ALLIUM LEAFMINER: PEELING BACK THE LAYERS OF INFORMATION NEEDED TO MANAGE THIS INVASIVE INSECT IN PENNSYLVANIA

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Introduction

Allium leafminer (ALM) *Phytomyza gymnostoma*, an invasive insect from Europe, was discovered in Lancaster County, Pennsylvania in December 2015 (Barringer, et al. 2018) and has since spread to at least five additional states (Figure 1a). Larvae feed in leaves, stems, and bulbs of all vegetable alliums (Figure 1b-d) causing plant damage, secondary infections and/or market rejection. Because no information existed on ALM in the U.S. initial population field studies began in fall 2016 to understand the lifecycle and research began in fall 2017 to evaluate the efficacy of various insecticides for this pest.

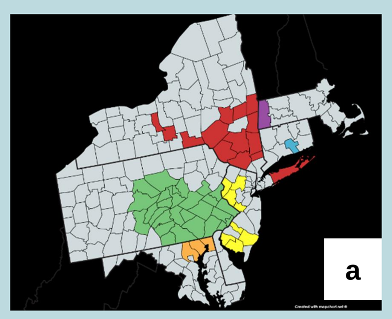

Figure 1
a) Distribution of allium leafminer, fall 2019.
b) Ornamental onion leaf showing allium leafminer damage.
c) Young onion showing allium leafminer larvae.
d) Leek showing allium leafminer pupae in lower portion of plant.

All poster photos by T. Elkner

Research Objective

- Develop management recommendations for ALM by:
  a) Determining ALM flight periods and create a degree day model to know when control measures were needed.
  b) Evaluate the efficacy of labeled insecticides for ALM control.

Research Hypothesis

- ALM flight periods will be similar to those in in Europe.
- Insecticides labeled for native leafminers (*Liriomyza sp.*) on vegetable alliums will control *Phytomyza gymnostoma.*

Materials and Methods

- ALM flight periods were determined by field scouting and the use of colored sticky traps on farms and monitoring sentinel plots.
- Onion transplants (var. Candy) were planted April 23 and harvested July 19 in 2018; transplants were planted April 8 and harvested July 11 in 2019. Plants were grown on black plastic using standard production methods.
- Leek transplants (var. Tadorna) were transplanted on July 5 and harvested on December 4 in 2018; transplants were planted on July 30 and harvested November 11 in 2019. Plants were grown on bare soil using standard production practices.
- Eight insecticide options were evaluated in 2018 (3 organic, 5 conventional) and six options (3 organic, 3 conventional) were evaluated in 2019 (Tables 1 & 2). Each treatment was applied to four reps in a RCB design using a CO_2 backpack sprayer.
- At harvest a subsample of plants from all plots was evaluated for oviposition marks and were dissected for ALM larvae and pupae counts.

Figure 2. Adult ALM flight duration for fall 2018 and 2019 and spring 2019.

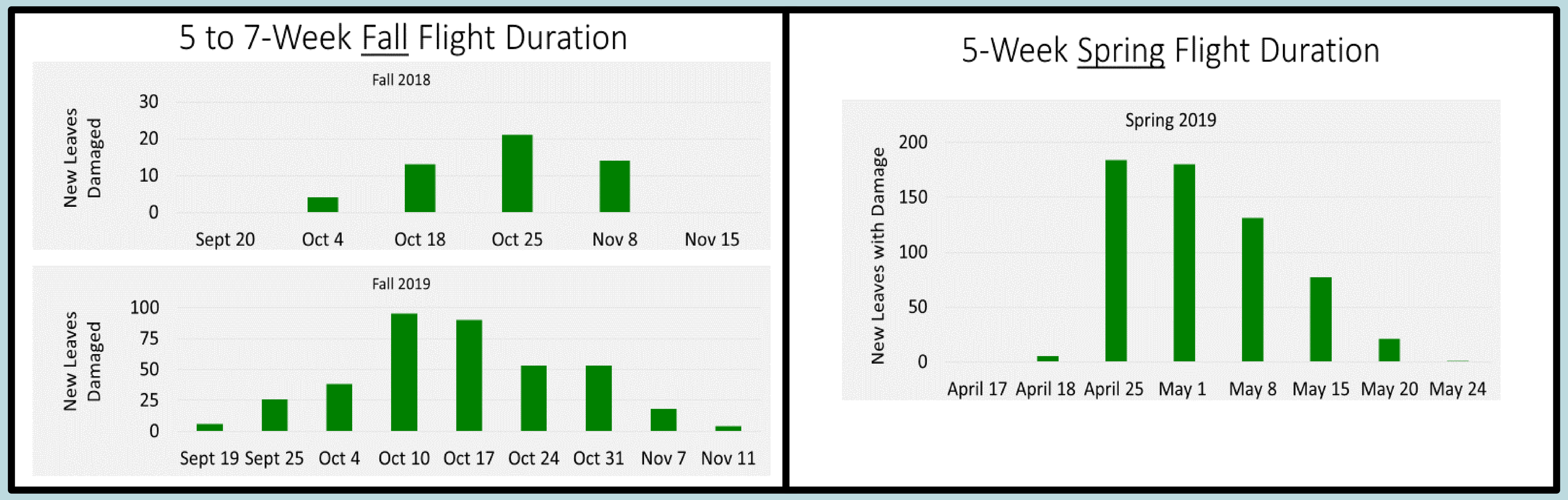

Table 1. Insecticide evaluation in leeks, 2018. Application dates were based on adult flight activity and label allowances.

Treatment	Rate (FL oz/A)	Spray Dates	Avg. # ALM/plant[a,b]	% Damaged Plants[a,c]
Pyganic	32	26-Sept, 2-Oct, 26-Oct, 31-Oct, 4-Nov	2.73 a	82.5 a
Control	----	----	1.53 b	55.0 a
Verimark Drip	10	24-Sept, 4-Oct, 24-Oct	0.85 bcd	40.0 a
Azera	48	26-Sept, 2-Oct, 26-Oct, 31-Oct, 4-Nov	0.83 bc	42.5 a
Aza-Direct	48	26-Sept, 2-Oct, 26-Oct, 31-Oct, 4-Nov	0.70 bcd	50.0 a
Scorpion Drip	10	24-Sept, 4-Oct, 24-Oct	0.68 bcd	35.0 ab
Scorpion Foliar	7	26-Sept, 2-Oct, 26-Oct, 31-Oct, 4-Nov	0.15 cd	10.0 bc
Exirel	20	26-Sept, 2-Oct, 26-Oct, 31-Oct, 4-Nov	0.10 d	10.0 c
Radiant	10	26-Sept, 2-Oct, 26-Oct, 31-Oct, 4-Nov	0.10 d	10.0 bc

[a] Means followed by the same letter are not significantly different (*P*> 0.05; Tukey's Studentized Range [HSD] Test; n= 4). Damage data were transformed using a sqrt (*x* + 0.001) function and insect count data were transformed using log (x + 1) function before analysis, but untransformed means are presented.
[b] Included both larvae and pupae.
[c] A plant was considered damaged if it had ≥ 1 larva or ≥ 1 pupa.

Table 2. Insecticide evaluation in leeks, 2019. Application dates were based on adult flight activity and label allowances. The 'Off Label Entrust' involved Entrust applied more than the seasonal allowable amount according to the label.

Treatment	Rate (FL oz/A)	Spray Dates	Avg. # ALM/plant[a,b]	% Damaged Plants[a,c]
Control	----	----	16.60 a	100 a
Entrust	6.0	25-Sept, 11-Oct	8.40 b	85 a
Radiant	10.0	25-Sept, 4-Oct, 11-Oct	5.13 bc	88 a
Exirel	20.0	25-Sept, 4-Oct, 11-Oct	5.03 bc	58 b
Aza-Direct	48.0	25-Sept, 4-Oct, 11-Oct, 21-Oct, 28-Oct	5.10 bc	78 ab
Scorpion	5.25	25-Sept, 11-Oct	3.88 c	88 a
Off Label Entrust	6.0	25-Sept, 4-Oct, 11-Oct, 21-Oct	1.23 c	53 b

[a] Means followed by the same letter are not significantly different (*P*> 0.05; Tukey's Studentized Range [HSD] Test; n= 4). Damage data were transformed using a sqrt (*x* + 0.001) function and insect count data were transformed using log (x + 1) function before analysis, but untransformed means are presented.
[b] Included both larvae and pupae.
[c] A plant was considered damaged if it had ovipositioning signs on any leaf.

Results and Discussion

- ALM have two flight periods per year (spring and fall) generally lasting 5-7 weeks (Figure 2) and survive as pupae at the soil surface between. Colored sticky trap counts were not as accurate as foliar damage in assessing ALM activity (data not presented).
- The degree day model suggests that spring emergence starts at 250 degree days at a threshold temperature of 3.5°C (38.3°F) using lab and field data; a second model (3.0°C; 37.4°F) of 400 degree days was equivalent or slightly more accurate. We plan to trial these models in the spring of 2020 to verify and refine their accuracy. Work continues on a fall emergence model.

Onions

- In both 2018 and 2019 we had good insect pressure as measured by oviposition marks but at harvest >99% of the bulbs had no ALM present, even in the control plots (data not presented). Therefore we could not evaluate the insecticide efficacy but based on these observations we conclude that the risk of infestation in bulbs of spring-planted sweet onions is low.

Leeks

- There was high ALM pressure in both years with 2019 being the greatest as evidenced by the % damaged plants (Table 2).
- Foliar applications performed better than soil applications of the same product (Table 1) which was consistent with results of 2017 (data not presented). Therefore we dropped drip treatments in 2019.
- In 2018 the most effective options were Scorpion (foliar), Exirel and Radiant (Table 1).
- In 2019 off-label Entrust (4 sprays) performed the best followed by Scorpion (2 sprays), Radiant and Exirel (3 sprays). Aza-Direct also performed well with a total of 5 sprays (weekly) (Table 2). All options, however, did not result in a marketable crop of leek. We had a very high ALM population since we repeatedly planted in the same field and did not destroy crop residue as recommended. Following recommended management procedures including crop rotation should reduce the ALM pressure and result in acceptable levels of control with the best options tested.

Conclusions

- ALM flight periods were slightly longer than reported for Europe.
- Management recommendations for ALM include crop rotation to avoid pupae, residue destruction and field scouting during emergence periods to determine when control measures are necessary (insecticide applications or exclusion).
- Conventional insecticides that were most effective for ALM control on leek included dinotefuran (Scorpion), cyantraniliprole (Exirel), and spintoram (Radiant) and organic options included spinosad (Entrust) and azadirachtin (Aza-Direct). These materials are equally effective for managing native leafminers.

References

- Barringer, L.E., S.J. Fleischer, D. Roberts, S.E. Spichiger and T. Elkner. 2018. The First North American Record of the Allium Leafminer. J. Integ. Pest Mgt. Vol. 9 (1). https://doi.org/10.1093/jipm/pmx034.

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