

## **Seedcorn Maggot as a Pest of Corn and Other Large-Seeded Crops**

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### ***Delia platura* (Meigen)**

The seedcorn maggot is a pest introduced from Europe in the mid 1800's that is now established and distributed throughout the United States and southern Canada. This pest of germinating seeds and seedlings attacks a wide range of large-seeded horticultural and agronomic crops, including corn and soybean. This fact sheet provides information on seedcorn maggot identification, life cycle, crop damage and management.

### **The Problem in Pennsylvania**

Each spring, a few corn and soybean or other large-seeded crop fields are severely attacked by seedcorn maggots. This pest is sporadic with most fields in the Commonwealth losing a few plants to this pest each year, but occasionally fields may suffer greater losses. The occurrence of this pest is not completely predictable, but its occurrence is more common under some soil management and cultural practices. In years when injury is widespread within a local area, these generalizations may not hold. Seedcorn maggot is mainly an early season pest that tends to cause greater losses in fields with abundant decaying organic matter, such as manure and green plant residues, and during years when the early growing season is cool and damp. Therefore, fields at highest risk of severe infestations include heavily manured fields, old pastures and hay fields that have recently been plowed under, fields with heavy-textured or wet soils, or fields with naturally high organic matter levels. The incorporation of cover crops into soil may also increase the risk of seedcorn maggot infestation. The effects of the application to and incorporation of manure into soil is especially a concern in Pennsylvania because of the common use of animal manures to fertilize crop fields.

### **Description & Life Cycle**

Female seedcorn maggot flies deposit tiny, white, elongated eggs in loose groups among debris and around plant stems near the soil surface. Legless, cylindrical, and tapered maggots that hatch from these eggs are dirty white with a yellowish tinge in color. Full-grown maggots are 1/5- to 1/4-inch (5 – 6.4 mm) in length. Two tiny black hooks that make up their mouthparts are the only visible feature of an otherwise indistinct head. The maggots use these hook-like mouthparts to feed in the seed or on the underground stems of seedlings. Maggots pupate in the soil inside a dark brown capsule-like puparium that resembles a grain of wheat in size and shape. Seedcorn maggot puparia can be found throughout the year. The maggot overwinters in the puparium and adult flies emerge from the puparia in the following spring when the temperatures increase. The adult seedcorn maggot fly is grayish black and about half the size of a house fly (1/4 inch long [6.4 mm]). Black bristles cover the body, including a pair of distinct crossed hairs on the head. The eyes are large and have a reddish purple color that can range in brightness. The wings are well developed, clear in color and usually have short fine hairs along the leading edge. They are longer than the thorax and rounded at the apex. The sixth vein typically reaches the wing margin.

The calypter, a small membranous flap at the base of the hind edge of the wing, is notably larger compared to other flies.



Image of calypter at base of fly wing. Photo credit: Graham Montgomery, BugGuide Creative Commons Attribution-Noncommercial 3.0 License.

The overwintering generation of seedcorn maggot flies emerges from puparia during late April and early May. Seedcorn maggot flies mate within 2 – 3 days of emergence, are attracted to recently plowed soil, and are stimulated to lay eggs by the presence of partially decayed organic matter in or on the soil and by germinating seeds. Eggs of later generations are frequently deposited around plant stems at the soil surface. Eggs hatch in soil as cool as 50F (10C). The maggots complete their development within the soil by burrowing into seeds or feeding on cotyledons that are emerging from seeds over 7 to 10 days, and then pupate in the nearby soil. The pupal stage requires about 10 days, depending on temperature, and then a new generation of adult flies emerges. The seedcorn maggot survives the winter in the pupal stage. The time required to develop from egg to adult is between 3 to 4 weeks. Although there are 3 to 5 generations each year in Pennsylvania, it is usually the first generation that causes damage to seeds and seedlings.



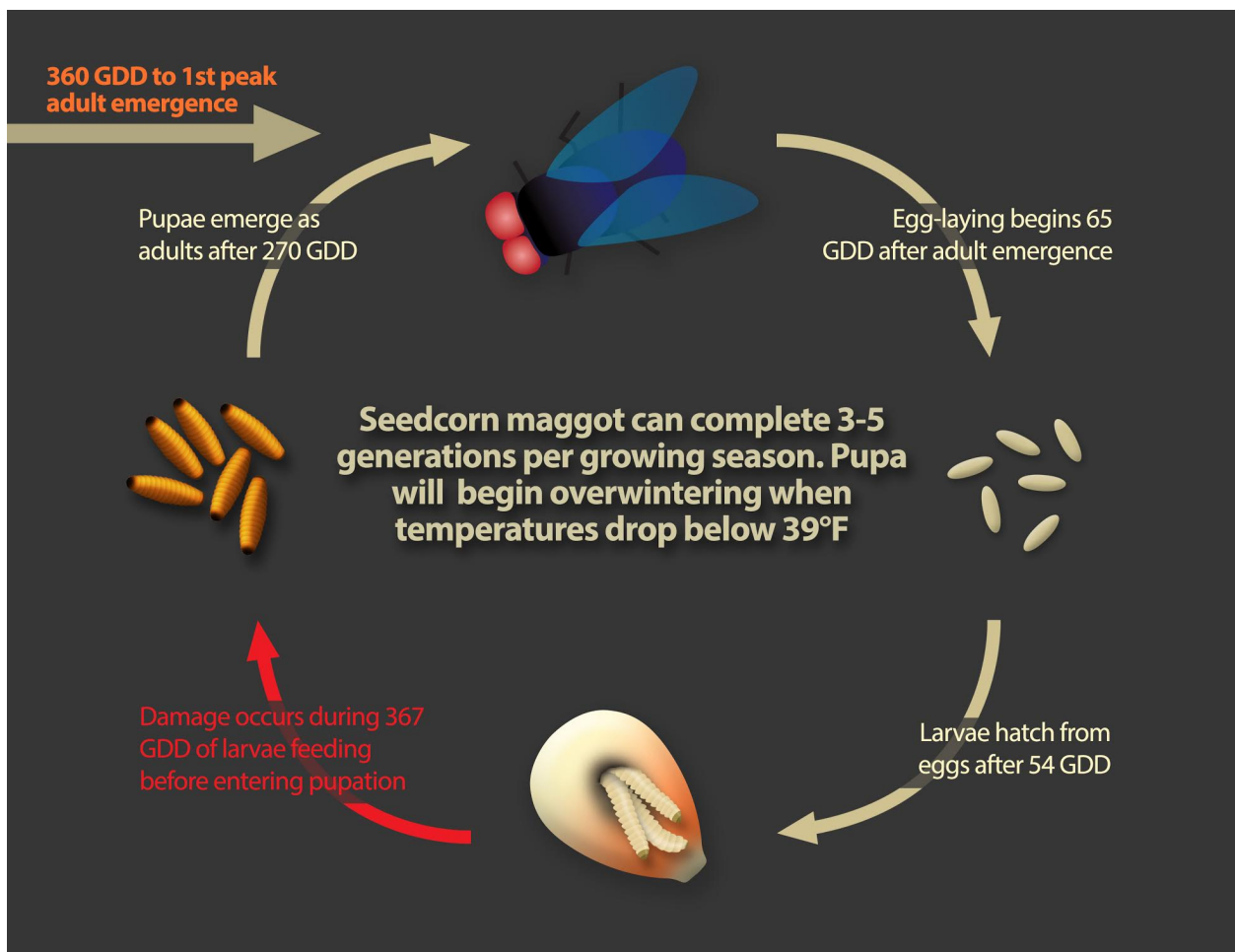
Adult *Delia* fly. Image Number: 5312054 (left) Image Number: 5312032(right)  
Photo credit: Pest and Diseases Image Library, Bugwood.org. Creative Commons Attribution-Noncommercial 3.0 License.



Adult *Delia* fly head showing distinctive cross hairs (left). Image Number: 5312041.. Photo credit: Pest and Diseases Image Library, Bugwood.org. Creative Commons Attribution-Noncommercial 3.0 License.



Wing of *Delia* showing venation and hairs on wing leading edge. Wing length 5.44 mm <http://bugguide.net/node/view/877556>. Photo credit: Richard Migneault, Bugwood.org. Creative Commons Attribution-Noncommercial 3.0 License.



Seedcorn maggot life cycle, including the number of growing degree days (GDD, base 39F) that are needed to complete each stage. Image credit: Nick Sloff, Penn State University

## Damage

Seedcorn maggots burrow into the seeds and destroy the seed germ. Damaged seed may germinate, but often there are not enough food reserves left in the seed for the plant to survive. Maggots also attack the underground stems of germinated corn and soybeans, resulting in weakened seedlings that seldom survive. Reduced plant stands are evident about a week after the corn plants start to emerge. If losses due to seedcorn maggot are suspected, carefully dig up the seeds in the row skips and examine them for evidence of seedcorn maggot damage. Seedlings are most susceptible in cold wet springs when seed germination and seedling growth is slowed by cool conditions, allowing the seedcorn maggot more time to damage seeds. If plant losses are high enough, consider re-planting.



Seeds showing feeding damage by seedcorn maggot larva. Image Number: 5434908. Photo credit: Mariusz Sobieski, Bugwood.org, Image Number: 5434907. Creative Commons Attribution-Noncommercial 3.0 License.

## Control

### *Cultural Control*

There are no rescue treatments for seedcorn maggot other than re-planting; therefore, management should be preventive. Cultural practices that speed germination and plant emergence will help reduce crop losses from seedcorn maggots. Where appropriate, delaying planting until soil is warm allows for rapid germination and early seedling growth. Because seedcorn maggot flies are attracted to decaying vegetation, plowing in sod, green manures or animal manures at least two to three weeks in advance of planting is recommended to allow residues to decompose before planting. Seedcorn maggot populations are generally higher after a legume (e.g., beans, peas) is incorporated into the soil than where a grass (e.g., corn, rye, wheat) is incorporated. Conservation tillage can result in lower seedcorn maggot populations because the plant residues occur mainly on the surface of the soil rather than being incorporated into the soil where decomposition occurs.

A cultural control tactic that can be used is to plant the field during a “fly-free” period between fly generations. Peak fly emergence can be estimated by accumulating growing degree-days (GDD) above 39F after January 1. The daily formula to use is: (maximum temperature-minimum temperature/2) -39 F. GDD calculators can also be found online by searching the term “growing degree day calculator.” A GDD calculator for the Northeast and Mid-Atlantic can be found at the Network for Environment and Weather Applications (NEWA) (<http://newa.cornell.edu/index.php?page=degree-days>). To use the NEWA GDD calculator, indicate the weather station closest to your location, and choose “Degree Days – Base 39.” Peak emergence of the overwintering generation of seedcorn maggot flies in the spring occurs at 360 GDD after January 1. This peak emergence can be monitored for your fields using yellow sticky cards. Alternatively, a small yellow plastic bowl filled with soapy water can be used. Empty the traps regularly and observe when the peak number of flies are caught. A “fly-free” period occurs 450 GDD after this peak adult emergence, as this is the estimated time when larvae from eggs laid by the overwintering generation will enter the non-feeding pupal stage, minimizing the risk of injury to developing seeds. Delaying planting will also allow the soil to warm up enabling faster germination of the seed.

<b><i>Delia</i> Growth Stage</b>	<b>Cumulative Growing Degree Days (GDD)</b>	<b>Activity</b>
<b>Peak adult emergence of first generation</b>	360	Egg laying
<b>Larvae emerge from eggs</b>	414	
<b>Three larval instars</b>	414-781	Feeding damage
<b>Pupation</b>	781-1051	“Fly-free” period. No feeding.
<b>Adults emerge and reproduce</b>	1116	Egg laying occurs
<b>Larvae of second generation emerge from eggs</b>	1170	
<b>Three larval instars</b>	1170-1537	Feeding damage
<b>Pupation</b>	1537-1807	“Fly-free” period. No feeding.
<b>Adults emerge and reproduce</b>	1872	Egg laying
<b>Larvae of third generation emerge from eggs</b>	1926	
<b>Three larval instars</b>	1926-2293	Feeding damage

<b>Pupation</b>	2293-2563 (or next season)	“Fly-free” period. No feeding.
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*Delia* growth stage and activity based on cumulative growing degree days (GDD, base 39F). Accumulated GDD needed for three generations of seedcorn maggot. Generally, corn and soybean seeds have emerged and are safe from damage after the first generation.

### **Biological Control**

There are several natural enemies of seedcorn maggot that can help keep populations in check. Natural enemies of insects can be attracted and conserved by providing a wide variety of flowering plants in or near the field and by avoiding use of broad-spectrum insecticides during periods when natural enemies are present. Reduced tillage systems generally have higher levels of predator activity than conventionally tilled fields. The benefits of reducing tillage are particularly useful for seedcorn maggot because they are attracted to decomposing residues that have been tilled into the soil. The additive effects of diverse natural enemies that attack different pest life stages are usually more effective in keeping pest populations low than a single natural enemy species.

Adult seedcorn maggot flies are attacked by spiders, male dung flies, yellow jackets, some digger wasps, and insect-eating birds. Several species of parasitic wasp attack the larval and pupal stages. Predaceous ground and tiger beetles (Carabidae), rove beetles (Staphylinidae), mites, and ants feed on seedcorn maggot eggs, larvae and pupae. In particular, rove beetles can be effective in keeping populations of seedcorn maggot below economically-damaging levels. Adults of the rove beetle, *Aleochara bilineata*, eat seedcorn maggots while the larvae of this beetle species parasitizes the maggots.



Left: Ground beetle, *Agonum cupripenne*      Right: Two *Poecilus lublandus* ground beetles feeding on a caterpillar

Photos by Nicholas Sloff

Seedcorn maggots are also susceptible to infection by insect pathogens. The beneficial insect-parasitic nematode, *Steinernema feltiae*, seeks out and kills seedcorn maggots in the soil. This species of nematode is well-suited for control of this pest because it maintains infectivity at soil temperatures below 50F. Naturally-occurring soil-inhabiting insect-parasitic fungi may infect and reduce populations of seedcorn maggot larvae.

The beneficial fungus, *Entomophthora muscae*, is an important naturally-occurring mortality factor for adult seedcorn maggot flies during humid or wet weather. Infected flies can be found clinging to the upper stems of plants, especially grasses. Their swollen abdomens are full of fungal spores, which are released into the air to infect other flies. There is currently no commercial formulation of *E. muscae*.



*Delia* Flies infected with *Entomophthora muscae*. Photos by Whitney Cranshaw, Bugwood.org. Creative Commons Attribution-Noncommercial 3.0 License.

### ***Chemical Control***

In an integrated pest management program, insecticides should not be relied on as a primary method of pest control, but as part of a management system based on cultural or biological controls for prevention of economically damaging populations of pests. When preventive practices fail and insecticide use is necessary, utilize the least toxic registered insecticide to reduce negative non-target and other environmental effects. Carefully consider information on the product label related to water quality and impacts on pollinators and natural enemies.

Currently, there is no chemical rescue treatment for seedcorn maggot. The available chemical control options for seedcorn maggot are preventive. One control option is to plant seeds pre-treated with an insecticide. If treating soybean or other legume seed with a planter box seed treatment, make sure that it will not affect the *Rhizobium* seed inoculant. Order of mixing may be important to prevent killing the inoculant. In some crops, application of a broadcast soil insecticide treatment that is incorporated into the soil prior to planting is an option. A potential side effect of using treated seeds or soil-applied insecticides is that natural enemies that may be keeping pest populations in check may be killed, resulting in resurgence of seedcorn maggot and other soil-associated pests.

### **Warning**

Pesticides are poisonous. Read and follow directions and safety precautions on labels. Handle carefully and store in original labeled containers out of the reach of children, pets, and livestock.



Dispose of empty containers right away, in a safe manner and place. Do not contaminate forage, streams, or ponds.

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