Literature Cited

1. Conover, C. A. and D. B. McConnell. 1981. Utilization of foliage plants, p. 519-543. In: J. N. Joiner (ed.). Foliage plant production. Prentice-Hall, Englewood Cliffs, NJ.
2. Durkin, D. and R. Kuc. 1966. Vascular blockage and senescence of the cut rose flower. Proc. Amer. Soc. Hort. Sci. 89:683-688.
3. Ferree, D. C. and F. R. Hall. 1975. Influence of benomyl and oil on photosynthesis of apple leaves. HortScience 10:128-129.
4. Fujino, D. W. and M. S. Reid. 1983. Factors affecting the vase life of fronds of maidenhair fern. Scientia Hort. 21:181-188.
5. Henley, R. W., B. Tjia, and L. L. Loadholtz. 1980. Commercial leatherleaf fern production in Florida. Fla. Coop. Ext. Serv., Inst. Food and Agr. Sci., Univ. of Fla. Bul. 191.
6. Mathur, D. D. and A. S. Bhagsari. 1983. Effect of photosynthetically active radiation, temperature, and antitranspirants on photosynthesis and respiration of leatherleaf fern. HortScience 18:189-191.
7. Mathur, D. D., R. H. Stamps, and C. A. Conover. 1982. Postharvest wilt and yellowing of leatherleaf fern. Proc. Fla. State Hort. Soc. 95:142-143.
8. Nell, T. A., J. E. Barrett, and R. H. Stamps. 1983. Water relations and frond curl of cut leatherleaf fern. J. Amer. Soc. Hort. Sci. 108:516-519.
9. Poole, R. T., C. A. Conover, and R. H. Stamps. 1984. Vase life of leatherleaf fern harvested at various times of the year and at various frond ages. Proc. Fla. State Hort. Soc. 97:266-269.
10. Sharma, D. P., D. C. Ferree, and F. O. Hartman. 1977. Multiple applications of dicofol and dodine sprays on net photosynthesis of apple leaves. HortScience 12:154-155.
11. Stamps, R. H. 1984. Production temperature effects on anatomy, morphology, physiology and postharvest longevity of leatherleaf fern (*Rumohra adiantiformis* Forst. Ching). PhD Thesis, Univ. of Fla., Gainesville.
12. Stamps, R. H. and A. R. Chase. 1984. Fungal inoculation, fungicide treatments, and storage affect postharvest decay and vase-life of leatherleaf fern fronds. HortScience 19:292-293.
13. Stamps, R. H., W. L. Currey, R. A. Dunn, D. E. Short, and G. W. Simone. 1986. Pesticides for use in commercial leatherleaf fern production in Florida—1986. Univ. of Fla., Inst. of Food and Agr. Sci., Agr. Res. and Ed. Cntr.—Apopka Cut Foliage Res. Note RH-86-C.
14. Stamps, R. H. and T. A. Nell. 1983. Storage, pulsing, holding solutions and holding solution pH affect solution uptake, weight change and vase life of cut leatherleaf fern fronds. Proc. Fla. State Hort Soc. 96:304-306.
15. Stamps, R. H. and T. A. Nell. 1986. Pre- and poststorage treatment of cut leatherleaf fern fronds with floral preservatives. Proc. Fla. State Hort. Soc. 99:260-263.
16. Wood, B., T. Gottwald, and J. Payne. 1984. Influence of single applications of fungicides on net photosynthesis of pecan. Plant Disease 68:427-428.
17. Wood, B. W. and J. A. Payne. 1985. Net photosynthesis of orchard grown pecan leaves reduced by insecticide sprays. HortScience 21:112-113.

Proc. Fla. State Hort. Soc. 100:364-368. 1987.

FOLIAGE DISEASE MANAGEMENT ON POINSETTIA PLANTS

ARTHUR W. ENGELHARD
University of Florida, IFAS
Gulf Coast Research & Education Center
5007 60th Street East
Bradenton, FL 34203

Additional index words. Alternaria euphorbiicola, Botrytis cinerea, Choanephora cucurbitarum, Phytophthora parasitica, blight, wet rot, Rhizopus, *Curvularia, Stemphylium, Corynespora.*

Abstract. **Foliage diseases of poinsettia plants are an important factor associated with plant production in Florida. Diseases that may be serious include alternaria blight (*Alternaria euphorbiicola* Simmonds and Engelhard), botrytis blight (*Botrytis cinerea* Pers. ex Fr.), scab (*Sphaceloma poinsettiae* Jenkins and Ruehle), and choanephora wet rot [*Choanephora cucurbitarum* (Berk. and Rav) Thaxter]. Other diseases of lesser importance include phytophthora blight (*Phytophthora parasitica* Dast.) and leaf spots caused by *Helminthosporium* sp., *Curvularia* sp. *Corynespora* sp., and others. The production and biology of spores and sclerotia on diseased and dead plant tissue are described. Components in a disease control program are discussed. Included are resistant cultivars, crop scouting, a fungicide program, and epidemiological parameters unfavorable to disease development.**

Foliage diseases of poinsettia plants affecting all above ground parts of the plant are a major production problem in Florida. Important diseases include alternaria blight (5, 7, 9, 11) (*Alternaria euphorbiicola*), botrytis blight (4, 14) (*Botrytis cinerea*), scab (*Sphaceloma poinsettiae*) (3, 4), and choanephora wet rot [*Choanephora cucurbitarum* (Berk. and Rav.) Thaxter] (6). The presence of bract necrosis (15) coupled with the large volume of Gutbier V-14 cultivars, which are susceptible to all the above diseases and conditions, has made foliage diseases the principle production problem in Florida.

The objectives of this paper are to describe briefly the important diseases and causal organisms, discuss the biology of the pathogens as it relates to potential disease occurrences, and detail a comprehensive disease management program.

The Diseases

The fungous diseases on the foliage of poinsettia plants in Florida in addition to those mentioned above are rhizopus wet rot [*Rhizopus stolonifera* (Ehr ex Fr.) Vuill.], phytophthora crown and stem rot (*Phytophthora parasitica* Dast) (10) and leaf spots incited by *Helminthosporum* sp., *Curvularia* sp., *Corynespora* sp., and others (4). Diseases of the foliage occur on cuttings in propagation, stock plants, pots grown for sale, and landscape plants.

Biology of Pathogens Disease, Cycle, and Symptoms

Alternaria blight. The initial symptom is a spot on any above-ground parts of the plant. On very susceptible cultivars, the spots enlarge and disease increases until the plants die. The pathogen grows on diseased plant parts and produces countless conidiophores on which conidia

Florida Agricultural Experiment Station Journal Series No. 8647.

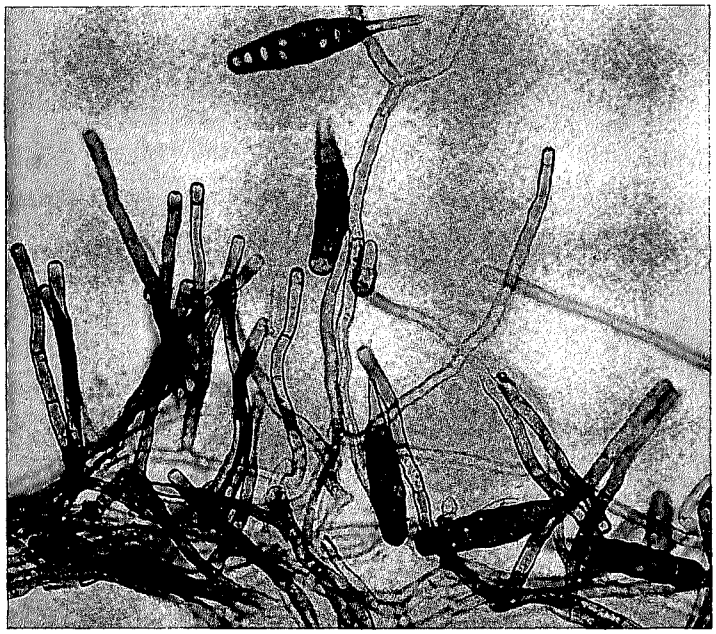

Fig. 1. Alternaria blight. Conidiophores and spores of *Alternaria euphorbiicola.*

(spores) grow (Fig. 1). All diseased tissues support spore production. Spores are windborne. When a spore lands on a leaf in the presence of a continuous water supply (rain, irrigation) it germinates, kills cells and causes a visible spot to develop within 24 hours (Fig. 2). Disease progresses rapidly in a temperature range of 21-29°C (70-84°F).

Botrytis blight. The *Botrytis* pathogen is a ubiquitous pathogen that grows readily on healthy and dead plant tissue. It causes a soft, wet decay of leaf tissue when moisture is present. It colonizes and produces countless spores on necrotic tissue resulting from mechanical injuries and on tissue affected by leaf or bract necrosis (Fig. 3). *Botrytis* produces the familiar gray mold which resembles a powdery gray mass. The mold consists of many conidiophores and clusters of conidia (Fig. 4). A slight amount of wind

Fig. 2. A germinated spore of *Alternaria euphorbiicola* (elongate dark structure) on a leaf of 'Gutbier' V-14 Glory. A leaf spot (dark area) was present in 24 hours.

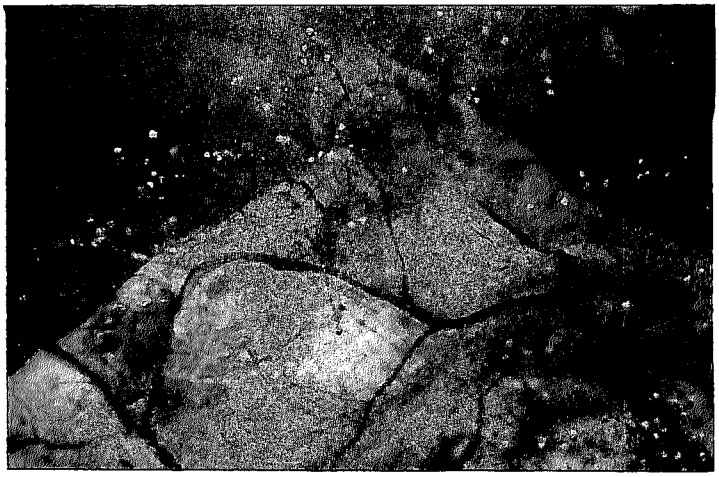

Fig. 3. *Botrytis cinerea.* conidiophores and conidia (in heads) on tissue necrotic from leaf marginal necrosis on V-14 Glory poinsettia.

or agitation releases a cloud of microscopic-sized spores that blow through the air.

Dead and diseased plants are a significant source of spore production for growing crop plants. They may be an important source of inoculum for future crops. An experiment was conducted at the Gulf Coast Research and Education Center (GCREC). Bradenton, to determine the potential pathological liability of plants left-over from the holiday season. Unsprayed poinsettia plants, grown outdoors in 15-cm pots for the Christmas season, were cut off at the crown in January and placed in open trays under trees. They were covered with a single layer of saran shade cloth. *Botrytis* grew and produced the gray mold stage and also sclerotia (small black irregular shaped overseasoning fungous structures). The sclerotia (Fig. 4) were picked from the plants and placed on sterile potato dextrose agar in petri plates. They grew and produced many condia (gray mold stage) and more sclerotia (Fig. 4). The conidia were used to prepare a spore suspension on June 23. Another spore suspension was prepared by washing conidia from old stems. The spore suspensions were sprayed onto unsprayed lavender-colored petunia flowers. In a replicated experiment, the flowers sprayed with the spore

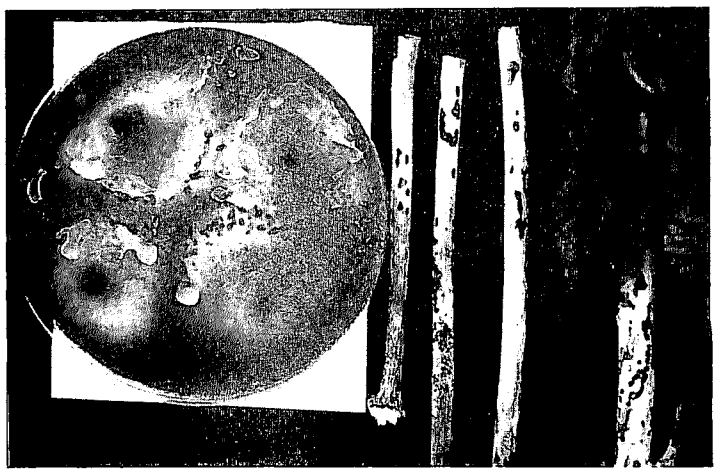

Fig. 4. Sclerotia (dark structures on old poinsettia stems) placed on a petri plate containing potato dextrose agar grew and produced many conidiophores and spores (gray mold) and more sclerotia.

suspension prepared from the stems had 134 spots, the flowers sprayed with the conidia from sclerotia 68 spots, and those flowers sprayed with water (controls) had 7 spots (indicating some natural infection). A similar procedure on pink colored petunia flowers produced 119, 155, and 32 spots respectively. Sclerotia are produced on some *Botrytis*-infected poinsettia stems. The sclerotia fall from stems when they dry and later germinate and produce conidia. The potential for infection of a new crop is high for at least 6 months when old, dead and diseased plants and plant parts are present.

Scab. Twenty-six cultivars were exposed in 1987 to *Sphaceloma poinsettiae.* All cultivars developed a high level of disease, indicating all the well known cultivars currently available are very susceptible. Raised lesions develop on all above ground parts of the plant. The lesions have a smooth, gray surface apparently devoid of any growth (Fig. 5), unlike what one sees with the alternaria disease and botrytis blight. However, examination of diseased tissue under a compound microscope shows many small conidiophores and tiny (5-7 μm). hyaline 1-celled spores (Fig. 6). The conidia have been found on diseased tissue every month of the year on plants at the GCREC, Bradenton. The conidia are dispersed with water and presumably also by wind since infections at distant points in crops sometimes occur.

Landscape plants may be a source of infection. They usually die within 3 years after becoming infected. Because of the year-round presence of this disease and of the conidia, plants should not be planted in the landscape near production areas.

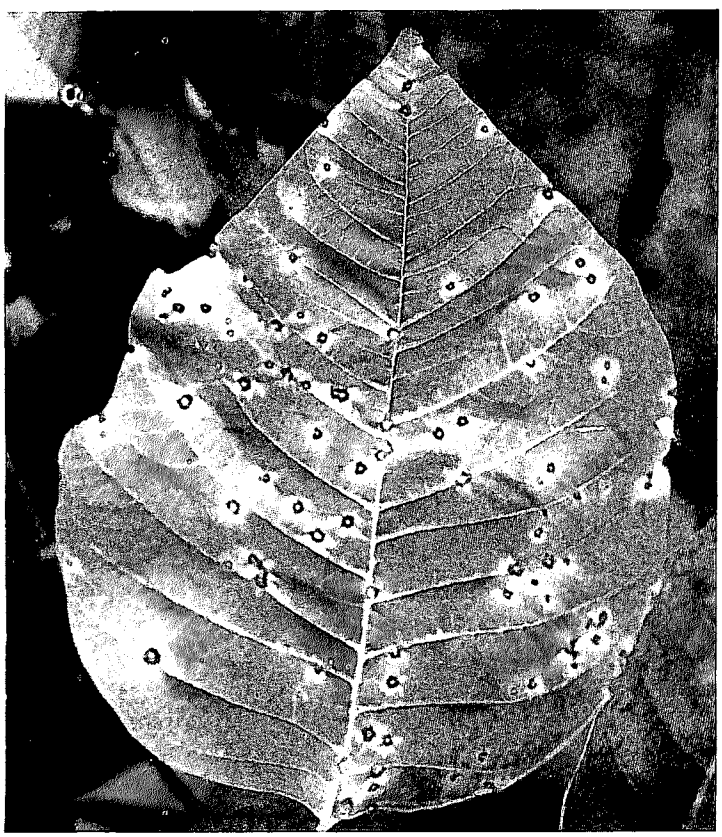

Fig. 5. Scab leaf spots incited by *Sphaceloma poinsettiae.*

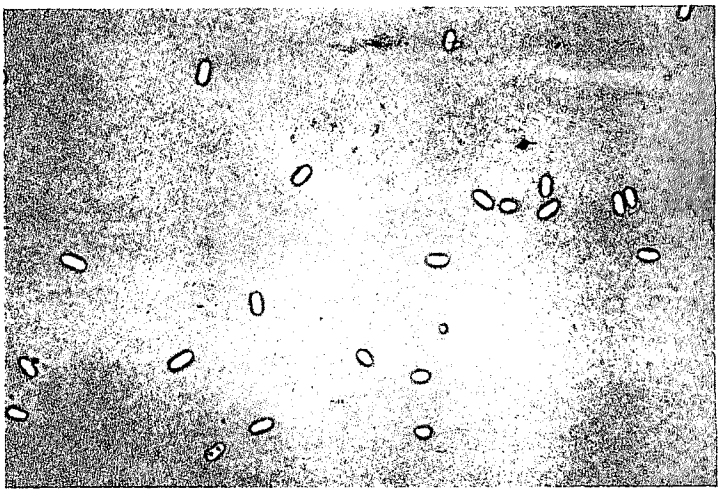

Fig. 6. Conidioa from a scab lesion (*Sphaceloma poinsetticola*).

Choanephora wet rot. The pathogen grows profusely on diseased plants and the host may be killed in a few days (Fig. 7). So many long sporangiophores are produced on diseased stems that a whisker-like growth is evident (Fig. 8) (6). A sporangium (mass of spores) is produced on the terminal end of each sporangiophore. The sporangial wall may dehisce at maturity exposing many airborne spores. When water, such as from rain or irrigation, hits a sporangium with an intact wall, the football-shaped spores immediately disperse, splashing to adjoining plants. The spores have several long appendages at each polar end. The appendages could function by helping the spores to stick to insects, man, and even in making them more easily transported by air. Disease incited by *Choanephora cucurbitarum,* also occurs on petunia, hibiscus, bell pepper, yellow squash and wild hibiscus (6). Blasquez (2) indicated sporulation on both pepper and wild hibiscus ceased soon after the ambient temperature dropped below 14.4°C (58°F). Wet rot on poinsettia occurs mainly during the August-September-October period, so it appears warm temperatures, moisture, and high humidity presumably are favorable for disease development.

Other diseases. Phytophthora blight (*Phytophthora parasitica*) appears in warm, rainy periods and is treated

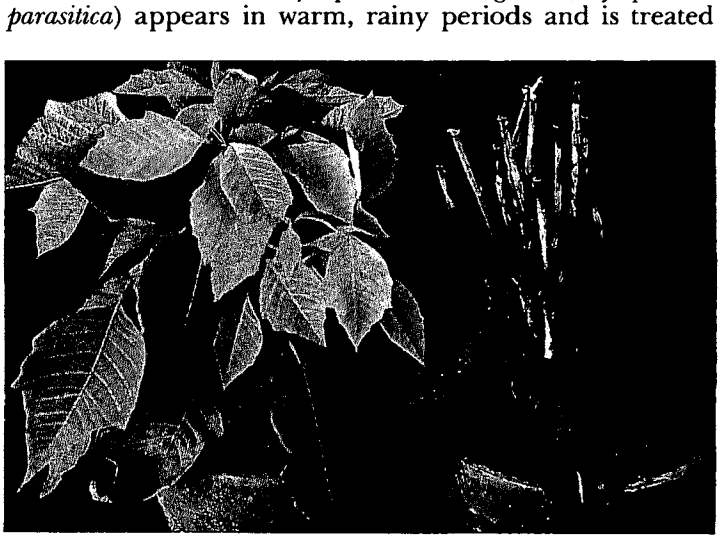

Fig. 7. Wet rot incited by *Choanephora cucurbitarum* on poinsettia plants. Plant on left has infection in top, plant on right shows advanced disease.

Fig. 8. *Choanephora wet rot.* "Whiskery" growth of sporangiophores and sporangia of *Choanephora cucurbitarum.*

with soil drenches similar to *Pythium* or *Phytophthora* water mold problems. Organisms such as *Helminthosporium* (*Bipolaris*) *Curvularia, Corynespora,* and *Stemphylium* (Fig. 9) cause small leaf spots that usually do not get larger than 6 mm in diameter. The organisms may blow into the production area from weeds and grasses growing in the vicinity. A good production practice is to cut weeds in ditches and perimeter areas.

A Disease Management Program

Elements of a disease management program include 1) control of the introduction and production of pathologically active organisms, 2) eliminate sources of inoculum, 3) use host germ plasm (resistance) that is unsatisfactory for disease development, 4) adjust the environment so that moisture, humidity and temperature are in ranges unsatisfactory for spore and/or disease development, 5) have an effective early warning system (scouting program) that signals the appearance of a problem, and 6) have a spray program that incorporates maximum efficacy and coverage of the foliage with the fewest applications and low cost.

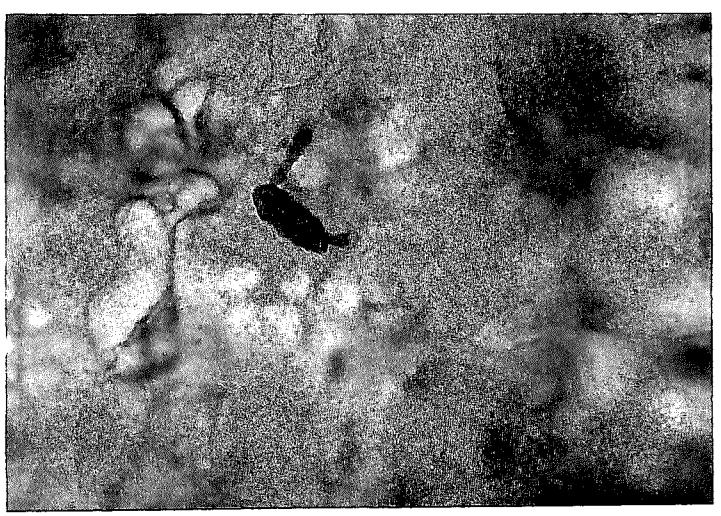

Fig. 9. A germinated spore of what appears to be *Stemphylium* sp. A small, round necrotic spot developed on the leaf.

Resistant cultivars. Alternaria blight is very severe on the Gutbier V-14 cultivars and on Minstral, intermediate on the Gutbier V-10 cultivars and very light on the Annette Hegg cultivars. Incorporating cultivars with higher levels of resistance in the cultivar pool reduces disease and the potential production and build-up of biological contaminants.

Little information is available on the susceptibility of poinsettia cultivars to botrytis blight. However, any cultivars that have growth problems which result in the development of necrotic tissue, such as the leaf and bract necrosis problem on V-14 cultivars (15), have increased susceptibility because of the saprophytic nature of *Botrytis cinerea* colonizing the necrotic tissue. Resistance to scab is not available. Twenty-six cultivars evaluated in 1987 were all very scab-susceptible.

Epidemiological factors. The spores of all the pathogens mentioned need water to germinate. To help prevent disease development, keep the foliage dry by watering plants so the foliage does not get wet (spaghetti system), install polyethylene sheeting over houses to control rain and dew, space plants to allow air movement in and around plants to aid drying, and run fans to keep air moving.

Remove diseased plants and plant parts to eliminate sources of inoculum. Place severely diseased plants in polybags at the site where they grew to minimize spreading the spores. Also, remove fallen leaves and plant parts. Remove spotted leaves from lightly diseased plants. Observe production areas with "hot" spots daily for disease and give extra fungicide sprays to contain serious diseas outbreaks. Berger (1), working with spores of *Cercospora apii* from celery, indicated "the daily number of spores trapped in a field provided a valid estimate of daily 'blight pressure', and to some extent estimated the amount of disease in the field". High spore counts were present when disease levels were high and vice versa.

Scouting the crop. A crop should be observed at regular intervals for problems as a good management practice. Price et al. (12, 13) reported that scouting a crop at least 2 times/week gave adequate indications on gypsophila and chrysanthemum of impending problems. Plants also should be inspected for insect damage, nutritional problems, leaf marginal necrosis or other conditions that result in the formation of necrotic tissue which is very susceptible to the growth of some pathogens, especially *Botrytis* and *Alternaria.* A scouting program prduces information that informs the producer how his crop is progressing and allows the grower to make decisions based on actual conditions that exist.

Fungicides. Fungicides are chemicals that are toxic to the fungous pathogen, i.e., they are fungitoxicants. Most fungicides used on poinsettia plants are protectant in their mode of action. When a spore lands on a sprayed surface, the toxicant is absorbed by the spore which then fails to germinate and disease does not develop. Disease can develop when a spore lands on an unsprayed surface and germinates (Fig. 2, 9). It is very difficult to cover the leaf

surfaces of poinsettia plants with spray. The leaves fold against each other, preventing spray coverage even when sprayed carefully from below. Inspecting leaves following spraying usually shows less than 50% of the total lower leaf surface is covered. Since spores are produced in great numbers on diseased tissue, it is not unexpected that some spores reach nonsprayed plant surfaces.

Some fungicides are classified as being systemic. They are absorbed by the plant, translocated either locally in a leaf or upward to other parts of the plant. The pathogen is controlled when it grows on a sprayed surface or when it attempts to grow into the host. Systemic actions as described would be ideal; in practice the systemic action is not as effective as the explanation would lead one to believe. Information about translocation of systemic fungicides in poinsettia plants is scant.

Fungicides offer the most important method of controlling diseases of the foliage. However, they should not be depended on as the sole method of disease control. They are a single component in a successful disease management program. If great numbers of spores are produced and disseminated in the area, fungicides do not keep the crop free of disease.

If a crop is scouted and no disease problems are found, then minimum rates of fungicides may be applied at 10-day intervals. Higher rates or a more frequent spray interval are not needed if disease is not present. If a disease outbreak occurs, then rates and frequencies must be increased. The fungicides effective for the control of the diseases are listed in Table 1. Tank-mix combinations, with each material at half-rates, have been effective and with the tank-mixes the appearance of pathogen-resistance to benomyl is reduced. The tank-mixes also control the minor diseases. Benomyl 50W at 0.25 lb/100 gal and the companion material (chlorothalonil 75W, mancozeb 80W, captan 50W) at 0.75 lb/100 gal tank-mixed have given good disease control when sprayed at weekly intervals. Under difficult conditions benomyl 50W at 0.5 lb/100 and the companion material at 1.0 lb/100 may increase effectiveness. However, high rates of fugicides are not a substitute for inadequate coverage of the foliage. High pressure and a large cloud of spray does not insure coverage, only good spray technique does. The current product label gives up-to-date information on the proper use of fungicides.

Table 1. Fungicides for control of alternaria blight, botrytis blight and scab of poinsettia.

	Alternaria blight	Botrytis blight	Scab
Benomyl + captan	+++[z]	++	+++
Benomyl + chlorothalonil	+++	+++	+++
Benomyl + mancozeb	+++	++	+++
Thiophanate M + mancozeb (zyban)	+++	++	+++
Benomyl 50W (Benlate)	—	++	+++
Captan 50W (Orthocide)	++	++	+++
Chlorothalonil 75W (Daconil)	+++	+++	+++
Iprodione 75W (Chipco)	+++	+++	+
Mancozeb 80W (Manzate/Dithane)	+++	++	+++
Vinclozolin 50W (Ornalin)	Plant Injury		

[z]+++ excellent, ++ good, + poor, — no control.

Literature Cited

1. Berger, R. D. 1971. Numbers of trapped *Cercospora apii* spores determined by length of temperature favorable moisture periods. and disease incidence. Phytopathology. 61:885 (Abstr.).
2. Blazquez, C. H. 1986. Choanephora wet rot of pepper. Proc. Fla. State Hort. Soc. 99:321-325.
3. Engelhard, A. W. 1983. Chemical control of scab (*Sphaceloma poinsettiae*) on outdoor grown poinsettia plants in Florida. Proc. Fla. State Hort. Soc. 96:285-287.
4. Engelhard, A. W. 1984. Diseases and their control p. 37-47. In: B. O. Tjia (ed.) Commercial poinsettia production in Florida. Fla. Coop. Ext. Service , Inst. Food Agr. Sci. Gainesville, Fla.
5. Engelhard, A. W. 1985. Poinsettia leaf spot and blight a destructive new disease. Newsletter. Florida Ornamental Growers Assoc. 8(4):1, 3.
6. Engelhard, A. W. 1987. Choanephora wet rot of poinsettia. Univ. Fla. Inst. Food Agr. Sci. Bradenton GCREC Res. Rpt. BRA1987-23.
7. Engelhard, A. W. 1987. Be on the lookout for alternaria blight. Greenhouse Grower 5(7):62, 64.
8. Engelhard, A. W. and J. B. Jones. 1985. Poinsettia: alternaria leaf spot and blight. Univ. Fla. Inst. Food Agr. Sci. Bradenton GCREC Res. Rpt. BRA1985-24.
9. Engelhard, A. W. and J. B. Jones. 1985. A leaf petiole and stem lesion disease of poinsettia incited by *Alternaria* sp. Phytopathology 75:1306 (Abstr.).
10. Engelhard, A. W. and R. E. Ploetz. 1979. Phytophthora crown and stem rot, an important new disease of poinsettia (*Euphorbia pulcherrima*). Proc. Fla. State Hort. Soc. 92:348-350.
11. Engelhard, A. W. and T. S. Schubert. 1985. Alternaria blight of poinsettia. Plant Path. Circ. No. 277. Fla. Dept. Agric. & Consumer Serv., Div. of Plant Ind., Gainesville, Fla.
12. Price, J. F., A. W. Engelhard A. J. Overman, V. W. Yingst, and M. K. Iverson. 1980. Integrated pest management demonstrations for commercial gypsophila. Proc. Fla. State Hort. Soc. 93:187-190.
13. Price, J. F., A. J. Overman, A. W. Engelhard, M. K. Iverson, and V. W. Yingst. 1980. Integrated pest management demonstrations in commercial chrysanthemums. Proc. Fla. State Hort. Soc. 93:190-194.
14. Trolinger, J. C. and D. L. Strider. 1985. Botrytis diseases. p. 17-101. In: D. L. Strider (ed.). Diseases of floral crops. Vol. 1. Praeger Special Studies, Praeger Scientific, New York.
15. Woltz, S. S. and B. K. Harbaugh. 1986. Calcium deficiency as the basic cause of marginal bract necrosis of 'Gutbier V-14 Glory' poinsettia. HortScience 21(6):1403.