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Insects Affecting Sugarbeets in North Dakota



Dean K. McBride
Extension Entomologist

Robert Dregseth
Research Specialist I

Albin W. Anderson
Professor of Entomology



NDSU EXTENSION SERVICE

North Dakota State University, Fargo, ND 58105

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The earliest record of sugarbeets being produced in North Dakota indicates that they were first planted in 1890. While sugarbeet trials were conducted over the next 30 years, there was no amount of commercial production until the first sugar factory was completed at East Grand Forks, Minnesota in 1926. The first record of sugarbeet production is for 1924 when 2,600 acres were harvested in North Dakota. The total value of this crop was \$194,000.

In 1953 there were 34,800 acres of sugarbeets harvested in North Dakota with a value of \$3,729,000. By 1977 sugarbeet production had reached a peak of 155,200 acres harvested in North Dakota with a total crop value of \$59,257,000. Sugarbeets have played an important role in the developing economy of the Red River Valley. Also, certain insects have played a role in the production of sugarbeets. Historically the sugarbeet root maggot has been without a doubt the main insect culprit affecting sugarbeet yields, but in recent years, cutworms, grasshoppers, flea beetles, white grubs and a few others have managed to take their "bite" out of sugarbeet profits as well.

Sugarbeet Root Maggot

History

The first record of sugarbeet root maggot infestation in North Dakota was reported by American Crystal Sugar fieldmen in 1947 and again in 1948 in the Auburn-St. Thomas area. At that time it was not known that the maggot species involved was the insect later identified as the sugarbeet root maggot, *Tetanops myopaeformis* (Roder). By the mid 1950s, sugarbeet root maggot damage was occurring throughout most of the light soil areas of the northern Red River Valley. Tests with chlorinated hydrocarbon insecticides indicated that planting time treatments mixed with fertilizer provided good maggot control with yield increases of from 2 to 4 tons per acre.

From 1957 through 1965, aldrin insecticide mixed with fertilizer became a highly accepted and effective method of controlling the sugarbeet root maggot in the light soil areas of the northern Red River Valley. In 1965, aldrin and dieldrin residues were found in sugarbeet pulp resulting in a substantial financial loss for the American Crystal Sugar Company. Due to this problem, the company's position has been to disallow the use of any chlorinated hydrocarbon insecticide in the production of sugarbeets since 1966.

Until effective alternate granular carbamate and organophosphate insecticides were registered in the early 1970s, sugarbeet growers in the late 1960s experienced some severe losses due to sugarbeet root maggot damage without effective controls.

The sugarbeet root maggot has spread in the Red River Valley. It is now present in all areas of the Valley where sugarbeets are grown, although the most severe infestations continue to occur in light soil areas. It can be assumed that the survivability of the maggot is enhanced by development in lighter soils.

Life Cycle (Figure 1) and Damage

In North Dakota the sugarbeet root maggot overwinters as a mature larva in the soil at depths of 6 to 10 inches. The maggot is seldom found below plow depth except in years when soil moisture is seriously depleted. In such cases, the overwintering maggots have been found at depths of 12 to 14 inches.

When soil temperature begins to rise in the spring, the maggots become active, moving to within 1 to 4 inches of the soil surface. Here they transform into the pupal stage. In the puparium the insect reaches the adult stage after which the fly emerges head first from the pupal case and crawls through the soil to the surface. Newly emerged flies have been observed down in the soil at a depth of 4 to 5 inches crawling toward the soil surface. Once above the soil the flies crawl to a protected place such as a clump of soil or under a plant leaf where their wings harden. After this has taken place the flies are capable of their characteristic, low-level flights, moving into the current season's beet fields.

The male fly may mate with the female in the field where it emerged or may do so after migrating to the new beet fields. The female flies deposit eggs in the current season's beet fields next to beet plants about 1/8 inch below the soil surface. If the soil is crusted, the eggs are deposited near the crown of the beet plants and occasionally in nearby soil cracks.

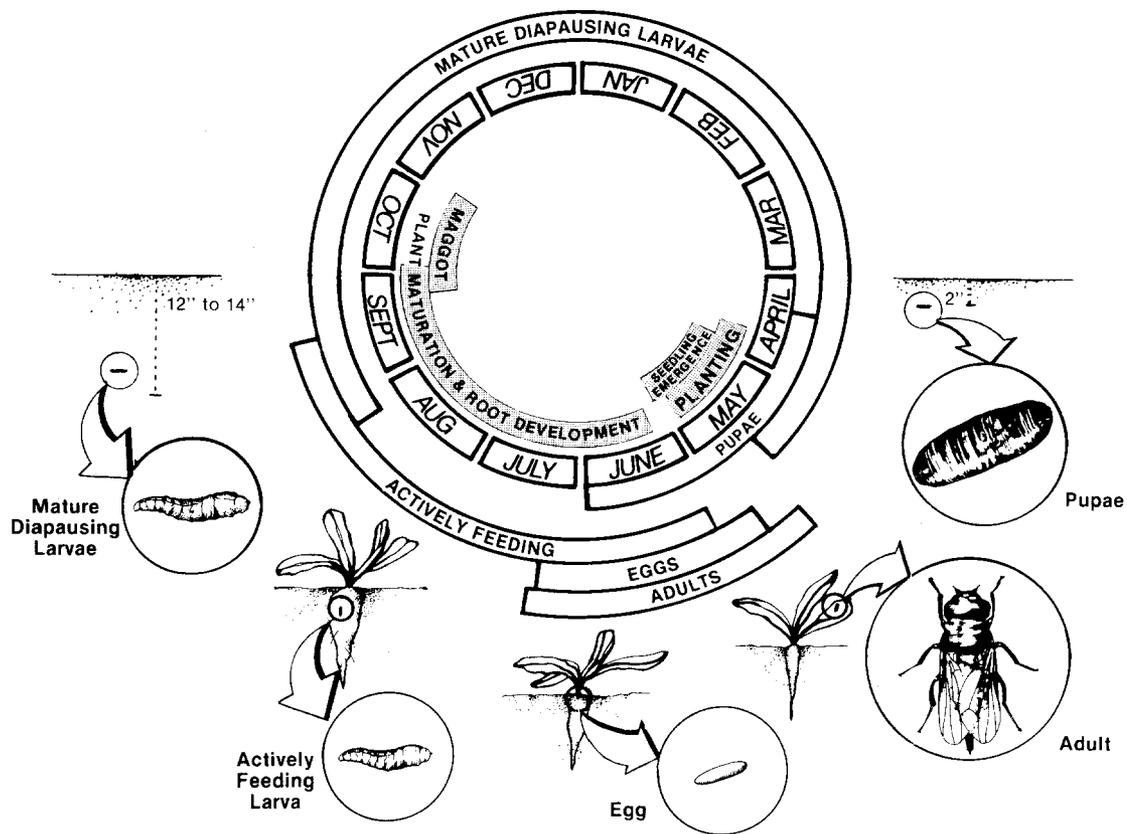
The eggs incubate for a period of about three to seven days depending upon soil temperature and moisture. After incubation the young maggots begin hatching and immediately start to feed on the roots of the sugarbeet seedlings. They damage the young beet plant roots by rasping on the surface causing leakage of beet juices from the damaged areas. Generally the heavily infested plants wilt, and if the tap root is severely damaged or severed, the plants die.

The maggots feed continuously on the beet roots until full grown. Then they go into diapause (a resting stage) for overwintering.

In North Dakota a second generation may sometimes occur when maggots mature early in the season, pupate and emerge as flies in late July or August. This occurred in 1970, 1971, and again in 1973. Apparently no damage has been attributed to second generation root maggots occurring this late in the season because normally the sugarbeets are large enough at this time to tolerate the maggots.

Soil moisture and temperature relationships appear to be a critical factor in sugarbeet root maggot development. When soil moisture is low in the spring, maggot fly development requires warmer weather. As soil

Sugarbeet Root Maggot Life Cycle



moisture increases with spring rainfall, the maggot development generally accelerates even though temperature may remain rather cool.

Further study of weather data and sugarbeet root maggot development in future years may provide necessary information regarding the most favorable balance between soil moisture and temperature requirements that allow for optimum maggot fly development and emergence.

Cutworms

Life Cycle and Damage

Two species of cutworms, the dark-sided *Euxoa messoria* and the red-backed *Euxoa ochrogaster*, appear to be most prevalent in causing damage to sugarbeets in the Red River Valley. The reddish-brown wings of the adult red-backed cutworm moth have characteristic bean-shaped markings. The dark-sided cutworm moth wings are gray with indistinct wing markings. The wing span of both species measures about 1¼ to 1½ inches from wing tip to wing tip.

Both cutworms have basically similar life cycles. The moths deposit eggs in mid to late summer almost exclusively in cultivated fields, and the eggs remain in the soil throughout the winter and early spring. Cut-

worm larvae of both species emerge in late May and early June. They are gray-brown in color with a brown mottled head capsule.

A well developed climbing habit exists in the larvae of both cutworm species. They feed primarily at night, chewing the sugarbeet seedlings at the soil surface or climbing up on the seedlings to chew on the young leaves. If there is crusted soil or hot, dry soil conditions, the feeding damage may occur just below the soil surface, in which case, effective control is difficult if not impossible.

During the day most of the cutworms conceal themselves in the upper 1 to 3 inches of soil in a C-shaped position near the crop plant. When mature the cutworms will be approximately 1½ inches long and pupation begins. Moths begin to emerge from pupal cases in mid-summer to initiate mating and egg laying activity.

Besides sugarbeets, the two cutworm species also attack sunflower, corn and potatoes.

Because growers often overlook or fail to identify cutworm damage until the insects have caused a significant reduction in stand, it is extremely important for beet producers to monitor their fields every two to three days in the early growing season for initial symptoms of cutworm activity. Early detection and early treatment can be extremely beneficial in preventing stand reduction and the need for a costly replanting operation.

Grasshoppers

Life Cycle and Damage

Of approximately 80 species of grasshoppers occurring in North Dakota, only a few species attack crop plants such as sugarbeets. These species consist primarily of the two-striped grasshopper *Melanoplus bivittatus*, differential grasshopper *Melanoplus differentialis*, red-legged grasshopper *Melanoplus femur-rubrum* and the grasshopper species *Melanoplus packardii*.

Grasshoppers pass the winter in the egg stage. These eggs are deposited in pod-like masses up to an inch long and from 1/2 to 2 inches below the surface of the soil. Each egg pod consists of from 20 to 120 elongate eggs securely cemented together and covered with soil particles. A single female may deposit from eight to 25 egg pods. They are primarily deposited in uncultivated ground such as field margins, pasture land and roadside ditches.

Most of the grasshopper egg laying activity occurs in late summer and fall. Hatching the next spring begins in late May and June. The young hoppers differ little from the adult, except in size and wing development. There are normally five or six nymphal instars that require 40 to 60 days to reach the adult stage.

As with other field crops, grasshopper attacks in sugarbeets frequently begin in early season around the margins with the young hoppers continuing to advance into the field, feeding as they move, if not controlled. At first their chewing damage will consist primarily of light shot-holing in the leaves of young beet seedlings. However, with heavy grasshopper infestations, severe leaf removal can occur to the extent that all or nearly all leaf material is consumed, in which case replanting may be necessary. The sugarbeet grower or fieldman who conscientiously makes frequent field checks should be able to detect early grasshopper activity and avoid serious feeding losses.

Flea Beetles

Life Cycle and Damage

There are numerous species of flea beetles but the species that most frequently attacks sugarbeets is shiny black and about 1/8 inch in length. They are somewhat oval-shaped and the hind legs are enlarged. When approached, these beetles jump very readily, hence the name flea beetle.

Flea beetles overwinter as adults in plant trash or other suitable sites. They begin to emerge in late April and May, feeding at first on suitable weeds. As soon

as sugarbeets are in the seedling stage, they are subject to attack by flea beetles. Injury consists of small round holes chewed in the leaves giving the foliage a shot-hole appearance. With severe shot-holing, plant growth is retarded and wilting of foliage can occur during hot, dry weather.

The beetles, after mating, lay their eggs in the ground near the roots or on the plants near ground level. After hatching, the larvae feed on the roots. They are whitish with a brown head capsule, attaining a length of nearly 3/16 inch when fully mature. After feeding for three to four weeks, pupation begins and finally the adult stage is achieved. Total development time from egg to adult is five to 10 weeks.

Wireworms

Life Cycle and Damage

Wireworms are among the most difficult insects to detect and control. Frequently a grower will not discover that he has a wireworm problem until he begins to observe bare, patchy areas in his field where, as a result of wireworm attack, the beet seeds have been destroyed or below ground feeding on beet seedlings has resulted in thinning of the stand. Often the crop may not come up well, or it may start well and later become thin and patchy because of the wireworms subterranean tunneling causing seedlings to wither and die.

If there is ample soil moisture later in the growing season, wireworms may damage beets by boring into the tap root. Such feeding activity frequently results in holes or winding galleries through the root.

Wireworms tend to be more prevalent in light textured soils or in land that has not been in crop production for a number of years. Frequent cropping and working the soil helps reduce wireworm problems.

Wireworms also have many other host plants upon which they will feed, including all types of crops grown in the state as well as various grasses, garden vegetables and flowers.

Wireworm larvae are usually hard, smooth, wire-like worms varying from 1/2 to 1 1/2 inches in length when mature. They are a yellowish-white to coppery color.

Adult wireworms are known as click beetles, the name being derived from the clicking sound that the insect makes when attempting to right itself after having landed on its back. The beetles are hard-shelled, usually dark brown or black in color and about 1/2 inch in length.

Wireworms overwinter mainly in the larval and adult stages in the soil. In spring the adults become active, later mating and the females depositing their eggs primarily around the roots of grasses. The egg stage requires a few days to a few weeks. After hatching, the wireworms spend from two to six years in the soil feeding on the roots during spring and early summer. As the soil becomes hot and dry, the larvae migrate downward so that it is often difficult to find them in dry summer weather even in severely infested fields.

Most wireworm species change to the pupal stage and later to the adult stage in cells in the soil during the late summer or fall of the year in which they become full grown. The adults remain in the soil until the following spring.

White Grubs

Life Cycle and Damage

Like wireworms, white grubs (*Phyllophaga spp.*) can often be very destructive and difficult to detect before considerable damage in sugarbeets has occurred. When fields infested with white grubs are planted to beets, the beets usually come up but the plants cease growing after reaching a height of several inches. Beet fields will show a patchy growth with varying sized areas, especially along the rows, where the plants are dead or dying. If the injured plants are pulled up, the roots will be found to be severely chewed or eaten off with usually several grubs in the soil around the base of the plant. White grubs will usually range from ½ inch to slightly over 1 inch in length. They are creamy white with a tannish-brown head capsule and a grayish-black coloration at the rear of the abdomen due to waste products visible through the exoskeleton. White grubs will usually be found in a curled or C-shaped position.

As with wireworms, white grubs tend to be more prevalent in light soils that have been undisturbed for a period of years. Pasture and grassland situations will often experience a considerable buildup of white grub populations. They will feed on all cultivated crops as well as native grasses.

White grubs spend the winter in the soil both as adults and as larvae of several sizes. In the spring the adults, known as May or June beetles, become active, flying about during the night and feeding on the foliage of trees and the leaves of some other plants. After mating, the female beetles return to the fields to deposit their pearly white eggs from 1 to several inches below the surface. The eggs hatch in two or three weeks, and the young grubs feed on the roots and underground parts of plants until early fall, when they are about ½ inch long. They then work their way down in the soil usually below the frost line and have been taken 5 feet below the surface.

As the soil warms in the spring, they work upward and, by the time plant growth is well started, they are feeding a few inches below the surface. Feeding continues throughout the season and, on the approach of cold weather, they again go deep into the soil where the second winter is passed, the grubs then being about 1 inch long. The third season they come up near the surface of the soil and feed until late spring or early summer; they can then change to the pupal stage in cells in the earth about 6 or 8 inches below the surface. During the latter part of the summer, they change to the adult beetle, but do not leave the soil until the following spring.

Beet Webworm

Life Cycle and Damage

Beet webworms overwinter as larvae in silk-lined cells or tubes in the soil within which they pupate in late spring. The first adults appear in late May or early June, and the larvae appear in late June or July. The second brood of adults appears in August and September, the larvae of which enter the soil to overwinter in the caterpillar and/or pupal stage. The moths are small night-active insects with a wing span of about 1 inch. They are smoky brown, mottled with dusky and straw-colored spots and lines.

Beet webworm eggs are laid in rows of two to 20 on the undersides of leaves. The eggs are white to yellow or green and oval shaped.

Beet webworm larvae are slender and active, dark green in color in early development, later becoming black with maturity at which time they will be about 1 to 1¼ inches in length. They have a black stripe down the middle of the back bordered by a white wavy line on each side. On each side of each segment there are three small dark spots, from which arise one to three hairs.

Beet webworms are not known to feed on grasses or cereal crops, but they have been found on flax, alfalfa, sweet clover, mustard, rape, sunflower, sugarbeets and various vegetables. Larvae will often migrate to these crops like armyworms when weed hosts become depleted due to defoliation, herbicides or drought. Hot weather will increase their food intake and also tends to contribute to a rapid rise in population.

Sugarbeets are seldom affected by beet webworms in the Red River Valley. The last time that any amount of treating was conducted for this insect problem was in 1960 when an estimated 50,000 acres were treated and in 1961 when approximately 60,000 acres were treated.

Sugarbeet Insect Control

PEST	INSECTICIDE	DOSAGE (actual toxicant)	REMARKS
SUGARBEET ROOT MAGGOT	Counter 15G*	1-2 lb/acre (4-8 oz/1,000 ft of row)	Apply in a band or modified in-furrow treatment at planting time or may be banded over the row as a postemergence treatment. Incorporate lightly into the soil. Do not place in direct contact with seed.
	Diazinon 14G	1-2 lb/acre (4.7-9.4 oz/1,000 ft of row)	Apply in a 7-inch band above the seed. Make application ahead of the press wheel. A second application may be made early postemergence in a 7-inch band over the row. (See label directions.)
	Dyfonate* 10-20G	1-1.5 lb/acre (10G: 7-10 oz/1,000 ft of row, 20G: 3.5-5 oz/1,000 ft of row)	Apply specified dosage in a 7-inch band over sugarbeet rows 22 or more inches apart. Apply at planting and lightly incorporate into the soil. Do not place Dyfonate granules in direct contact with seed.
	Lorsban 15G	1.5-2 lb/acre (6.75-9 oz/1,000 ft of row)	Apply as a 5-inch band treatment at planting. Note: For control of both cutworms and root maggots, see cutworm section.
SUGARBEET WEBWORM	Carbaryl (Sevin)	1-2 lb/acre	Do not apply within 14 days of harvest.
	Dylox SP, EC	1 lb/acre	Do not treat within 14 days of harvest. No restriction on feeding tops to livestock.
	Endosulfan (Thiodan) EC	1 lb/acre	Do not feed treated tops to livestock. Do not enter treated fields within 48 hours after application. Fields must be posted.
	Methomyl* (Lannate)	0.25-1 lb/acre	Do not apply within 7 days of harvest. Do not feed tops to livestock within 30 days of last application.
	Parathion EC*	8 oz/acre	Do not apply within 15 days of harvest. Aerial application only. Do not enter treated fields within 48 hours after application. Fields must be posted.
NOTE: The first brood of webworms normally will occur in late June and the second in early August. The economic threshold for sugarbeet webworms is 1 to 2 worms on 50 to 75% of the leaves.			
WIREWORMS	Counter 15G*	1-2 lb/acre (4-8 oz/1,000 ft of row)	Apply as a modified in-furrow treatment at planting time.
	Diazinon 14G	2-4 lb/acre	Broadcast and work into soil 4-8 inches just prior to planting.
	Dyfonate 20G*	4 lb/acre	Broadcast and work into soil 4-8 inches just prior to planting.
CUTWORMS <i>Control of cutworms is advised when there is 4 to 5% cutting of seedling beets.</i>	Carbaryl (Sevin)	1-2 lb/acre	Broadcast applications may be made with either ground or aerial equipment. Treatments may be repeated as necessary but do not apply within 14 days of harvest.
	Dylox SP, EC	1 lb/acre	Apply specified dosage/acre using sufficient water for complete coverage. Repeat as necessary. Do not apply within 14 days of harvest. No restriction on feeding tops to livestock.
	Lorsban 4E	1 lb/acre	Apply by air or ground equipment in sufficient water for good coverage. Do not apply within 30 days before harvest. Do not allow livestock to graze in treated areas nor harvest treated beet tops as feed for meat or dairy animals within 30 days after last treatment.
	Lorsban 15G	1-2 lb/acre (4.5-9 oz per 1,000 ft of row)	Apply in a 5-inch band at planting or postemergence (up to the 2 to 4 true leaf stage.)
FLEA BEETLES	Carbaryl (Sevin)	1-1.5 lb/acre	Do not apply within 14 days of harvest.
	Methyl parathion*	4-6 oz/acre	Do not apply within 20 days of harvest; 60 days if tops are to be fed to animals. Do not enter treated fields within 48 hours after application. Fields must be posted.
GRASS- HOPPERS	Carbaryl (Sevin)	0.5-1.5 lb/acre	Do not apply within 14 days of harvest. The lower rate (0.5 lb) is suggested for nymphs on small plants or sparse vegetation. The higher rate (1.5 lb) is suggested for mature grasshoppers or when material is applied to crops requiring greater coverage.
	Diazinon AG 500	0.5 lb/acre	Tops may be fed to beef and dairy animals.
	Lorsban 4E	0.25-0.5 lb/acre	Do not apply within 30 days before harvest. Do not allow livestock to graze in treated areas nor harvest treated beet tops as feed for meat or dairy animals within 30 days after last treatment.
	Malathion EC	1.75 lb/acre	Do not apply within 3 days of harvest.
	Malathion ULV	8 oz/acre	Do not apply within 7 days of harvest if tops are to be used as feed.
	Methyl parathion*	4-6 oz/acre	Do not apply within 20 days of harvest; 60 days if tops are to be fed to animals. Do not enter treated fields within 48 hours after application. Fields must be posted.

* EPA has classified this insecticide as a restricted use pesticide. Restricted use pesticides are to be applied by or under the direct supervision of certified pesticide applicators only.

