Controlling Diseases and Insects on Garden Flowers
Michigan State University Extension Service
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Revised April 1948
60 pages

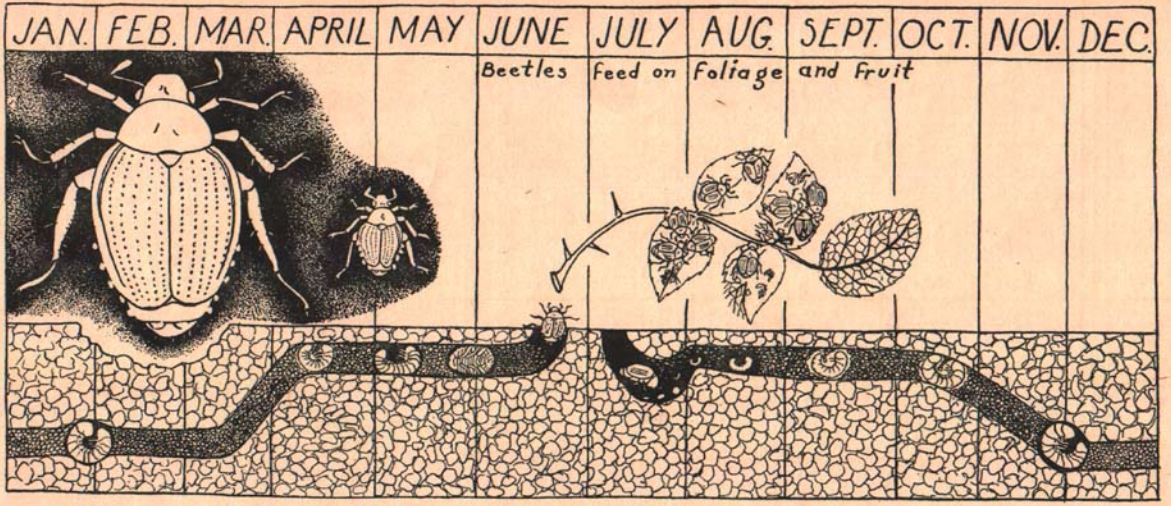
EXTENSION BULLETIN 271

Controlling
DISEASES AND INSECTS ON GARDEN FLOWERS

Prepared by
Departments of Botany and Plant Pathology, Entomology, and Horticulture

MICHIGAN STATE COLLEGE
COOPERATIVE EXTENSION SERVICE
EAST LANSING

THE JAPANESE BEETLE



The Japanese beetle is not established in Michigan. Small infestations have occurred in Detroit from time to time but have been eradicated by the State Department of Agriculture. Our purpose in mentioning the Japanese beetle is to point out ways by which the pest may be identified.

The head and thorax of this insect are metallic green, the wing covers golden brown. The five white tufts of hair along each side of the posterior end of the thorax are practically always present.

The sketch above illustrates the beetle and shows the pest's life-cycle.

If you see Japanese beetles or beetles which you think may be Japanese beetles, send specimens to the Department of Entomology, Michigan State College.

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There is no effort in this bulletin to catalog all of the diseases and insects which may affect garden plants. Description of treatments is also streamlined. The control methods suggested are those which have been successful with readily available materials and machinery.

The presentation of the information and insects and their treatment is by alphabetical arrangement of host plants. Usually, treatments are indicated in the description of the pest with fuller directions as to dosage, dilutions, mixing, etc., on pages 42 to 53.

Several general considerations in spraying must be kept in mind at all times. The more important are set forth in the next few paragraphs.

1. Do not apply any spray when the temperature is 85° F. or above. Nicotine and other sprays directed solely at aphids are possible exceptions.
2. Lead and calcium arsenates are interchangeable for all situations requiring arsenates in this bulletin, except for turf treatments. See (13), page 46.
3. **Amount of dust required per 50-foot row:** Most dusts are applied at the rate of 25 to 30 pounds per acre. This varies with crop, size of plants, thickness of stand, nature of dust and other factors—in a small garden 2 to 3 ounces of dust is required to treat a 50-foot row crop for each application.
4. **Amount of spray required per 50-foot row:** Where sprays are applied at the rate of 125 to 150 gallons per acre, about 2 quarts will be required to treat a 50-foot row.
5. When insect or disease cannot be identified send insect samples to Entomology Department and disease samples to Botany Department, Michigan State College.

WARNING

Many insecticides and fungicides have a tendency to stain wood, painted surfaces, or stone. This must be taken into consideration when spraying in cities on ornamental plantings. Where a structure is thoroughly wetted before and thoroughly washed down after an application, the damage caused by stains will be lessened.

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	AGERATUM
Red spider	See PHLOX.
Thrips	Several species. Mostly pollen feeders. Casual, migrating in from weeds or grass. **Use rotenone** (24) **or pyrethrum dust** (23), **DDT** (18b), **or organic phosphate dusts** (17), **or tartar emetic** (16), **or DDT** (18), **or organic phosphate** (17a) **as a spray.**
	ALYSSUM
Powdery mildew	White moldy patches on leaves. See DAHLIA.
White rust	Pale yellow spots on leaves with white blisters. Disease spreads from shepherd's purse and purslane (pusley). **Destroy diseased plants.**
Wilt	Stems rot at base. Leaves wilt and die. **Spray** (2) **especially stems, three times at 10-day intervals.**
Yellows	See ASTER, CHINA.
Cyclamen mite	See SNAPDRAGONS.
Red spider	See PHLOX.
Thrips	See AGERATUM.

Plant bugs	See CHRYSANTHEMUMS.
Diamond-backed moth	See CANDYTUFT.
Cabbage worms	Velvet green caterpillars feeding on foliage, present throughout season. **Dust with rotenone** (24), **or DDT** (18b).
Flea beetles	See CHINESE LANTERN.
	ANEMONE
Gray mold (crown rot)	Rotting of crowns. **Destroy diseased plants. Saturate soil about diseased plants** (1).
Rhizome rot	Decay of underground stems (rhizomes). Black bodies up to one inch long develop on surfaces. **Dig up and destroy affected plants.**
	ASTER, CHINA (Callistephus)
Rust	Small orange-colored spots on leaves in late summer which later turn yellow and fall. **Destroy severely diseased plants. Dust** (5) **once a week up to flowering time.**
Wilt	Plants wilt. Brown streaks in woody parts of stems. Roots and stems rot in wet weather. **Rotate** (38). **Use resistant strains** (37). **Treat seed** (6) **and plant in clean soil.**

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	ASTER, CHINA (Callistephus)—Con.
Yellows (virus)	Leaves and flowers yellowish green. Plants stunted and bushy. **Grow in cloth-screened plots to keep out leafhoppers which carry disease. Remove and burn diseased plants as quickly as discovered. See six-spotted leafhopper.**
Garden flea hopper	See CHRYSANTHEMUM.
Lace bugs	See CHRYSANTHEMUM.
Plant bugs	Several species. See CHRYSANTHEMUM.
Red spider	See PHLOX.
Root aphids	Several species. Transplanted from roots of weeds and grass by ants. Stunts growth and causes plants to wilt down during heat of day. Severely infested plants fail to flower. **Water with two tablespoons 15% parathion** (17) **in a gallon of water. Chlordane** (20).
Six-spotted leafhopper	Active pale yellowish leafhopper about 1/8 inch long Often stunts plants and causes leaves to curl. Known to carry aster yellows. **Use DDT** (18 or 18b) **at 5-day intervals.**
Stalk borers	See DAHLIA.
Blister beetles	Several species; black, gray or striped beetles about 3/4 inch long feeding on petals, or pollen. Appear suddenly and usually in great number, disappearing with equal rapidity. **Hand-pick or use DDT** (18) **or** (18b).

	ASTER, HARDY
Rust	See ASTER, CHINA.
Red spider	See PHLOX.
Lace bugs	See CHRYSANTHEMUM.
Thrips	See AGERATUM.

	BULBS, HARDY
Blue mold	Narcissus, (daffodil, jonquil) crocus, hyacinth, and tulip. Affects all bulbs. Rot starts in mechanical injuries and penetrates stored bulbs. They become powdery or hard and dry. **Sort and select only healthy bulbs for planting. Treat bulbs** (7a). **Avoid mechanical injuries when digging. Rapid curing and drying is most important. Keep dry in storage.**
Breaking (virus)	Affects tulips. Bleached stripes and irregular mottling of flowers. Leaves sometimes mottled and plants stunted. **Spray to control aphids in growing season. Control aphids in storage. Destroy affected plants.**
Fire (Botrytis blight)	Affects tulips. Leaves and flowers flecked with small gray or brown spots. When bulb attacked, plants are dwarfed, pale yellowish-green. Flowers distorted or blasted. Stems cankered and may rot off. **Inspect and discard diseased bulbs. Treat bulbs** (7f) **and plant in new location. Remove diseased plants, roots, and all, and burn.**

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	BULBS, HARDY—Con.
Nematodes or ring disease..	Affects daffodils. Dark-colored circles in cross-sectioned bulbs. Yellowish pockets in scales. Bulbs either fail to grow or do not blossom. Shoots twisted. Leaves may show yellowish swollen areas. **Treat bulbs with hot water** (7b), **to kill nematodes and plant in new location. Remove affected plants and soil in which roots are growing.**
Root and bulb rots.....	Affects tulips, daffodils. Roots and bases of scales decay. Disease spreads up on stems. **Remove all diseased plants from beds and burn. Select clean healthy bulbs. Treat bulbs** (7a). **Rotate** (38).
Silver streak (virus).....	Affects narcissus, daffodil, jonquil. Dark streaks on leaves and flower stalks bleach out later. Merging of streaks produces blotches. **Remove and destroy diseased plants at once.**
Yellow stripe (virus).....	Affects narcissus, daffodil, jonquil. Raised streaks light green to yellow on leaves. Flowers may show bleached streaks. **Remove diseased plants and destroy. Inspect again in three weeks after first finding diseased plants.**
Aphids (foliage).....	Several species. Control see CALENDULA.
Aphid (root).....	See ASTER, CHINA.
Bulb mite.....	White shining mites common in bulbs with decay tissue. Healthy bulbs not infested. **Protect bulbs in soil to prevent winter injury. Care in the harvesting and storage of bulbs. Water with 2 tablespoonfuls 15% parathion** (17) **in one gallon water. Chlordane** (20).

Bulb scale mite.....	Distorted foliage and flowers, scar-like yellowish-brown, longitudinal streaks on leaves or flower stems and twisted stems. On stored bulbs this microscopic mite works between the inner bulb scales, causing rot to develop. Spreads rapidly in storage. See BULB MITE.
Greater bulb fly.....	One generation per year—sometimes two years are required to complete a generation. Infested bulbs produce smaller foliage and less of it than healthy bulbs and the foliage dies down prematurely. Infested bulbs in storage show basal depression discolored and in advanced stage of infestation the bulbs are soft. One larva to a bulb. Flies active shortly after blooming, in heat of day. Damage less in open wind-swept field, than on ornamental plantings. See LESSER BULB FLY.
Lesser bulb fly.....	Several species. Field injury similar to narcissus bulb fly. Two or more generations each year. Many maggots present in each bulb. Decay organism always present—bulbs suffering from winter injury, eelworm or poor storage conditions always susceptible. **Use chlordane** (20), **parathion** (17).
Millipeds.....	Sometimes injures unhealthy bulbs. Damage common in ornamental plantings where there is not enough sunlight and with poor air circulation. **Remove bulb at end of growing season and re-plant in the fall in a well drained soil. Use poison bait** (14b), **or chlordane** (20) **or DDT** (18b).
Red spider.....	Often attacks foliage causing it to dry prematurely and may blast bulbs. See PHLOX.
Sow bugs.....	Sow bugs attack bulbs under about the same conditions a millipeds and respond to the **same control measures.**

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	CALENDULA
Leaf spot	Small brown spots on leaves, enlarge and merge with others killing leaves. Whole plants often killed. **Dust (4) at one-week intervals, beginning when plants are one month old.**
Powdery mildew	Circular areas on leaves covered with white mold. **Dust (5) or spray (3). Do not use bordeaux mixture.**
Aphids	Several species. Remove sap from tender terminals and blast buds. **Use pyrethrum dust (23) or nicotine dust (21) or nicotine sulfate and soap (22) as a spray, or organic phosphate (17).**
Blister beetles	Several species. See ASTER, CHINA.
Cabbage looper	Pale green caterpillar with whitish stripe down back. Defoliate plants. **Use rotenone dust (24), or DDT (18b).**
Grasshoppers	Several species. Usually migrate in from grassland—occasionally attack foliage and flowers. **Chlordane (20), or parathion (17).**
Greenhouse leaf-tier	See SNAPDRAGON.
Leafhoppers	Several species. Stunt foliage and deform buds. **Pyrethrum (23), or DDT (18b).**
Plant bugs	Several species. See CHRYSANTHEMUM.
Red spider	See PHLOX.

	CAMPANULA
Leaf spot	Various sized brownish dead areas on leaves. **Spray** (2).
Spotted wilt (virus)	More or less circular areas with indefinite margins. Yellow changing to brownish. **Destroy affected plants. Spray to control insect carrier (thrips). See Ageratum (thrips).**
Stem rot	Base of stems rot. Grayish-brown discoloration of stem, sometimes tiny black bodies on and in rotted parts. **Remove and burn diseased plants. Rotate** (38) **or sterilize soil** (9). **Avoid crowding of plants.**
Thrips	See AGERATUM.
	CANDYTUFT (Iberis)
Aphids	Several species. See CALENDULA.
Diamond back	Active light green caterpillar about 3/8 inch long when mature. Wiggles backward when disturbed. Defoliation. Builds lace-like cocoons on underside of foliage. **Calcium arsenate and gypsum** (10) **or rotenone dust** (24), **or DDT** (18) **or** (18b), **or parathion** (17).
Plant bug	Several species. See CHRYSANTHEMUM.
Slugs	Several species. Bodies coated with slime which leaves a silvery trail when dry. Rasps holes in leaves and destroys flower petals. **Use metaldehyde bait** (14d), **or DDT** (18b). **Provide drainage. Open up plantings to permit sunshine and good ventilation.**

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	CANNA
Bud rot	Whitish spots on leaves, later turning black. Flower buds turn black and die. Use healthy root stocks. **Treat root stocks** (7c). **Avoid crowding plants.**
Grasshopper	Various species. Occasionally, attacks flowers or foliage late in season. See CALENDULA.
Spotted cucumber beetle	A green beetle with ornaments of 12 black spots, varying in size and arranged in transverse rows. Adults feed on petals and pollen. **Hand pick. Use cryolite (11) or DDT (18), or (18b).**
	CARNATION
	See DIANTHUS.
	CENTAUREA
Downy mildew	Pale greenish or reddish irregular spots on upper sides of leaves. Lower sides of leaves have white, moldy appearance. Leaves collapse and die. **Remove and burn affected parts. Plant in open, sunny places. Rotate** (38). **Spray** (1).
Wilt	See ASTER, CHINA.
Common stalk borer	See DAHLIA.
Red spider	See PHLOX.

	CHINESE LANTERN (Physalis)
Common stalk borer.....	See DAHLIA.
Flea beetles.....	Small jumping beetles 1/16 inch long eating small holes on undersides of foliage but leaving the upper side uninjured, this drops out shortly leaving the foliage with a shot hole appearance. **Use cryolite (11) or calcium arsenate and gypsum (10) or DDT (18) or (18b).**
Red spider.....	See PHLOX.
Three-lined potato beetle..	Reddish yellow beetle with 3 black stripes lengthwise of wing covers, or slate gray grubs covered with waste material, feeding side by side along the edges of the leaves. **Use DDT (18) or (18b).**
Tortoise beetles.....	Several species. See MORNING GLORY.
	CHRYSANTHEMUM
Leaf spot.....	Dark brown spots on leaves which enlarge and merge. Leaves soon shrivel and drop. **Pick diseased leaves and burn. Spray (1) or (2) young plants.**
Nematodes or root knot...	Small fleshy, swollen knots on roots. Plants dwarfed, wilt in dry periods. Do not blossom. **Pull and destroy affected plants. Rotate (38).**
Powdery mildew.....	See DAHLIA.
Stunt.....	Plants dwarfed, flowers earlier than normal. **Remove and destroy affected plants.**
Wilt.....	Lower leaves brown at tips, progressive upward. Plants yellow and wilt. **Use resistant varieties (37). Rotate (38). Practice sanitation (39).**
Yellows.....	Flowers abnormal, light green color. Plants may be dwarfed. See ASTER, YELLOWS.

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	CHRYSANTHEMUM—Con.
Aphid	Black aphids congregated on terminal growths or green aphids on foliage. Stunted foliage, accumulation of honeydew and presence of sooty fungus. **Use nicotine sulfate and soap** (22) **or pyrethrum** (23), **or organic phosphate** (17).
Cyclamen mite	Distortion of terminal growth. Foliage stunted, bronzed, thickened and may split or crack. **Use parathion** (17).
Garden flea hopper	Normally feeds upon weeds, occasionally migrates into cultivated plantings. Work similar to that of plant bugs. **For control see PLANT BUG.**
Greenhouse leaf-tier	See SNAPDRAGON.
Lace bugs	Pale unhealthy foliage, flecked on undersides with numerous dark resinous spots. Presence of adults and nymphs on undersides of foliage. **Use parathion** (17), **or DDT** (18) **or** (18b).
Marguerite fly	Winding mines between the surfaces of the leaves. See DAISY.
Midge	Cone-shaped gulls on foliage and stems. Seldom a problem on plant growing in the open. **Use tobacco dust** (25) **or nicotine sulfate and soap** (22) **as a spray, or DDT** (18) **or** (18b).
Plant bugs	Several species. Dead areas on foliage where bugs have removed the sap from tissue. Blasted buds. Stunted growths. **Use nicotine dust** (21) **or pyrethrum** (23) **or DDT** (18) **or** (18b).
Red spider	See PHLOX.
Thrips	See DIANTHUS.

	CLARKIA
Thrips	See DIANTHUS.
Red spider	See PHLOX.

	COLUMBINE (Aquilegia)
Wilt	Crown and stems rot. Leaves wilt and dry. **Remove and destroy diseased plants. Rotate** (38) **or sterilize soil** (9). See p. 36, under "Damping off."
Aphids	Several species. Stunted plants. Accumulation of honeydew and presence of sooty fungus. **Use nicotine sulfate and soap** (22) **or nicotine** (21) **or pyrethrum dust** (23), **or organic phosphates** (17).
Borer	Caterpillar enters stem and works down into the larger fleshy roots. One brood each year. **Inject a few drops of carbon disulfide** (26) **into tunnels and plug openings with soil. Remove all plant refuse at end of season including top ½ inch of soil for a foot around each plant and replace with fresh soil. Chlordane** (20) **early in season on soil and on plants.**
Cyclamen mite	Distortion of terminal growth, thickening and stunting of foliage. Bronze tone to leaves. **Use rotenone-sulfur dust** (24, 35) **or parathion** (17).
Leaf miner	Irregular winding mines or blotches made by tiny maggots mining between the surfaces of the leaf. Several generations per year. **Hand pick and destroy infested leaves. Use chlordane** (20) **or parathion** (17) **on soil in vicinity of plant.**
Red spider	See PHLOX.
Stalk borer	See DAHLIA.

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	COSMOS
Powdery mildew.....	See DAHLIA.
Stem blight.....	Brown lesions which girdle stems of mature plants. Top parts wilt. Black dots numerous on cankered surface. **Pull up and destroy diseased plants. Spray** (1).
Aphids.....	Several species. Removes sap from tissues, stunts growth. Accumulation of honeydew and presence of sooty fungus. **Use nicotine dust** (21) **or pyrethrum dust** (23); **nicotine sulfate and soap** (22) **spray, or organic phosphate** (17).
European corn borer.....	See DAHLIA.
Leafhoppers.....	Several species. Sucking mouthparts feed on undersides of leaves. **Use DDT** (18) **or** (18b).
Red spider.....	See PHLOX.
Spotted cucumber beetle...	See CANNA.
Stalk borer.....	See DAHLIA.

DAHLIA

Blue mold	See BULBS, HARDY.
Mosaic (virus)	Pale green to greenish yellow bands along the veins. Symptoms vary in different varieties. Early season infection causes dwarfing. **Destroy infected plants as soon as noted. Spray to control insects to prevent spread of disease** (23, 29, 17) **or dust** (18b).
Powdery mildew	Patchy white mold over leaf surfaces. May distort terminal growth. **Dust once a week until end of season** (5), **beginning last week in August, or earlier if disease appears.**
Ring spot (virus)	Yellow or light green spots which later develop ring patterns scattered over leaves or involving a large part of the leaf or the entire leaf. Early infections may cause dwarfing of the plant. **Destroy diseased plants. Spray to control insects to prevent spread of disease** (23, 29, 17, 18b).
Root rot	Tubers soft wet rot in storage, turn black. Infection through surface breaks. **Handle tubers carefully when digging. Store at 45° F. or lower. Cover with dry sand.**
Stunt	A dwarf or weak growth. Causes are variable—virus, insect injury, drought, (especially in the early part of the season), improper nutrient condition of the soil. **Plants of ordinary varieties are best destroyed. Rare varieties should be handled in isolation plantings the following year; if stunt is due to virus, plants should be destroyed. Control insects** (23, 29, 17, 18b) **to prevent spread of disease.**
Wilt	Plants wilt. Bases of stems may rot. Brown to black streaks inside stem. Select healthy tubers. **Destroy wilted plants. Rotate** (38). **Proper drainage is important.**

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	DAHLIA—Con.
Aphids	Numerous species. Accumulation of honeydew and presence of sooty fungus. **Spray with nicotine sulfate and soap** (22) **or dust with nicotine** (21) **or pyrethrum** (23) **or organic phosphates** (17) **or** (17a).
Common stalk borer	Larvae marked with longitudinal chocolate-brown stripes interrupted on front quarter with a brown band. Mature specimens are about 1½ inches long. Tunnel inside stems causing infested branches to wilt or break. Quantities of chewings and frass at openings of tunnels and at intervals along infested stems. **Fall cleanup to eliminate over-wintering eggs; check plants frequently and remove borers by hand. Dust with DDT** (18b) **or chlordane** (20).
Cyclamen mite	See CHRYSANTHEMUM.
European corn borer	White or cream colored larvae with dark tubercles, about 1 inch long, tunneling inside stem causing branch to break over. Accumulation of frass and chewings at entrance and at various places along stems. **Keep plant covered with rotenone dust** (24), **DDT** (18b), **or parathion** (17) **from the time the fresh eggs hatch until all have been hatched.**
Potato leafhopper	Pale yellowish green insect about 1/6 inch long feeding on undersides of leaves causing tip burn. Also note presence of cast skins. **DDT** (18) **or** (18b).
Red spider	See PHLOX.
Tarnished plant bug	Blast buds. Stunt plant growth. **DDT dust** (18) **or** (18b).
White grubs	Feed on root system, stunting growth and cause plants to wilt during heat of the day. **Use lead arsenate** (13) **or parathion** (17). **Hand pick.**
Wireworms	Tunnel through underground stems; heavily infested plants may be stunted or killed. **Hand pick. Trap crop. See wireworm soil insects (page 38). Parathion** (17), **or chlordane** (20).

DAISY, SHASTA AND PYRETHRUM (Chrysanthemum spp.)

Crown gall	Large swellings on crown and roots. **Pull up and destroy affected plants.**
Leaf spot	Dark, irregular-shaped spots with lighter centers containing minute black specks. **Spray** (2) **at 10-day intervals. Sanitation** (39)
Powdery mildew	See DAHLIA.
Stem rots	Base of stem rots. Plant wilts and dies. **Pull up entire plant and burn. Rotate** (38). **Soil sterilization** (9).
Yellows (virus)	Yellowish, spindling and stunted plants that do not blossom. Many side branches. **Spray or dust with DDT** (18) **or** (18a) **to control leafhoppers. Destroy infected plants. Disease spreads from infected weeds. See six-spotted leaf hopper under ASTER, CHINA.**
Cyclamen mite	See CHRYSANTHEMUM.
Marguerite fly	Winding mines burrowed out in the leaves. Several generations. **Hand pick. Use chlordane** (20), **or parathion** (17) **on soil in vicinity of plants.**
Leafhoppers	See ASTER.
Plant bugs	See CHRYSANTHEMUM.
Red spider	See PHLOX.
Spotted cucumber beetle	See CANNA.

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	DELPHINIUM
Black spot	Irregular, tarry, black spots on leaves. Blossoms distorted, black spotted. Stems attacked. **Practice sanitation** (38). **Drench ground** (9). **Spray plants** (1), **if disease has been present. Pick off diseased leaves and burn. Avoid wetting foliage when watering.**
Crown rot	Lower leaves yellow and die. Stems rotted at and below ground. Plants die quickly. White mold over lower stems in wet weather. **Remove badly diseased plants and burn. Drench soil** (9). **Sanitation** (38). **Do not use manure to fertilize plants.**
Mosaic	Light and dark green mottling of leaves. **Destroy affected plants.**
Powdery mildew	See DAHLIA.
Cyclamen mite	Stunts young plants and blasts buds. Foliage crinkled. Severely infested plants seldom get to be more than 2-3 inches high. **Use parathion** (17).
Leafcutter bees	Circular pieces cut from flower petals or leaves and used by bees to build nest in stems of various pithy-stemmed plants such as dahlia and delphinium. Spectacular though of little importance. **Remove and burn infested stems. DDT** (18) **or** (18b).
Red spider	See PHLOX.
Stalk borer	See DAHLIA.

DIANTHUS, GARDEN PINKS, CARNATION (Dianthus)

Leaf spots	Gray spots with black centers or light brown spots with purple margins on leaves and stems. Also water-soaked pale-brown spots. **Spray** (2) **at 14-day intervals to blooming. Do not sprinkle foliage. Use only disease-free cuttings.**
Rust	Chocolate-brown powdery spots bursting through leaf surfaces. **Keep foliage dry. Dust** (5) **until blooming and after flowering.**
Wilts	Wilting, stunted growth, inside tissues brownish to greenish color. Leaves and stems softened and crush easily. **Use cuttings from healthy plants only. Root in new sand. Practice sanitation** (38). **Avoid injury to plants in cultivation. Use resistant varieties** (37).
Aphids	See DAHLIA.
Cutworms	See under Soil Insects. **Use poison bait** (14b) **or DDT** (18) **or** (18b), **or chlordane** (20).
Grasshoppers	See CALENDULA.
Plant bugs	See CHRYSANTHEMUM.
Red spider	See PHLOX.
Sow bug	See SOIL INSECTS (page 37).
Stalk borer	See DAHLIA.
Thrips	Several species, small insects 1/16 to 1/8 inch long. Blast unopened buds. Feed on both upper and lower surfaces of leaves, blasting flower buds. **See AGERATUM.**
Variegated cutworm	Larvae climb stems and eat holes in carnation buds. Work mostly at night. **Hand pick. Poison bait** (14b) **or DDT** (18b) **or chlordane** (20).

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	FORGET-ME-NOT (Myosotis)
Crown rot and wilt	See DELPHINIUM; root and crown rot.
Powdery mildew	See DAHLIA.
Yellows	See DAISY.
Aphid	See COSMOS.
Cyclamen mite	See SNAPDRAGON.
Greenhouse leaf-tier	See SNAPDRAGON.
	GAILLARDIA
Six-spotted leafhopper	See ASTER, CHINA.
	GERANIUM (Pelargonium)
Leaf spot	Small to large brown spots on leaves. Leaves soon drop off. **Plant in sunny locations. Do not sprinkle leaves. Space plants for aeration. Pick off and burn affected leaves.**
Mosaic (virus)	Foliage crinkled, yellow, or mottled. **Destroy affected plants. Use only healthy plants for propagation.**
Stem rot	Soft black rot at base of cuttings. **Sterilize cuttings** (8), **and root in new sand.**
Aphids	Several species. See COSMOS.
Cyclamen mite	Infested leaves stunted, thickened and usually with a bronze case. Infestations common on tender tissue. **See DELPHINIUM.**

	GLADIOLUS (See Michigan Special Bulletin 350, "Diseases of Gladiolus")
Bacterial leaf-blight	Water-soaked spots on leaves, enlarge and lengthen. Leaves killed. More prevalent in young stock. **Treat corms** (7d). **Rotate** (38).
Blue-green mold	Reddish-brown sunken spots, which under moist conditions soon become covered with white mold which later turns green with spores. **Avoid mechanical injuries when harvesting. Cure rapidly. Store in cool (40°F.), dry storage. Select clean firm corms to plant. Sanitation** (39) **in storage.**
Dry rot	Small reddish-brown spots on corms detectable only if husks removed. Tobacco-brown stains on husks. Corms shrivel to dry and black mummies. May have small (1/16 inch) black bodies on husks. Plants from diseased corms may soon die back from leaf-tips until whole plant is affected. **Dip corms in calomel** (7d). **Plant in new soil.**
Fusarium rot	Light tan-colored, water-soaked areas on corms which become sunken and wrinkled in concentric zones. Develops in storage. **Pull and destroy dying plants. Cure corms rapidly. Practice surface sterilization** (7d). **Rotate** (38).
Leaf spots	Leaves with gray, red or brown spots. Petals with brown spots. **Treat corms with ceresan** (7), **spray or dust leaves with Dithane Z-78** (5a).
Mosaic	Leaves mottled light and dark green, or with gray streaks. Plants dwarfed. Petals mottled or bleached. **Destroy diseased plants found in field.**
Scab	Small reddish-brown spots on leaves near bases. Elongated, eroded black areas on dry husks. Circular, brown to black crater-like depressions in corms. Lesions may fuse forming large irregular diseased areas. Central parts of lesions have shiny, varnished appearance. **Select clean corms. Practice surface sterilization** (7d). **Rotation** (38).
Yellows	Leaves yellow from tips downward. Plants die during hot weather. Brown color in core extending laterally to surface of corm. Roots rot. **Destroy infected plants or corms. Use resistant varieties** (37). **Rotate** (38).

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	GLADIOLUS—Con.
Leafhoppers	See DAHLIA.
Red spider	See PHLOX.
Tarnished plant bug	Adults feed on opening buds removing chlorophyll from the edges of the petals or blasting the blossoms. **Dust with DDT** (18).
Thrips	Infested corms with russeted surface, frequently infested corms fail to produce flowers or fail to grow. Adults feed in the open on foliage leaving injured whitened areas, color of flowers streaky, flowers worthless. **Treat cured corms with naphthalene** (28) **or DDT dust** (18b). **Spray growing plants with tartar emetic** (16) **at weekly intervals, from the time they are 6 inches high until blossoming and keep blooms cut just ahead of the opening of the first flower, or dust with DDT** (18b) **or organic phosphates** (17).
Tulip aphid	Attacks plants in storage and in the ground. Common on roots of wild lettuce. **Not advisable to grow gladiolus on sandy land seeded to wild lettuce the previous season. Fumigate corms with cyanide** (27) **before storage. Spray aphids on leaves with nicotine sulfate and soap** (22). **Use pyrethrum** (23) **or DDT** (18b) **or spray parathion** (17) **on ground in vicinity of plants.**
Fall webworm	Several caterpillars including fall webworm eat foliage and flowers. **Never a problem where plants are sprayed with tartar emetic** (16) **or DDT** (18) **for control of thrips. Hand pick.**
Wireworms	Sometimes kills plants. **Trap. Hand pick.** See SOIL INSECTS, **parathion** (17) **or chlordane** (20).
White grubs	Kill plants or cause them to wilt. **Hand pick.** See SOIL INSECTS, **parathion** (17) **or chlordane** (20).

GOLDEN GLOW

See RUDABECKIA.

GOURDS

Angular leaf spot	Spots on leaves, at first water-soaked, later chalky and angular. Exudate on lower sides of leaves. Fruits have small soaked spots which are signs of soft rot. **Practice rotation** (38) **and sanitation** (39). **Use seed treatment** (6).
Anthracnose	Reddish-brown dry leaf spots, enlarging to involve entire leaf. Stems and petioles attacked. **Use seed treatment** (6). **Spray** (1) **one-half strength.**
Downy mildew	Yellow spots on leaves with white downy mildew on lower surfaces. Heavy defoliation may occur. Stems, and other parts may be attacked. **Spray** (1) **one-half strength.**
Wilt	Wilting of leaves. Later entire plant affected. White ooze exudes from stem when cut across. **Remove and destroy diseased plants. Control cucumber beetles which carry the casual bacillus.**
Aphids	Black or dark green aphids on undersides of foliage causing plants to wilt in heat of the day. **Dust with rotenone** (24) **or pyrethrum** (23) **or nicotine 4%** (21) **or spray with nicotine-soap** (22), **or organic phosphates** (17).
Cucumber beetle	Greenish-yellow beetle with longitudinal black stripes about ¼ inch long. Adults feed on foliage and fruit. May inoculate plants with wilt. Larvae burrow in main stems and root stock. **Use calcium arsenate in gypsum** (10). **Lead arsenate or calcium arsenate in bordeaux mixture** (12, 29), **rotenone** (24).
Flea beetle	See CHINESE LANTERN. Small beetles feeding on foliage. **Use rotenone.**

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	GOURDS—Con.
Red spider	See PHLOX.
Squash bug	Dark brown "stink bugs" about 5/8 inch long. Suck sap from plant tissues as soon as it appears. Eggs laid in groups on under surfaces of leaves. Cover nodes at intervals so each vine will have several different root systems. **Cover colonies with soil. Trap.** (see page 37). **Hand pick. Spray young buds with nicotine-soap 1-400** (22) **or pyrethrum** (23) **at manufacturer's recommendations.**
Squash vine borer	Masses of frass and chewings crowded out through opening along the main vine or at the basal portion indicate the presence of the larger fleshy borer. **Induce plants to strike root at several intervals along the vine. Spray with nicotine sulfate 1-400 with soap** (22) **at weekly intervals or nicotine sulfate 1-400 plus lead arsenate 1/2 cup to 3 gallons. Dispose of vines immediately after harvest to reduce next year's supply of borers.**
	GYPSOPHILA
Graymold	Gray spots on flower buds and stems. **Pick off diseased parts. Spray** (1) **or** (2) **at 14-day intervals.**
Yellows	See ASTER, CHINA.
	HELIANTHUS
	See RUDABECKIA.
	HELIOPSIS
	See RUDIBECKIA.

	HELENIUM
Powdery mildew.....	See DAHLIA.
	HIBISCUS
Powdery mildew.....	See DAHLIA.
Rust.....	See HOLLYHOCK.
	HOLLYHOCK (Althaea)
Leaf spots.....	More or less angular brown dead areas on leaves. **Practice sanitation** (39). **Spray** (2), **if diseases have been prevalent previously.**
Rust.....	Brown or orange cushion-like 1/16 inch spots on undersides of leaves, yellow and sunken on upper surfaces of leaves. Also attack stems. **Pick off affected leaves. Dust** (5) **weekly all season as precautionary measure. Sanitation** (39).
Aphids.....	See DAHLIA.
European corn borer.....	See DAHLIA.
Leafhoppers.....	See DAHLIA.
Red spider.....	See PHLOX.
Stalk borer.....	See DAHLIA.
Thistle butterfly.....	Caterpillar folds several leaves together and fastens with a web. At first skeletonizes leaves—later defoliates plant. Caterpillar 1¼ inches long, light greenish-yellow, mottled in brown and ornamented with light fleshy spines. **Hand pick. Calcium arsenate in gypsum** (10). **Chlordane** (20 **or DDT** (18).

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	IRIS
Leaf spot	Irregular eye-spot, gray-centered with brown-bordered areas. Kills leaves after blooming period. **Practice sanitation (39) in the early spring. Dead leaves must be destroyed before new growth begins.**
Mosaic	Yellow striping and mottling of leaves. Plants stunted. **Destroy affected plants.**
Rhizome rots	Rhizomes develop dry-rot without foul odor. Roots may also rot. Leaves and shoots turn yellow and die in a few weeks. **Destroy diseased plants. Cut away rotted parts of less severely affected rhizomes and surface sterilize (7f). Dininfect (9) soil or plant in new soil.**
Soft rot	Wilting and collapse of leaves by soft rot at bases. Rhizomes rotted with foul odor. **Destroy badly diseased plants. Cut away rotted parts of rhizomes and treat (7f) then set in new soil. Practice sanitation (39). Control borers (See Iris borer).**
Aphids	Numerous species of little importance. **Use nicotine sulfate and soap (22) or use pyrethrum as a dust (23) or as a spray, or organic phosphates (17).**
Common stalk borer	See DAHLIA.
Gladiolus thrips	See GLADIOLUS.
Iris borer	Tiny larvae working as leaf miners and stem borers in June—but by July or August develop into larger larvae in the roots surrounded with slime-like rot. Infested plants wilt, become unthrifty and die. **Hand pick. Use calcium cyanide (27). Clean up and burn plant refuse before growth starts in the spring. Use parathion (17), or chlordane (20).**

Iris weevil	Small stout, black-snouted beetle with wing covers edged in grey, feeding on buds and pollen of Iris, sparing the petals. Larvae develop in the seed pods. **Destroy wild iris in the vicinity of plantings, hand pick and dispose of infested seed pods. Use DDT** (18).
Verbena bud moth	Eggs are also laid in seed pods of iris, and larvae destroy the seeds. **Enclose seed pods in sacks. Remove and destroy infested pods. Use DDT** (18) **or chlordane** (20).
	LILY, HARDY (Lilium)
Gray mold blight (Botrytis)	Small reddish-brown oval spots on leaves enlarge and become grayish in center. Brown spots on flowers. Brown lesions on stems and bulb scales. **Practice sanitation** (39). **Spray** (1) **with Penetrol (See Sec. 31.) as a spreader at rate of 1 oz. to 6 gal. of the bordeaux at 10-day intervals except during flowering, or dust** (5a), **or cuprocide dust (7 lb. of cuprocide, 30 lb. of sulfur, 63 lb. of loom-kill talc). Dip bulbs in a wettable sulfur** (3), **1 lb. to 1 gal. water and reset in new soil.**
Mosaic (virus)	Leaves mottled light and dark green. Leaves become twisted and curled, reduced in size or mottled in circular to irregular patterns without distortion or stunting. **Destroy affected plants at once. Control aphids.**
Yellow flat	Leaves pale green, curl down giving plant a flat rosette appearance. **Destroy affected plants at once.**
Aphid	See DAHLIA.
Bulb mites	See BULBS.
Red spider	See PHLOX.
Stalk borer	See DAHLIA.

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	LUPINE (Lupinus)
Leaf and stem rot	Grayish-brown spots on basal leaves and on stems. **Cut back and burn affected parts. Practice sanitation** (39). **Spray** (2) **at 14-day intervals until blooming.**
Powdery mildew	See DAHLIA.
Flea beetle	See CHINESE LANTERN.
Leafhopper	See DAHLIA.
Plant bugs	See CHRYSANTHEMUM.
Red spider	See PHLOX.
	MARIGOLD (Tagetes)
Fusarium wilt	Severe wilting, stems turn brown and shrivel at ground level. Roots decay. **Destroy affected plants. Rotate** (38).
Yellows	See ASTER, CHINA.
Aphids	See DAHLIA.
Blister beetles	See ASTERS.
Leafhoppers	See DAHLIA.
Plant bugs	See CHRYSANTHEMUM.
Red spider	See PHLOX.
Thrips	See AGERATUM.

	MIGNONETTE (Reseda)
Blight	Small circular pale yellow areas soon merge killing entire leaves. **Spray (1) at 1/2 strength at 7-day intervals. Practice sanitation (39).**
Yellows	See ASTER, CHINA.
Cabbage worms	See ALYSSUM.
Corn earworm	Larger caterpillar resembling a cutworm eating the petals off at their bases. **Hand pick. Use pyrethrum (23). DDT (18) or chlordane (20).**
Red spider	See PHLOX.
	MONKSHOOD (Aconitum)
Crown rot	Plants turn yellow, wilt. Black streaks in stems and roots. See DELPHINIUM.
Mosaic	See DELPHINIUM.
	MORNING GLORY (Ipomaea)
Tortoise beetles	Several species. Brilliant, irridescent changeable green-gold beetle, somewhat compressed, but resembling lady-bird beetle. Defoliates. Seldom important in Michigan. **Hand pick. DDT (18).**
	NASTURTIUM (Tropaeolum)
Aphids	Black aphids congregated on terminal growths on undersides of the leaves. **Pyrethrum (23) or nicotine dust (21) or nicotine sulfate and soap (22) as a spray, or organic phosphates (17).**
Cabbage worms	See ALYSSUM.

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	PANSY, VIOLA, VIOLET (Viola)
Leaf spots	Small greenish-yellow or brown spots which enlarge or affect entire leaves. **Spray** (2) **at 14-day intervals after blooms are picked. Do not sprinkle foliage. Practice sanitation** (39).
Scab	Bright yellowish-brown to whitish spots on leaves, and stems. **Spray** (2) **at 10-day intervals. Do not use seed from diseased plants.**
Aphids	Several species. **Use pyrethrum** (23), **or parathion** (17).
Cutworms	See SOIL INSECTS. **Use poison bait** (14b), **DDT** (18), **or chlordane** (20), **or parathion** (17) **as spray over ground in vicinity of plants.**
Garden slugs	See SOIL INSECTS (page 37).
Red spiders	See PHLOX. **Use parathion** (17).
Sow bugs	See SOIL INSECTS (page 37).
Variegated fritillary	Caterpillars sometimes cause serious damage to foliage. Mature specimens 1¼ inches long, orange-red with whitish longitudinal bands and ornamented with prominent black spines bearing tubercles. **Hand pick. Chlordane** (20) **or DDT** (18).
Wireworms	See SOIL INSECTS. **Trap and hand pick. Water ground with chlordane** (20) **or parathion** (17).

PEONY (Paeonia)

Crown elongation	Many weak spindly shoots develop which do not bloom. **Pull up entire plant and destroy.**
Gray mold blight (Botrytis)	Dark brown to black areas on leaves which become soft and covered with gray felt in wet weather. Stems may show brown cankers just below soil level which result in wilting of entire branch. Blossoms and buds turn dark brown and rot. **Practice thorough sanitation** (39), **cutting stalks below soil level in autumn and sprinkle 1 to 2 tablespoons of copper carbonate around dormant buds of plants in September. Do not mulch in winter. Spray** (1) **plus sticker (1 ounce of Penetrol to 6 gallons of bordeaux)** (31) **at 14-day intervals, beginning when shoots are 3 inches high to blooming time and after flowering. Plant in open, sunny places.**
Leaf mold	Large irregular brown to purplish areas on leaves which become olive-green in wet weather. Occurs after blooming. **Practice sanitation** (39).
Ring spot or mosaic	Yellow areas on leaves of some shoots, which often show concentric ring or band arrangement. No dwarfing. **Remove and burn diseased plants including roots, so latter cannot be used for propagation.**
Root knot (nematodes)	Small to large brown swellings on roots. Excessive number of erect wiry shoots. Plants stunted and do not blossom. **Practice rotation** (38). **Destroy affected plants. Treat roots of especially valuable varieties** (7e).
Ants	Affect numerous species. Attracted to peonies when in bloom because of nectar glands on stems. Ants often nest under plants at this time, sometimes loosening the soil about the roots and pushing the plant out of the ground. **Dust with DDT** (18). **Use chlordane** (20), **or parathion** (17).

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	PEONY (Paeonia)—Con.
Plant bugs	Deform buds. See CHRYSANTHEMUM.
Rose chafer	Long-legged, awkward, grayish brown beetles about ½ inch long. Appear in swarms about the time peonies bloom. **Pyrethrum with mannitan monolaureate spreader (23). Mechanical barriers such as cloth or screen cages. 10% DDT dust or DDT sprays (18) or (18b).**
Thrips	See DIANTHUS.
	PETUNIA
Mosaic (virus)	Light and dark green mottling of leaves. Causes distortion of leaves and dwarfing of plant. **Remove and burn affected plants at once.**
Stem and root rot	Yellowing and dying of lower leaves. Rotting of stem at ground level followed by decay of roots. One type is a seed-borne disease. **Treat seed (6). Rotate (38). Dig up and burn diseased plants.**
Cycleman mite	See SNAPDRAGON. **Parathion (17).**
Flea beetle	See CHINESE LANTERN.
Red spider	See PHLOX.

PHLOX

Leaf blight	Dying of leaves progressively upward from bases of stems. **No control known. Replace with non-susceptible varieties.**
Leaf spot	Small dark-brown circular spots up to 1/8 inch in diameter. Appears first on lower leaves. Spots merge, forming larger blotches, leaves killed. Plants are stunted and bloom is sparse. **Dust** (4) **or spray** (1) **at 7-day intervals until plants bloom and after flowering.**
Nematodes	Root knot, small fleshy swellings on roots. Plants stunted. **Remove and burn affected plants. Rotate** (38).
Nematodes, foliar	Stems and leaves distorted, swollen places on stems and leaves may crack. **Remove and burn affected plants.**
Powdery mildew	See DAHLIA.
Blister beetles	See ASTER, CHINA.
Corn earworm	Caterpillar likes to feed on open blossom. **Hand pick. Use pyrethrum dust** (23), **DDT** (18b) **or chlordane** (20).
Plant bugs	See CHRYSANTHEMUM.
Red spider	Mites collect on undersides of lower leaves. Infested leaves dry and drop. Plant sheds leaves from the base up. Always more of a problem with plants on sandy soil. **Rotenone dust** (24) **or rotenone-sulfonated castor oil spray** (24), **or organic phosphates** (17).

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	POPPY (Papaver)
Blight	Water soaked spots on leaves. Stems and flowers, which turn black. Defoliation. **Sanitation** (39). **Collect seeds only from healthy plants.**
Downy mildew	Seedling blighted. Pale green spots on leaves of older plants, with white mold often covering spots. Stems distorted, plants fail to bloom. **Spray** (1) **beginning when seedlings are 1 inch high at 14-day intervals until blooms open. Use seed from disease-free plants.**
Yellows	See ASTER, CHINA.
Aphids	Several species. Remove sap from foliage. **Use nicotine sulfate and soap** (22) **or dust with pyrethrum** (23) **or nicotine** (21). **Use organic phosphates** (17).
	RUDBECKIA, GOLDEN GLOW, HELIANTHUS, HELIOPSIS
Aphids	Several species. The larger red aphids infesting terminal stems are abundant in summer and fall. See DAHLIA.
Stalk borer	See DAHLIA.
	SALVIA
Red spider	See PHLOX.

SNAPDRAGON (Antirrhinum)

Blight	Pale brown to gray sunken spots with darker border on leaves and stems. **Spray (1) or (2) at 10-day intervals if disease appears. Do not wet foliage when watering.**
Damping-off	Seedlings under crowded moist conditions wilt and collapse. Black or brown water-soaked decay at ground line. **Avoid over watering seedbeds. Top-dress seedbed with 1/2 inch clean, washed sand. Treat seeds (6) before sowing. Sterilize (9) soil for beds and seed flats.**
Gray mold (Botrytis)	Branches and flower spikes may wilt. Light brown areas at bases of flower stalks. Light brown to gray spore masses on lesions in wet weather. **Cut off and burn affected parts. Keep plants well spaced for ventilation. Sanitation (39).**
Root knot	See CHRYSANTHEMUM.
Rust	Brown, powdery pustules on lower surfaces of leaves and on stems. **Use resistant varieties (37). Practice sanitation (39).**
Aphids	See DAHLIA.
Cutworm	See CUTWORMS under PANSY.
Cyclamen mite	Microscopic pearl white mites infesting terminal growth causing "rosette" or "buttoning". Also found on foliage causing distortion. **Use parathion (17).**
Greenhouse leaf-tier	Small greenish caterpillars about ¾ inch long feeding when young as skeletonizer, later rolling the foliage together and fasten with a web when they defoliate plants and later pupate within nest. **Hand-pick. Chlordane (20) or parathion (17).**
Red spider	See PHLOX.

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
	SOIL-BORNE DISEASES OF GENERAL IMPORTANCE
Damping-off.....	Plants are subject to attacks by several soil-inhabiting fungi while they are in the seedling stages. The seedlings wilt, fall over and die, owing to rotting of the stem at the soil level or by rotting of the roots. **Seedbed soils should be sterilized. Use formaldehyde, 1 part to 50 parts of water at the rate of 1/2 to one gallon per square foot of soil. If soil is dry it may be necessary to use lower dilution, 1 part to 30 of water. The soil should be in a loose friable condition. Sprinkle formaldehyde solution on soil, then water and cover it with canvas or wet papers, for 48 hours. Remove cover, work over soil and allow to dry for several days to remove formaldehyde gas before sowing seed.**
	SOIL-INFESTING INSECTS AND ALLIES OF INSECTS MAY ATTACK ANY AND ALL TYPES OF PLANTS
Ants.....	A number of species. Common in sandy soil. Some species form a common nest or hill while others have underground tunnels with many openings. Capable of destroying vegetation, also harbor plant lice and scale insects in their nests. **Inject carbon disulfide** (26) **or calcium cyanide** (27) **into nest and plug opening (do not apply this treatment within 2 feet of shrubs or annuals). 4% chlordane dusts are very efficient against ants** (20). **Where colonies are established around plants such as rose bushes or peonies dike around the nest and flood with nicotine sulfate, 1 ounce in 6 gallons soap suds, using 2-1/2 to 3 gallons to each square foot treated. It may be necessary to repeat this application from time to time.**
Bees.....	Several species. Solitary bees burrow into soil. Especially destructive to sun-exposed terraced lawns. Adults are valuable pollenizers. **To kill adults, spray with fly spray in heat of day when bees are on wing. To kill larvae in soil inject carbon disulfide** (26) **or granular calcium cyanide** (27) **into the nest and close the opening. Apply DDT** (18) **or chlordane** (20) **to the soil around infested area.**

Cutworms	Several species winter over in soil as immature larvae ready to attack vegetation in early spring. **Spread poison bait before planting** (14b), **or spray or dust with DDT** (18) **or chlordane** (20).
Earthworm	Common angle worm. Presence of worms on lawns and on walks is objectionable as well as are piles of castings on grass sods. **Use mercuric chloride** (15).
Millipeds	Common spring and fall on well fertilized lawns. Occasionally injure seedlings or attack roots of plants. May girdle plants at ground level. **Use poison bait** (14b). **Flood infested area with a contact spray** (18) **or** (22). **Open up area to air and sunshine.**
Slugs	Soft bodied mollusks, common in damp places where they can find protection. Their bodies are coated with a slime-like covering which leaves a trail wherever they move—this when dry, takes on a silver color. Attack petals and foliage. **Metaldehyde bait under boards** (14d). **Use cinders or a dust** (30) **to check travel. Spray or dust foliage with lead arsenate** (12) **or DDT** (18).
Sod webworm	Colonies of caterpillars around grass roots more or less protected with silken webs or on planting where the soil has recently been in grass sod. **Not a problem where the soil has been treated with lead arsenate. Use nicotine sulfate and soap** (22) **at the strength recommended for the control of aphids to kill colonies in soil (2-1/2 gallons per square foot). Chlordane** (20) **or parathion** (17).
Sow bug or pill bug	Flat-bodied crustaceans with 7 pairs of legs, common in damp places where the soil contains an abundance of organic matter. They feed on roots and tender portions of plants. **Poison bait [see cutworms** (14b)**] or 9 parts sugar with 1 part paris green—apply dry.**
Squash bug	**To trap, place shingle or small piece of board on ground near base of plant. Examine every morning to destroy bugs.**
White grubs	Several species. Adults known as May or June beetles. Grubs feed on grass roots. If numerous may shear the grass free from the roots making it possible to roll the sod up. **Use lead arsenate in soil** (13). **Hand-pick.**

INSECTS AND DISEASES	CHARACTERISTICS AND CONTROL
Wireworms	A number of species. Adults known as click beetles. Eggs laid in sod and larvae feed on roots of grass, bulbs, and underground stems of different plants. **Trap with sprouting grain, such as barley or corn, and hand-pick or kill with calcium cyanide** (27). **Try mixing chlordane dust** (20) **with soil.**
	SPEEDWELL
	See VERONICA.
	STOCKS (Matthiola)
Bacterial blight	Dark water-soaked areas on stems which later turn brown. Leaves yellowish. Seedlings wilt. **Destroy affected plants. Use certified seed.**
Club root	Small roots rot and larger roots develop galls. **Destroy affected plants. Rotate** (38).
Damping-off	Collapse of seedlings and older plants. See SNAPDRAGON, and SOIL-BORNE DISEASES page 36.
Foot rot	Roots rot, base of stem girdled with black canker. Seedlings "damp-off". **Destroy affected plants. Sterilize** (9) **soil. Rotate** (38). **Plant resistant varieties** (37).
Mosaic	Mottled light and dark green leaves. Petal colors "break" i.e., show bleaching and streaking. **Destroy affected plants. Control aphids** (23, 21, 22).
Diamond-backed moth	See CANDYTUFT.
Flea beetle	See CHINESE LANTERN.
Red spider	See PHLOX.

SWEET PEA (Lathyrus)

Anthracnose	White spots on leaves. Shoot tips and flower stalks dry up. Seed pods shrivel and bleach. Leaves drop. **Practice sanitation** (39). **Treat seeds** (6).
Fasciation	Dense growth of short fleshy thick stems one to three inches long at bases of plants. Plants dwarfed but bloom. **Soil sterilization** (9). **Treat seeds** (6).
Powdery mildew	See DAHLIA.
Root rots	Roots decay, plants dwarfed and yellowish. Seedlings "damp-off". **Sterilize soil** (9). **Rotate** (38).
Mosaic (virus)	Mottled, light and dark green leaves which curl. Plants dwarfed, when flowers form show bleaching in streaks of color i.e., "breaking." **Destroy diseased plants. Control insects.**
Spotted wilt (virus)	More or less circular yellow spots with indefinite borders on leaves. These turn brown. Bleached spots on petals. Reddish-brown streaks on stems similar to bacterial streak. **Destroy diseased plants promptly. Control insects.**
Streak	Reddish-brown streaks on stems, flower stalks, flowers and pods. Small dark brown spots on leaves, which enlarge into irregular dead areas. **Treat seeds** (6). **Practice sanitation** (39).
Aphids	Large green or pink aphids infesting stems and leaves in June-July. Stunt growth. Cause accumulation of honeydew and appearance of sooty fungus. **Use nicotine sulfate and soap** (22) **or dust with nicotine dust 4%** (21) **or pyrethrum** (23), **or organic phosphates** (17).
Plant bugs	See CHRYSANTHEMUM.
Red spider	See PHLOX.
Sow bugs or pill bugs	See SOIL.

	VERBENA
Mosaic	Greenish yellow mottling of young leaves. **Pull up and burn affected plants. Control insects.**
Powdery mildew	See DAHLIA.
Aphids	Several species. See CALENDULA.
Blister beetles	See ASTER, CHINA.
Budworm	A greenish-yellow larvae about ½ inch long when mature, burrowing into new shoots and causing them to wither. **Clip and destroy infested terminals. Use chlordane (20) or DDT (18).**
Cutworms	See SOIL.
Cyclamen mite	See SNAPDRAGON.
Red spider	See PHLOX.
Thrips	See DIANTHUS.

	VERONICA
Aphids	See COSMOS.
Lace bugs	See CHRYSANTHEMUM.
Plant bugs	See CHRYSANTHEMUM.
Red spider	See PHLOX.
Stalk borer	See DAHLIA.

	VIOLET
Violet	See PANSY.
	ZINNIA
Powdery mildew	See DAHLIA.
Spotted wilt (virus)	See ASTER, CHINA.
Yellows (virus)	See ASTER.
Aphids	See COSMOS or DAHLIA.
Blister beetle	See ASTERS.
Cutworms	Several species. They cut plants off at ground level in early spring. In late summer larvae feed on petals. **See under PANSY.**
European corn borer	See DAHLIA.
Leafhopper	See DAHLIA.
Plant bugs	See DAHLIA.
Spotted cucumber beetle	See CANNA.
Stalk borer	See DAHLIA.

Spraying and Dusting Materials

Disease and insect control materials can be divided into three groups according to the purpose for which they are used. (A) fungicides, materials used to control diseases; (B) insecticides, materials used to control insects; (C) accessory materials, materials used as activators, spreaders, stickers, and correctives.

FUNGICIDES

In general, spraying, dusting and disinfecting materials used to control diseases contain either copper, sulfur, or mercury. Some of the common fungicides used for garden plants are:

SPRAYING MATERIALS

1.* **Bordeaux mixture**—Bordeaux mixture is a mixture of copper sulfate and lime. It is used to control several foliage diseases on garden flowers. Bordeaux is being replaced as a fungicide in sprays by proprietary copper compounds because of the ease of mixing and storing of the latter materials. The formula for bordeaux varies in the amount of copper sulfate and lime, depending upon the disease to be controlled. The formula 4-6-50 is in common use for the control of diseases affecting garden flowers. In a formula for bordeaux, the first figure always signifies the amount of copper sulfate in pounds, the second figure the amount of fresh hydrated spray lime in pounds, and the third figure the amount of water in gallons.

Copper sulfate is obtainable in three grades based on particle size. These grades are referred to by the trade as powdered, snow, and small and large crystals. The powdered and snow grades are recommended for convenience in the preparation of bordeaux.

Only fresh hydrated lime prepared for spraying purposes should be used in the preparation of bordeaux. Mason's hydrate and agricultural lime are not satisfactory.

To make a 4-6-50 bordeaux:

For 50 gallons,

1. Fill tank 2/3 full of water and have agitator running.
2. Add 6 pounds spray lime to tank opening strainer and wash through.
3. Dissolve 4 pounds of copper sulfate in a pail of water and pour slowly through strainer into tank.
4. Add water to make 50 gallons.

*Control measures throughout the preceding portion of this bulletin are given code numbers in parentheses. These numbers refer to corresponding numbers on this and following pages.

For 1 gallon,

1. Add 2 ounces (10 tablespoonfuls) spray lime to 2 quarts of water. Stir thoroughly.
2. Dissolve 1 1/3 ounces (4 tablespoonfuls) of copper sulfate in 2 quarts of water with constant stirring.
3. Pour 1 and 2 together into sprayer with constant stirring.

For larger amounts, use equivalent quantities.

2. Proprietary copper compounds—Proprietary copper compounds are manufactured copper fungicides containing copper in a relatively low soluble form. They are sold under various tradenames. A partial list of these materials includes, Basicop, Bordow, Cupro K, Cuprocide, COCS, Oxobordeaux, Spraycop, Tennessee 26, Tennessee 34, and Tri-Basic. Proprietary copper materials can be used as substitutes for bordeaux in the control of a number of plant diseases. They are less injurious to plants, vary in copper content and should be used according to manufacturers' recommendations.

3. Wettable sulfurs—Wettable sulfurs contain finely divided particles of elemental sulfur to which a wetting agent has been added. They can be obtained in both the dry and paste forms. Wettable sulfurs are sold under various tradenames. A partial list of wettable sulfurs include Dritomic, Flotation paste, Flotox, Kolofog, Magnetic, Mike, Sulfix, Sulforon and 3 M. They vary in sulfur content and particle size. The products containing the largest amount of sulfur and the smallest sized particles are the most effective. In general, the amount of the dry form to use is 4 to 5 tablespoons to one gallon or 1 to 1½ pounds to 20 gallons of water, or 5 to 8 pounds to 100 gallons of water. Wettable sulfurs are protective fungicides, and the plants must be kept covered ahead of and during infection periods if good control is to be obtained.

3a. Organic fungicides—Within the past few years new organic fungicides have been made available for disease control. A partial list of these materials includes such trade names as: fermate, karbam, dithane, parzate, zerlate, puratized N5-E, and phygon. Fermate and karbam (ferricdimethyldithiocarbamate) have been sufficiently tested to be recommended for the control of certain diseases on ornamental plants. Fermate and karbam should be used at the rate of 1½ pounds to 100 gallons of water to give adequate protection against plant diseases during the growing period. Hydrated lime should not be used with these two materials.

3b. Zinc—Dithane Z-78 or Parzate, 1½ pounds to 100 gallons of water (1 oz. to 4 gallons) are new fungicides effective in the control of leaf diseases, especially on gladiolus. Use a wetting agent like Triton 1956-B or DuPont spreader-sticker with these sprays.

3c. Formalin—Contains formaldehyde and is used for disinfecting seeds, tools, soil, etc. For disinfecting soil use formalin 1 part to 50 parts water. Apply at the rate of ½ gallon per square foot with a sprinkling can.

Cover treated area with paper, canvas or boards for 48 hours. Stir soil thoroughly to aerate it. Do not replant in treated soil for at least ten days or until all odor disappears.

3d. Chloropycrin—Satisfactory for sterilizing small areas of soil. The soil needs loosening by spading and should be of proper moisture content. Follow manufacturer's directions.

3e. Methyl bromide is being used experimentally for control of certain insects, diseases, and weeds. Dangerous and should be used only by trained personnel.

DUSTING MATERIALS

4. Copper dusts—Two kinds of copper dusts are available as fungicides: (a) monohydrated copper sulfate-lime dust and (b) proprietary copper dusts. The monohydrated copper sulfate-lime dust is usually prepared by mixing 20 parts by weight of monohydrated copper sulfate and 80 parts of fresh hydrated spraying lime and is known as a 20-80 copper-lime dust. The proprietary copper dusts are prepared by mixing a proprietary copper material with some inert material as talc for a carrier. The proportion of proprietary copper compound to the diluent varies with the copper content and the disease to be controlled. In general the dust should contain 5 to 7 percent metallic copper. For example, a 5-percent copper dust prepared from a proprietary copper compound containing 25 percent metallic copper would contain 4 pounds of the copper compound and 16 pounds of talc.

5. Sulfur dusts—Sulfur dusts contain finely divided particles of elemental sulfur to which a conditioner has been added to make it flow readily. They are usually high in sulfur content and can be used as straight sulfur dusts or diluted with other materials.

5a. Zinc dusts—Dusts containing Dithane Z-78 and Parzate are safe and effective in the control of many leaf diseases.

FUNGICIDES FOR SPECIAL TREATMENTS

6. Seed treatment—Semesan is used as a dust for thinly coating the seeds and applied just before sowing. It is one of the most satisfactory protectants for flower seeds. Do not use more dust than will adhere to the seed when dust and seed are shaken in a closed container.

7. Bulb and corm treatments for disease control:

(a) **Daffodils**

Use special "2% Ceresan" or "Semesan" according to manufacturer's directions in container.

(b) **Daffodils** (Nematodes)

Soak bulbs 2½ hours in hot water maintained constantly at 110° to 111½° F. Cool quickly in cold water following treatment.

(c) **Dahlia**

Use Semesan, 1 ounce to 3 gallons of water. Soak tubers 1 hour and plant immediately.

(d) **Gladiolus**

Use 1 ounce of Ceresan in 3 gallons of water, adding enough Dreft to make the powder wettable. Soak corms for 15 minutes just before planting. Or use Calomel, 1 pound to 5 gallons of water with a wetting agent such as Dreft. Dip corms for 1 minute to wet thoroughly. Plant at once.

(e) **Peony**

Soak divisions 10 minutes 100° F., then transfer immediately to hot water maintained constantly at 120° F., for 30 minutes. Remove and cool immediately in cold water and plant if possible in medium to heavy clay loam soil. Mulch roots after ground freezes with light covering of straw or leaves for first winter after treatment.

(f) **Tulips**

Use Semesan, 1 ounce in 3 gallons of water, or a 1-120 solution of formaldehyde. Soak bulbs 1-2 hours just prior to planting.

8. **Cuttings treatment**—Use 1 ounce Semesan to 3 gallons of water. Soak cuttings 30 minutes just before setting in cutting bench.

9. **Soil drench**—1 ounce of Semesan to 3 gallons of water. Drench soil around plants to be treated. See p. 36.

9a. **Turf treatment**—Two parts mercury chloride (corrosive sublimate) and 1 part mercurous chloride (calomel) are mixed together and applied at the rate of 3 ounces per 1,000 square feet for control of brown patch and dollar spot on turf. The common way of using the 2-1 mixture is to thoroughly combine the proper dosage of the chemicals for 1,000 square feet with 2 cubic feet of dry screened sand or soil to enable uniform spreading, broadcast, and wash into the soil by heavy sprinkling. In extremely hot weather reduce dosage to 2 ounces per 1,000 square feet of turf. This treatment also kills some earthworms.

INSECTICIDES

Materials used to control insects can be divided into three groups: (a) stomach poisons—those used to control leaf eating insects, such as caterpillars, beetles, and slugs; (b) contact insecticides—those used to control

sucking insects such as mites, aphids, and leafhoppers; (c) fumigants—materials which control insects by giving off poisonous gases; (d) repellents.

STOMACH POISONS

Stomach poisons in general use contain arsenic, fluorine, or rotenone.

10. Calcium arsenate—Usually not considered as safe on foliage as lead arsenate. Fresh calcium arsenate seldom causes injury. It is used at the rate of 1½ to 3 pounds per 100 gallons of spray, or 2 tablespoonfuls per gallon of spray. As a dust, it can be used undiluted or with diluent.

Calcium arsenate 1 part and gypsum 19 parts give a satisfactory dust for the control of many leaf-eating caterpillars and beetles. The dust is too heavy to apply with a duster, and it is necessary to use a shaker or a burlap bag.

11. Cryolite—Natural or synthetic. It is a stomach poison often recommended for the control of certain beetles. It contains fluorine and is very poisonous to animals and man. It is usually applied as a dust, one part cryolite to one part bland carrier such as pyrophylite, flour, or talc. It is not compatible with any alkalines nor with many of the common insecticides and fungicides.

12. Lead arsenate—This is the standard stomach poison used to control chewing insects. Use 2 to 3 tablespoons to a gallon of water, plus ½ cup of milk.

Lead arsenate is compatible with fungicides and contact poisons.

13. Lead arsenate in soil—Turf may be protected against the various root feeding grubs similar to the white grub by incorporating lead arsenate in the upper 3 inches of soil at the rate of 10 pounds per 1,000 square feet. Treatment is usually made while building a lawn by thoroughly screening together lead arsenate and dry topsoil or sand in the proportion of 10 pounds lead arsenate to 2 cubic feet of topsoil or sand. The mixture is then spread evenly over the fitted ground at the stated rate, worked into the top 3 inches, the seed or stolons planted, or the sod laid.

Established turf is treated by spreading a lead arsenate-soil or lead arsenate-sand mixture evenly over the grassy surface as a topdressing and sprinkling, or allowing the rain, to wash it down about the grass roots. However, instead of using one application of lead arsenate on established turf at the rate of 10 pounds per 1,000 square feet, two applications made approximately 6 months apart, at the rate of 5 pounds of lead arsenate per 1,000 square feet should be made to avoid injury. This method is not so effective as grub proofing done when a lawn is made.

Extremely alkaline or extremely acid soils are more difficult to protect.

14. Poison bait—Several different combinations are used as poison bait, each of which fits a particular need.

A. For grasshoppers

INGREDIENTS	SMALL QUANTITIES	LARGE QUANTITIES
*White arsenic	4 ounces	5 pounds
Salt	4 ounces	5 pounds
Molasses	1 pint	2 gallons
Bran	5 pounds	100 pounds
	(1 lemon ground)	Banana oil 3 ounces
Water—enough to make finished bait "form" when squeezed.		

*Paris green or sodium fluosilicate may be substituted for white arsenic. **(Never use lead arsenate in bait.)**

Combine the poison, the molasses, and the salt in 3 pints of water for small quantities or in 6 gallons of water for large quantities and work into the bran until the bran is thoroughly wetted adding more water as needed and last of all, add the banana oil.

To control grasshoppers, spread **in the forenoon** at the rate of 10 to 20 pounds per acre.

B. For cutworms. The same combination is used to control cutworms except the salt is omitted. To control cutworms spread bait **late in the afternoon or early evening** and use 20 to 40 pounds per acre (one pound per 1,000 square feet).

C. To control strawberry root weevil, the same combination used to kill cutworms can be used profitably but better results will follow if oil of apple is substituted for banana oil. This bait should be under boards, sacks, or in covered trenches so it will remain moist. The beetles like to congregate in dark protected places and feed.

D. Metaldehyde baits attract slugs. There are several proprietary preparations on the market using this material as a killing agent among which are Bug-Geta, Orione, and Slug-O. To prepare a home mixed bait:

INGREDIENTS	QUANTITIES
Molasses	2 tablespoonfuls
Calcium arsenate	1 ounce (2 tablespoonfuls)
Metaldehyde	0.5 ounces (1 tablespoonful)
Bran	1 pound
Water	1 pint

E. Sow bugs are attracted to fresh vegetables coated with paris green or white arsenic. An old and well tried bait is made by combining nine parts powdered sugar with one part paris green. This bait is effective so long as it is dry.

F. A very convenient bait for cutworms can be made by using: 2 pounds dandelions chopped fine, 1 ounce sodium fluosilicate, or (paris green) or (white arsenic).

Where proper precautions are followed, it is safe to use poison bait.

1. In garden, avoid permitting the bait to touch plants, otherwise burning will follow.
2. Wash hands thoroughly after handling poison bait.
3. See that livestock do not gain access to the bait before it is spread.
4. Clean all utensils thoroughly and do not store or allow any accumulation of bait to stand.

15. Mercuric chloride—Soaking 2 hours is sufficient for disease control. See Sec. 27, 28, 18, and 7. It is advisable to make this treatment just before planting. **Use an earthen, glass, or wooden container since there is a corrosive reaction with metal.**

To control earthworms use 2 to 3 ounces mercuric chloride to 50 gallons of water. This is sufficient to treat 1,000 square feet and wash into the soil with at least twice the amount of water. Where applied dry, use 2 to 3 ounces per 2 cubic feet of sand or dry soil per each 100 square feet and water liberally.

16. Tartar emetic—To control gladiolus thrips on growing plants.

INGREDIENTS	SMALL QUANTITIES	LARGE QUANTITIES
Tartar emetic	1 ounce	2 pounds
Brown sugar	2 ounces	4 pounds
Water	3 gallons	100 gallons

Apply as a mist and cease spraying before droplets unite. Start spraying when plants are 6 inches above ground and spray weekly up to the time buds show color.

CONTACT INSECTICIDES

17. Phosphates—Organic phosphates (HETP, TEP, and parathion) are very effective against small insects and mites. The only organic phosphate with a pronounced residual effect is parathion. Parathion 15% wettable powder one pound per 100 gallons has given excellent control of mites. Organic phosphate insecticides are very poisonous and should be handled with care and according to the printed directions of the manufacturer.

18. DDT, Dichloro-diphenyl-trichloroethane—Effective against many insects. It is especially effective against leaf hoppers, small beetles, caterpillars and bugs. DDT kills some aphids, others are unaffected. DDT is not compatible with lime-sulfur and alkalies, but may be used with bordeaux. DDT is a waxy substance and must be formulated correctly for use. It is not always a quick killer like pyrethrum and nicotine. Wettable powders are the safest form for foliage application.

18a. DDT 5% in oil solution is recommended for treating certain borers by injection into the holes made by the insects. A mechanic's oil can is a convenient applicator. DDT oil sprays are too erratic for general foliage application.

18b. DDT is ground with various talcs, clays, etc., to form wettable powders. DDT is safe on foliage in this form. Privet, bleeding heart and delphinium are commonly likely to be injured by it. Two pounds of 50% wettable powder per 100 gallons of spray is a common dosage and is effective against a wide range of insects.

18c. DDT 50% wettable powder and fixed nicotine make an effective combination. Nicotine gives quick kill and those insects not killed by it are irritated. The DDT in the combination is residual and the killing effect is prolonged by its presence. The fixed nicotine combination is especially effective against insects feeding inside webbing. Three pounds of wettable powder DDT 50% and 3 pounds of fixed nicotine make an effective long-lasting combination. DDT also kills certain beneficial insects such as bees, and the U. S. Public Health Service is investigating the health hazards involved. This Agency advises caution in the use of the material until more is known concerning its effect on man and other warm-blooded animals.

19. Dicyclohexylamine salt of dinitro-ortho cyclohexylphenol (DN-111)—DN-111 is a specific for mites on foliage. It can be applied in sprays with lead arsenate and wettable sulfurs. It is incompatible with oils and alkalis. Use according to manufacturers' recommendations.

20. Chlordane—Sold as a wettable powder (40-50%) or as a dust (2-4%). Wettable powder chlordane is used at the rate of 2-2½ pounds per 100 gallons of spray. Chlordane is excellent for cutworm and ant control. The 2-4% dust will probably be best for ant control. Two pounds of 4% chlordane dust mixed into the top 4 inches of soil will kill the grubs and wireworms in 100 square feet of soil.

21. Nicotine dusts—Various strengths of commercial nicotine dusts are available. To make a fresh nicotine dust use:

For a 2% dust—2 pints nicotine sulfate to 50 pounds hydrated lime or in small lots 4 ounces to 5 pounds. For a 3% dust—3 pints nicotine sulfate to 50 pounds hydrated lime or 6 ounces to 5 pounds. (Or place ½ pound hydrated lime in a tight container and add ½ teaspoonful nicotine sulfate.)

Nicotine dusts give the best results when no wind is blowing and when applied during the heat of the day. Where possible, confine the fumes under a cover for 3 to 5 minutes. (See tobacco dust, Section 25.)

22. Nicotine sulfate, 40%—A contact spray used with soap or other alkaline activating agents in spray.

Standard mixture: 1 pint to 100 gallons spray, plus 4 to 6 pounds dissolved soap. (In small quantities, use 1 teaspoonful to a gallon warm soap suds—2 tablespoonfuls to 5 gallons warm soap suds.)—See Sec. 32.

23. Pyrethrum—Pyrethrum is a plant product. It is specific for certain insects such as aphids and when used with a high pyrethrin content and with a good wetting agent, it gives the best control yet offered for rose chafers. Since different brands vary as to pyrethrin content follow the suggestions of the manufacturer. Pyrethrum is harmless to warm-blooded animals.

24. Rotenone, Derris, Cube—Obtained from the roots of tropical plants. A very effective spray to control mites, thrips, aphids, and other soft-bodied insects is made with the following combination:

INGREDIENTS	SMALL QUANTITIES	LARGE QUANTITIES
Rotenone 4%.....	4½ tablespoonfuls	10 ounces
Pyrethrum extract(2% Pyrethrins).	8 tablespoonfuls	2 quarts
*Sulfonated castor oil.....	2 tablespoonfuls	1 pint
Water.....	3 gallons	50 gallons

*Also called Turkey red oil.

Add the sulfonated castor oil to the water and with a small quantity of the combination make the powder into a paste and agitate. Two or more applications at 10-day intervals. The pyrethrum is added to take care of cyclamen mites and thrips (not gladiolus thrips).

Rotenone dusts combined with sulfur form a very satisfactory dust for control of cyclamen mite. Combinations commonly used are 1 part rotenone to 3 parts dusting sulfur. There are several commercial brands available in which rotenone, sulfur and usually proprietary coppers are the main ingredients. Do not expect a maximum kill with rotenone until 48 hours after application.

25. Tobacco dust—Differs from nicotine dusts in that it is nicotine on a non-alkaline or neutral carrier and has the advantage that it can be used where lime would not be desirable. The strength varies with different brands and it is necessary to follow the manufacturer's recommendations. When it is necessary to cut the strength, be careful to use a neutral carrier such as talc.

This material is very satisfactory to work in around the roots of plants to control aphids and where only a small number of bulbs or corms are to be stored a 3 or 4 percent tobacco dust is practical and effective. (See nicotine dust, Section 21.)

26. Carbon disulfide is explosive.

27. Granular calcium cyanide—To kill ants or bees nesting in the soil inject from ½ to 1 teaspoonful into the nest at intervals of 2 to 4 weeks and close the opening to confine the fumes.

To kill iris borer, cover the exposed roots with soil

an inch or more deep and apply 1 ounce per square foot, then cover with soil to confine the fumes. Do not disturb the plant for at least 70 hours, then remove the excess soil.

To kill wireworms place one teaspoonful sprouting grain as far as possible (two feet) from plants to be protected in order to attract the worms. After waiting about a week for the worms to congregate inject the calcium cyanide below the bait. The amount used will vary with the method of application but ½ teaspoonful injected under each batch of wireworms will give a good kill.

To fumigate cured gladiolus corms in storage to control thrips, use 2½ ounces per each 100 cubic feet of space and repeat the treatment in 10 to 15 days because at this strength the eggs are not killed. Fumigated corms should not be handled or exposed to light for at least 24 hours after fumigation.

To kill narcissus bulb fly inside stored bulbs, use 16 ounces of granular calcium cyanide or 7 ounces sodium cyanide (pot method) per 100 cubic feet. The bulbs should be dry when fumigated and they should not be exposed to sunlight or disturbed for 24 hours after fumigation.

Storage infestations of aphids, thrips—and in fact, all insects which may occur in bulb storages—may be eliminated by fumigation as outlined for gladiolus corms.

REPELLENTS

Certain materials either as sprays or dusts have a certain insecticidal value in keeping injurious insects away from plants. Among such materials are: Bordeaux mixture, naphthalene (See section 28) and white dusts.

29. Bordeaux mixture—A repellent for certain insects, such as leafhoppers, plant bugs, and flea beetles, and it is also used as a sticker-spreader for arsenical sprays. See section 1 for preparation.

ACCESSORY MATERIALS

31. Commercial spreaders and stickers—There are upon the market a large number of spreaders and stickers developed for use with specific materials. Very commonly these spreaders and stickers are satisfactory when used for the purpose for which they were made. Often they work poorly if not used in just the way intended. When using commercial spreaders and stickers read all directions carefully and follow them.

32. Soaps—The most important use of soap is as wetting and activating agent with nicotine sulfate. One-half pound of soap flakes or 1 pound of ordinary laundry soap or 1 ounce of Dreft is generally recommended to 25 gallons (one cubic inch of laundry soap, one tablespoonful of soap flakes or ½ teaspoonful of Dreft to one gallon) of spray. Soaps must be thoroughly dissolved.

33. Soybean flour—Soybean flour is used as a sticker and spreader with a number of materials. A special grade of flour is available for spraying purposes. In general, it should be used at the rate of 1 ounce to 25 gallons or ¼ pound to 100 gallons of spray. A good method of adding it to the spray mixture is to make it into a thin paste before adding it to the spray solution in the tank.

34. Sulfated alcohols—A number of sulfated alcohols are sold as spreaders, activators and extenders. Of these, sodium lauryl sulfate, commercially known as Dreft, Drene, etc., or the du Pont sticker-spreader can be used to remove honey dew from foliage. It is recommended at 4 ounces per 100 gallons and best results follow where the spray is applied at 200 to 300 pounds pressure. The plants should be rinsed with water to remove the material within 24 hours after application. Dilute any accumulation of sulfated alcohol on the grass to prevent damage. It may be used in the same amounts with nicotine sulfate in place of soap, although in this case a few ounces (6-8) of lime may be added.

35. Sulfur—This may be used as a diluent for a number of different insecticides or it may be used straight to kill cyclamen mites on ornamentals, or it may be used to repel insects on weeds bordering ornamental plantings.

SUPPLEMENTARY CONTROL MEASURES

37. Resistant varieties — Some diseases are most satisfactorily controlled by the planting of resistant varieties. Only a limited number are available at present. Rust-resistant snapdragons and wilt-resistant aster seed is obtainable from most seedsmen. Yellows-resistant gladioli and wilt-resistant chrysanthemums are available from usual sources.

38. Rotation—The growing of plants continuously on the same site often results in the gradual accumulation of harmful insects and disease organism in the soil and its environs. In general, the changing of planting sites each year for annual flower crops is desirable.

39. Sanitation—Sanitation is simply good housekeeping, and its practice will aid materially in insect and disease control. The collection, removal, and burning of dead leaves, and other plant parts which may harbor fungi or bacteria causing diseases will help in their control. In some cases it is the only means of keeping disease in check.

Many injurious insects which overwinter in the shelter afforded by plant litter will be destroyed at the same time.

40. Screen-topped cages — Bulb flies on narcissus appear after all but very late varieties have bloomed. When plantings can be protected with cages with cloth sides and screen tops, it will be possible to grow fly-free bulbs.

QUANTITIES OF COMMON INSECTICIDES REQUIRED FOR SMALL AMOUNTS OF SPRAYS BASED ON GENERALLY ACCEPTED FORMULAS

MATERIALS	1 GALLON	3 GALLONS	100 GALLONS
Calcium arsenate	3½ tablespoons	11 tablespoons or ⅔ cup	4 pounds
Lead arsenate	3 tablespoons	9 tablespoons or ½ cup	4 pounds
Derris powder (4-percent rotenone)	5 tablespoons	1 cup	5 pounds

These quantities are based on standard measuring cups and spoons level full.

EQUIVALENT QUANTITIES OF LIQUID MATERIALS WHEN MIXED BY PARTS

	DILUTIONS			
WATER	1-400	1-800	1-1000	1-1600
100 gallons	1 quart	1 pint	1½ cups	½ pint, 1 cup
25 gallons	1 cup	½ cup	⅓ cup	¼ cup
5 gallons	3 tablespoons	5 teaspoons	4 teaspoons	2½ teaspoons
1 gallon	2 teaspoons	1 teaspoon	¾ teaspoon	½ teaspoon

These quantities are based on standard measuring cups and spoons level full.

Approximate equivalents for use in measuring liquid insecticides and fungicides.

3 teaspoons = 1 tablespoon
2 tablespoons = 1 fluid ounce
16 tablespoons = 1 cup
16 fluid ounces = 1 pint or pound
1 pint = 2 cups
8 pints = 1 gallon

APPROXIMATELY EQUIVALENT QUANTITIES OF DRY INSECTICIDAL MATERIALS FOR VARIOUS QUANTITIES OF WATER

WATER	QUANTITIES OF MATERIALS					
100 gallons	1 pound	2 pounds	3 pounds	4 pounds	5 pounds	6 pounds
25 gallons	4 ounces	8 ounces	12 ounces	1 pound	1 pound, 4 ounces	1 pound, 8 ounces
5 gallons	4 tablespoons	8 tablespoons	¾ cup	1 cup	4 ounces	5 ounces
1 gallon	2 teaspoons	4 teaspoons	7 teaspoons	3 tablespoons	4 tablespoons	5 tablespoons

The number of tablespoons per ounce of dry fungicides and insecticides varies so greatly that it is impossible to give accurate measures in teaspoons, tablespoons, or cups. 5-6 tablespoons equal approximately one ounce at different rates. The amounts given in teaspoons, tablespoons, and cups are the averages of a number of materials. If there is any information on the package as to dosage for small amounts of spray, follow manufacturer's directions. If there are no accompanying directions for mixing small quantities, use the table above.

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Issued October 1945
First Revision, April 1949
Second Printing of First Revision, November 1951

Cooperative extension work in agriculture and home economics. Michigan State College and U. S. Department of Agriculture cooperating. C. V. Ballard, Director, Cooperative Extension Service, Michigan State College, East Lansing. Printed and distributed under acts of Congress, May 8 and June 30, 1914.

~~APRIL 1949—10M~~

2P/1RV 11:51-10M