BIOAg Project Report

Report Type:
Final

Title:
Identifying *Delia* root maggots to aid vegetable seed growers in the PNW

Principal Investigator(s) and Cooperator(s):
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Abstract:
Delia spp. (Diptera: Anthomyiidae), are a group of root-feeding maggots (fly larvae) impacting vegetable seed production, an $18.2M industry in Washington State. Adult flies lay eggs in the soil near germinating seeds so that hatching maggot may feed on developing seedlings. Planting time for vegetable seed crops is a critical, narrow window to achieve adequate temperatures for germination, avoidance of overly rainy conditions, and proper daylength for seed-set. While it is unlikely that growers will be able to adjust their planting dates based on pest status, the ability to predict the egg-laying window of *Delia* flies would help growers manage their risk precisely and conservatively, by either omitting or including an insecticide at seeding if planting times overlap (or not) with egg-lay. Degree day models exist for key *Delia* species to the PNW, but these models are not widely used due to development and validation east of the Continental Divide. Our project will validate phenology models for the top two *Delia* pests in the PNW (seedcorn maggot and cabbage maggot), identifying flies to species with molecular techniques, and test if model-predicted oviposition time can be used to guide management.

Project Description:
Survey *Delia* flies throughout Skagit County vegetable crops using sticky card traps and confirmation with molecular barcoding. Determine if crop injury by maggots is connected to model-predicted ovipositional timing via retroactive sampling of injury. Provide growers with trap captures numbers and phenology predictions to aid in decision making and build a platform for implementation of future recommendations.

Outputs:
Overview of Work Completed and in Progress:

Spinach seed was planted in a carefully controlled trial on-site at WSU NWREC. Planting techniques were improved over a similar trial conducted in 2024. *Delia* maggot timing was calculated for the region based on a published degree day model. However, maggot infestations were not detected during the season. This suggests the fly has emergence rates that change year-to-year due to variable weather and other factors, or suggests that there is a need for development of a degree day model specific to the region. As part of the project, we planted spinach seed treated with experimental insecticides, and we found that heavy seed coats can be deleterious to proper spinach germination. Treatments that require large amounts of product will lead to dried seed treatments that are too thick for spinach to sprout or will delay germination significantly.

Insights: The pest status of *Delia* root maggots remains unclear. While these flies clearly exist in the area (as shown via sticky card captures and prior reports), in two years of surveying we have yet to identify a field where it has been the cause of economic damage. While we do see infestations sporadically, they are mainly secondary—the result of another source of injury, such as disease (in one major case, rhizoctonia, confirmed by Dr. Du Toit). In 2025, our team visited numerous commercial sites, where *Delia* maggots were the suspected cause of poor spinach stand emergence, but neither our team nor the crop advisors could find any conclusive evidence of maggot pressure. We believe that seedcorn maggot (*D. platura*) and other related root maggot pests should remain on the radar, as they are known to cause regular economic damage in other regions (in Hermiston, OR, for instance). However, there does not appear to be a current need for further experimentation in Western Washington, where clearer issues like cabbage maggot (*D. radicum)* exist.

Methods, Results, and Discussion:

Methods

A 0.3 acre plot at WSU NWREC was selected and prepared for planting spinach. Ro-Neet herbicide was applied for preemergence weed control, and 16-16-16 granular fertilizer was applied. Six treatments (Verimark, Coragen Evo, Lumiverd, *Beauvaria bassiana*, Cruiser, and untreated control) were prepared by Universal Seed Co. Treatments were laid out in a randomized complete block design. Experimental subplots were 10’ in length by six rows (on 22” row spacing), with 2-row buffers to the east and west, and 3’ buffers between subplots to the north and south. Five replicates of each treatment were planted, for a total of 0.13 acre plus surrounding buffer area.

Seeds were planted by hand on 23 May 2025, to ensure proper spacing (3”) and depth (1/4”) (Figures 1 and 2). Spinach was planted slightly late to ensure overlap with predicted seedcorn maggot emergence and egg laying (USPest.org Degree Day Model). The plot was hand-weeded as necessary to keep spinach seedlings from being overtaken. A stand count was conducted on 18 June 2025, and a second stand count on 2 July.

A destructive sampling of spinach plants was conducted on 2 July 2025. Five plants were randomly selected in each treatment subplot and examined to look for any larvae or pupae of seedcorn maggot. Out of the 150 plants examined, only 1 puparium was found in the control plot.

Results

Results of stand count evaluation (Figure 3) showed overall low emergence (including for the control treatment). A total of 40 seeds were planted in each row, and few rows reached 50% emergence. The results of the stand count on 2 July (not pictured) were not significantly different than 18 June. Spinach emergence was especially low for *B. bassiana* (MBI). This product called for a much higher application rate than other products, and being experimental, was not designed with seed treatments in mind. We believe the thicker seed coat prevented emergence within this treatment. Variation in emergence in other treatments could be caused by the same issue.

Discussion

A lack of pest pressure during the last two seasons has made research into seedcorn maggot a challenge. Following the initial reports and identification in preceding years, there have not been reports of serious infestation or seedcorn maggot acting as a primary pest. In 2024 we investigated a maggot infestation, but it became apparent that it was a secondary infestation following a rhizoctonia infection in the field (Du Toit, personal communication). In 2025 we responded to reports of maggot infestation in several spinach fields, but upon visiting the sites we were unable to recover any pests. We conclude that seedcorn maggot did not have a substantial emergence this year and the results of the stand count can

be attributed to the seed treatments themselves. This is supported by the lack of any serious seedcorn maggot injury in the region.

Figure 1. Entomology Lab planting spinach. Left-to-right: Claire Winslow, Gusta Beard, Emma Waiss, Cooper Wendley. Photo credit: Charles Coslor.

Figure 2. Planting spinach seed. Charles Coslor in foreground with Cooper Wendley observing in background. Photo credit: Louis Nottingham.

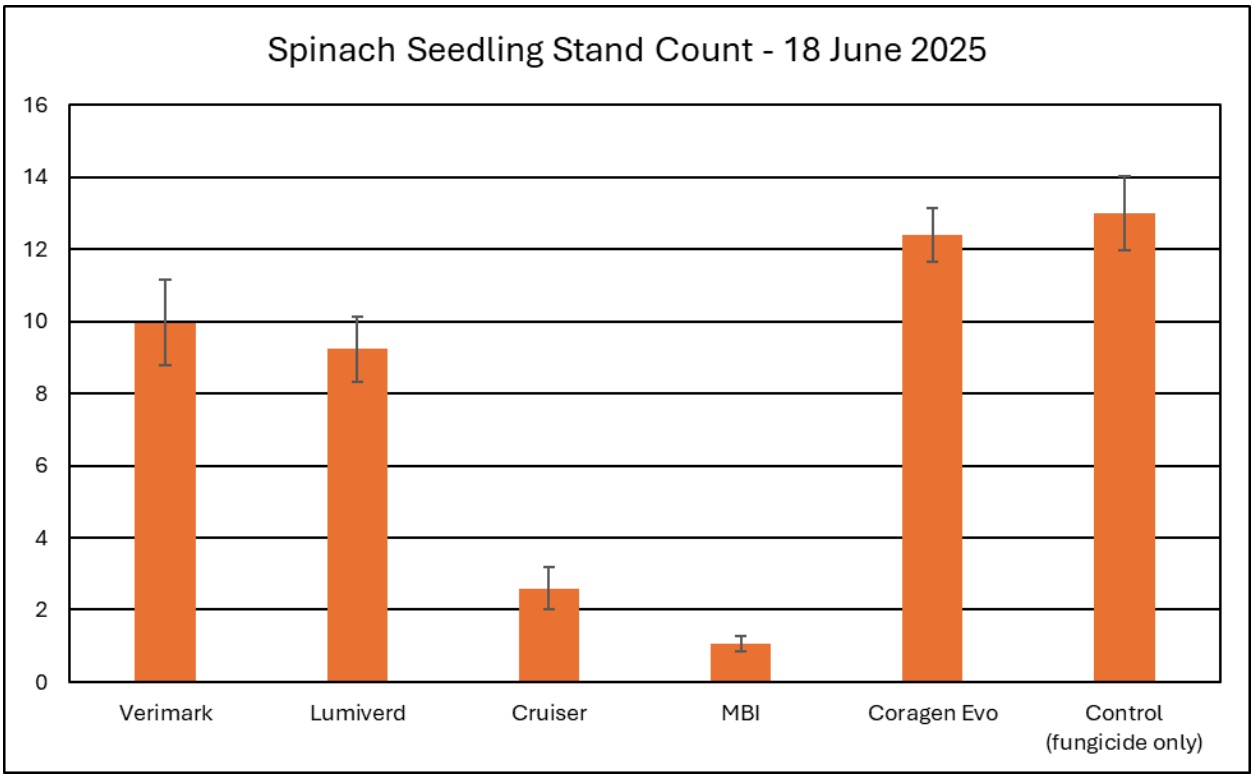

Figure 3. Numbers of spinach seedlings found in subplots (average number per row). Orange vertical bars represent seedling counts, with small vertical bars representing standard error of the mean.

Publications, Handouts, Other Text & Web Products:

NARF Field Day handout

Outreach & Education Activities:

NARF Field Day presentation, 10 July 2025.

Impacts:

Short-Term:

Root maggots are present in the region but are not causing damage on a regular basis due to year-to-year variation. We responded to grower reports of spinach injury but were unable to locate causative pests.

Intermediate-Term:

Our goal was to capture *Delia* root maggots and identify them using morphological and molecular techniques. This would have led to refinement of degree day models, help growers predict potential outbreaks, and enable them to respond appropriately with Integrated Pest Management techniques. Instead, we found that root maggots can be very elusive. There are also other factors contributing to poor spinach stand emergence, including day length, planting depth, soil moisture, seed treatment, and crop variety.

Long-Term:

Awareness of root maggots as a potential pest in spinach seed has been increased among growers in the region, and we have reinforced the perception that the Horticultural Entomology Lab at WSU Mount Vernon NWREC responds to insect pest concerns. In the future this will lead to additional reporting and expand our understanding of root maggot biology.

Additional Funding Applied for/Secured:

WCIPM - $17,468

NARF - $24,316

Graduate Students Funded:

N/A

Recommendations for Future Research:

Pest surveys should be timed to coincide with significant outbreaks, though it is not clear yet how to predict if or when a root maggot outbreak in spinach will occur. Good communication with growers and commercial research leaders in the seed industry will help facilitate this.