Integrated Pest Management Guide for Sugarbeet Root Maggot

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The sugarbeet root maggot, *Tetanops myopaeformis*, occurs wherever sugarbeets are grown in Idaho. It is most likely native to North America but did not become a serious pest in Idaho until the 1960s. Infestations historically have been most damaging in Minidoka and Cassia counties. Localized infestations also occur around Filer in Twin Falls County and near Notus and the Dry Lake area of Canyon County. Recent surveys suggest that infestations seldom reach damaging levels in other areas.

This publication will help you design an integrated pest management program (IPM) for the sugarbeet root maggot. The IPM approach combines cultural controls with field scouting and thresholds to ensure that controls are used only when needed. Beet growers who use IPM can increase profits while reducing the harmful environmental effects of pesticides.

Pest Description

Sugarbeet root maggots develop through four life stages: egg, larva, pupa, and adult. Eggs are white, slightly curved, and about 1/25-inch (1 mm) long. Larvae are white legless maggots without distinct heads. The body grows to 1/3-inch long, tapering to a cone at the head end. The pupa is a tan, hard-shelled capsule slightly smaller than a full-grown larva. The eggs, larvae, and pupae all occur in the soil. Adults are medium-sized flies with two wings and a shiny, black body. (Refer to the section *Scouting, thresholds, and insecticides* on page 4 for a more detailed description of adult flies.)

Life Cycle

Sugarbeet root maggots overwinter as full-grown larvae 12 or more inches deep in the soil of the previous year's beet fields. As soil temperatures warm to the mid-40s during the spring, maggots move upwards and pupate within a few inches of the surface. Fly emergence begins during mid-April in western Idaho and during mid-May in eastern Idaho.

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Fly numbers in most areas usually are low until late May. Populations then increase rapidly and reach seasonal peaks during the last week in May or the first week of June. Fly numbers decline to undetectable levels within a week or so after they peak. One exception to this general pattern occurs in the Mini-Cassia area, where fly populations often begin to build by mid-May and remain at high levels for several weeks. In all areas, cool, wet, and windy weather slows adult emergence while unseasonably warm spring temperatures advance fly emergence. During periods of cool temperatures, adults remain still on the soil surface and do not fly even when prodded. They have nutritional reserves to live without feeding for 2 or more weeks. Nectar feeding on mustards and other flowers prolongs their lifespan.

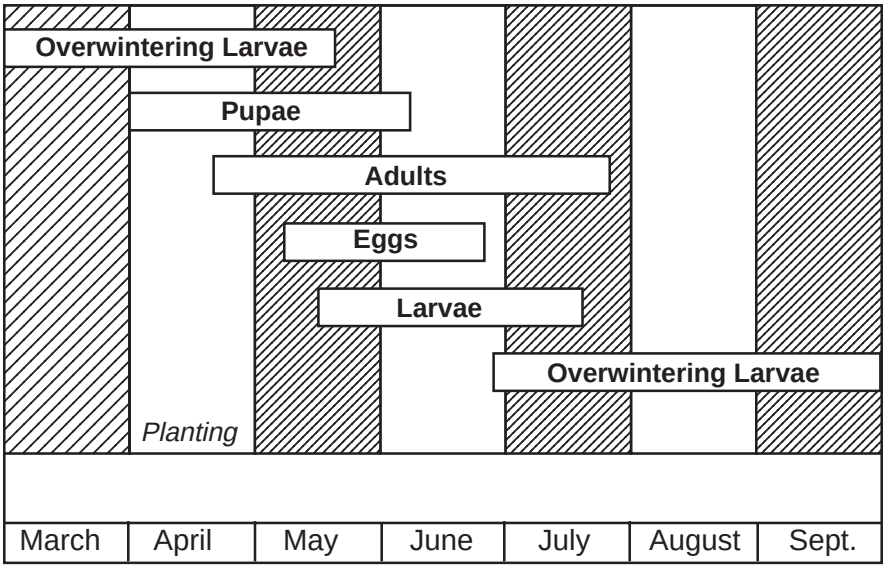


Fig. 1. Generalized life cycle of sugarbeet root maggot.

Adult flies begin to lay eggs 3 to 10 days after emergence. Females have an *extendible ovipositor* (egg-laying tube), which they use to deposit batches of 8 to 15 eggs in the soil next to sugarbeet plants. Each female lays about 120 eggs that hatch in 1 to 3 days. Soil moisture is critical for egg survival. Eggs die without hatching if the soil is hot and dry.

Maggots feed on sugarbeet roots and develop through three larval stages. They reach full size early- to mid-July, after which they stop feeding and enter a state of diapause until the following spring. Usually a single generation develops annually. There is some evidence that a small portion of the population pupates during July and emerges as flies during August.

Host Plants and Damage

Only larvae cause damage. They reduce yield tonnage and lower root sucrose content by scraping the root surface with rasping mouthhooks. They do not tunnel into the beet like wireworms nor do they feed above ground like cutworms or crown borer larvae. Only maggots hatching from eggs laid during the current growing season cause injury. Overwintering larvae never feed on the crop during the spring.

Crop losses depend on the number of maggots present and on the size of the sugarbeet plant. Seedlings are most susceptible to injury because maggot feeding can cut the root and kill the plant. Probability of stand loss is greatest for late planted sugarbeets that are in the seedling stages when flies reach seasonal peaks.

On older plants, maggot feeding appears as black, oozing lesions ranging from pinhead to dime size. When infestations are severe, lesions may cover the entire root surface. Feeding on the root tip causes the taproot to fork and branch. Above ground, damaged plants wilt during May and June, especially between irrigations. Losses are compounded when root-rot pathogens invade maggot feeding wounds. In fields with histories of root rots, even minor root maggot infestations can combine with soil pathogens and eliminate the stand.

Sugarbeets, table beets, swiss chard, and spinach are the only commercial host plants. Spinach is the preferred host both for adult egg-laying as well as for larval development. The only weedy host plant is garden orach (*Atriplex hortensis*), an herb that has escaped cultivation. Extensive testing in Idaho with other weeds has shown that none of the following is a host: **black nightshade**, **curly dock**, **lambsquarters**, **prostrate pigweed**, **redroot pigweed**, and **Russian thistle**.

The relative concentrations of sugarbeets in an area compared with nonhost crops may explain why populations perennially reach damaging levels in certain areas. Since root maggot adults are weak fliers and larvae have narrow host ranges, areas with extensive sugarbeet acreage provide a better environment for this pest. The more abundant and concentrated the larval food supply, the greater the potential larval population.

Integrated Pest Management Strategies

Cultural methods

Root maggot management begins with cultural methods that reduce the numbers of flies colonizing fields and laying eggs. Crop rotation helps control this pest but is ineffective by itself because flies move among neighboring fields. Early planting gives beets a head start on root maggots so that the crop is beyond the susceptible seedling stage when feeding begins. Deep fall tillage after harvest exposes overwintering larvae to freezing temperatures and naturally occurring predators.

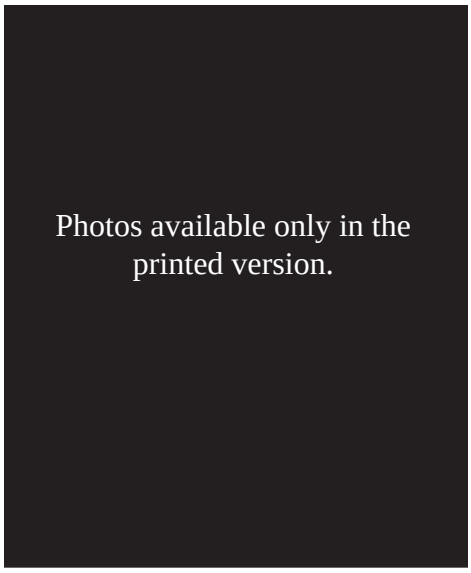


Fig. 2. Blickenstaff sticky-stake trap used to monitor sugarbeet root maggot flies.

Irrigation scheduling also can decrease plant injury. Frequent irrigation forces larvae toward the soil surface where feeding causes less injury. When practical, avoid planting sugarbeets in fields with sandy-textured soils because damage is often greater in lighter soils.

Other cultural practices are less useful. Weed control has no impact because none of the common sugarbeet weeds are host plants. In theory, planting a border of spinach as a trap crop around fields could attract egg-laying flies away from sugarbeets, but this tactic has not proven effective in Idaho. Private industries have been developing maggot-resistant varieties for several years but have not yet released them to the commercial market.

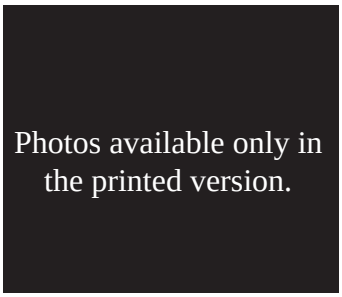
Biological controls

Naturally occurring predators of larvae and pupae include ground beetles, stilleto (therivid) flies, and birds. A naturally occurring soil fungus, *Metarrhizium anisopliae*, infects larvae and can cause heavy mortality. We do not know enough about our native beneficials to suggest practical ways of manipulating and enhancing their impact.

No commercial biocontrols are available. Work is underway to identify strains of *Bacillus thuringiensis* (BT), microbial insecticides that kill sugarbeet root maggot larvae. Microscopic predatory nematodes that seek out and kill larvae have not been effective when tested in Idaho. Researchers are also testing ways to control larvae by killing the bacteria that live within their gut and aid in digestion.

Scouting, thresholds, and insecticides

About half of Idaho's sugarbeet acreage is annually treated with insecticides to control root maggot larvae. In most areas, postemergence applications are more cost-effective than planting time applications. This especially is true in sprinkler irrigated fields (as compared to furrow irrigated fields). One reason that postemergence treatments are more effective is because there is no way to know at planting time if insecticides are needed. Root maggot flies do not begin to lay eggs until 4 to 6 weeks after planting. Secondly, even if infestations do develop, at-planting applications are too early for maximum larval kill. Research has shown that maggot control is most effective when insecticides are applied within 10 days of peak fly emergence. Insecticides are most effective then because the



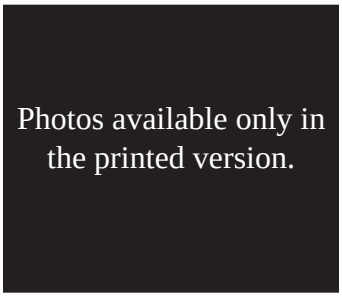


Fig. 3. Male (top) and female (bottom) sugarbeet root maggot flies have a smoky brown patch on their wings. Also look for black legs with white "knees" and "ankles."

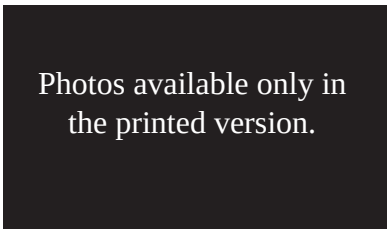


Fig. 4. Other species of root maggot flies have grayish bodies with easy-to-see hairs and bristles.

Fig. 5. March flies are twice the size of sugarbeet root maggots. Long, spiny legs and an oval black spot on the wing further distinguish march flies from other species. These are not harmful to plants.

timing is better; peak fly emergence indicates that most of the population is laying eggs and larvae will soon be hatching. (One exception is the Mini-Cassia area; see the section *Maggot scouting and thresholds in the Mini-Cassia area* on page 8 for specific recommendations.)

You can determine when adult flies are emerging by monitoring populations with homemade Blickenstaff sticky-stake traps. Blickenstaff sticky-stake traps simply consist of an orange colored 1 x 10-inch stripe painted on a white 2 x 2-inch post (fig. 2). Sugarbeet root maggot flies are attracted to the orange face where they are captured in a film of insect trapping adhesive. One commercial brand of trap adhesive is Tangle-Trap. It is manufactured by the Tanglefoot Company, Grand Rapids, Michigan, 49594, (616) 459-4139. The aerosol spray formulation is easier to use than the brush-on types.

Traps capture many different types of insects. Use this combination of features to differentiate sugarbeet root maggot flies from other common species (fig. 3):

- **Size**: ¼-inch long, stocky, stout-bodied appearance superficially similar to housefly; the tip of the male's body is rounded and the female's body comes to a point,
- **Color**: shiny, oily black body, without obvious stripes, bristles or hairs,
- **Wings**: one transparent pair with a smokey brown patch located along the leading edge, about one-third of the distance from where wings attach to the body,
- **Legs**: entirely black except for yellowish-white "knees" and "ankles."

Two other flies that resemble sugarbeet root maggots are the **onion maggot** and the **seed corn maggot** (fig. 4). Both are the same size as sugarbeet root maggots but have dull grayish bodies with darker stripes. These two also have hairs and bristles on their body that can easily be seen with the naked eye. March flies (fig. 5) are also commonly seen in sugarbeet fields. They are about twice the size of sugarbeet root maggot flies with a long-legged appearance. Each wing is marked with a black, oval spot. This spot is more distinct than the brownish smudge-like patch on the wing of the sugarbeet root maggot. March flies are not harmful to plants.

Instructions for Using Sticky Traps

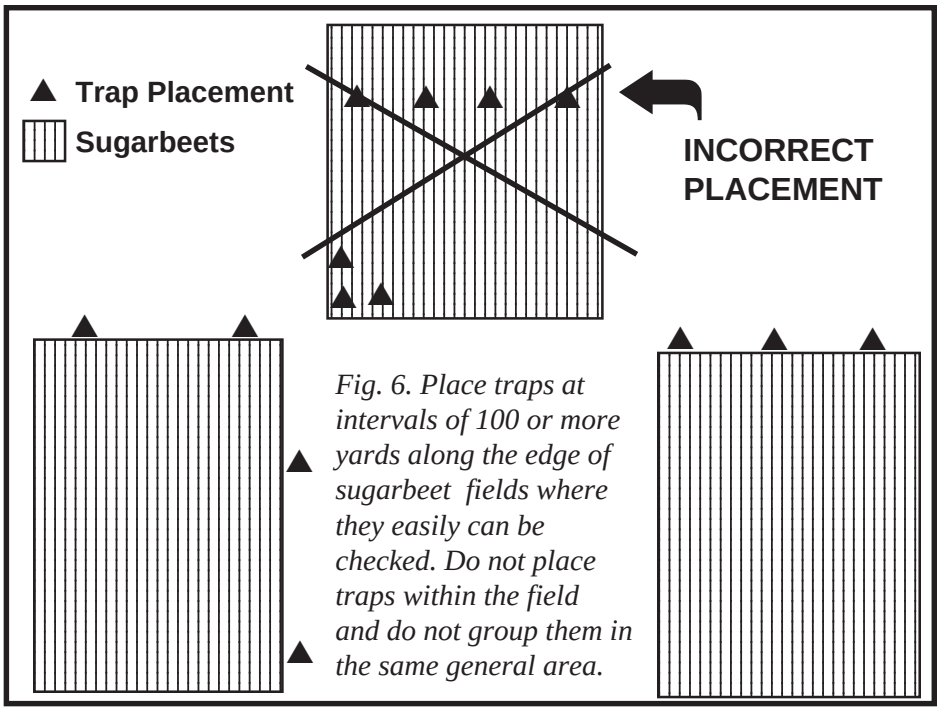


Fig. 6. Place traps at intervals of 100 or more yards along the edge of sugarbeet fields where they easily can be checked. Do not place traps within the field and do not group them in the same general area.

Using sticky traps is simple, but you must follow these instructions:

1. Use three or more traps per field. Place traps along the fencerow or along the ditchbank next to the sugarbeet field. Do not place traps within the field. Locate traps where you can easily check them; space them at intervals of several hundred yards (fig. 6). Point the orange face either north or east with the bottom of the orange stripe 1 foot above ground level. Trim back any weeds that block or interfere with the trap.

2. You can save scouting time by monitoring one field, but it is more accurate to check each individual field. Patterns of fly activity can differ substantially between adjacent fields.

3. Begin trapping by April 15 in the Nyssa — Nampa area and by May 1 elsewhere. Check traps at least twice weekly. The time of day you check traps does not matter. Frequent checking is best because dusty winds coat the trap with dirt and reduce capture efficiency. Additionally, traps sometimes capture so many other insects that they cover the entire orange surface and prevent further captures.

4. After checking each trap, scrape the orange surface clean with a putty knife. Reapply trap coating as needed.

5. Check traps until you see a definite peak in fly captures. Although captures can change erratically, seasonal peaks normally occur between May 23 and June 7. Warm weather advances these dates; cold, windy, and rainy weather delays these dates.

6. Keep records as shown in figure 7. Each time you check traps, record the number of sugarbeet root maggot flies captured. Then calculate the *trap average*, the average number of flies per trap. Divide the trap average by the number of days since the last time you checked your traps. The resulting value is the *daily average* and is necessary to adjust for any differences in time intervals between checks. Without this correction, you might incorrectly identify the date of peak capture and make the wrong control decision. Finally, keep a running tally of your trap averages from the beginning of the season.

How to Make a Control Decision

When the daily average column shows that captures of root maggots have peaked, you are ready to make a control decision. Compare the *running tally* on the day of peak with the thresholds in table 1. If your running tally is greater than the thresholds, apply an insecticide. But if your tally is less than the thresholds, control is not needed because yield losses from maggot feeding will be less than the cost of purchasing and applying insecticides.

In the example (fig. 7), the daily average reached a peak of 10 flies on May 25. The running tally on May 25 was 50 flies. Now consult the thresholds in table 1 to see if 50 flies justifies using insecticides for larval control. For instance, assume that your contract price is $40 per ton and that it costs $20 per acre to purchase and apply a granular insecticide. Table 1 states that the threshold is 43 flies. In this example, the infestation is severe enough to require control. But if fewer than 43 flies had been captured, then insecticides would not have been needed. As a rule of thumb, maggot control is justified if an average of 40 to 45 flies are captured per trap from the beginning of the season

DATE	NO. FLIES CAPTURED trap 1	trap 2	trap 3	TOTAL	TRAP AVERAGE average no. flies per trap	No. of days since traps last checked since beginning	DAILY AVERAGE average no. flies per day	RUNNING TALLY total TRAP AVERAGES
	+	+	=		÷ =	÷ =		
	+	+	=		÷ =	÷ =		
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Fig. 7. Keep written records of trap captures. Calculate the average number of flies per trap as well as average per trap per day.

until peak. Unless you capture an average of at least 34 flies per trap, yield losses will be too small to measure.

When peak fly captures exceed thresholds, you should apply insecticides within 10 days. The longer the delay between peak fly capture and insecticide application, the less effective larval control will be. See your Extension agricultural agent or the field staff of the Amalgamated Sugar Company for information about currently labelled insecticides.

Granular insectides require moisture after application to move the active ingredient into the soil from the carrier. In sprinkler irrigated fields, insecticides can be applied over the top of the row and lightly incorporated. Sprinkler irrigation immediately after application helps move the insecticide into the root zone. Always read the label for specific recommendations regarding placement.

Table 1. Economic thresholds for sugarbeet root maggot. Thresholds are the average number of flies trapped from the beginning of the season until peak capture. Control is not needed unless the average number of flies captured per trap from the beginning of the season until peak is greater than these thresholds.

Contract price ($)	Sugarbeet cost of insecticide and application ($/acre)			
	10	20	30	40
20/ton	43	52	61	67
30/ton	40	46	52	56
40/ton	38	43	47	44
50/ton	38	41	44	47

Maggot Scouting and Threshholds in the Mini-Cassia Area

Heavy, prolonged fly emergence often occurs in the area north of Rupert and Paul as well as the area south of Burley from Milner to Declo. Fly captures frequently exceed the threshold of 40 to 45 flies by mid-May and continue increasing for three or more weeks, eventually reaching peaks of several hundred flies. Growers in these areas should not wait until peak capture before applying insecticides for maggot control. Instead, split your applications into at-plant and postemergence treatments. This extends insecticide effectiveness. Do not permit granules to touch the seed when applying insecticide at planting time because plant injury (phytotoxity) can result. Mini-Cassia growers should still use sticky-stakes as an aid to time postemergence treatments. Make applications as soon as fly numbers exceed economic thresholds. Do not delay. Or consider application at first cultivation if traps show that flies are approaching economic thresholds.

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