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 one ounce of the dry powdered calcium arsenate to one gallon of water. Casein spreader, skim milk or soap, one ounce dissolved, to one 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. For flea beetles 1 part calcium arsenate thoroughly mixed with 4 parts of talc or diatomaceous earth is suggested.

Caution: Recent investigation indicates 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 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.

2. **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 one gallon of water. The addition of one ounce dissolved 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 nicotine sulphate 40 per cent. A dust containing from 4 to 5 per cent by weight of the 40 per cent nicotine sulphate is recommended. (Nicotine sulphate 4 ounces and hydrated lime 5 pounds will make a 5 per cent nicotine sulphate dust.) The nicotine dust deteriorates rapidly and should be used at once or kept in an airtight container. 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

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

Extension Bulletin 551 March 1941

by means of spindles placed on the ends of the keg. The hydrated lime is first placed in the keg and pebbles or rock about the size of a hen's egg are added, one pebble to each pound of dust. The nicotine sulphate in liquid form is then poured into the keg and the door tightly closed. The keg is then rotated for about 10 minutes. The dust is passed through a $\frac{3}{8}$-inch mesh screen to remove pebbles. As stated above, it should be used immediately or placed in airtight containers. Nicotine dust is most effective when temperatures are above 60° F.

3. **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 12-spotted cucumber beetle and similar insects. This dust can be made by the same methods employed in making the nicotine dust.[2] The amount of liquid pyrethrum extract required to make a dust of sufficient strength will vary with the brand of material used. An extract containing 2 per cent of pyrethrins (active ingredients) was used at the rate of 6 ounces of the extract to 5 pounds of diatomaceous earth and found to be satisfactory in killing the western 12-spotted cucumber beetle.

4. **White mineral oil and oil containing pyrethrins.** Sweet corn may be protected against injury by the corn earworm by the use of oils in the silks. White mineral oils of 150 to 250 viscosity are used. Not more than $\frac{1}{4}$ teaspoonful of oil is used per ear. The oil is applied by means of a force oiler with long slender spout. Oil containing 0.2 per cent of pyrethrins is more effective than oil alone. The oil tends to interfere with the fertilization of the ears when applied to unpollinated corn silks. Applications are made during the period between the time when the silks have wilted and the time when their tips have turned brown. Use $1\frac{1}{4}$ fluid ounces 20 per cent pyrethrum extract to one gallon oil.

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

6. **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 on page 1). A home-made complete dust may be made by thoroughly mixing $7\frac{1}{2}$ pounds of calcium arsenate, $17\frac{1}{2}$ pounds of sulphur, and $22\frac{1}{2}$ pounds of good hydrated lime. Place this in a keg, add $2\frac{1}{2}$ pounds of nicotine sulphate 40 per cent, and proceed with the same methods as used in making nicotine dust.[2]

7. **Corrosive sublimate** is recommended against the cabbage maggot and onion maggot when used at a strength of 1 ounce to 12 gallons of water, applied at intervals of a week or ten days during the flight period of the fly. Use about a cupful to wet the soil immediately surrounding each plant. Drenching the soil with the solution of corrosive sublimate is also of value in combating radish maggots, earthworms, slugs and larvae of fungous gnats. The preparation and handling of this chemical should be

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

safeguarded as *it is a deadly poison.* As it corrodes metals, the solution should be prepared in a glass, glazed, or wooden vessel, which should be thoroughly cleaned or destroyed immediately after use. Use of hot water will hasten the solution of the corrosive sublimate.

8. **Tar-paper 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. Ready-made disks may be purchased.

9. **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	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 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 two days before sprinkling the lawn again. The formula given is enough for one application to an area of 8,000 square feet. Since cutworms and earwigs are active mostly at night the bait is applied in late evening.

10. **Metaldehyde bran bait** is effective in controlling garden slugs. A bran bait containing 3 per cent metaldehyde by weight is broadcast or put out in small piles at the rate of 10 or 12 pounds per acre. During cool, damp weather, the bait is more effective if 3 or 4 pounds of calcium arsenate are thoroughly mixed with the bait. Metaldehyde bran bait is sold under various trade names.

11. **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 out. Keep seed in tight containers to prevent reinfestation. The gas is not effective if the temperature is much below 60° F.

12. **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. Rotenone loses strength with age. It is important to be sure of getting fresh material.

13. **Mercurous chloride** (Calomel) when thoroughly mixed with onion seed at the rate of 2 pounds of calomel to one 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.

14. **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 like a slide trombone. Considerable pressure can be maintained with this pump. 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: (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 $1.00 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 doubled cheesecloth and shaken over the plants.

CONTROL OF PESTS OF COMMON VEGETABLES

Small 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 the crop. A dust containing not less than half of 1 per cent rotenone[12] is applied at the rate of 15 pounds per acre when beetles first appear in the spring. Application is repeated whenever beetles or larvae reappear. After cutting season, foliage is dusted with calcium arsenate or rotenone whenever beetles or larvae appear.
BEAN	Bean weevil	Fumigate seed immediately after harvest with carbon bisulphide and destroy all vines.[11]
	Western 12-spotted cucumber beetle	Experiments indicate following to be of value: Leave trap rows. Drive beetles to trap rows by dusting with hydrated lime. Spray beetles on trap rows with pyrethrum spray or dust.[3] Most damage done by adults about time beans bloom. Control measures should be applied when first damage noticed.
	Aphis	Spray with nicotine sulphate.[2] 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.[2] Thrips usually appear in numbers after beans bloom. Control measures should start with first appearance of thrips.
	Seed-corn maggot	No satisfactory control. Plant shallow in heavy, wet soil and in wet seasons. Avoid sod land or new land, especially in cold, wet seasons.
BEET	Flea beetles Leaf beetles	Periodic applications of calcium arsenate or rotenone spray or dust.[1, 12] First application to be made when injury first noticed. (If beet tops are to be used as food, use rotenone.)
BRUSSELS SPROUTS	Aphis	Spraying or dusting with nicotine when aphids first appear.[2]
CABBAGE CAULIFLOWER KALE BROCCOLI	Cabbage worms Diamond-back moth	Usually present in early spring when plants are first set out. Dust with a rotenone or pyrethrum dust[12, 3] at intervals of 2 weeks as long as worms are present.

CONTROL OF PESTS OF COMMON VEGETABLES (*Continued*)

Crop	Insect	Control program
CABBAGE CAULIFLOWER KALE BROCCOLI (*continued*)	Cabbage root maggots	Use tar-paper disks[8] or wet soil around plants with corrosive sublimate solution[7] 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 which produce the maggots.
	Flea beetles	Repeat applications of rotenone dust.[12]
	Cabbage aphis	Appear soon after plants are set out. As soon as lice appear and before leaves curl, spray with nicotine sulphate. Nicotine dust effective in warm weather.[2]
CUCUMBER MUSK-MELON SQUASH	Striped cucumber beetle 12-spotted cucumber beetle	Dust with mixture of calcium arsenate powder 1 pound, land plaster 20 pounds, when plants appear above ground. Repeat application every 4 days during fair weather and after each rain.
	Aphis	*See* Cabbage aphis.
	Seed-corn maggot	*See* Bean.
EGG PLANT	Flea beetle Western 12-spotted cucumber beetle	*See* Potato. Spray or dust with pyrethrum.[3]
HORSERADISH	Diamond-back moth	*See* Cabbage.
ONION	Thrips Appear in early spring but usually not serious before early July.	Burn or plow under grassy or weedy borders near onion field in early winter to destroy thrips. When thrips appear in spring, spray with nicotine sulphate.[2] Dust with nicotine dust when temperatures are above 60° F.
	Onion maggots	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.[13]
PEA	Pea weevil	Fumigate seed with carbon bisulphide[11] immediately after harvest and destroy all vines. Repeat applications of rotenone dust[12] beginning at blossoming.
	Pea aphis	*See* Bean.
	Seed-corn maggot	*See* Bean.

CONTROL OF PESTS OF COMMON VEGETABLES (*Continued*)

Crop	Insect	Control program
POTATO	Grub worm and wireworms	These insects are more prevalent in potatoes grown on new or sod land, or land not well drained.
	Flea beetles	Dust with a ⅔ of 1 per cent rotenone dust. Apply spray as soon as beetles appear. Repeat applications at 10-day intervals as long as beetles are present.
	Colorado potato beetle	Dust or spray with calcium arsenate.[1] 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 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. *See* Cabbage.
SPINACH	Leaf miner	Repeated applications of nicotine sulphate spray or dust are suggested.
	Western 12-spotted cucumber beetle	Pyrethrum.
SQUASH	Squash bug	Place small boards or old carpet near vines when they first come up. The bugs collect beneath these objects and may be destroyed. Pyrethrum sprays[3] are of value.
	Western 12-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 silk at intervals of 4 days until silk shoots become dry. Use a calcium arsenate of fluosilicate dust.[1] By means of a pressure oil can "squirt" ¼ teaspoonful of white mineral oil, or oil containing pyrethrin, into silks. Apply between time silks begin to wilt and the time the tips turn brown.[4]
	Earwigs	Poison bran mash.[6]
	Seed-corn maggot	*See* Bean.
TOMATO	Green tomato horn worms	Pick off by hand or spray with calcium arsenate, or dust with calcium arsenate dust mixture.[1] If tomatoes have formed, use pyrethrum spray. Usually appear about time young fruit is forming.

CONTROL OF PESTS OF COMMON VEGETABLES (*Continued*)

Crop	Insect	Control program
TOMATO *(Continued)*	Tomato fruit worm	Spray before fruit is half grown with calcium arsenate or dust with calcium arsenate dust mixture.[4] Pyrethrum should be used in later applications.
	Flea beetle	*See* Potato.
VEGETABLES GENERALLY	Cutworms Earwigs	Poison bran mash standard control.[9] 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.
	Garden slug present when garden is planted in early spring.	Use a metaldehyde bran bait. Apply the bait in small piles, about 1 tablespoonful about the plants to be protected. Broadcast the bait over the garden at the rate of 10 or 12 pounds per acre at the time seed is planted, and continue at 2-week intervals as long as damage is noticed.[10] Since slugs continue migrating into gardens, control measures should begin before planting and continue as long as slugs are present.
	Symphilids or garden centipedes	No effective control measures known.
	Grasshoppers	Spray or dust plants with calcium arsenate.[4] Spread poison bran bait[9] as suggested for cutworms.
	Red spider-mites	Suggested spraying with summer oil emulsion 1½ gallons to 100 gallons of water, or repeated applications of a sulphur-lime dust. (*See* Complete dusts.[6]) Usually do not appear in serious numbers until weather becomes warm in June or July.
	Millipeds	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 bugs	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.

Cooperative Extension Work in Agriculture and Home Economics
Wm. A. Schoenfeld, Director
Oregon State College and United States Department of Agriculture, Cooperating
Printed and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914