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CONTROL of ORNAMENTAL PLANT DISEASES

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AN EXPANDED research program on ornamentals has been carried on by the Auburn University Agricultural Experiment Station at its Ornamental Horticulture Field Station, Spring Hill, since 1952.

To help solve problems of commercial nurserymen, landscape gardeners, and home owners, investigations have been conducted relating to fertilizer requirements of ornamentals; disease, insect, and weed controls; nematodes and nematocides; growth regulators; and aides in establishing grasses, and controlling diseases and insects of lawns.

This report presents results from ornamental disease control studies. It is a compilation of data obtained from 1952 to 1960.

DISEASES and FUNGICIDES

Application rates of various fungicides tested are expressed as pounds of the commercial formulation per 100 gallons of water. The chemicals were applied uniformly to the entire leaf surface, using a 15-gallon sprayer at 100- to 150-pound pressure. A spreader-sticker (DuPont, Ortho, or Santomerse S) was applied at the rate of 1 pint per 100 gallons of spray material, unless otherwise indicated.

The fungicides reported here are available under several trade names. Common names of the fungicides, with the commercial formulations used shown in parentheses, are as follows:

captan (Captan, Orthocide)
chloranil (Spergon)
ferbam (Fermate, Karbam)
maneb (Dithane M-22, Manzate)
nabam (Dithane D-14, Parzate liquid, Pearson's Super Fungicide)
pentachloronitrobenzene (PCNB, Terraclor)
phenyl mercury acetate (PMAS, PMA)
thiram (Arasan, Tersan, Thioneb, Thylate)
zineb (Dithane Z-78, Ortho zineb, Parzate)

Other fungicides evaluated at this Field Station are as follows:

Actidione RZ
Agrimycin 500
Citroxin
Copper A
Delsan
Dowicide B
Dyrene
Emmii
omadine disulfide*
Panogen
Phaltan
Sunox
zinc omadine*

* Experimental compounds of Olin Mathieson Chemical Corporation, Baltimore, Md.

Aleppo Pine

Damping-off and leaf spotting diseases caused by seedborne fungi were controlled on Aleppo pine by the following seed treatments listed in decreasing order of effectiveness: Spergon (excess amount); Panogen (1 to 1000) 30-minute soak; Emmii (1 to 1500) 10-minute soak; Captan 75 (excess amount); Arasan 75 (excess amount); Semesan (1 teaspoon per quart of water) 60-minute soak; Delsan A-D (excess amount); and Phaltan 75 (excess amount).

Azalea

Petal blight, caused by the fungus *Ovulinia azalea,* is favored by warm, wet weather. In cool, wet springs much of the petal blight is caused by *Sclerotinia cinerea* (*Botrytis cinerea*). The recommendation for azalea petal blight control for the past 15 years has been zineb wettable powder or nabam plus zinc sulfate.

In 1959 new fungicidal testing was begun at the Field Station. Phaltan (1¼ pounds plus ½ pint of a spreader-sticker) was compared to nabam (1 quart Dithane D-14 and ½ pound of 36 per cent zinc sulfate plus ½ pint of a spreader-sticker). From the seventh through the twelfth applications, the rates of both materials were doubled.

Zineb gave 92 to 97 per cent control and Phaltan gave 15 to 25 per cent control of *Ovulinia* blight after conditions became favorable for disease development.

In 1960, tests were conducted with Actidione RZ and Phaltan on several different varieties of azaleas. The cool, relatively dry weather with occasional frosts was unfavorable for early development of the *Ovulinia* azalea petal blight fungus. However, conditions were somewhat more favorable for development of *Botrytis* blight. Petal blight control resulted from use of Actidione RZ where only *Ovlinia* blight was involved. Three weekly applications of Actidione RZ (8 ounces plus ½ pint of a spreader-sticker) gave 80 per cent healthy blooms as compared with 4 per cent healthy blooms on untreated plants.

In another test at low temperature and high humidity (maintained by a fog mist system on a time clock), rates of 8, 12, 16, and 20 ounces of Actidione RZ were compared. *Botrytis* blight developed regardless of treatments. Rates of 12 ounces and higher resulted in temporary yellowing and twisting of new shoot growth.

Phaltan was evaluated at rates of ⅔, 1⅓, and 2 pounds plus ¼ to 1 pint of a spreader-sticker. Five applications were used during a 20-day period. Control of *Botrytis* blight resulted at all concentrations, although the 2-pound rate bleached the petals. A formulation of Phaltan plus PCNB at the rate of 1⅓ pounds plus 0, ¼, ½, and 1 pint of a spreader-sticker also gave good control but with a similar bleaching of the petals.

Cylindrocladium damping-off, leaf drop, and crown rot are caused by the fungus *Cylindrocladium scoparium*. The fungus produces brown mycelial strands on infected leaves and stems. It develops rapidly under conditions of high temperature and high humidity, such as those found in propagation benches. This disease is often destructive to shadehouse-grown azaleas and pyracantha during summer rainy periods. Propagation from infected plant increases occurrence of the disease in the propagation house.

During 1956, 1957, and 1958, fungicidal control tests were conducted. In early screening tests, organic mercury compounds (PMAS and Semesan), Sunox, and Spergon were fairly effective as dips, but were toxic to the azalea cuttings with repeated applications. In later experiments, soaks proved more effective than dips in controlling the disease. Thirty-minute soaks with Phaltan or Dyrene at 2 pounds or Citroxin at 1 pound were effective and safe.

In two cooperative tests[1] azalea liners were dipped with fungicides just before packing for shipment. Control during winter shipment was obtained with Sunox (5 to 10 ounces), zineb (2 pounds), and thiram (Thylate 2 pounds) plus a spreader-sticker. With a spring shipment, control was obtained from the following higher rates of the same materials plus spreader-sticker: Sunox 20 ounces, zineb (Dithane Z-78, 6 pounds), and thiram (Thylate, 4 pounds). Lining crates with polyethylene increased survival but also increased defoliation of the liners by the disease.

Aucuba

Phomopsis leaf and stem blight, caused by the fungus *Phomopsis* sp., produces a rapid black rot of the leaves, stems, and sometimes the roots of Aucuba. Moderately infected cuttings were soaked in various fungicides for 30 minutes before being placed in the rooting media. Application rates of the fungicides and percentage of healthy rooted cuttings were as follows: Thioneb (2 pounds) 100 per cent, Phaltan (2 pounds) 92 per cent, and water only (control) 82 per cent. The rooted cuttings getting the Thioneb treatment were also 15 per cent heavier than those of the other treatments.

Caladium

Caladium bulb rot often occurs if the bulbs are left in the ground or if dug and stored without chemical treatment and proper packing in dry peatmoss to prevent shrinkage. The most common organisms involved are species of *Fusarium.* One-hour soaks of the freshly dug bulbs using the following fungicides gave good protection against bulb rot for 3 to 4 months; Dowicide B (3 pounds), Captan 75 (3 pounds), Semesan (2 pounds), Spergon (4 pounds), Sunox (1 pound) and PMAS (1 pint).

Camellias

Leafspotting, damping-off, and bud rot make up a complex of disease symptoms frequently resulting from infection of camellias by the dieback fungus, *Glomerella cingulata,* in the propagation bench. Control of this disease complex with fungicidal soaks of the cuttings prior to planting was studied. With the Tomorrow variety of camellia, combinations of 2 pounds of a Phaltan or Thioneb soak followed by a basal dip in 25 per cent or 50 per cent Chloromon (a rooting aid extracted from alfalfa) or Hormodin No. 3 were compared. The Phaltan soak plus a basal dip in 50 per cent Chloromon gave 83 per cent well-rooted cuttings. Rooting varied from 0 to 50 per cent with the other treatments.

With Pink Perfection cuttings from *Glomerella*-infected plants, 11 different fungicides were evaluated as 30- and 60-minute soaks. The experiment was begun in early fall after greenhouse temperatures had begun to drop. Weather conditions were not favorable for disease development. However, data on toxicity of the chemicals to camellia, as well as to their effectiveness in controlling the disease, were obtained. The treatments with their respective increase in percentage of healthy rooted cuttings over those of the controls were as follows: Citroxin (1 pound) 30-minute soak, 12 per cent; Thioneb (2 pounds) 30-minute soak, 12 per cent; Phaltan (2 pounds) 60-minute soak, 6 per cent; Agrimycin 500 (1 pound) 30-minute soak, 8 per cent. Maneb (Manzate and Dithane M-22, 1 pound) 30-minute soak and zineb (Dithane Z-78, 2 pounds) 30-minute soak apparently were phytotoxic since rooting was reduced.

Phytophthora root rot is caused by the soil-inhabiting fungus, *Phytophthora cinnamoni,* which attacks more than 120 different plant species. Wet, poorly drained, and poorly aerated soils favor disease development. Results of experiments during 1957 and 1958[2] showed that levels of

[1] Conducted cooperatively with Tokuji Furuta, associate horticulturist, Department of Horticulture.

[2] Unpublished data from cooperative experiments with R. D. Rouse and John I. Wear, soil chemists, and Fred Adams, associate soil chemist, Department of Agronomy and Soils.

calcium above that normally found in sand-peat mixtures of potting soils and in liner beds reduced root-rot damage to Pink Perfection camellias. Gypsum (calcium sulfate) was superior to calcium carbonate.

Chrysanthemum

Botrytis blight is a serious cool-weather disease of chrysanthemums and a year-round problem of all cut flowers in cold storage. An evaluation of fungicides for control of this disease was conducted by dipping freshly infected chrysanthemum blooms in various fungicides used at the rate of 2 pounds plus one pint of a spreader-sticker. The blooms were then held at 60 degrees Fahrenheit in plastic bags for 1 week. Phaltan and Agrimycin 500 were the most effective fungicides, while Thioneb and omadine disulfide were satisfactory. Floristick and zineb gave little control of *Botrytis* blight.

Loquat

Entomosporium and anthracnose leafspot are two distinct leafspotting, seed-transmitted diseases that were identified. *Entomosporium* leafspot, caused by *Entomosporium maculatum,* produces small, brown circular spots on infected leaves. Anthracnose, caused by *Colletrotrichum gloeosporiodes,* progresses rapidly, usually inward from the leaf margin, and produces large, black, dead areas. Results of seed treatment studies conducted in 1955 showed that excess dust applications of Arasan or Captan prevented seedling infection. The effective spray materials that controlled the spread of leafspot were Thylate (2 pounds) and Citroxin (½ pound) plus spreader-sticker.

Magnolia

Phyllosticta leafspot is the most destructive leafspot of magnolia. The small, black, circular lesion is caused by the fungus *Phyllosticta cookeri.* This fungus is seed-transmitted and is also spread from diseased to healthy plants by splashing water. Control consists of harvesting clean seed, immediate removal of the pulp from the seed by washing, seed treatment, and planting in a covered bed. The bed is watered by flooding rather than by syringing the plants. Diseased plants should be removed as observed. To avoid overcrowding, healthy plants are transplanted while small. Fungicidal sprays or dusts should be applied as necessary to control spread of the disease. (See results of *"spray tests."*)

A minor leafspot disease, caused by the fungus *Glomerella cingulata,* is controlled in the same manner.

Seed treatment studies in 1954 revealed no benefit from pulp removal when the seed were planted immediately. In 1956, pulp removal increased seed germination over 300 per cent in most treatments where seed were planted immediately or stored for 75 days at 45 degrees Fahrenheit.

Results of chemical treatments were variable. Arasan was an excellent treatment when used as a 45-minute soak at the rate of 1 teaspoon per quart of water per ¼ pound of seed. As a dry treatment (all that would stick to the seed), Arasan reduced germination by 50 per cent. However, several seed treatments proved satisfactory when applied to the seed after removal of pulp and the seed either planted immediately or held at 45 degrees Fahrenheit for 75 days. These treatments were Captan 75 (excess amount), Delsan A-D (excess amount), Semesan (one teaspoon per quart of solution), 30-minute soak; and Panogen (1 to 1000) 30-minute soak. Excellent results were obtained from additional treatments of pulp-removed seed that had been treated and stored for 75 days at 45 degrees Fahrenheit. Immediately after the storage period, the seed were given the following subsequent treatments: (1) Semesan applied as a 30-minute soak (1 teaspoon per quart of solution); (2) 10 minute rinse in running water; (3) air dried; and (4) then dusted with Arasan (excess amount). The same treatment on uncleaned seed reduced germination to zero.

Spray tests involving 36 fungicides were tested in 1959. The following chemicals plus a spreader-sticker gave control of *Phyllosticta* leafspot without visible plant injury at the following dosage rates: Agrimycin 500 (2 pounds), Captan 50 (4 pounds), Sunox (½ pound), zineb (2 pounds), Thioneb (2 pounds), Terraclor (2 pounds), and omadine disulfide (2 pounds).

Sunscald of new growth is a common trouble of young, fast-growing magnolia seedlings. This usually happens in the middle of the day. It can be controlled by light watering when the leaves begin to wilt.

Mite damage is often confused with leaf spotting on both the American and Japanese magnolias. Actually it is caused by a microscopic-size mite belonging to the genus *Phyllocoptes.* This mite cannot be seen with an ordinary hand lens. It produces a browning of new growth leaves and stem tips. The damage progresses outward from the stem to the base of the lower side of leaf. Results of experiments conducted at this Field Station[3] showed that Thimet, demeton, Systox, parathion, and malathion gave good control.

Photinia

Entomosporium and Cercospora are two leafspotting, seed-transmitted diseases of *Photinia serrulata* are caused by the fungi, *Entomosporium maculatum* and *Cercospora* sp. Fungicidal treatment tests were conducted for control of these diseases. The seed were harvested, pulp removed, treated, and planted January 25, 1958. The percentages of healthy plants from the various treatments on April 15, 1958 are as follows: zinc omadine (excess amount), 58.4 per cent; Panogen (1 to 1000) 30-minute soak, 57 per cent; Arasan (excess amount), 44.4 per cent; Panogen (1 to 1000) 60-minute soak, 38 per cent; Orthocide 75 (excess amount), 33.4 per cent; and control, 32.4 per cent.

St. Augustine Grass

Gray leafspot, caused by the fungus *Piricularia grisea,* is most severe under warm, wet conditions. When applied at the rate of 2 pounds with a spreader-sticker at weekly intervals for 2 months, the following materials gave partial control of the disease: Agrimycin 500, Copper A, ferbam (Fermate), maneb (Dithane M-22), Phaltan, tihram (Thioneb), and zineb (Dithane Z-78). Terraclor was ineffective.

[3] Conducted cooperatively with Robert H. Mount, formerly assistant in entomology, Department of Zoology-Entomology.

NEMATODES and NEMATOCIDES

Nematodes have been identified as one cause of poor growth, chlorosis, and deteriorated root systems of many species of nursery stock.

Knots or galls are produced only by the root knot and lance species of nematodes. These galls are common on gardenia, boxwood, and holly. Other nematodes arrest normal root development causing the plant to produce numerous, short stubby roots on azaleas and camellias.

Chlorosis of azalea, holly, and Photinia leaves is usually associated with stubby roots. Still other species of nematodes penetrate and kill portions of the root systems of boxwood, holly, camellia, arborvitae, and grasses.

The best treatment for nematodes is to sterilize the area before planting and then take precautions to prevent reinfestation of the area through use of clean plants, sanitation, and control of drainage water.

Experimental nematocides evaluated at the Field Station include Dowfume W-85 liquid, Fumazone, Nemagon, VC-13, and Mylone 85 per cent wettable powder.

If the area becomes reinfested, it may be drenched with Fumazone, Nemagon, or VC-13 to reduce the nematode population. Some plant varieties are more easily injured by nematocides.

Treatment to kill the nematode only is not recommended for potting soils or plant beds because of the added benefits of weed, insect, and fungus control derived from complete sterilization. However, in open fields application of a nematocide is practical and recommended for nematode control.

Control of nematodes with split applications of 9 gallons each of Dowfume W-85 per acre 16 days apart followed by planting 30 days later gave 227 per cent increase in weight of *Ilex rotundifolia* over that of the controls. This material was injected into the soil to a depth of 8 to 10 inches with tractor-drawn equipment.

Nemagon and VC-13 in various formulations killed nematodes in the soil around nursery plants without plant injury. However, both Nemagon and Fumazone were found to be toxic to many plant species when used as a drench at rates in excess of 1½ gallons (17 pounds active per gallon) per acre. Camellias, magnolias, and pines were sensitive to the material, whereas the Hinodegari variety of azalea was not affected by 6 gallons of the concentrate per acre. Applications of ½ to 1 pound of 10 per cent granular Nemagon per cubic yard of potting soil stimulated many plant species, whereas higher rates retarded growth. Plant injury was more severe when plants were planted in dry potting mixtures.

VC-13 was non-toxic to *M. soulangeana,* Hinodegari azalea, and Elizabeth and Pink Perfection camellias when applied as drenches of 39, 78, 157, and 314 gallons per acre. Shell Pink sasanqua was stunted by the same rates of materials.

Mylone 85 per cent wettable powder when used properly was found to be an effective soil sterilant. Control of nematode and Phytophthora root rot was excellent with 300 pounds of Mylon 85W per acre. Weed control was excellent, except for nutgrass. Nutgrass control with the Mylone was found to be more effective as soil temperature and soil moisture increased. Soil surface water seals of ¼ acre-inch (determined by placing containers and measuring water collected) were as effective as ½ acre-inch seals when sufficient soil moisture was already present. When the soil was dry, an acre-inch was necessary to thoroughly saturate a heavy muck soil to the point of runoff.

Both plastic and paper effectively sealed soil containing sufficient moisture for good plant growth.

Rolling the soil after Mylone application and prior to watering decreased the amount of water necessary for a good seal.

The necessary waiting period before planting varied from as little as 10 days on light sandy soil at high temperatures to 30 days or longer on cold, heavy, wet soils.

SUMMARY

Disease control practices that have proved effective in production of disease-free seedlings are as follows:

(1) Select clean seed from healthiest plants.

(2) Harvest seed before they fall to ground, and extract them immediately from the fruit pulp.

(3) Treat seed with a fungicide, and plant immediately in sterilized soil. Check explanations under specific plants for desired seed treatments.

(4) Grow seedlings in flats in the greenhouse or in covered cold frames; water by flooding rather than syringing to prevent fungus spread from plant to plant.

(5) Remove and destroy diseased plants immediately.

(6) Apply once a week protective fungicidal spray or dust, such as zineb, maneb, thiram, or Phaltan, covering both leaf surfaces.

To produce clean, rooted cuttings and liners, use the following procedure:

(1) Select cuttings from clean stock plants, and prepare them on a clean cutting bench.

(2) Soak cuttings for 30 to 60 minutes in 2 pounds of zineb or Phaltan plus 1 pint of spreader-sticker.

(3) Stick cuttings in clean rooting media.

(4) Remove diseased cuttings or liners as observed.

(5) Spray cutting bed weekly with zineb (2 pounds), Phaltan (1⅓ pounds), Citroxin (5 ounces) or other fungicides plus spreader-sticker. Alternation of materials may be desirable to prevent buildup of toxicity. If *Cylindrocladium* leaf blight and damping-off are present, double the dosage rate and spray every 3 to 4 days.

(6) Transplant cuttings as soon as they are well rooted to sterilized beds and away from diseased plants.

(7) Avoid overcrowding in the liner bed.

(8) If any leafspot disease exists, use preventive fungicidal sprays as listed under disease-free seedling production.

Following these disease control practices during propagation will ensure healthy liners and seedlings with a minimum of spraying or dusting.