

3115



### CONTROL OF INSECTS AND DISEASES IN VEGETABLE GARDENS

The successful control of garden pests is linked in a definite way with good farming practice. Under many conditions cultural practice may be just as important as the application of insecticides or fungicides and the carrying on of other methods of artificial control.

By good farming practice is meant such activities as garden sanitation, which includes the collection and destruction of crop remnants at the time the edible portions are harvested and the cleaning up of the debris in autumn or early spring, as well as the burning over of waste land and weed patches in the vicinity of gardens, where many insects and disease-producing organisms spend the winter in a variety of stages; the careful selection of plants and seeds; crop rotation; and the careful cultivation of the soil prior to and following seeding and transplanting.

As with animals, sickly plants are much more susceptible to the attacks of diseases and insects than healthy ones. It is, therefore, essential that every effort be made to produce strong healthy plants which will be capable of rapid, vigorous growth able to offset insect and disease attack, not only in spring but throughout the entire growing season. Only the most vigorous transplants and seedlings should be retained and their growth should be encouraged by careful cultivation, generous use of fertilizers and judicious thinning and weeding as necessary.

No matter what precautions are taken, insect and disease outbreaks are apt to occur in certain sections of the garden and in certain crops during most years. Under such conditions, the grower must resort to the use of insecticides and fungicides or other artificial methods of protecting the garden from pests. To make the most effective use of these artificial control practices, the gardener should become familiar with the common insects and diseases so that they may be quickly recognized. Growing crops should be carefully and systematically examined during the entire season in order that outbreaks of garden pests may be detected in their early stages. Insects and diseases are much easier to control when they first appear than after they have become established and for this reason the gardener should be in a continuous state of preparedness, by having adequate supplies of insecticides and fungicides on hand, all spraying and dusting equipment in first-class working condition, and all preparations made for the launching of a plant protection campaign at short notice.

For further information, apply to your nearest Dominion Laboratory of Entomology or Plant Pathology, or write to the Division of Entomology, Ottawa, for information on insects, or the Division of Botany and Plant Pathology, Ottawa, for information on diseases.

## INSECTS ATTACKING VEGETABLES

Numbers in brackets following control recommendations refer to formulae given on page 4

Insect	Plants Attacked	Description of Insect and Type of Injury	Control Recommendations	
			Eastern Canada	Western Canada
Cutworms.....	Miscellaneous field and garden crops.	Dull-coloured caterpillars which cut off the plants at the ground level, feed chiefly at night, hiding in the soil during the day.	Scatter poisoned bran bait over infested land in the evening of a warm day, using 20 lb. per acre (1).	Same as for Eastern Canada. For red-backed cutworm, use oil bait (8). Baits not effective against pale western cutworm.
Aphids..... (Plant Lice).	Cabbage, turnips, spinach, peas, potatoes, etc.	Small, soft-bodied insects, green, grey or black in colour, found in clusters on twig endings or in curled leaves. Suck out plant juices.	Spray infested plants when air temperatures are high with nicotine sulphate, using $\frac{1}{4}$ teaspoonfuls with 1 oz. of laundry soap in 1 gallon of water.	
Flea Beetles.....	Potatoes, tomatoes, turnips, radishes, etc.	Tiny, quick-jumping beetles, black, dark grey or dark blue in colour which eat small round holes in the leaf tissues.	Treat infested plants with a proprietary dust containing rotenone. In the case of potatoes, spray with bordeaux (2) to which has been added calcium arsenate at the rate of 2 lb. to 40 gallons. Cryolite 1 part, flour 4 parts, also makes an excellent dust.	
Blister Beetles....	Potatoes, beans, caragana, clover, etc.	Large, soft-bodied beetles, grey or black in colour or blue with a metallic sheen. Frequently present in swarms feeding on foliage.	Dust plants with barium or sodium fluosilicate diluted with 6 parts of flour. In Alberta use special dust formula (3).	
European Earwig...	Miscellaneous garden crops.	The adult earwig is dark reddish-brown with long antennae and a pincer-like structure at the end of the body. The insect is a foliage feeder attacking many varieties of plants.	Scatter poisoned bait (4) on ground where insects are abundant, using 30 lb. to a city lot. Community action essential to secure effective control.	
Beet Webworm....	Sugar beets, lettuce, onions, peas, beans, cabbage, weeds, etc.	Slim, active caterpillar, green or yellow in colour marked with black lines and circles. When abundant marches in armies. Feeds on leaves of all garden plants.	Of no importance in Eastern Canada.	Spray infested plants and surrounding weeds with paris green or calcium arsenate 3 lb., hydrated lime 3 lb., water 100 gal. To protect threatened field, surround with a trench. In irrigated sections, fill trench with water and spray surface with used crankcase oil.

Cabbage Maggot.	Cabbage, cauliflower, turnips, radishes.	White, legless maggot, one-quarter inch in length which attacks the roots of cabbage, cauliflower and other related crops.	Apply $\frac{1}{4}$ to $\frac{1}{2}$ cupfuls of corrosive sublimate solution (6) to the stems of transplants and surrounding soil as soon as set out and repeat twice at weekly intervals.
Onion Maggot.....	Onions.	White, legless maggot closely resembling the cabbage maggot. Tunnels in the roots and lower portions of the stems. Infested seedlings wilt and die. Onions malformed.	Make four weekly applications of oil emulsion spray (7) commencing when seedlings are 1 to 1½ inches high. Spray both plants and soil.
Carrot Rust Fly...	Carrots, celery, parsnips.	Slender, legless maggots, creamy-white in colour which form rusty-red tunnels in the roots of carrots, celery and allied plants.	Broadcast crude naphthalene over foliage and ground of carrot plot, three times at weekly intervals, when flies are present. Use 1 lb. to 100 square feet of soil surface.
Colorado Potato Beetle.	Potatoes, tomatoes, egg plant.	Hard-shelled beetles with black and yellow stripes. The larvae are soft, brick-red with black markings. Entirely foliage feeders. Both forms are destructive.	Dust with calcium arsenate or paris green 1 part and hydrated lime 10 parts. Sprays of calcium arsenate or paris green are also effective.
Cabbage Worm....	Cabbage, cauliflower, turnips.	Velvety-green caterpillars which feed both on the leaves and in the hearts of the plants. Large, circular holes are eaten in the foliage.	On the prairies use either calcium arsenate, paris green or white arsenic—1 part to 10 parts of hydrated lime.
Striped Cucumber Beetle.	Cucumbers, melons, squash.	Small beetles, ornamented with yellow and black stripes. Feed on the leaves of cucumbers and melons, particularly seedlings.	Substitute a dust containing rotenone when plants approach marketable size. When plants are small dust with calcium arsenate 1 part and gypsum 19 parts. Repeat when beetles reappear. Pay particular attention to the under surfaces of the leaves.
Tobacco Hornworm.	Tomatoes.	Extremely large, green caterpillars with a horn at the posterior end. Devour potato leaves and green fruit, often stripping entire plants.	Spray with lead arsenate 2 lb. to 40 gal. water. Make first application in early July. Repeat when necessary. In small plots hand pick caterpillars and destroy.
European Corn Borer.	Corn.	Dirty-white caterpillars, often with a pinkish tinge, which bore into stalks and ears of corn. Badly infested stems break and fall over.	Of no commercial importance in Western Canada.  Not reported from Western Canada.

## RECOMMENDED FORMULAE

## (1) Poisoned Bran Bait (for cutworms)

Bran.....	20 pounds
Paris green.....	1 pound
Water.....	2½ gallons

Mix wet and dry ingredients separately. Bring together in a large tub and stir thoroughly before using.

## (2) Bordeaux Mixture

Copper sulphate.....	4 pounds
Hydrated lime.....	4 pounds
Water.....	40 gallons

Dissolve the copper sulphate in the water. Sift in the hydrated lime while the solution is being thoroughly agitated.

## (2A) Burgundy Mixture

Prepared in the same manner as bordeaux, using sal soda (sodium carbonate, washing soda) instead of lime.

## (2B) Fixed Copper Fungicides

Follow manufacturer's directions.

## (3) Blister Beetle Dust (Alberta)

Paris green.....	1 part
Derris.....	1 part
Wheat flour.....	10 parts

## (4) European Earwig Bait

Bran.....	12 pounds
Pilchard oil.....	1 quart
Sodium fluosilicate.....	1 pound

Mix the sodium fluosilicate and bran together while dry, then add the fish oil and stir until it is completely absorbed by the bran.

## (5) Beet Webworm Poisoned Bait

Weeds (lamb's quarters or other attractive herbage).....	50 pounds
Paris green.....	1 pound

Cut the weeds fairly fine and moisten thoroughly with water. Sprinkle the paris green over the herbage and by means of a fork turn over several times to ensure even distribution of the poison.

## (6) Corrosive Sublimate Solution

For the control of root maggots, dissolve 1 ounce of corrosive sublimate in 10 gallons of water. As this insecticide loses its value if it comes in contact with metals, it should be mixed in and applied from wooden, glass or earthenware vessels only. It is a deadly poison when taken internally.

## (7) Lubricating Oil Emulsion

Lubricating oil.....	1 gallon
Bluestone.....	2 ounces
Hydrated lime.....	2 ounces
Water.....	1 gallon

Pour the oil into a container or into the sprayer; dissolve the bluestone in half the amount of water, stir the hydrated lime into the other half and add both to the oil. Pump the mixture back upon itself through the nozzle under high pressure until all the oil is properly emulsified. The above amounts of stock emulsion should be diluted with 40 gallons of water. Agitate while the water is being added. Oil should have a specific gravity of 24 to 27 A.P.I., a viscosity at 100° F. of 100 to 200 seconds, and an unsulphonatable residue of 60% to 90%.

## (8) Oil Bait for Red-backed Cutworms

Bran.....	25 pounds
Oil.....	2 quarts
Sodium fluosilicate.....	1 pound

Any light-weight mineral oil can be used, such as No. 10 or No. 20 lubricating oil. Crank case drainings should never be used. In preparing the bait the oil and poison are mixed and kept thoroughly stirred. This mixture is then slowly worked into the bran until every particle is moistened.

## DILUTION TABLES

Amounts of each stomach poison to be mixed with various quantities of water for biting insects

Water in gallons	1	5	20	40	80	120
Lead arsenate.....	5-1/5 level teaspoon	2 oz.	1/2 lb.	1 lb.	2 lb.	3 lb.
Calcium arsenate.....	2-2/5 level teaspoon	1 1/2 oz.	3/8 lb.	3/4 lb.	1 1/2 lb.	2 1/4 lb.
Paris green.....	1-1/3 level teaspoon	1 oz.	1/4 lb.	1/2 lb.	1 lb.	1 1/2 lb.

An equal quantity of hydrated lime should be added to Paris green and arsenate of lime.

Amounts of stomach poisons to be mixed with hydrated lime as a dust for biting insects

Hydrated lime	1 pound	5 pounds	10 pounds	50 pounds	100 pounds
Lead arsenate, 1-8.....	2 oz.	10 oz.	1 1/4 lb.	6 1/2 lb.	12 1/2 lb.
Calcium arsenate, 1-11.....	1 1/2 oz.	7 1/2 oz.	14 1/2 oz.	4 1/2 lb.	9 lb.
Paris green, 1-16.....	1 oz.	5 oz.	10 oz.	3 3/8 lb.	6 1/4 lb.

Amount of nicotine sulphate to be added to water for various strengths of spray for sucking insects

Dilution	WATER			
	1 gallon	5 gallons	20 gallons	40 gallons
3/4 pint nicotine sulphate to 100 gallons water.	1-1/5 teasp. nic. sulp. 1 oz. soap	6 teasp. nic. sulp. 1/2 lb. soap	3 oz. nic. sulp. 1 lb. soap	6 oz. nic. sulp. 2 lb. soap
1 pint nicotine sulphate to 100 gallons water.	1-3/5 teasp. nic. sulp. 1 oz. soap	8 teasp. nic. sulp. 1/2 lb. soap	4 oz. nic. sulp. 1 lb. soap	8 oz. nic. sulp. 2 lb. soap
1 1/2 pints nicotine sulphate to 100 gallons water.	2-2/5 teasp. nic. sulp. 1 oz. soap	12 teasp. nic. sulp. 1/2 lb. soap	6 oz. nic. sulp. 1 lb. soap	12 oz. nic. sulp. 1 lb. soap

Amount of nicotine is in fluid ounces. Amount of soap is in weight avoirdupois.

Amount of nicotine sulphate to be added to hydrated lime for 2 per cent and 3 per cent nicotine dusts for sucking insects

	QUANTITY OF DUST REQUIRED			
	5 pounds	25 pounds	50 pounds	100 pounds
2 per cent dust.....	1/2 lb. nic. sulp.	1 1/4 lb. nic. sulp.	2 1/2 lb. nic. sulp.	5 lb. nic. sulp.
	4 1/4 lb. hyd. lime	23 1/4 lb. hyd. lime	47 1/2 lb. hyd. lime	95 lb. hyd. lime
3 per cent dust.....	3/8 lb. nic. sulp.	1 7/8 lb. nic. sulp.	3 3/4 lb. nic. sulp.	7 1/2 lb. nic. sulp.
	4 5/8 lb. hyd. lime	23 1/8 lb. hyd. lime	46 1/2 lb. hyd. lime	92 1/2 lb. hyd. lime

## DISEASES OF VEGETABLES

(Numbers in brackets following control recommendations refer to formulae given on page 4)

Crop	Disease	Description of Injury	Control Recommendations
Asparagus.....	Rust.....	Reddish-brown pustules filled with dusty spores on leaves and stems.	Use a resistant variety (Martha Washington, Mary Washington).
Bean.....	Anthraxnose.....	Pod spots, brown and sunken, with dark centres; seed spotted; irregular stem and leaf lesions.	Use a resistant variety (Robust, Well's Red Kidney, Geneva, Ferry Marrow, etc.) Practise crop rotation and select seed from disease-free pods.
	Bacterial blight.....	Leaf spots large, irregular, with light margins; defoliation frequent. Pod spots brown, with irregular margins (resemble sun-scald). Stem lesions may cause girdling and wilting.	Use disease-free seed. Cultivate only when dry, and keep free from weeds. Use a resistant variety (Robust, Yellow Eye, etc.)
Beet.....	Leaf Spot.....	Spots on leaves, at first brown, later becoming ashen grey with purple margins.	Crop rotation. Sanitation, destroy affected foliage or plough deeply into the ground. Spray every 10 days with bordeaux 4-5-40 (2).
Celery.....	Blackheart.....	Hearts black or brown and water soaked; often totally rotted.	Use a resistant variety (Florida Golden, Golden Phenomenal, Golden Plume). Where soil moisture is controlled by irrigation and drainage, maintain an even supply; otherwise delay planting early crop, and rush harvesting when disease appears.
	Early and late blights..	Irregular dead areas on leaves and stalks; late blight lesions usually smaller and covered with tiny black fruiting bodies.	Spray with burgundy (2A), or bordeaux 4-5-40 (2), or dust with copper lime 20-80. Commence in the seed bed and repeat at weekly intervals. When tarnished plant bugs are present spray with 20 lb. wettable sulphur, 30 lb. lime, and 4 lb. copper sulphate in 40 gal. water.
Cabbage.....	Yellows.....	Plants dwarfed and sickly yellow; frequently older leaves drop off.	Practise long rotations. Use a resistant variety (Penn. State, Ballhead, Copenhagen, Market, Wisconsin All Season, Jersey Queen, Detroit resistant, Early Resistant, Early Resistance, Copenhagen No. 19, All Head Select, Wisconsin Ballhead, etc.).
Cabbage, cauliflower, turnip, radish, etc.	Black rot.....	Leaves show dark brown or black veins, wither and fall from plant; vascular bundles darkened.	Rotate crops. Treat seed with Semesan (as directed) or mercuric chloride, 1 tablet in 1 pint of water (or ½ oz. in 3 gal.) for 30 mins. Destroy diseased seedlings.

	Blackening of stems and decay	Use hot water treatment. Write for directions.
Blackleg	Blackening of stems and decay	Use hot water treatment. Write for directions.
Club-root	Irregular knobby swellings on the roots. Plants wilt during hot days.	Favoured by acid soil. Apply lime as indicated by soil test. Use long rotation. Do not plant seedlings from an infested flat or seed-bed.
Bacterial soft rot	A soft, watery light brown decay of the fleshy parts of most vegetables.	Cultivate only when dry, and avoid injury to plants. For future protection, gather up and destroy crop refuse, and practise long rotations.
Smut	White swellings (boils) filled with black powdery spores, on any part of the plant.	Collect and burn boils before they open and scatter sooty spores. Rotate crops.
Bacterial wilt	A typical wilting and dying of part or all of a plant.	Control cucumber beetles. (See insect section). Remove and destroy infected plants at once.
Leaf spots	Irregularly shaped brown or greyish areas on leaves or stems, and occasionally fruit spots.	Spray or dust with a (2B) fixed copper fungicide at frequent intervals.
Fungus wilts	Typical wilting of the vines.	Disinfect seed (Semesan, as per direction on package). Use a long rotation.
Midlew	A purplish mould on leaves, causing water soaked areas. Leaf dies and turns yellow or white.	Rotate crops. Do not plant sets near seed onions. Keep free from weeds. Destroy crop refuse.
Smut	Appears as dark streaks within the tissue of leaves or bulbs, filled with brown powdery spores.	Formalin, 1 pint in 10 gal. water, applied while seeding at the rate of 100 gallons per acre.
Soft rot and neck rot	Decay of the bulb or bases of the leaves.	Make certain bulbs are mature before harvesting. Cure and dry properly before storing.
Blight	Brown to purplish, irregular, usually small areas on leaves, pods and stems.	Use disease-free seed. Practise crop rotation and sanitation. Do not plant too thickly and keep free of weeds to assure good aeration.
Leaf and pod spot	Definite, sunken, tan to brown spots, more or less circular, usually with dark brown margin, on leaves, and pods.	Use Certified Seed. Disinfect bags, tools, and machinery with 1 pint of formalin in 25 gal. water or 2% Lysol, and storage houses with whitewash containing 1 lb. copper sulphate in every 10 gal.
Bacterial ring rot	Rolling of leaflets (mostly on individual stems) which turn yellow, wilt and die. Tubers show a cream to brown, diffuse, cheesy rot around the vascular ring.	Use Certified Seed. Treat seed with 8 oz. mercuric chloride added to 1 qt. of commercial hydrochloric acid, and diluted to 25 gal. with water. Soak uncut seed for 5 min. and dry promptly. Or soak tubers in formaldehyde solution (1 pint formalin in 25 gal. water) for 2 hrs. then dry. Semesan Bel may be used as directed by manufacturers. Rotate crops.
Blackleg	Plants upright and stiff, yellowish to light green. Base of stem turns black and rots. Tubers show brown or black rot proceeding from the stem end.	
Rhizoctonia and scab	Purplish black scurfs, and rough, raised, or depressed, corky scabs on tubers.	
Cabbage, cauliflower, turnip, carrot, celery, etc.		
Corn		
Cucumbers, melons, squash, etc.		
Onion		
Pea		
Potato		

## DISEASES OF VEGETABLES—Continued

Crop	Disease	Description of Injury	Control Recommendations
Potato—concluded.....	Early blight.....	Dry, brownish spots with well-defined margin, on leaves and stems.	Spray with bordeaux 4-4-40 (2) apply 80-100 gal. per acre, beginning when plants are $\frac{1}{2}$ in. high and repeat at 10-day intervals, oftener in wet weather. When potato beetles are present, add 2 lb. calcium arsenate to each 40 gal. spray.
	Late blight.....	Irregular, dark-brown, water-soaked areas on leaves and stems. Mildew on under side of leaves in moist weather. Reddish-brown tuber rot.	
Potato, tomato, cucumbers, peppers, etc.	Virus diseases (mosaics, leaf roll, streaks, yellows, etc.)	Foliage mottling, crinkling, leaf rolling, dwarfing and spindling of plants, and mottling or distortion of fruit.	Use Certified Seed potatoes, and seeds from healthy plants. Plant resistant varieties. Where only a few plants are affected, remove and destroy them early. Avoid handling healthy plants after diseased ones. Keep free from weeds, and remove weeds adjacent to plantings. Destroy crop refuse.
Tomato.....	Leaf spots, blights and fruit rots.	Dead areas on leaves, cankers on vines, and diseased lesions on fruits.	Treat seed with red copper oxide. Spray twice in seed-bed, first when true leaves are formed and again 4 or 5 days before transplanting, using a fixed copper fungicide (2B). When hornworms are present, add 2 lb. calcium arsenate to each 40 gal. spray.
Seedlings of most plants.	Damping-off.....	Either a rotting or killing of the seed before it emerges, or a rotting of the seedling at or near the ground level, causing it to fall over and die.	Sterilize soil and disinfect seeds. Water seed-beds as little as possible, provides good ventilation, and keep humidity low. If the disease appears, water soil at the rate of 2 gal. per square yd. 2 or 3 times at 4-day intervals with either copper oxide, or Semesan (1 oz. in 3 gal.) or bordeaux (3 oz. copper sulphate and $\frac{1}{2}$ oz. lime in 5 gal. water).

*Soil Sterilization.* Live steam is preferable, but formalin may be used. With steam, maintain a temperature of at least 180° F. for 30 min. With formalin, use 1 pint in 6 gal.; apply 4 gal. per cubic foot of soil. Mix thoroughly and cover for 2 days, then thoroughly aerate it before using. For small amounts of soil use 2½ tablespoons formalin in 6 times its volume of water, for each bushel of soil.