Cornell University

Department of Entomology

New York State Integrated Pest Management Program

Onion maggot

Delia antiqua Meigen

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Introduction

Onion maggot, *Delia antiqua,* is a serious pest of onion and related Allium crops (i.e., garlic and leek) in northern temperate regions throughout the world including North America. Although onion maggot will also attack wild relatives of onion, it is not capable of maintaining high populations on wild hosts. Onion maggot completes three generations per year in northern regions. All three generations can be destructive, but the first generation is the most damaging because it can routinely reduce plant stands by over 50% if crops are not protected[1,2].

Description

Adults: Adult onion maggots (Fig. 1A) appear similar in size (~6 mm / ~0.25 in), shape and color as houseflies; however, they are more slender, have longer legs, and overlap their wings when at rest. Adults live for 2 to 4 weeks and can lay hundreds of eggs.

Another member of this genus, the seedcorn maggot, *D. platura,* looks quite similar to onion maggot and is also an important seed and root pest of crops. Seedcorn maggot adults typically appear in onion fields prior to the emergence of onion maggot adults.

The greyish-brown adult looks almost identical to the onion maggot adult, except that it is approximately half to three-quarters its size (~3 mm / ~0.1 in). Seedcorn maggot may also damage onion seedlings and infest damaged bulbs later in the season.

Eggs: Adult onion maggots deposit white elongated eggs (Fig. 1B) ~l.25 mm in length (~0.05 in) on the soil near the stem and occasionally on the young leaves and neck of the onion plant.

Larvae: Larvae are tapered, creamy-white in color, and reach a length of ~8 mm (~0.3 in) (Fig. 1C).

Pupae: When fully-grown, the larva leaves the onion plant and enters the soil to pupate at a depth of 5-10 cm. The pupa is chestnut brown and ~7 mm long (~0.3 in) (Fig. 1D).

Life cycle

The onion maggot life cycle lasts from 37 to more than 60 days. The first-generation adults emerge from pupae around mid-May in the northeastern US, with peak flights occurring about 2 weeks later (Table 1)[3,4,5].

Adults can survive for 2-4 weeks and females may lay hundreds of eggs, beginning approximately 7 to 10 days after emergence. Eggs hatch in 2 to 5 days, and most newly hatched larvae move below the soil surface and burrow into the basal plate of the onion plant or feed on the roots. Any injury site on the plant facilitates larval entry, and larvae will feed on developing plants and onion bulbs for 2 to 3 weeks. Upon reaching maturity, larvae leave the onion and pupate in the surrounding soil. Offspring of the first and second-

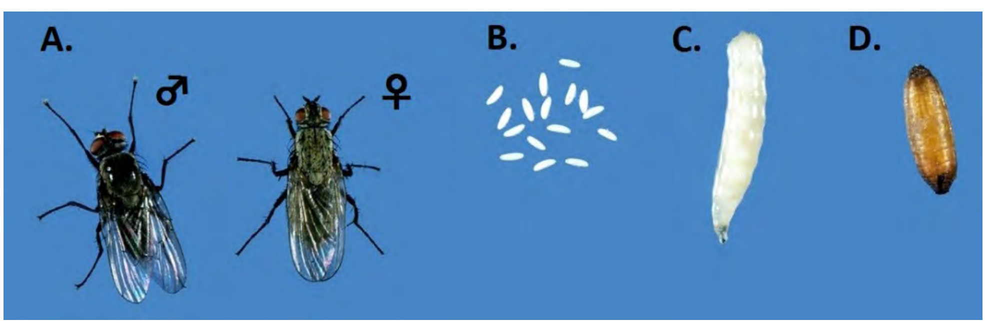

Photo: J.Ogrodnic, NYSAES Photo

Figure 1. Life stages of the onion maggot: A, adult; B, eggs; C, larva; D, pupa.

Flight	Month(s)	Accumulated Degree Days$_{40°F/4°C}$ @ ~50% Adult Emergence (°F / °C)				
		New York[3]	New York[4]	Quebec[5]	Average	Range
1st	Late May to late June	712 / 378	801 / 427	1018 / 548	844 ±157 / 451 ±88	712-1018 / 378-548
2nd	Mid-July to mid-August	1554 / 846	1963 / 1073	2450 / 1343	1989 ±449 / 1087 ±249	1554-2450 / 846-1343
3rd	Late Aug. through Sept.	2743 / 1506	3245 / 1785	3492 / 1922	3160 ±382 / 1738 ±212	2743-3492 / 1506-1922

Table 1. Timing of onion maggot flights in eastern North America

generation adults will remain in the pupal stage for 2 to 4 weeks before emerging as adults. The second generation of adults begins emerging in early July with peaks in mid-to-late July. Emergence of the third or fall flight begins in late August, peaks in early-to-mid September, and may continue into October. Larval offspring of the third adult generation develop into pupae and overwinter in that stage. Surviving pupae that emerge as adults constitute the spring flight of the following growing season.

Damage

Only the larva causes damage. Larvae use their hooked mouth parts to enter the base of the plant and then feed on the internal plant tissues. Younger plants are more vulnerable to larval feeding and damage than older plants because the below-ground portion of the plant and bulb become inherently more difficult for the larva to penetrate as it grows[2]. Damaged seedlings first wilt, become flaccid, and die (Fig. 2 and 3). Seedlings often die before larvae are fully grown, forcing them to move to adjacent plants. Second-generation larval feeding on developing bulbs can distort their growth and also provide entry points for bacterial pathogens that can cause bulbs to rot. Feeding by third-generation larvae on mature onion bulbs can result in an unmarketable product (Fig. 4). Even after onions are undercut, windrowed, and left to dry in the field, bulbs may still be vulnerable to damage. Depending on the timing of undercutting in preparation for harvest, second or third generation adults may lay eggs on these bulbs and larvae can then bore into all parts of the bulb, not just the basal plate. Again,, feeding on these bulbs may permit easy entry by plant pathogens. Because the majority of onion bulbs are stored after harvest, infected and rotting onions might reduce the quality of adjacent onions in storage.

Monitoring

There are various methods available to assess onion fly activity. An inverted-screen cone trap baited with damaged onions has been a commonly used fly trap. Its effectiveness is greatest early in the season for detecting flight activity when onion plants are small.

As the crop grows, the relative attractiveness of these traps decreases, lessening their accuracy in predicting second generation population activity. Yellow sticky traps placed around field edges just above the growing foliage can also be used to monitor fly activity[5]. Monitoring the cone or sticky traps once a week should aid in determining relative seasonal activity. Another method for monitoring onion maggot adult activity involves visually observing flies in the field. Adults are usually more active during mid-day in spring and fall, and on cloudy, cool summer days. When temperatures are hottest during summer, adults are usually present in onion fields early in the morning and late afternoon, but are more difficult to find mid-day. Onions damaged by equipment wheels, cultivation, maggot feeding, or onion smut are more attractive to ovipositing onion maggot adults and should be preferentially observed for fly activity.

Photo: B. A. Nault

Figure 2. Damage to onion seedlings by onion maggot larvae.

Management

Onion growers can reduce onion maggot damage through non-chemical and chemical control tactics. Some of the most effective options are summarized below.

CULTURAL CONTROL

Rotating onions to fields that are as far away as possible (≥1.2 km / ≥0.75 mi) from the previous season's onion crop will reduce onion maggot populations and the resulting damage by "escaping the infestation in space"[7]. Planting onions midway or late in the onion planting period (late-April to mid-May) will reduce maggot damage to plants by "escaping the infestation in time"[2]. While planting too late in the season can result in a higher risk of the crop producing undersized bulbs, this tactic could be used in fields that have a chronic history of high onion maggot populations. Removing cull onions from the field after harvest and fall plowing will help reduce the number of overwintering flies.

Photo: C. A. Hoepting

Figure 3. Damage to a young onion plant by onion maggot larvae.

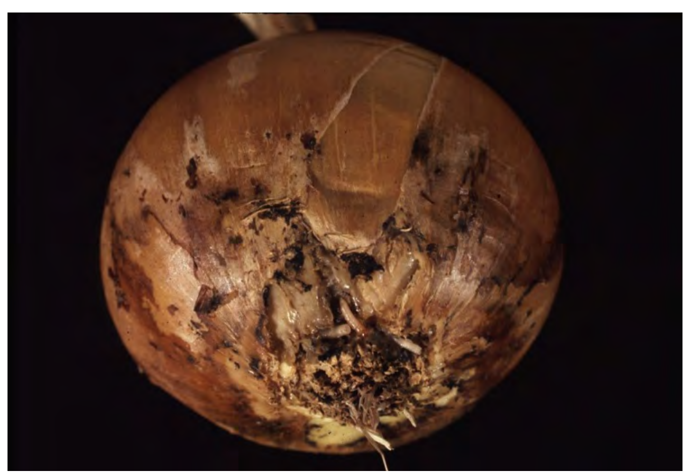

Photo: J.Ogrodnic, NYSAES Photo

Figure 4. Damage to an onion bulb by onion maggot larvae.

Similarly, removing volunteer onions early in spring and minimizing herbicide and cultivation damage to onion plants may also aid in suppressing onion fly populations. During the onion crop's most vulnerable period (early-season),using a floating row cover could prevent oviposition.

BIOLOGICAL CONTROL

Natural enemies of onion maggot do occur in onion fields, but their impact on onion maggot infestations is not well understood. Predatory beetles eat both onion maggot eggs and larvae, while predatory flies and birds consume adults. Parasitic wasps can be found early in the season attacking first generation maggots. When environmental conditions are cool and moist in the spring and fall, the parasitic fungus *Entomophthora muscae* can infect and kill large numbers of adults (Fig. 5). The potential of these naturally-occurring control organisms may be optimized by spraying insecticides and fungicides only when needed and choosing materials with the least impact on the beneficials.

PLANT RESISTANCE

Currently, there are no available onion cultivars resistant to onion maggot.

CHEMICAL CONTROL

Insecticides applied at planting either as a seed treatment or as an in-furrow drench treatment can protect onion seedlings from first-generation larvae and perhaps second-generation larvae in some years[1]. Delivering insecticides as seed treatments is convenient because the application does not require water (as the in-furrow drench treatment requires), thus saving resources and saving valuable time when planting windows are narrow. Targeting onion maggot adults with foliar insecticide applications is not effective[8]. Onion maggot populations are notorious for developing resistance to insecticides[9], so classes of insecticides should be rotated frequently to mitigate resistance development. No effective insecticide and delivery methods are available to protect transplanted onions from maggot damage; however, research is currently underway to address this issue. **Consult Cornell University's Integrated Crop and Pest Management Guidelines for Commercial Vegetable Production for the most effective insecticides and rates, including insecticides that may be approved for organic production: veg-guidelines.cce.cornell.edu.**

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Photo: J.Ogrodnic, NYSAES Photo

Figure 4. Adult onion maggot infected and killed by the entomopathogenic fungus *Entomophthora muscae.*

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