALM.
- The recommendation is to make **2-3 total applications when ALM flies are active on a 1-2 week interval beginning 2 weeks after adult activity begins**.
  - Staging the insecticide applications too close to first emergence is too early and does not result in as good control.
  - Similarly, starting insecticide application too late also does not result in good ALM control.
- Effective conventional insecticides for ALM management include:
  - **Exirel** (cyantraniliprole, IRAC Group 28) at 13.5 fl oz/acre. 2(ee) label required for NY growers.
  - **Radiant** (spinetoram, IRAC Group 5) at 8 fl oz/acre. Do not apply more than 2 apps of IRAC 5 insecticides before rotating to a different mode of action.
- Exirel and Radiant work best when used with an adjuvant that has penetrating properties.
- **For insecticide resistance management, it is important to rotate IRAC groups.**
- First emergence of ALM flies is identified by the first detection of their activity (oviposition/egg-laying sites and mining). This requires scouting. The first insecticide application should be made 2 weeks after the first detection of ALM, and the second 1-2 weeks after that. If ALM pressure is high (e.g. a lot of crop damage), a third application should be made 1-2 weeks after the second.
- Note: Although the NYSIPM fact sheet discusses using growing degree day (GDD) models to predict ALM activity in the spring, field experience has not found GDD very reliable. No GDD models exist for the fall generation.

- ***Grower Experience:*** **Use of conventional insecticides has been readily adopted by conventional growers for fall leeks and spring and fall scallions with high levels of success.**
  - Since scouting for first detection of ALM requires a skilled scout and is labor-intensive, most conventional growers simply make the first insecticide application during the third week of September and then spray every 7-10 days until mid-October for a total of 3-4 sprays.

Control of ALM with Organic Insecticides is Variable

- Effective organic insecticides for ALM management include:
  - **Entrust SC** (spinosad, IRAC Group 5) at 6 fl oz/acre rate co-applied with **M-Pede** (potassium salts of fatty acids) 1%-1.5% v/v for better penetration of the waxy cuticle.
  - **Azera** (azadirachtin + pyrethrins, IRAC Group 3A) at 56 fl oz/acre co-applied with **OROBOOST** at 0.25% v/v adjuvant.

- Since these organic insecticides do not have as much residual activity as the conventional insecticides used for ALM control, the following is recommended:
  - 2 weeks after first ALM fly emergence: Azera + OROBOOST
  - 1 week later: Entrust + M-Pede
  - 1 week later: Entrust + M-Pede
  - If pressure is high: 1 week later: Azera + OROBOOST
- It is important to use the recommended adjuvants with each insecticide. Cornell research studies showed that Nu-film P did not increase efficacy of Entrust, while M-Pede reduced efficacy of Azera.

- ***Grower Experience:*** **Adequate control of ALM with organic insecticides has been hit and miss.**
  - **For fall leeks, organic growers have either stopped growing fall leeks or use row covers instead.**

Other ALM Management Strategies

- **Do not import infested plant material** (transplants or cloves) and plant them on your farm.
- **Destroy ALM infested plant material** by burning or burying as deep as possible.
- **Solarize ALM-infested soil** by applying clear plastic over the infested area and leaving the ground covered for about a month to kill the pupa.
- **Delay planting** to avoid the spring egg-laying period, **and/or harvest early** to avoid the fall egg-laying period.
  - This technique combined with the use of crop covers for longer growing season crops like leeks, provides good control of ALM.
- **Rotate** as far away as possible from previous ALM-infested allium plants (crops or weeds).
- Although planting alliums on **metalized reflective plastic mulch** consistently reduces ALM damage compared to alliums planted on either black or white plastic, it does not reduce ALM densities to below economically damaging levels.
  - When used in combination with spraying Entrust, metalized reflective plastic mulch can be effective for ALM control in scallions.

Do muck onion growers need to be concerned about ALM?

- **Not in direct seeded onion.** This crop does not have any susceptible green foliage during the spring or fall ALM generations that would be exposed to egg-laying (before June and after late August).
- Early-planted onion transplants conceivably could become infested with ALM.
- Most of the insecticides used in muck grown onions for controlling onion thrips have decent efficacy on ALM. These include Exirel, Minecto Pro, Radiant, Warrior and Agri-Mek. NOTE: Movento is NOT effective!
- ALM was first detected in Orange County in New York in 2016. ALM oviposition sites and mines are sometimes observed in the earliest plantings of transplanted onions.
  - Not once in the past 8 years has ALM resulted in anything other than extremely minor injury in muck grown transplanted onions.
  - The ALM population does not appear to have built up during this time period in the muck.

Scouting for ALM

- Females leave distinct oviposition (egg-laying) sites in relatively straight rows along the leaves of Allium plants (Fig. 3 & 6). Sap often exudes from these spots.
- ALM flies may be associated with oviposition sites, as they feed on the fluid that leaks from the holes (exudate) (Fig. 6). Flies are 0.1-inch long, dark brown with a yellow head and yellow knees.
- Larvae reach up to 0.3 inch in length and are yellowish white and can be found between the upper and lower leaf surface within the mines (Fig. 2).
- Mature larvae make their way towards the base of the bulb, leaving yellowish or white streaks along the leaves (Fig. 2 & 3).
- Pupa are reddish brown bullet shaped 0.15 inch in length that tuck in between leaves/scales or may be seen in the soil next to infested plants (Fig. 2).

For more information:

NYSIPM Vegetable Pest Fact Sheet: Allium Leafminer Identification, Biology and Control (Rekha Bhandari, Pin-Chu Lai and Brian A. Nault, Cornell AgriTech, April 2023): https://cals.cornell.edu/new-york-state-integrated-pest-management/outreach-education/fact-sheets/allium-leafminer.

Final Report to NESARE Partnership Grant ONE19-336: Developing Integrated Pest Management Strategies to Reduce Damage from the Invasive Allium Leafminer on Organic Farms (Grundberg, March 2022): https://projects.sare.org/project-reports/one19-336/

Allium Leafminer: Information for Home and Public Gardens (ENYCHP, NYSDAM, USDA-NIFA, NESARE, March 2020): https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/575/files/2020/05/NYSDAM-ALM-Fact-Sheet_CT.pdf