

*Vegetable Garden*

**INSECT-PEST CONTROL**

H. H. Crowell • H. E. Morrison

B. G. Thompson • Don C. Mote

Oregon State System of Higher Education  
Federal Cooperative Extension Service  
Oregon State College  
Corvallis

Extension Bulletin 676

Revised February 1950

# Vegetable Garden

## INSECT-PEST CONTROL

By

H. H. Crowell, H. E. Morrison, B. G. Thompson,  
and Don C. Mote\*

**T**HE USE of an insecticidal material for the control of one pest or another in the vegetable garden is often necessary. These insecticidal materials may be applied as a spray or a dust. The dusting of vegetable crops may prove, for many, the more acceptable form of application, since it requires the minimum of preparation and effort. Insecticides are for the most part available in dust form, and dusting equipment is comparatively inexpensive and easily operated. The more important insecticides for vegetable gardens are discussed below:

1. **Cryolite** (sodium fluoaluminate). Cryolite is effective for the control of most of the leaf-eating insects. It is available in small packages under various trade names. The directions for use, found on the label, should be followed carefully.

*Caution:* Cryolite is poisonous to humans and higher animals as well as to insects. It should be used and stored with appropriate precautions. The treatment of vegetables should be so regulated that those parts to be eaten do not carry a poisonous residue. Application of this material to vegetables, the leafy portion of which is soon to be eaten, is not recommended.

2. **DDT** (Dichloro-diphenyl-trichloroethane). DDT is one of the most effective insecticides ever discovered for the control of some insects, but it is not effective against a number of others. A tremendous amount of information is now available on the effects of DDT on insects, plants, and higher animals. As an acute poison to higher animals, DDT is not considered dangerous, but it accumulates in the body and may constitute a health hazard through its chronic toxicity. Furthermore, the use of DDT against one insect may bring about an increase of other pests more difficult to control. For example, the use of DDT on beans for the spotted cucumber beetle may kill the natural enemies of the black bean aphid and red spider-mites, thus allowing these pests to increase to damaging numbers.

\* Assistant entomologist, assistant entomologist, entomologist, entomologist, respectively, of Oregon Agricultural Experiment Station.

For use on vegetable crops it is suggested that DDT be applied as a dust: 3 per cent for most insects, 5 per cent for *Lygus* and other true bugs, and 10 per cent for onion thrips.

**3. New organic insecticides.** Since the discovery of DDT, an ever-increasing number of new insecticides have been developed. Some of the most promising of these are discussed below:

(a) *Methoxychlor*: This chlorinated hydrocarbon is a close relative of DDT. It is considerably less toxic to higher animals than DDT and is safer to use on sensitive plants, such as cucumbers. Formulations are on the market for both spraying and dusting.

(b) *Chlordane*: This chlorinated hydrocarbon is reported to be effective against many vegetable pests. It is particularly promising for control of root maggots.

(c) *Toxaphene*: A chlorinated product of the turpentine industry, this organic insecticide has been found to be useful mainly for control of grasshoppers and plant bugs.

(d) *TEPP* (Tetraethyl pyrophosphate): This is one of the organic phosphates and is effective against most aphids and red spider-mites. It is a strong poison and is particularly hazardous to use because it may be absorbed through the skin. Directions on the label should be followed carefully.

(e) *Benzene hexachloride*: This chlorinated hydrocarbon may impart a disagreeable taste to many food products and its use is not recommended for home gardeners.

(f) *Lindane*: This is the common name now given to the purified gamma isomer of benzene hexachloride. Lindane has almost no odor, compared to the crude, or technical benzene hexachloride. However, it, too, has been found to impart off-flavors to certain food products when used in slightly excessive amounts and its use in the home garden is not recommended.

(g) *Piperonyl cyclonene*: This is a newly developed compound with very low toxicity for higher animals. It is not used alone but in combination with pyrethrum. Sprays and dusts of this material in combination with pyrethrum and rotenone are on the market and may be used for control of many vegetable insect pests.

**4. *Sabadilla*.** This insecticide is made from the ground bulbs of a lily-like plant. It is available as 10 and 20 per cent dust formulations. It has very low toxicity to higher animals, will not injure sensitive plants, and is effective against plant bugs such as squash and *Lygus* bugs. The dust may cause sneezing when breathed.

5. **Nicotine sulphate** (Black Leaf "40"). This is the standard recommendation for aphids. As a spray, it is usually used at the rate of  $1\frac{1}{4}$  teaspoonfuls to 1 gallon of water. The addition of 2 or more tablespoons of dissolved or powdered alkaline soap to each gallon of spray is necessary in order to secure proper wetting and killing of the aphids. Nicotine sulphate is also available in a lime carrier as a 4 per cent dust. The 3 and 4 per cent dusts of the alkaloid nicotine appear to be equally effective. Nicotine insecticides are most effective at temperatures above 70° F.

6. **Pyrethrum**. This plant product from the Chrysanthemum family has very low toxicity for higher animals and gives a very rapid knock-down of a wide variety of insect pests. The effects of pyrethrum alone, however, are often temporary, the insects recovering later to continue their feeding.

New materials, such as piperonyl cyclonene and others, have recently been developed which, when added to pyrethrum preparations, greatly increase the toxicity of the material. Fortified pyrethrum preparations are available as liquid concentrates for sprays and as dusts.

7. **Rotenone**. This is a plant product, like pyrethrum, and is extracted from the roots of Derris, Cubé, and other tropical plants. Rotenone is usually included in the "complete dusts" for control of some chewing insects and particularly for aphids. It is also available as a liquid extract for spraying. The proper dilutions and directions for use will be found upon the container. A dust carrying 1 per cent rotenone is recommended for many garden insects. Rotenone has low toxicity to higher animals. Applications to vegetable crops must be repeated when necessary, since sunlight inactivates this material after a few days.

8. **Sulphur**. Finely ground sulphur dusts are of some value against spider-mites. The sulphur is usually incorporated in some other insecticide dust preparation (see Complete dusts), usually for its effect on fungous diseases of plants.

9. **Complete dusts**. These are mixtures of stomach and contact poisons, together with fungicides for plant diseases. They are available on the market under various trade names such as "three-in-one," "all-in-one," etc. Complete dusts are quite convenient for use by the home gardener. Care must be taken, however, to note on the labels whether one or more of the ingredients may constitute a poisonous residue hazard if the dust is applied to leafy vegetables soon to be eaten.

10. **Poison baits.** The standard remedy for cutworms, earwigs, grasshoppers, and slugs is the use of poisoned bran baits. Various formulations of these baits are available at local feed, seed, and insecticide stores under a number of trade names.

As an insurance against cutworm injury, broadcast bait over the garden after the soil is prepared and just before planting.

Poison bait for earwig control contains fish oil as an attractor. Full directions for the use of this material will be found on the package labels.

For control of the garden slug, usually necessary in the spring and during wet seasons, a bran bait containing 3 per cent metaldehyde and 5 per cent calcium arsenate by weight can be scattered around the garden. This bait is readily available in pellet form, which is much easier to distribute than the loose bran mash. Note the manufacturer's suggestions on the package label.

*Caution:* Care should be exercised in the application and storage of poison baits to protect children, pets, and wild life from harm.

11. **Calomel** (mercurous chloride). This material is quite poisonous to man. The pure chemical is effective for use in controlling the onion maggot, and a dust containing 4 per cent calomel has been recommended for cabbage-maggot control.

12. **Soil fumigants.** Chlorinated propane-propylene applications at the rate of 35 gallons per acre in late summer or early fall have given satisfactory control of the symphyliid. The material should be applied with a power soil applicator to a depth of 8 or more inches. Good soil moisture, temperature, and tilth are prerequisites for effective control. The material is hazardous to plants and animals, and directions on the label should be followed carefully.

Ethylene dibromide, at the rate of 2 gallons actual material per acre, is effective for wireworm control. The material is available in 10, 20, and 85 per cent concentrations. It is necessary to dilute high concentrations for effective distribution in the soil. It may be applied with a power soil applicator or a plow-sole injector to a depth of 8 or more inches. Good soil moisture and tilth are prerequisites for satisfactory control. The material is hazardous to plants and animals, and directions on the label should be closely followed.

13. **Sweet-corn-silk oils.** Ready-mixed preparations of white mineral oil and pyrethrum for corn-earworm control are available at most seed and insecticide stores. A medicine dropper can be used in small gardens to squirt 10 or 15 drops of oil into tips of the ears after inserting the dropper  $\frac{1}{4}$  to  $\frac{1}{2}$  inch. Oiling will prevent fertili-

zation of the kernels, so wait until the silks just start to turn brown. Mark treated ears with chalk so later-developing ears can be treated later.

14. **Spray equipment.** The type of sprayer to use is governed somewhat by the size of the area to be sprayed. There are many different makes of sprayers on the market which can be classified as to type somewhat as follows:

(a) *Hand atomizer* (fly-spray type): This sprayer is adequate for very small areas or a few plants, and is the least expensive.

(b) *Compressed air type*: This consists of an airtight tank with an attached air pump. The tank is partly filled with the spray solution and pressure is built up with the pump. A fairly high-pressure spray can be maintained and quite an area covered with one pumping of this type sprayer.

(c) *Slide-action pump*: This consists of two brass tubes, one working inside the other, and, with steady pumping, considerable pressure can be built up. Besides being useful for gardens, it is also suitable for spraying trees up to 20 or 25 feet tall.

15. **Hand dusters.** Several types of hand dusters are suitable for dusting garden crops. There are three general types:

(a) *Bellows type*: in which the air blast is generated by a bellows operated by a lever.

(b) *Cylinder type*: in which a piston is utilized to make the air blast in much the same manner as the fly-spray atomizer.

(c) *Rotary fan type*: in which the air blast is created by a fan turned by a hand crank. This is the most expensive of the three types and is more suitable for larger areas of row crops.

The bellows and cylinder types are made in various sizes and range in cost from \$1.50 up. For the treatment of individual plants in small gardens these two types of dusters give good coverage with the least waste of dust.

## CONTROL OF PESTS OF COMMON VEGETABLES

Superior figures refer to paragraph numbers, pages 3 to 7.

Crop	Insect pest	Control program
ASPARAGUS	Asparagus beetle	Poultry will eat beetles without damaging crop. Keep crop cut clean to market size. 3 per cent DDT <sup>2</sup> , 5 per cent methoxychlor <sup>3</sup> , 1 per cent rotenone <sup>7</sup> , or fortified pyrethrum formulations <sup>6</sup> are effective. DDT dust should be applied immediately after a cutting in order to reduce residue hazard. After cutting season is over, DDT can be used on plants when necessary for control of the beetles.
BEAN	Western spotted cucumber beetle	3 per cent DDT <sup>2</sup> , 5 per cent methoxychlor <sup>3</sup> or fortified pyrethrum formulations <sup>6</sup> are effective. DDT should not be used after pod formation because of residue hazard.
	Black bean aphid	Spray or dust with nicotine sulphate <sup>5</sup> . Aphids may appear before beans bloom. Control should be applied when first observed and repeated when necessary.
	Thrips	Spray or dust at intervals with nicotine sulphate <sup>5</sup> . Thrips usually appear in numbers after beans bloom. Control measures should start with first appearance of thrips.
	Nitidulid beetle	Present in blossoms as tiny, black beetles. Primarily pollen feeders, but in some cases damage to blossoms has occurred. No satisfactory control measures known.
BEET	Flea beetle Leaf beetle	3 per cent DDT <sup>2</sup> dust if greens <i>not</i> to be used for food. 5 per cent methoxychlor <sup>3</sup> , rotenone <sup>7</sup> or fortified pyrethrum formulations <sup>6</sup> also effective.
	Aphid	Spray or dust with nicotine sulphate <sup>5</sup> when aphids first appear.
BROCCOLI BRUSSELS SPROUTS CABBAGE CAULI- FLOWER KALE RAPE	Cabbage worm Diamond-back moth	3 per cent DDT <sup>2</sup> or cryolite <sup>1</sup> effective. To prevent poisonous residues, use rotenone <sup>7</sup> , fortified pyrethrum formulations <sup>6</sup> , or methoxychlor <sup>3</sup> after heads begin to form.
	Cabbage root maggot	Ring plants at time of transplanting with one level teaspoonful of 4 per cent calomel <sup>11</sup> dust or 5 per cent chlordane <sup>8</sup> dust. Calomel treatment must be repeated at 10-day intervals for 2 or 3 applications.
	Flea beetle	Control is very important with small plants or seedlings. Repeated applications of cryolite <sup>1</sup> , DDT <sup>2</sup> , rotenone <sup>7</sup> , methoxychlor <sup>3</sup> , or fortified pyrethrum formulations <sup>6</sup> . Cryolite and DDT should not be used after heads start forming.

## CONTROL OF PESTS OF COMMON VEGETABLES (Continued)

Crop	Insect pest	Control program
CARROT	Carrot rust fly	Repeated applications of 3 per cent DDT <sup>2</sup> dust beginning at seedling stage gives some degree of protection.
CUCUMBER MELON SQUASH PUMPKIN	Western striped cucumber beetle Western spotted cucumber beetle	Repeated applications of methoxychlor <sup>3</sup> , rotenone <sup>7</sup> , or fortified pyrethrum formulations <sup>6</sup> . Cryolite <sup>1</sup> may be used if no residue problem is involved. 3 per cent DDT <sup>2</sup> effective but will cause plant injury under moist conditions. Protection of seedlings most important.
	Aphid	Spray or dust with nicotine sulphate <sup>5</sup> when aphids first appear.
	Squash bug	Repeated applications of 20 per cent sabadilla <sup>4</sup> dust as needed. Bugs usually appear at the end of May.
EGGPLANT	Flea beetle Western spotted cucumber beetle	Sprays or dusts of DDT <sup>2</sup> , methoxychlor <sup>3</sup> , rotenone <sup>7</sup> , or fortified pyrethrum formulations <sup>6</sup> are effective.
HORSE-RADISH	Diamond-back moth	Dusts or sprays of DDT <sup>2</sup> , methoxychlor <sup>3</sup> , rotenone <sup>7</sup> or fortified pyrethrum formulations <sup>6</sup> are effective.
ONION	Thrips	10 per cent DDT <sup>2</sup> dust, 3 applications at 10-day intervals, beginning when the first thrips are seen, is effective.
	Onion maggot	Thoroughly mix seed with calomel <sup>11</sup> at rate of 2 pounds of calomel to 1 pound of seed. Plant shallow. Or mix 1 ounce of 50 per cent wettable chlordane <sup>8</sup> to 2 gallons of water and apply to 100 feet of row with sprinkling can. In commercial planting where formaldehyde is used for smut control, add chlordane to formaldehyde solution at rate of 4 pounds of 50 per cent wettable chlordane per acre.
PEA	Pea weevil	3 applications at 10-day intervals of 3 per cent DDT <sup>2</sup> , 1 per cent rotenone <sup>7</sup> , or 5 per cent methoxychlor <sup>3</sup> dusts, beginning at blossom time.
	Pea aphid	Repeated applications of 5 per cent DDT <sup>2</sup> , 1 per cent rotenone <sup>7</sup> or 4 per cent nicotine sulphate <sup>5</sup> dusts. Very early planting may reduce amount of mosaic disease which is spread by aphids.
POTATO	Flea beetle	To prevent larval injury to tubers, dust with 3 per cent DDT <sup>2</sup> or 1 per cent rotenone <sup>7</sup> at 10-day intervals, starting when first potatoes show above ground. Continue applications as long as plants remain green.

## CONTROL OF PESTS OF COMMON VEGETABLES (Continued)

Crop	Insect pest	Control program
POTATO (Continued)	Colorado potato beetle	Dust or spray with cryolite, <sup>1</sup> DDT <sup>2</sup> , or methoxychlor <sup>3</sup> . Make first application as soon as beetles appear on young plants and a second about 2 weeks later.
RADISH	Radish or cabbage maggot	Exclude the egg-laying flies. Plant radishes in rows or beds, and when second pair of leaves appear, place 10- or 12-inch boards on edge along the row, join the ends by short boards, and cover top with mosquito bar or fly screen.
	Flea beetle	Repeated applications of cryolite <sup>1</sup> , DDT <sup>2</sup> , methoxychlor <sup>3</sup> , rotenone <sup>7</sup> , or fortified pyrethrum formulations <sup>6</sup> .
SPINACH	Leaf miner	Repeated applications of nicotine sulphate <sup>5</sup> spray or dust is suggested.
	Western spotted cucumber beetle	Applications of methoxychlor <sup>3</sup> or fortified pyrethrum formulations <sup>6</sup> as needed. Control most important on young plants.
SWEET CORN	Corn earworm	Individual ear treatment with mineral oil-pyrethrum solution <sup>10</sup> is effective. 5 per cent DDT <sup>2</sup> dust, applied directly to the silks as soon as the first ones show and repeated 3 times at 4-day intervals, is also effective.
TOMATO	Flea beetle	Spray or dust with DDT <sup>2</sup> , rotenone <sup>7</sup> , methoxychlor <sup>3</sup> , or fortified pyrethrum formulations <sup>6</sup> . Control most important on young plants.
	Tomato hornworm	Pick off by hand or dust with cryolite <sup>1</sup> or fortified pyrethrum formulations <sup>6</sup> .
VEGETABLES GENERALLY	Cutworm Grasshopper Garden slug Earwig	All may be controlled by certain poisoned bran baits <sup>10</sup> available on the market. Many species of <i>cutworms</i> pass winter in larval stage and may be present at time garden is planted. Poison bait applied just before planting is good insurance.
		Poison bran baits <sup>10</sup> and sprays or dusts of toxaphene <sup>8</sup> or chlordane <sup>9</sup> , applied to ditch banks and areas surrounding garden, are helpful in protecting garden from advancing <i>grasshopper</i> swarms.
		<i>Slugs</i> are often present when vegetables are planted in spring and continue to migrate into gardens. Control measures should begin before planting and continue as long as slugs are present. Use a metaldehyde-calcium arsenate-bran bait <sup>10</sup> .

**CONTROL OF PESTS OF COMMON VEGETABLES** (Continued)

Crop	Insect pest	Control program
VEGETABLES GENERALLY (Continued)		<i>Earwigs</i> may appear in damaging numbers in June and continue through summer. Fish oil-bran baits <sup>10</sup> are standard control. 5 per cent DDT <sup>2</sup> dusts have been used successfully in killing earwigs.
	Millipeds	Place diced vegetables (potato, carrot) dipped or dusted with paris green about their haunts or sprinkle 1 part dry paris green and 9 parts sugar by weight about infested places. <i>Caution:</i> Paris green is a poisonous arsenical and care should be taken in the application and storage of this material so that children, pets, and wild life will not be harmed.
	Sow bug and pill bug	Sprinkle haunts with same materials suggested for millipeds, or with a poison bait made of paris green 1 part, white flour 2 parts, sugar 2 parts, by weight. Note <i>caution</i> above.
	Red spider mite	Repeated applications of refined dusting sulphur <sup>8</sup> (see Complete dusts <sup>9</sup> ). General use of new chlorinated hydrocarbon insecticides may increase the mite problem.
	Symphylid	No satisfactory control measures known for small gardens. Complete pulverizing of soil and addition of commercial fertilizer to stimulate plants may be helpful. Sow seeds or set plants when soil is on dry side. Use of chlorinated propane-propylene <sup>12</sup> soil fumigant has been satisfactory for large plantings.
	Wireworm	DDT <sup>2</sup> applied at the rate of 10 pounds of actual DDT per acre is effective if thoroughly disked, forked, or rotary tilled into the soil to a depth of 6 or more inches. Do not spade under. DDT kills wireworms very slowly and, when applied in the spring, will not protect an immediately planted crop. Damage to late-season root crops will be reduced, however, and wireworms will be kept out of the treated soil for <i>several years</i> . For larger plantings it is possible to get immediate (but temporary) reduction of wireworms by the use of ethylene dibromide <sup>12</sup> (2 gallons of the actual material per acre).