Vegetable Garden INSECT-PEST CONTROL

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INSECTICIDES are applied by means of a liquid carrier or a dust carrier. Dusting vegetable crops may prove for many the more acceptable form of application. Spray materials are for the most part available in dust form, and dusting outfits are comparatively inexpensive and handy. The most important insecticides for vegetable gardens are discussed below.

1. **Calcium arsenate,** it is believed, is now so standardized that it may be substituted for lead arsenate in the control of vegetable insects. This material may be used either in the dry form as a dust or made up into a liquid spray. For liquid spraying it is generally used at the rate of 1 ounce of the dry powdered calcium arsenate to 1 gallon of water. Casein spreader, skim milk or soap, 1 ounce dissolved, to 1 gallon of spray is usually added to wet waxy leaves such as those of cabbage.

The dry calcium arsenate dust (70 per cent tricalcium arsenate) may be thoroughly mixed with an equal part of hydrated lime and used as a dust. See *Caution* under CRYOLITE (next item).

2. **Cryolite** (sodium fluoaluminate) may be substituted for calcium or lead arsenate. For liquid spraying, it is generally used at the rate of 1 ounce of the dry powder to 1 gallon of water; soap (dissolved at rate of 1 ounce per gallon) is added to wet waxy leaves. The dry cryolite powder may be mixed with sulphur, clay, talc, or flour (*never with lime*) and applied as a dust.

Caution: Recent investigations indicate that the lead in the lead arsenate combination is quite difficult to remove by the ordinary washing methods. Calcium arsenate is therefore less objectionable than lead arsenate for use on vegetable crops. Great care should be exercised, however, in the use of any arsenical, cryolite, or other material that leaves a poisonous residue on the edible parts of vegetables. The treatment of vegetables should be so regulated that those parts to be eaten do not bear a poisonous residue. Application of these materials to leafy vegetables, spinach, asparagus, and the like, that are to be eaten is not recommended.

3. **DDT** (Dichloro-Diphenyl-Trichloroethane) is one of the most effective insecticides ever discovered for the control of some insects but is not effective against a number of others. Since DDT insecticidal preparations have been available for experimental study

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on agricultural crops for only three years, much additional experimental work is needed before complete recommendations can be made for all insects. 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 others such as the squash bug and other true bugs, and 10 per cent for onion thrips.

Caution: Although DDT is not considered as poisonous to man and higher animals as are calcium arsenate, cryolite, and nicotine sulphate, care should be exercised in its use. Do not apply excessively, wash vegetables well before using, and do not use on leafy vegetables such as lettuce, chard, and beet tops which are to be eaten as greens. The treatment of vegetables such as beans and tomatoes should be discontinued soon after blossom time. Vegetable tops, vines, etc., treated with DDT should not be fed to live stock.

4. **New organic insecticides.** There are a number of new organic insecticides now being offered. Among these are hexaethyl tetraphosphate, benzene hexachloride, and chloronated hydrocarbons. Insufficient experimental data on these materials limit recommendations at this time.

5. **Nicotine sulphate or Black Leaf 40** is the standard recommendation for aphids. As a liquid spray, it is usually used at the rate of 1¼ teaspoonfuls to 1 gallon of water. The addition of 2 tablespoons of dissolved or powdered soap to each gallon of spray increases the spreading and sticking qualities of the solution.

This material may be made up into a dust spray by impregnating hydrated lime with 40 per cent nicotine sulphate. A dust containing from 4 to 5 per cent by weight of the 40 per cent nicotine sulphate is recommended. (Four ounces of nicotine sulphate and 5 pounds of hydrated lime will make a 5 per cent nicotine sulphate dust.) To make this dust at home, procure a keg (a 5-gallon keg will handle 5 pounds of dust); cut a door in the side; felt the edges to prevent leakage; and mount on a frame by means of spindles placed on the ends of the keg. Place hydrated lime in the keg and add one egg-sized pebble for each pound of dust. Then add liquid nicotine sulphate and close the door tightly. Rotate keg for about 10 minutes. Remove dust and pass through a ⅜-inch mesh screen. If not used immediately, store dust in airtight containers. Nicotine dust is most effective at temperatures above 60° F.

6. **Pyrethrum extract.** Several brands of pyrethrum extract are on the market in Oregon. The dilution to use varies with the insect and brand of material used. The proper dilutions and directions for making will be found on the container.

A pyrethrum dust has proved successful in the control of the western 11-spotted cucumber beetle and similar insects. This dust can be made by the same methods employed in making the nicotine

dust.[5]* The amount of liquid pyrethrum extract required to make a dust of sufficient strength will vary with the brand of material used. For western 11-spotted cucumber beetle, use 6 ounces of 2 per cent pyrethrin extract to 5 pounds of diatomaceous earth.

7. **Sulphur.** For the destruction of red spider mite on foliage, finely ground sulphur dust is of value. For the vegetable garden the sulphur dust is generally diluted with hydrated lime, calcium arsenate, and nicotine sulphate (see COMPLETE DUSTS below).

8. **Complete dusts** containing a stomach poison, a contact spray, and a fungicide are on the market in Oregon under various trade names such as "three-in-one," "all-in-one," etc. These dusts are of value in protecting the garden from insect attack. Dusting is begun as soon as the plants appear above ground and repeated at intervals of 10 to 14 days. When this is thoroughly done, it is believed that most insect troubles will be prevented. It is not advisable to continue the application of this dust on leafy vegetables or other vegetables soon to be eaten (see *caution* under paragraph 2 on page 3). A homemade complete dust may be made by thoroughly mixing 7½ pounds of calcium arsenate, 17½ pounds of sulphur, and 22½ pounds of good hydrated lime. Place this in a keg, add 2½ pounds of 40 per cent nicotine sulphate, and proceed with the same methods as used in making nicotine dust.[5]

9. **Tarpaper disks,** 2½ inches in size, are of value in protecting plants against cabbage maggot. To make tar protectors, cut 2½-inch squares of tarred building paper. Drive a spike through the center and make a slit from one side to the hole made by the spike. Place the square around the plant just after setting out and press the paper closely around the stem and down against the ground. The paper squares must fit snugly. Readymade disks may be purchased.

10. **Poison bran mash** is the standard remedy for cutworms, earwigs, and grasshoppers. The following formula makes enough for a city garden or one-third of an acre:

Coarse wheat bran	5 pounds
White arsenic or paris green	3 ounces
(*or* sodium fluoride or sodium fluosilicate	5 ounces)
Molasses or sirup	1 pint
Water to make a crumbly mash	2 to 3 quarts

The dry ingredients are first thoroughly mixed and the water and molasses added. If too much water is used, the mash will be sloppy and hard to scatter; use just enough water so that it will be wet and still fall apart readily after being pressed together in the hands. The poison bait is broadcast over the area as soon as the

* Superior figures refer to insecticides discussed on pages 1 to 4.

first cutworm or grasshopper injury is noticed. As an insurance against cutworm injury, broadcast over the garden after soil is prepared, and just before garden is planted.

Another bait recommended for earwig control is as follows:

Bran	12 pounds	Mix dry bran and sodium fluosilicate; then add fish oil and mix again. Use no water.
Sodium fluosilicate	1 pound	
Fish oil	1 quart	

Scatter bait along fences, piles of boards, wood piles, trees, or other places where earwigs may hide. The poison also is scattered over the lawn, after which it is best to wait 2 days before sprinkling the lawn again. The formula given is enough for one application to an area 8,000 square feet. Since cutworms and earwigs are active mostly at night the bait is applied in late evening.

11. **Metaldehyde calcium arsenate bran bait** is effective in controlling garden slugs. A bran bait containing 1¾ per cent metaldehyde and 5 per cent calcium arsenate by weight is broadcast at the rate of 10 or 12 pounds per acre. If pellet form is used, 4 to 5 pounds is enough. Metaldehyde calcium arsenate bran bait is sold under various trade names.

12. **Carbon bisulphide** is the most practical fumigant substance for the treatment of beans, peas, and other seeds for weevils. It can be used, when properly applied, for the treatment of seeds intended for planting or for food. This material is inflammable. *Keep all lights, sparks, or flames away from it.* Do not use in a heated room. It is used in an airtight chamber at the rate of 10 to 30 pounds for every 1,000 cubic feet of space. The liquid may be placed in very shallow pans on top of seed to be fumigated, or dashed on gunny sacks previously spread over top of seed. For fumigating small amounts, place seed in a 2-quart jar, pour 1 tablespoonful of carbon bisulphide over seed, and close the lid tightly. Allow gas to act for 48 hours before opening to air. Keep seed in tight containers to prevent reinfestation. The gas is not effective if the temperature is much below 60° F.

13. **Rotenone-bearing dusts and sprays.** Insecticides made from derris or cube root have only recently come into common use. The killing power of derris or cube is due to the presence of several complex materials of which the better known is called rotenone. These insecticides lose their poisonous qualities after exposure to bright sunlight for about one week. They are applied both as a dust and a spray. The dilution to use varies with the insect and commercial brand of material used. The proper dilutions and directions for use will be found upon the container. A dust carrying ¾ of 1 per cent rotenone appears to be strong enough for controlling most garden insects.

14. **Mercurous chloride** (Calomel), when thoroughly mixed with onion seed at the rate of 2 pounds of calomel to 1 pound of seed and then planted in the usual way, gives good protection against onion maggot. The extra bulk of calomel makes it necessary to open the planter up one notch; e.g., if it is desired to plant 3 pounds of seed per acre, the planter is set at 3½ pounds. Shallow planting gives best maggot control. When the formaldehyde treatment for smut is used with the calomel-treated seed, there may be a reduction in the onion stand. This is most pronounced when an excess of formaldehyde is used or when the seed is deep-planted.

15. **Spray equipment.** The type of sprayer to use is governed somewhat by the size of the area to be sprayed. For small areas, potted plants, etc., the ordinary hand atomizer as used for fly sprays is satisfactory. For the ordinary home garden, a knapsack sprayer is quite satisfactory. Several types of knapsack sprayers are on the market. These may be grouped under three heads as follows:

(1) *Compressed air type:* This consists of an airtight tank to which is attached an air pump. The tank is partly filled with the spray solution and pressure secured by pumping air into the tank. A strongly constructed tank is necessary in this type because of the high pressure maintained.

(2) *Bucket pump type:* This usually consists of a single-cylinder pump with the handle extending under the right arm of the operator. The pump is operated with the right hand and the spray nozzle with the left. The operation of this type requires considerable labor.

(3) *The slide-action pump:* The pump consists of two brass tubes, one working inside the other. Considerable pressure can be maintained with this pump. It is also suitable for spraying trees up to 20 or 25 feet tall.

16. **Hand dusters.** Several types of hand dusters are suitable for dusting garden crops. There are three general types: (1) the *bellows type,* in which the air blast is generated by a bellows; (2) the *cylinder type,* in which a piston is utilized to make the air blast; and (3) the *rotary fan type.* The last is the most expensive of the three but is suitable for larger areas. The bellows and cylinder types are made in various sizes and range in cost from $1 up. For the treatment of individual plants in small gardens these two types of dusters give good coverage with the least waste of dust.

A muslin bag may be used if hand dusters are not available. In general, this method of application is not as effective as application with a good hand-dusting machine, but on small plants and for small gardens it may be used successfully. The dust is placed in a bag made of thin muslin or double cheesecloth and shaken over the plants.

CONTROL OF PESTS OF COMMON VEGETABLES

Superior figures refer to insecticides discussed on pages 1 to 4.

Crop	Insect	Control program
ASPARAGUS	Common asparagus beetle	Keep crop cut clean to market size. Poultry will eat beetles without damaging crop. 3 per cent DDT dust, applied immediately *after* a cutting to reduce residue hazard, will give control for about 3 weeks. After cutting season is over, DDT can be used on plants when necessary.[3]
	Cutworm	Apply cutworm bait[10] early, in order to avoid damage to shoots. Cutworms usually do more damage than beetles to shoots.
BEAN	Bean weevil	Fumigate seed immediately after harvest with carbon bisulphide and destroy all vines.[12]
	Western 11-spotted cucumber beetle	3 per cent DDT dust most effective for this pest. Not used after pod formation because of residue hazard.[3]
	Aphid	Spray with nicotine sulphate.[5] Nicotine dust effective in warm weather. Aphids begin to appear before beans bloom. Control should be applied when first observed.
	Thrips	Spray at intervals with nicotine sulphate or nicotine dust.[5] Thrips usually appear in numbers after beans bloom. Control measures should start with first appearance of thrips.
	Seed-corn maggot	No satisfactory control. In heavy, wet soil and in wet seasons plant shallow. Avoid sod land or new land, especially in cold, wet seasons.
	Nitidulid beetle	Present in blossoms as tiny black beetles. Primarily pollen feeders but in some cases damage to blossoms has occurred. Dusting with calcium arsenate, cryolite[2] or 3 per cent DDT dust is suggested.
BEET	Flea beetle Leaf beetle	3 per cent DDT dust as needed if greens *not* to be used for food.[3] If tops to be used as greens, use rotenone.[23]
BRUSSELS SPROUTS	Aphid	Spraying or dusting with nicotine[5] when aphids first appear.
CABBAGE CAULIFLOWER KALE BROCCOLI	Cabbage worm Diamond-back moth	3 per cent DDT dust effective until heads start to form.[3] After heads form, dust with rotenone or pyrethrum.[13, 6] Calcium arsenate or cryolite dust equally effective.

CONTROL OF PESTS OF COMMON VEGETABLES (*Continued*)

Crop	Insect	Control program
CABBAGE CAULI-FLOWER KALE BROCCOLI (*Continued*)	Cabbage root maggot	Use tar-paper disks[9] or dust soil around plants with 4 per cent calomel[14] at intervals of 10 days, beginning 3 days after transplanting. Make 4 applications. Screen late plants with mosquito bar or wire to exclude the flies that produce the maggots.
	Flea beetle	Repeat application of rotenone[13] or 3 per cent DDT dust.[3]
	Cabbage aphid	Appear soon after plants are set out. As soon as lice appear and before leaves curl, spray with nicotine sulphate.[5] Nicotine dust effective in warm weather.
CARROT	Rust fly	3 per cent DDT dust[3] in seedling stage gives some control.
CUCUMBER MUSK-MELON SQUASH	Striped cucumber beetle 11-spotted cucumber beetle	Dust with mixture of calcium arsenate powder[1] 1 pound, land plaster 20 pounds, when plants appear above ground. Repeat application every 4 days during fair weather and after each rain. On squash, 3 per cent DDT dust[3] is effective. Protection of seedlings particularly important. In some cases DDT has proved injurious to cucumbers and some varieties of squash.
	Aphid	*See* Cabbage aphid.
	Seed-corn maggot	*See* Bean.
EGG PLANT	Flea beetle Western 11-spotted cucumber beetle	3 per cent DDT dust[3] is effective.
HORSE-RADISH	Diamond-back moth	*See* Cabbage.
ONION	Thrips Appear in early spring but usually not serious before July.	10 per cent DDT dust[3], 3 applications at 10-day intervals beginning when first injury appears.
	Onion maggot	Thoroughly mix seed with calomel at the rate of 2 pounds of calomel to 1 pound of seed. Plant shallow. Set planter for ½ pound more seed than required to allow for extra bulk of calomel.[14]

CONTROL OF PESTS OF COMMON VEGETABLES (*Continued*)

Crop	Insect	Control program
PEA	Pea weevil	3 per cent DDT dust[3] at blossom time repeated 3 times at 10-day intervals.
	Pea aphid	*See* Bean. 5 per cent DDT dust[3] has given promising results. Aphids must be controlled early to prevent mosaic disease.
	Seed-corn maggot	*See* Bean.
POTATO	Grub worm and wire-worm	These insects are more prevalent in potatoes grown on new or sod land, or land not well drained.
	Flea beetle	3 per cent DDT dust[3] very effective. See Station Circular of Information 227 (revised) *Potato Flea Beetle Control,* for timing for tuber flea beetle control.
	Colorado potato beetle	Dust or spray with calcium arsenate[1] or 3 per cent DDT dust.[3] Make first application as soon as beetles appear on young plants and a second about 2 weeks later.
RADISH	Radish maggot or cabbage maggot	Exclude the egg-laying flies by planting radishes in rows. When second pair of leaves appears, 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. *See* Cabbage.
SPINACH	Leaf miner	Repeated applications of nicotine sulphate spray or dust are suggested.
	Western 11-spotted cucumber beetle	Pyrethrum. 3 per cent DDT dust[3] might be used to protect seedlings not more than 2 inches long but not used thereafter because of residue hazards.
SQUASH	Squash bug	Dust with 5 per cent DDT[3] or 10 per cent sabadilla dust. Direct dust at crown of plant and undersides of leaves first. Application in seedling stage. Repeat at 10-day intervals.
	Western 11-spotted cucumber beetle	*See* Cucumber.
SWEET CORN	Corn earworm	Fall, winter, or early spring plowing followed by frequent summer cultivation is said to be of value. Dust the silks at intervals of 4 days until silk shoots become dry. Use a calcium arsenate[1] or cryolite[2] dust.

CONTROL OF PESTS OF COMMON VEGETABLES (*Continued*)

Crop	Insect	Control program
SWEET CORN (*Continued*)	Earwig	Poison bran mash.[10]
	Seed-corn maggot	*See* Bean.
TOMATO	Flea beetle	*See* Potato.
	Green tomato horn worm	Pick off by hand or spray or dust with calcium arsenate or cryolite.[2] If tomatoes have formed, use pyrethrum spray. Usually appear about time young fruit is forming.
	Tomato fruit worm	Spray or dust before fruit is half grown with calcium arsenate or cryolite.[2] Pyrethrum should be used in later applications.
VEGETABLES GENERALLY	Cutworm Earwig	Poison bran mash standard control.[10] Many species of cutworms pass winter in larval stage and are present at time garden is planted. Poison bait applied just before planting is good insurance. 5 per cent DDT has been used successfully in killing earwigs.
	Garden slugs present when garden is planted in early spring.	Use a metaldehyde calcium arsenate bran bait.[11] Since slugs continue migrating into gardens, control measures should begin before planting and continue as long as slugs are present.
	Symphilid or garden centipede	No effective control measures known. Suggest complete pulverizing of soil and addition of commercial fertilizer to stimulate plants. Sow seeds or set plants when soil is on the dry side.
	Grasshopper	Spray or dust plants with calcium arsenate.[1] Spread poison bran bait[10] as suggested for cutworms.
	Red spider-mite	Suggested spraying with summer oil emulsion 1½ gallons to 100 gallons of water, or repeated applications of a sulphur-lime dust. (*See* Complete dusts.)[8] Usually do not appear in serious numbers until weather becomes warm in June or July.
	Milliped	Place diced vegetables (potato, carrot) dipped or dusted with paris green about their haunts. Sprinkle dry paris green 1 part and sugar 9 parts by weight, about infested places.
	Sow 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.

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CONTROL OF PESTS OF COMMON VEGETABLES (*Continued*)

Crop	Insect	Control program
VEGETABLES GENERALLY (*Continued*)	Wireworm	Fumigants such as carbon bisulphide, ethylene dibromide, dichloropropane-dichloropropylene mixture, and dichloro-nitroethane when properly applied have given control of wireworms. The fumigant manufacturer's recommendations should be followed carefully to insure success. The fumigant may be applied with a weed-gun applicator, injecting a small amount in holes 12 inches apart, staggering the doses. DDT[3] applied at the rate of 10 pounds of actual DDT per acre is effective if thoroughly disked into the soil to a depth of 6 inches. 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 cut down, and wireworms will be kept out of the treated soil for several years. Crude naphthalene in flake form, applied at the rate of 300 pounds per acre a week before any seeds are planted, has given control of wireworms. The crude naphthalene is scattered by hand over each spadeful of soil as it is turned over and the entire garden soil is thoroughly pulverized and mixed with the crude naphthalene crystals.

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