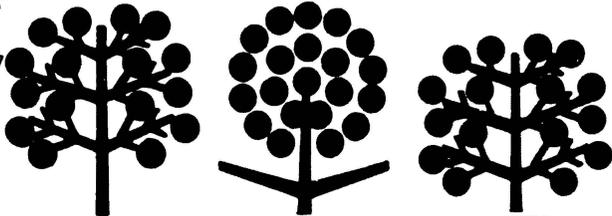


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PROPAGATING AND GROWING DISEASE-FREE PLANTS

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Stem rot of cuttings and root rot diseases that occur in propagation are perennial problems for Virginia Nurserymen. These diseases reduce the number of saleable plants that are scheduled to be grown. Such loss can be minimized through the proper use of modern propagation techniques, such as well-drained, pathogen-free propagating materials and chemicals.

Rooted cuttings are susceptible to infection by pathogenic water molds and other soil-borne pathogenic fungi. Pathogens are introduced into the propagation system, cold frames, or containers. Artificial soil mixtures (soil-less culture), pasteurization, soil fumigants, and systemic or protectant fungicides can reduce the chance of infection. Loss of plants in the field can frequently be traced to plants which were infected in the propagation bench. Plant species observed to be susceptible to disease are azalea, boxwood, juniper, rhododendron, aucuba, pieris, Japanese holly, fatsia, fatshedera, and ivy.

SYMPTOMS OF DISEASE - Symptoms of root and stem rots in the propagating bench are yellowing and dropping of the lower leaves, blackening and decay of stems, and failure of cuttings to root. Frequently, the disease results in large groups of rotted cuttings. Cuttings that root but are infected in the propagating bench may appear to be healthy until they are planted out; these plants usually make retarded growth and their foliage is yellow, roots turn brown, and the plant usually dies, either in the container or in the field.

PLANT PATHOGENS - Several different soil-borne fungi can invade cuttings of azalea and rhododendron. Species of *Pythium* and *Phytophthora* (water molds), as well as *Rhizoctonia solani* and *Cylindrocladium* infect and rot cuttings. Japanese holly liners may be infected by *Thielaviopsis basicola*. Poinsettia cuttings may be infected by *Thielaviopsis basicola*, *Rhizoctonia solani*, *Fusarium* and *Pythium*. Under certain conditions, fungi previously considered to be non-pathogenic, such as *Pestalotia*, may infect cuttings. Cuttings infected by soil-borne fungi may produce roots and survive for several months in a stunted condition.

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GENERAL SANITATION - Disease-causing fungi can be harbored in the propagating bench, on plant containers and plant debris. The floor of the greenhouse is often infested with disease-causing organisms. A water hose, which has been lying on the floor, may become contaminated and spread pathogens if pulled across the benches. In addition, employees who have infested soil on their hands, tools, or shoes can contaminate the operation. Weeds growing in the walkways and under the benches may harbor fungi, bacteria, or viruses.

CARE OF STOCK PLANTS - Cuttings should never be taken from plants that are obviously diseased; that is, have leaf spots, stem blights, witches brooms, crown galls, rusts, powdery mildews, virus symptoms, wilts, or other symptoms. Cuttings that are taken from healthy-appearing plants usually root more successfully. Insects that attack the foliage and stems should be controlled by a regular spray program. In addition, stock plants should be sprayed at least every 2 weeks from April to September with a fungicide like mancozeb (Fore, Dithane M-45, or Manzate 200 80% WP) at 1-1/2 lb/100 gal of water to prevent leaf spots and stem blights that may be transmitted to the cuttings.

TREATMENT OF THE HEADHOUSE AND PROPAGATION HOUSE -

1. Before sticking a new crop, remove all old rooting medium from the propagating benches and all plant debris from under the benches.
2. Treat all unpainted woodwork, flats, baskets, and greenhouse benches with a 2% copper naphthenate to eradicate plant pathogens from the surface of wood. It is not necessary to repeat this treatment between each set of cuttings, but an annual treatment is suggested.
3. If all the plants are removed from the greenhouse, the interior can be disinfested with formaldehyde (1 part of 37% formaldehyde solution in 50 parts of water). This treatment should be used at the beginning of the propagating season.
4. Spray the headhouse, under benches, painted woodwork, and walkways in the propagating house with a disinfectant. Repeat this treatment at least once every 2 weeks. Most disinfectants do not penetrate soil or organic matter. Steam-sterilize all propagating tools, such as knives, or soak in 1 part of household bleach in 9 parts of water for 10 minutes.
5. Steam-sterilize propagating benches prior to filling with pathogen-free rooting media or surface-sterilize benches and pasteurize medium between each set of cuttings.

CARE OF CUTTINGS - Always use new or uninfested medium in the propagating bench. For hard-to-root cuttings, some root inducing hormone is usually necessary. Rooting materials that have been found to be relatively pathogen free are perlite, vermiculite, Weblite, ground pine bark and peat moss. Pasteurization of media is accomplished with air-steam at 145-165°F for 30 minutes. If plain steam is used, sterilize the medium for 30 minutes at 180°F. Care should be taken to avoid over-sterilization because of ammonium toxicity and because minor elements such as manganese and other toxic materials may be present. Air-steam will kill the plant pathogens but allow the beneficial fungi and bacteria to survive.

For superior rooting results, bottom heat under the propagating bench is recommended. Generally, either electric heating cables or steam pipes are placed beneath the bench. A thermostat of some type should be included to maintain a medium temperature of 72-75°F. Some growers use as high a temperature as 80°F.

Water cuttings after sticking to assure contact between cuttings and media. Infestation of the medium and contamination of the cuttings by the fungi Rhizoctonia solani and Cylindrocladium spp. can be prevented by applying a wetting agent and benomyl (Benlate 50% WP) fungicide 8 oz/100 gals of water at the rate of 1 pint per square foot surface area. Wetting agents aid in the distribution of the fungicide uniformly throughout the medium. Water used for misting should be free of pathogens.

All cuttings under misting systems should be drenched with captan (Captan 50% WP) at 2 lbs/100 gals of water every 2 weeks OR alternate drench treatments applied monthly, consisting of benomyl (Benlate 50% WP) 8 oz/100 gals plus ethazol (Truban 30% WP or Terrazole 35% WP) 3 to 6 oz/100 gals. Misting should be controlled so that plants remain turgid at all times. All cuttings that wilt and die and all dead leaves should be removed from the propagating and growing area and placed in a tight container to prevent spread of disease. Immediately after drenching, apply additional water in order to wash excess fungicide residue from the leaves and into the rooting medium and thereby prevent possible leaf burn. Do not apply Truban or Terrazole until after the cuttings have rooted.

CARE OF ROOTED CUTTINGS - After rooted cuttings are transplanted, the new growth should be protected with mancozeb (Fore or Manzate 200 80% WP) or Daconil 2787. Containerized stock placed on polyethylene film may be infected by water mold fungi that spread in water. Standing water around the base of containers should be avoided by placing containers on gravel or other well-drained materials, or on concrete block or benches.

The most critical factor for successful production of root rot-free container ornamentals is excellent drainage of the growing mixture. The air volume of container media should be at least 20%. It is important that the air volume does not decrease in containers during the growing season because of breakdown of organic constituents like peat moss.

Once cuttings are rooted, they may be transplanted in media containing 100% German or Canadian peat moss. Many growers are using mixtures containing soil, peat moss, pine bark, Weblite, perlite, styrofoam, vermiculite, and other amendments.

After potting or transplanting to greenhouse benches, cold frames, or the field, the plants should be protected by drenching with surfactants such as Aquagro or Tergitol plus one of the fungicide combinations listed below.

1. A mixture of 8 oz of benomyl (Benlate 50% WP) plus 10 oz of diazoben (Lesan 35% WP) in 100 gals of water OR
2. Eight oz. benomyl (Benlate 50% WP) plus ethazol at the rate of 3 to 6 oz with 100 gals of water per 400 sq ft or apply in sufficient amount to saturate the soil mixture, such as 1/2 pint per 6" pot OR

3. Eight oz. benomyl (Benlate 50% WP) plus ethazol at the rate of 3 to 6 oz with 100 gals of water per 400 sq ft OR
4. Use 6 to 12 oz of Banrot 40% WP (contains thiophanate methyl plus ethazol) to 100 gals of water to 400 sq ft, or apply in sufficient amount to thoroughly saturate soil mix in container, such as 1/2 pt to a 6" pot. Re-treat at 4 to 12-week periods if necessary, using 4 to 8 oz per 100 gal rate. This mixture of fungicides controls diseases caused by the major root rot fungi.
5. Because certain fungi, like Pestalotia, regularly associated with azalea, are not affected by any of the above mentioned fungicides, it is suggested that captan (Captan 50 W) at the rate of 2 lb/100 gal (2 tbsp/gal) be used on alternate months in azalea production.

DISEASE PREVENTION IN THE FIELD - Diseases caused by water mold fungi can be avoided by growing plants on raised beds and having good sub-soil drainage. However, if fields are infested with soil-borne water molds or they are introduced on plants, in water or soil, a large percentage of the diseased plants grown in this manner may appear healthy when sold and shipped, but die after planting from root rot when exposed to conditions of high moisture and high temperature. Therefore, preplant soil fumigation with methyl-bromide chloropicrin is suggested. The soil should be free of clods, loosened to a depth of 12" and in good seedbed condition. It is important that the fumigant penetrates to the water table, which should be below the zone into which roots grow. A wet clay layer under peat beds is not penetrated by methyl bromide and allows spores of Phytophthora spp. to survive. The soil temperature should be 50°F or higher at a 6" depth, with adequate moisture for seed germination. The chemical is introduced as a gas under a gas-tight plastic sheeting over the area to be fumigated. The manufacturer's instruction on dosage rate and the aeration period needed prior to transplanting in the fumigated soil should be followed.

Recontamination of methyl-bromide-fumigated poorly-drained beds, by Phytophthora and Pythium, may occur. Spores of these fungi are attracted to plant roots and swim into the root zones, causing infection. Since the natural soil-inhabiting microflora have been eliminated by fumigation, Phytophthora can spread more rapidly when it re-enters wet fumigated soil.

It is possible that water molds like Phytophthora could be introduced through an irrigation system that draws and recirculates water from a catch basin. Circumstantial evidence through observation of disease development in one Virginia nursery strongly suggests this to be the case. Avoid using run-off water from diseased container plants for irrigation, if possible.

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KEYS TO PROPER USE OF PESTICIDES

1. Read the label on each pesticide container before each use. Follow instructions to the letter; heed all cautions and warnings, and note precautions about residues.
2. Keep pesticides in the containers in which you bought them. Put them where children or animals cannot get to them, preferably under lock and away from food, feed, seed, or other material that may become harmful if contaminated.
3. Dispose of empty containers in the manner specified on the label.

SEE YOUR DOCTOR IF SYMPTOMS OF ILLNESS OCCUR DURING OR AFTER USE OF PESTICIDES.