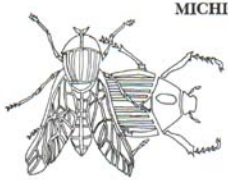
MICHIGAN INSECT AND PEST CONTROL ⑥



INSECTS and NEMATODES

in Field Beans Soybeans and Sugarbeets

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Many species of insect pests injure field beans, soybeans and sugarbeets. Damage by these insects has been scattered and relatively minor during the past few years. However, one or more of the pests have lowered yields of these crops in some fields each year, and their "general" lack of importance has been little consolation to the grower who has lost money to one of their scattered attacks. Growers who have had insect problems know that they must stay alert to prevent damage to their crops. If they are complacent and do not check the fields, the insects can damage crops before the grower is aware of their presence. Suggestions on how to check fields of field beans, soybeans and sugarbeets for insects and what to do if the insects are found in threatening numbers are presented in this bulletin.

PLANNING CONTROL

The objective of controlling an insect pest is to *protect* the crop from losses caused by the insect. This means that the insect damage must be anticipated and measures taken to protect the crop *before* the damage is done. The damage of only a few insects can be predicted with any accuracy. Most of the crop pests appear in a few fields each year and in many fields during some years. The grower is never sure what insect may appear in his field during a season. Most losses from insects are caused because the pest appears unexpectedly.

The grower should stay alert to insect problems as the first step in effective insect control:

1. Review past problems that you or your neighbors have had with pests and expect trouble again.
2. Become familiar with the insects — how they look, where and when they are found, and the appearance of their damage. The pests are not damaging every year, but some of them can always be found every year. The grower should look for them so that he can identify them with certainty. The pests are generally most abundant in wet, weedy areas of the field. Examine these areas especially closely for insects that may be scarce in the rest of the field. Descriptions of the pests are given in this bulletin. The County Agricultural Extension Agents can help identify a pest when the grower is uncertain of its identification.
3. Service and calibrate your insecticide application equipment (see the section on "Calibrating Equipment") and check for sources of insecticides to be sure the equipment will be ready before the insects appear.
4. Become familiar with the safe, effective use of the insecticides you use. Some points on the safe use of the insecticides are given in this bulletin. Insect container labels offer specific instructions and warnings for the insecticides that the grower will actually use. READ THE LABEL before purchasing the insecticide.
5. The most important step — the critical point in effective insect control — is to CHECK THE FIELDS periodically for the appearance of the pest, its stages of development and its numbers. Suggestions on what to look for are given in this bulletin. Warnings on insects will be given by the County Agricultural Extension Agent. These warnings can be given only if you are alert to the presence of the pests. Check your fields in order to be ready to *protect* them from the insects before the damage is done. Alert the County Agricultural Extension Agent to the presence of these insects so that he can warn other growers of the threat.

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Selecting an Insecticide

Carefully consider the specific insecticide that you will use. The first point is, of course, to be sure that the particular insecticide is effective against the insect. The insecticides recommended in this bulletin are known to be effective and are suggested for general use against the specific pest. There often are other insecticides that are not noted in the recommendations. Their omission may be for several reasons, most commonly because they have not been tested in Michigan. The container label lists insects that can be controlled with that insecticide and instructions on how to use that insecticide safely and effectively. If a non-recommended insecticide is used, check its label very carefully to be sure that that insecticide can be used effectively on the particular pest and crop.

Insecticides generally kill more than one species of insect. Where two or more pests are threatening the crop, it is desirable to choose an insecticide that will kill both pests. Check recommendations to see if one or a mixture of insecticides can be applied at the same time at a saving of application costs.

Formulation

The proper insecticide formulation depends on the type of application equipment available as well as the recommendations for specific formulations. If only a duster or granular applicator is available, or only a dust or granule is recommended, there is no real choice. Sprayers can use either dry or liquid insecticide concentrates (wettable powders, flowables, or emulsifiable concentrates). In general, liquid formulations tend to remain in suspension better and cause less nozzle blockage in weed-type sprayers than wettable powders. This is because weed-type sprayers do not have mechanical agitators. Some wettable powders suspend well without heavy agitation, and jet-agitation fittings are available for weed-type sprayers. Wettable powders can be used in weed-type rigs if carefully selected or provided with better agitation in the tank. Either wettable powder or liquid concentrates can usually be used in row-type sprayers with mechanical agitators.

Days to Harvest

The number of days between applications and the harvesting or grazing of the crop also influences the selection of an insecticide. Some insecticides can be applied only at planting time, others may be used right up to the day of harvest. These limitations are placed on the use of the insecticide to avoid undesirable residues on the crop. These are noted in the recommendations and also on the label of the insecticide container. They should be followed, as it is possible that an insecticide residue on the commodity could make it unsalable. The residues from persistant insecticides (such as DDT, dieldrin, aldrin, heptachlor, chlordane, BHC, and lindane) will remain in treated soil several years after application and could contaminate later crops planted in the field. Avoid using the persistant insecticides whenever possible. Do not use them at all if there is a possibility that the treated field will be planted to crops for which the persistent insecticides are not recommended.

Insecticides are poisons and some are highly toxic. In spite of this, few sicknesses and deaths are caused by insecticides. They can be used safely, but they must be handled carefully. READ THE LABEL on the container for instructions on safe use. Select an insecticide that, without doubt, can be used safely. Do not use an insecticide if there is any question of its safe use — such as lack of adequate storage, lack of safety equipment for handling and application, danger of drift or danger of people or livestock entering the treated field.

READ THE LABEL on the insecticide container and follow its instructions for safe use even though the insecticide may be relatively safe.

The price per acre and availability of the insecticide are two other factors to consider. Usually only a few insecticides are stocked by a farm store. They can be obtained easily if their use is anticipated far enough ahead to order and receive them. Check with the farm supply dealer in advance of the season for the specific insecticide that is needed.

Calculate cost of insecticide on a per-acre basis and not on a per-pound or per-gallon basis. One insecticide may cost more per gallon than another, but it may require less per acre and, therefore, be less expensive in actual use. Discounts are sometimes given for sales of large containers or case lots of insecticides. These should be investigated if you need any large amount of insecticide. Similarly, costs for aerial applications are low per acre if the aerial contractor is assured of a large acreage in an area.

Amount of Insecticide

Insecticides are sold as dry (granular or wettable or soluble powders) or liquid (flowable and emulsifiable concentrates) formulations. The amount of active insecticide in a formulation is given on the label as the percentage, by weight, of the dry formulation and as pounds per gallon of the liquid formulations. Recommended amounts of an insecticide are given as the weight, in pounds, of *active insecticide* to be used per acre. The recommended amount must be converted to the amount of formulation needed to give the recommended amount of active insecticide. This transformation can be made for dry formulations using the equation:

$$\text{pounds of formulation} = \frac{100R}{P}$$

where R is the recommended amount of active insecticide per acre in pounds, and P is the percentage of actual insecticide in the formulation. For example, if you are using a 50 percent wettable powder (P = 50) and want to apply 1½ pounds of active insecticide per acre (R = 1.5):

$$\text{pounds of formulation} = \frac{100 \times 1.5}{50} = 3 \text{ pounds}$$

A similar transformation can be made for liquid formulations, using the equation:

$$\text{pints of formulation} = \frac{8R}{P}$$

where R is the recommended amount of active insecticide per acre in pounds and P is the pounds of active insecticide in a gallon of formulation. For example, if you have an emulsifiable concentrate containing 5 pounds of active insecticide per gallon ($P = 5$) and want to apply 1 pound of actual insecticide per acre ($R = 1$):

$$\text{pints of formulation} = \frac{8 \times 1}{5}$$

$$= 1.6 \text{ pints (about 26 liq. oz.).}$$

Calibrating Equipment

Granular application — The amount of active insecticide to apply per acre is determined directly by the amount of formulation that is applied when granular insecticides are used. The granular applicator must be precisely calibrated to deliver no more than the amount of insecticide necessary to control the insect. This calibration can be done by:

1. Adjusting the feed indicator to the approximate setting;

2. Taping plastic bags to the drop spout of the granular applicator to collect the granules dropped by the applicator;

3. Running the tractor for a measured distance, in feet, at normal speed with the granular applicator going;

4. Recovering and weighing (in ounces) the weight of the granular insecticide delivered by the applicator into the plastic bags;

5. Determining the pounds of granular insecticide delivered per acre by using the equation:

$$\text{lbs granules per acre} = \frac{2723A;}{LW}$$

where A is the ounces of granules per spout; L is the feet traveled during the test; and W is the width of the swath in feet covered by the nozzle. For example, if the nozzle is placing granules in 32 inch rows of corn ($W = 2.67$) over a distance of 400 feet ($L = 400$) and 5.5 ounces of granules are delivered at the spout ($A = 5.5$):

$$\text{lbs/A} = \frac{2723 \times 5.5}{400 \times 2.67} = 14.02 \text{ lb. of granules per acre}$$

6. Readjusting the feed indicator on the granular applicator and repeating the test until the desired amount of granular insecticide is delivered per acre;

7. The calibration of the granular applicator should be checked by recording the actual amount of insecticide delivered after a measured acreage and readjustments made when needed.

Sprayers — The amount of active insecticide per acre applied by a sprayer is determined by the amount of water applied per acre and the amount of insecticide formulation in that amount of water. The amount of water needed per acre will vary with the crop and the insect to be controlled:

1. About 10 to 15 gallons per acre for:
   sprays applied to open soil prior to planting
   seedling plants

2. About 20 gallons per acre for chewing insects on larger plants

3. About 40 gallons per acre for aphids and mites on large plants.

The amount of water delivered per acre should be determined, and only the amount of insecticide formulation needed (see the section "Amount of Insecticide") to control the insect should be added to the amount of water. The amount of water sprayed per acre can be determined by:

1. Measuring the distance traveled in feet in one minute by the tractor at the normal spraying speed (88 feet per minute is equal to 1 mile per hour).

2. Selecting nozzles, strainers and a spraying pressure that should deliver the desired amount of water per acre. This information is available in spray equipment manuals or can be furnished by the equipment dealer.

3. Collecting and measuring, in liquid ounces, the amount of spray delivered by a nozzle in one minute. Check several nozzles and use the average amount delivered per nozzle.

4. Determining the gallons of water delivered per acre by using the equation:

$$\text{gallons per acre} = \frac{340AN}{LW}$$

where A is the liquid ounces delivered per nozzle per minute; N is the number of nozzles in the boom; L is the distance in feet traveled in one minute; and W is the width in feet covered by the spray from the boom.

For example:

—if the tractor travels 260 feet in one minute ($L = 260$),

—the spray covers 21⅔ feet ($W = 21.67$),

—there are 13 nozzles on the boom ($N = 13$),

and an average of 16 liquid ounces of water are delivered per nozzle per minute ($A = 16$):

$$\text{gal/A} = \frac{340 \times 16 \times 13}{260 \times 21.67} = 12.55 \text{ gals. of spray per acre}$$

5. Readjusting tractor speed or spraying pressure and repeating the test until the amount of spray desired per acre is obtained.

6. The actual amount of spray applied to a measured acreage should be checked and the sprayer readjusted as needed to apply the exact amount of spray that is required.

Methods of Application

Seed treatment is the coating of seed with an insecticide to protect it from insects. It is best done by

the seed dealer at the same time that he applies fungicides to the seed. Some ready-treated seed is available, but it is not easily obtained in Michigan. Seed treatment dusts to be applied by the grower at planting time are available and should be used when treated seed is not available. Follow instructions on the label of the seed treatment to be sure to obtain an even coating on the seed.

Preplant broadcast applications, as their name implies, are sprays or granules of insecticide spread over the entire field before planting. They are best done immediately before the final disking or dragging of a field; this final operation will work them into the soil surface. A spreader type granular applicator or weed-type or row-type sprayers can be used. Adjust the granular applicator or sprayer to give a uniform coverage of the soil. Work the insecticide into the soil immediately after it has been applied.

Preplant soil band application is a spray or granule applied before planting in a seven or ten-inch band centered where the seed will be placed. A regular sprayer or granular applicator can be adjusted to cover the desired width of band. The insecticide should be worked into the soil surface immediately after it has been applied.

Soil furrow applications of spray or granular insecticides are made in a furrow at planting time. Special equipment is available for this application, or equipment can be adjusted to this use. The insecticide can be applied into the fertilizer furrow and should be placed to the side and below the seed to keep it out of contact with the seed.

Granular foliage applications are especially effective against insects in the soil surface of many crops. Center the nozzle directly over the row and adjust its height so that the granules cover most of the plant; that is, concentrate the granules on the plant itself and do not try to cover the open ground between the plants.

Foliage spray applications are applied with weed-type or row-type equipment. These types of sprayers — with one nozzle centered on the row at a height that will cover most of the plant (as in a granular foliage application) — are effective against leaf feeders in smaller plants (especially flea beetles, slugs, and grasshoppers) at 15 to 20 gallons of spray per acre.

Aerial applications, as the name implies, are made by aircraft. Aerial sprays are effective against the leaf-feeding insects, including those that appear late in the season. The amount of spray applied per acre will depend on the equipment used. Effectiveness depends on the pilot's skill and thoroughness, and care should be taken to select a reliable air contractor.

SAFE USE OF INSECTICIDES

Insecticides are poisons that kill insects. Many of them are also highly toxic to man and other animals, and some retain their potency long after application. They should be stored, handled and applied with respect to their dangerous nature. By law, the label of the insecticide container clearly lists the precautions needed for the safe use of that insecticide. READ THE LABEL to be sure you understand these precautions and can follow them before using any insecticide. Almost all cases of direct poisoning from insecticides result from carelessness in storing and handling the concentrate insecticide. Store all insecticides where they cannot possibly be contacted accidentally by children, livestock or feed. A sturdy, locked cabinet in a machine shed is a good place to store them. Handle the insecticides with all care. READ THE LABEL on the container for special equipment that may be needed for handling or applying the insecticide. Wash and change clothes after using an insecticide and wash immediately if concentrate insecticide is spilled onto the skin.

Use care in applying the insecticide to avoid drift onto adjacent fields or waters, and avoid exposure of bees, livestock and wildlife to insecticides. Apply sprays only when winds are soft (generally less than five miles per hour), and cover soil insecticides with dirt immediately after application.

Advise neighboring beekeepers that insecticides are to be applied so that they can move their hives if necessary. Honey bees work the flowers of many crops. Do not apply an insecticide to flowering crops without giving the beekeepers special notice. Honey bees are very important to Michigan's agriculture and beekeepers deserve accommodations to protect the bees from unnecessary kill.

Insecticides, such as DDT and dieldrin, persist as pollutants in soils, streams, and even in our bodies long after they have been applied. The actual threat that these residues pose is disputed, but the fact that they do exist is not. Their continued use should be reduced to the minimum necessary, and insecticide recommendations are made with this point in mind.

Insecticides can also kill wildlife and insects other than the pests for which they are applied. Use the insecticides only when they are needed to protect the crop and then use the least amount of insecticide in the safest way possible.

The costs, dangers, and difficulties in use of the insecticides make them poor means of controlling insects. Research is underway on other, non-chemical means of controlling pests. For now and the near future, chemicals are the only reliable means of control that can be used. They must be used safely.

FIELD BEAN AND SOYBEAN PESTS

A summary of how to check fields of beans and soybeans for insects is given in Table 1. Note that problems with some insects can be anticipated even before the field is planted. Small plants are especially susceptible to insect damage. Fields should be checked for insects especially frequently when the plants are small. The insects tend to be most abundant in wet, weedy areas of a field and in the borders of a bean

Table 1. Checking field beans and soybeans for insect pests.

WHEN	WHERE	WHAT	WHY
Before planting	Field	Sod, old pasture, weeds	Expect wireworm and white grubs
		High organic matter	Expect seedcorn maggot
GERMINATION	Areas of poor stand or wilting seedlings	Thick-bodied grubs in soil	White grubs
		Slender, hard bodied worms in the soil	Wireworms
		Spindle-shaped maggots in seed or stem of seedling	Seedcorn maggot
	Areas of cut plants	Cylindrical, dark worms near bases of plants	Cutworms
SMALL PLANTS	Areas of silvery plants	Very small yellowish to black active insects under leaves	Bean thrips
	Leaves	Irregular holes through leaves; brownish beetle under leaves	Mexican bean beetle adults
		Dark, slimy animals near bases of plants	Slugs
LARGER PLANTS	Leaves	Irregular holes; cylindrical green worms under leaves	Green cloverworm
		Leaves skeletonized, yellow spiny grubs under leaves	Mexican bean beetle larvae
		Leaves curled; small, sidewards-running insects under leaves	Leafhopper
		Leaves bronzed; fine webbing under leaves	Twospotted spider mite
		Leaves curled; small colonies of insects on stems and leaves	Aphids
	Leaves, flowers and green pods	Oval-shaped, active running insects, ⅛ to ¼ inches long	Plant bugs

Table 2. Insecticides recommended for insect control in field beans and soy beans; 1972

PEST	INSECTICIDE	LBS. OF ACTIVE INSECTICIDE	LIMITS ON USE
SEEDCORN MAGGOT	diazinon	2 oz/bu seed	Do not use treated seed for food, feed, or oil.
	dieldrin	½ oz/100 lb seed	Do not use treated seed for food or feed.
WIREWORMS, WHITE GRUBS	parathion	4 lb/A	Apply prior to planting. Do not contaminate ponds or streams.
	diazinon	4 lb/A	Apply prior to planting. Work into soil immediately after applying.
	chlordane	4 lb/A	Apply prior to planting. Work into soil immediately after applying. Non-dairy farms only.
MEXICAN BEAN BEETLE, APHIDS AND LEAFHOPPERS (soil furrow application)	disulfoton (Di-Syston)	1 lb/A	60 days. Soil applications only.
	phorate (Thimet)	1 lb/A	60 days. Place 2 inches below and 2 inches to the side of the seed.
CUTWORMS	carbaryl (Sevin)	1½ lb/A	0 days.
	trichlorfon (Dylox)	1½ lb/A	Do not apply in soybeans. 14 days in field beans.
BEAN THRIPS, MEXICAN BEAN BEETLE, GREEN CLOVERWORM AND LEAFHOPPERS	carbaryl	1 lb/A	0 days.
	malathion	1¼ lb/A	0 days soybeans; 1 day field beans.
	azinphosmethyl (Guthion)	½ lb/A	Do not ensile or feed treated forage. 4 applications per season in field beans. 30 days field beans; 21 days soybeans.
PLANT BUGS	carbaryl	1 lb/A	0 days.
	malathion	1¼ lb/A	0 days soybeans; 1 day field beans.
MEXICAN BEAN BEETLE, BEAN THRIPS, APHIDS, AND MITES	carbophenothion (Trithoin)	½ lb/A	21 days for forage of field beans; 7 days for beans of field beans; 7 days for beans of soybeans; do not feed treated soybean forage to livestock. Apply only 2 applications per season in field beans.
MITES	dicofol (Kelthane)	½ lb/A	45 days; do not feed treated forage to meat or dairy animals.
APHIDS	malathion	1¼ lb/A	0 days soybeans; 1 day field beans.
	demeton	½ lb/A	21 days.
SLUGS	carbaryl (Sevin)	1 lb/A	0 days.

field adjacent to weedy fields. These areas should be especially well checked for insects. Notes on how to recognize the insects are given below and recommendations on the control of the pests are summarized in Table 2.

White Grubs and Wireworms

The adults of the white grub (May beetles or June bugs) and the adults of the wireworms (click beetles) usually lay their eggs in grassy fields, sod, old pasture and weeds. The larvae that hatch from these eggs feed on the roots of grasses and on the roots of beans that may be planted in these fields. The larvae can persist and cause damage for two years after the sod has been plowed down. The white grubs have white, thick, soft, cylindrical bodies and curl into a c-shape when disturbed. They have a definite head, six small legs just behind the head, and range up to 1½ inches in length.

Wireworms, as their name implies, have tan, hard, thin, cylindrical bodies. They also have a definite head and six small legs just behind the head. Neither white grubs nor wireworms have fleshy legs near their rear. Look for white grubs and wireworms in plow furrows while fitting the land, and apply an insecticide if they are easily found. Check the roots of wilting seedling plants for feeding and the soil around each plant for the grubs or worms. If there is still time, these affected areas and a margain around them may be disked, an insecticide applied and the area replanted.

Apply the insecticide as a spray or granule to cover the soil surface. Work the insecticides into the upper layer of soil immediately after application. It is a good practice to apply insecticide just before final disking.

Seedcorn Maggot

The seedcorn maggot is a whitish, spindle-shaped larva that lacks both a definite head and legs. The maggots tunnel into the seed and into the stems of the seedlings. Their damage appears as areas of poor stand or as weak, wilting seedlings. The adults of the maggots are small flies. They lay their eggs in soils that are high in organic matter (muck soils of fields that have had a lot of weeds, stubble or manure plowed down in them). The maggots hatch from these eggs and cause the damage to beans. Start looking for areas of poor stand as soon as the beans start to germinate. Check the seed and stems of the seedling for the maggots.

Seed treatment with an insecticide is the recommended control. It is best done by the seed dealer at the same time he treats the seed with fungicides. Seed treatment formulations of the insecticides are available for use in planting-box applications if ready-treated seed is not available. Follow instructions on the label of the seed treatment to be sure to obtain an even coating of the seed.

Cutworms

Cutworms, as their name implies, cut the stems of small plants and eat the plant. They can be expected in fields that are weedy or poorly drained, but they can appear in any field. The cutworms are the larvae of the miller moths. They have a round, dark head, six small legs just behind the head and ten fleshy legs at the back end of their bodies. Their bodies are dark colored, soft and cylindrical. They curl their bodies tightly when disturbed and may try to bite when handled; their bite is painless and harmless.

Cutworms cut the plant at night and hide in the soil surface near the plants during the day. Check fields every few days following germination for plants that are cut at their bases. Search the soil around the cut plants for the cutworms and apply an insecticide if they are common in the field. If not controlled, the large cutworms can destroy a stand very quickly. Do not delay applying an insecticide if it is needed. Apply insecticides, either as sprays or granules, in a band just wide enough to cover the plants.

Bean Thrips

Bean thrips are very small, oval-shaped insects that rasp the surface of the bean leaves and suck up the plant juices. Their damages appears as silvery areas on the underside of the leaves. Severely attacked plants will wilt quickly in dry weather. Bean thrips have been especially damaging during cool, dry spells early in the season. Young thrips (nymphs) are yellow to reddish in color and wingless. Adult thrips are dark grey to black and have two pair of feathery wings. Both nymphs and adults are active and, while small, can be seen running on the underside of the bean leaves.

Mexican Bean Beetle

The adult Mexican bean beetle is hardshelled, about ¼ inch long, round and copper-tan in color with prominent black spots on its wings. Adults overwinter in sheltered places and move into the beans in early spring. Adults feed by eating irregular holes through the leaf from the lower surface of the leaf. Seedling beans should be checked for the adults and sprayed if they are common in the fields. Adults lay groups of orangish eggs in clusters of up to 50 on the underside of the leaves. The larvae that hatch from these eggs are oval, yellowish, have prominent spines on their back, and are up to ⅜ inches long. The larvae feed on the tissues between the veins of leaves. Their feeding gives the leaves a skeltonized appearance. Fields should be checked for the larvae and their damage, and a spray applied when damage is easily seen. The larvae are more damaging and harder to control than the adult. An early spray to control the adult may save extra sprays needed for larvae control.

Green Cloverworm

The green cloverworm is a cylindrical larva with a definite head, six small legs just behind the head and

fleshy legs near the tail end of its body. The worm is light green, and has faint, narrow white lines running the length of its body. They range in size to nearly 1½ inches long when fully grown and drop to the ground when disturbed. They feed by eating irregular holes through the leaf from the lower surface of the leaf. The worms are hard to spot on the leaves, but their damage is easily seen. Check field damage by looking for holes in the leaves, shaking the plant, and counting the worms that are found. A spray is needed when 6 to 12 worms per foot of row are found.

Bean Aphid

Aphids are small, round, soft-bodied insects that are found in colonies on the stems and leaves. There are several species that damage field beans. These range in color from pale green to almost black. The most common species is the bean aphid, a species which is black. Aphids suck plant juices and inject a toxic saliva into the plant. This causes a general weakening of the plant, and a curling of the leaves. Aphids excrete a sticky "honey dew" that often becomes covered with a sooty fungus. Check for aphids by looking for curled leaves and honey dew. Examine plants when these are seen, and apply an insecticide when nearly all plants have aphids on them.

Sprays are recommended for the control of aphids in beans. A row-crop type sprayer or a weed-type sprayer that is carefully adjusted to completely cover the plant with spray are recommended.

Leafhoppers

Leafhoppers are small, spindle-shaped to oval, active insects. They range in color from pale green to dark grey. The potato leafhopper is the most common species and is pale green. Leafhoppers have the peculiar habit of running sidewards when disturbed. They suck sap from the plant and generally weaken the plant when they are abundant. The potato leafhopper injects a toxic saliva into the beans that causes the leaves to curl and may destroy the plants. Check fields by looking at the underside of the leaves for sideways-running small insects. Apply a spray when about 5 or more leafhoppers are found per plant.

Plant Bugs

Plant bugs are active insects, oval to elongate in form and ranging from small to ⅜ inches in length. The most common species is the tarnished plant bug. This insect is oval, about ¼ inches long, light grey to dark brown, and usually has a yellow V-shaped mark in the center of its back. It sucks plant juices and injects a very toxic saliva into the plant. This saliva can cause a blasting of the flowers or shriveled or spotted seeds when the bugs feed on the flowers or pods. A few fields of white beans showed hard, blackened spots on seeds, caused by the feeding of this pest in 1970. The tissue under the spot is hardened. This is the first record of appreciable damage from tarnished plant bug to beans in Michigan. We are not sure why the damage occurred in 1970, nor if further damage is to be expected in future seasons. Check fields in the green pod stage and apply spray if they are common.

Two Spotted Spider Mite

The two spotted spider mite, a relative of the spiders and only distantly related to insects, is a minute, rounded, eight-legged animal that feeds by sucking sap from the lower surface of the leaf. Affected leaves turn yellow to bronze and dry and fall off when severely attacked. A fine webbing with the small whitish to reddish mites under the leaves will identify the cause of the damage. Apply spray as soon as the yellowing of leaves is noted. The mite is most abundant during dry spells, and several applications may be needed to obtain control of the mites during drought years.

Slugs

Slugs are not insects. They are mollusks related to the clam, snail and octopus. They feed at night by chewing irregular holes through the leaves of beans and hide during the day in the soil near the bases of plants. The holes in the leaves and the slimy trails that they make on leaves are easily seen during the day.

A search of the soil and debris near the plants will reveal a soft, dark, slimy, rounded to elongate animal that ranges from ½ to 1½ inches long. Slugs are most abundant during cool, moist springs and are often damaging only in the wetter areas of the field. They can severely damage small plants when the slugs are abundant. Apply a spray to the affected area if their damage is seen on most plants in the area.

SUGARBEET PESTS

Insects have been a very minor problem in sugarbeets during the past few years, but growers should still stay alert for them. Flea beetles and cutworms can ruin young stands of beets very quickly. Fields should be especially well checked during the time the beet plants are small.

The sugarbeet root maggot has not been found in Michigan, and webworms have been very rare in our beet fields. These are both severe pests in the western areas of sugarbeet production. Growers should collect any unusual insects that are damaging their beets, place them in a little bottle of rubbing alcohol, and give the insects to their County Agricultural Extension Agent or sugar company field man for identification.

The appearance of new insects in sugarbeets, especially the sugarbeet root maggot, would be of great importance to the sugarbeet industry. Early detection would allow time to warn growers to prepare for their control ahead of extensive damage. Growers are urged to assist in the detection of new pests.

A summary of how to check fields of sugarbeets for their present insect pests is given in Table 3. Rec-

Table 3. Checking sugarbeet fields for insects.

WHEN	WHERE	WHAT	WHY
PRE-FITTING	Surrounding fields	Field of grains and grasses Vegetable gardens	Flea beetle Spinach leafminer
	Field itself	Sod, weeds, and poor drainage	White grubs, wireworms, cutworms and flea beetles
FITTING	Plow furrow	Thick bodied grubs Slender larvae	White grubs Wireworms
GERMINATION AND SMALL SEEDLINGS	Areas of poor stand or stunted plants	Thick bodied grubs Slender larvae Dark, cylindrical worms	White grubs Wireworms Cutworms
SMALL PLANTS	Leaves Underside of leaves	Shot holes or corky spots Grey eggs in a semicircle, irregular mines in leaves	Flea beetle Spinach leafminer
ANY TIME	Leaves and stems Leaves Stunted areas	Oval, active insects Curled leaves Chewed leaves Wooly spots on roots Soil sample	Tarnished plant bug Aphids and other sucking insects Chewing insects Sugarbeet root aphid Sugarbeet cyst nematode
DRY SPELL	Wilted areas	Wooly spots on roots	Sugarbeet root aphid
HARVEST	Roots	Pinhead size cysts	Sugarbeet cyst nematode

Table 4. Insecticides recommended for the control of insect pests of sugarbeets, 1972

PEST	INSECTICIDE	LB/A OF ACTIVE INSECTICIDE	LIMITS
WIREWORMS AND WHITE GRUBS	Parathion	4	Do not contaminate ponds and streams
	Diazinon	4	
CUTWORMS	Carbaryl (Sevin)	1½	14 days
	Trichlorfon (Dylox)	1½	Beets — 14 days; Tops — 28 days
	Parathion	½	15 days
FLEA BEETLES	Carbaryl (Sevin)	1½	14 days
	Parathion	½	15 days
	Endosulfon (Thiodan)	½	0 days; do not feed tops to livestock
SPINACH LEAF MINER	Endosulfon (Thiodan)	½	0 days; do not feed tops to livestock
	Parathion	½	15 days
	Trichlorfon (Dylox)	1½	Beets — 14 days; Tops — 28 days
APHIDS	Parathion	½	15 days
	Endosulfon (Thiodan)	½	0 days; do not feed tops to livestock
	Malathion	1	3 days
	Diazinon	½	0 days
TARNISHED PLANT BUG, LEAFHOPPERS, BLISTER BEETLES	Malathion	1	3 days
	Endosulfon (Thiodan)	½	0 days; do not feed tops to livestock
	Parathion	½	15 days
SUGARBEET CYST NEMATODE	Aldicarb (Temik)	4	

ommended insecticides are given in Table 4. Insecticide residue in beets is of extremely great concern to the sugarbeet industry. The insecticides recommended here were approved for use when the bulletin was written. Any changes in the use of the insecticides will be sent to County Agricultural Extension Agents and sugar company field men as soon as they are known. Growers should check with the agent or field man before using insecticides on beets.

White Grubs, Wireworms, and Cutworms

These insects are discussed in the section of "Field Bean and Soybean Pests". They do the same damage to sugarbeets that they do to these other crops. Cutworms are serious pests of young beets. The large worms can destroy a stand in a very short time. Fields of small beets should be checked frequently for cutworms. Do not delay in applying an insecticide if the worms are easily found.

Spinach Leafminer

The spinach leafminer is a pest of sugarbeets as well as a great number of other crops, including spinach. It can be found anywhere in a field of sugarbeets, but has been most commonly found near buildings. Its presence there may be caused by the proximity to the home gardens where vegetables have been raised. The spinach leafminer is the larva of a fly that looks like a small housefly. The fly lays its eggs on the undersurfaces of the leaves of small sugarbeets. The eggs are small, gray, elongated, and are laid in a semi-circle of about 6 to 12 or more eggs. The spinach leafminer hatches from the eggs and tunnels within the leaf. These tunnels are small and narrow at first, but become irregularly shaped, whitened blotches on the leaves as they become larger. These mines are flecked with frass and the miner can be seen within them. The miners are headless and legless with white to yellowish spindle-shaped bodies.

Check the undersides of the leaves of small sugarbeets for eggs of the spinach leafminer during the latter half of May and early June. Apply a spray of recommended insecticide when eggs are seen on at least about one-half the plants examined. Continue to examine a threatened field daily for signs of the first tunnel. Apply insecticide as soon as possible after the first small mines are seen.

The miner is very difficult to control once established within the leaves. If the pest is not noticed until nearly all of the eggs have hatched and most of the mines are large, the cost of a spray is not justified. Apply the insecticide as a spray that will cover the underside of the leaves. A row crop sprayer is best, but a weed-type sprayer can be adjusted, with care, to give the needed coverage.

Flea Beetles

Flea beetles are small, round, dark-colored hard-shelled beetles that spring into the air when disturbed. The larvae live on the roots of grains, grasses and some weeds. Flea beetles can be expected in sugarbeet fields that are weedy or close to grain fields. They are active insects, however, and may appear in any field. They eat small, round "shot-holes" completely through the young leaves of sugarbeets or feed on the upper surfaces of leaves, causing a round corky spot on the leaf. Their feeding retards the early growth of the plant, and they can kill small plants when the flea beetles are numerous.

Fields of sugarbeets should be checked for the damage and the presence of the flea beetles themselves at the same time that the fields are checked for cutworms. Weedy areas and the edges of sugarbeet fields that border on grain crops or grasses should be especially well checked for flea beetles. Some flea beetles are found in all fields of sugarbeets and established sugarbeets will tolerate the feeding of the flea beetles. Apply sprays only if the beets are small, and nearly all plants show some sign of feeding by beetles.

Plant Bugs, Aphids, Other Foliage Pests

Plant bugs and aphids occasionally damage sugarbeets in Michigan. They have been described in the section of "Field Bean and Soybean Pests". Leafhoppers and blister beetles are also recorded as damaging to sugarbeets, but these have not been of importance over the past few years. Apply insecticide as a spray that will completely cover the leaves. A row-crop sprayer is best, but a weed-type sprayer can be adjusted to give the needed coverage.

The Sugarbeet Root Aphid

The sugarbeet root aphid, as its name implies, feeds in colonies on the roots of the sugarbeet. Its feeding causes a stunting and general lack of vigor of the plants. Its damage is most easily seen during drought when the affected areas wilt much more quickly than plants in other parts of the field. These areas are usually circular, scattered over the field, and of varying size. The roots of plants in these areas have little mats of wax fibers on them. The root aphids secrete this wax and feed within its protection. The root aphids are soft-bodied, small, rounded, and light yellow. They move very slowly when disturbed. No practical control for this pest is now known.

The Sugarbeet Cyst Nematode

The sugarbeet cyst nematode is not an insect. Its damage had been restricted to an area south and east of Bay City, but it has also damaged beets in St. Claire County and may appear in other parts of the state. It is a microscopic, worm-like animal that parasitizes the roots of beets. Its feeding weakens the plants and stops the growth of the feeder roots. Its wounds on the roots also serve as entrances to fungi and other organisms that further reduce the yield of the crop. The sugarbeet cyst nematode persists in the field as clusters of eggs that are enclosed in the transformed female body called a cyst. Cysts are pin-

head in size, rounded, and straw to brown in color. They can be seen adhering to the rootlets at harvest time. The eggs will not hatch until induced to do so by exudates from a host root, such as sugarbeets, cabbages and other crucifers, and some weeds. The eggs may remain viable for several years in the soil.

The only visual symptom of the sugarbeet cyst nematode damage is simply a lack of vigor of the plant that is impossible to differentiate from other causes. Your sugar company field man can take a soil sample from an unthrifty field for positive identification of the sugarbeet cyst nematode. Once a field is known to be infested, sugarbeets should be put on a four-year rotation with non-host crops and kept clean of weeds. The cysts from infested fields are carried to the sugar plant on the harvested beets and may be carried away on the tare soil. Tare soil should be dumped on non-crop lands to prevent the possible spread of the nematode.

Soil fumigation has proved effective against the sugarbeet cyst nematode. Soil fumigation requires highly specialized equipment and knowledge, and is not generally recommended for use by growers. Custom applicators may be available for soil fumigation for nematode control. Growers should check with their County Agricultural Extension Agents and sugar company field man for information on the availability of fumigation equipment in the grower's area. Granular nematicides applied before planting have also proved to be effective against the sugarbeet cyst nematode. Recommendations on the use of granular nematicides are summarized in Table 4.

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