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# INFLUENCE OF SOIL FUNGICIDES ON PRODUCTION EFFICIENCY OF *PEPEROMIA GRISEO ARGENTEA* 'BLACKIE'

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Soil-borne diseases are important constraints to efficient production of many types of greenhouse crops. Direct plant losses and delayed growth of crops affected with various types of root and stem rotting diseases contribute to higher production costs, unpredictable growth, and reductions in plant quality at the time of sale. Familiarity and use of sanitary growing practices advocated by Baker, et al. (1) are necessary for control of soil-borne diseases. The growing medium and container, the plant used for production and cultural operations are potential avenues of entry for soil-borne pathogens into the crop production cycle. Sanitary production practices can be effectively used to eliminate soil-borne pathogens from greenhouse production programs provided the procedures are uniformly adopted for all facets of the growing operation.

## SANITATION AND THE GROWING MEDIUM

The growing medium is an important and common source of soil-borne pathogens for greenhouse crops. Use of a wide

range of growing media for commercial production of ornamental plants has generally restricted efforts to adopt uniform sanitation measures for specific types of plant production. Production strategies for commercial greenhouse crops should insure initially low populations of soil-borne pathogens in growing media at the time the growing cycle is initiated. High populations of soil-borne pathogens cannot be controlled by applications of chemical sanitation measures following introduction of plants into the growing medium. When populations of soil-borne pathogens are high, greater amounts of active ingredients in chemical drenches are required for effective disease control. With few exceptions, applications of harsh chemical treatments necessary to overcome the problem result in delayed crop growth and are not effective for complete eradication of soil-borne pathogens.

Production of plants in growing media containing soil or other media constituents with initially high populations of soil-borne pathogens requires a supplemental program of sanitation before the growing cycle can be initiated Applications of steam heat or fumigants, such as methyl bromide or chloropicrin, are often employed as a pathogen knockdown procedure to eliminate or reduce populations of soil-borne pathogens from growing media prior to the planting operation A microbiological vacuum created by the biologically destructive action of steam or fumigants is partially overcome by the use of aerated steam for treatment of growing media (1) Media pasteurization with aerated steam (160°F, 30 minutes) leaves many of the beneficial microorganisms capable of suppressing root disease activity by soil-borne pathogens (1). Re-use of growing media for propagation beds or for container growing is always a dangerous production practice because of the presence of high populations of soil-borne pathogens. All re-used growing media and containers should be exposed to heat or chemical fumigants before the planting operation in order to avoid severe root disease problems.

Soil-borne diseases can be reduced by careful selection and handling of growing media prior to the planting operation. In recent years, commercial greenhouse producers have relied heavily on soilless potting mixtures as a method of reducing soil-borne disease problems. Several commercial potting mixtures are formulated with media constituents containing low levels of soil-borne pathogens. Mixtures of commercial peat moss, perlite, vermiculite, styrofoam, calcined clay, volcanic rock or washed sand can also be prepared for use as soilless potting mixtures that contain initially low populations of soil-borne pathogens. Grower experience has shown that the use of soilless potting mixtures cannot completely overcome the

problem of soil-borne diseases without the use of additional sanitary precautions during the cropping cycle. Applications of soil fungicides at the time of planting have been effectively used to maintain sanitary growing conditions where soil-borne pathogen populations are initially low.

## LIMITED AVAILABILITY OF DISEASE-FREE PLANTING MATERIALS

Limited availability of disease-free planting materials for production of ornamental crops is a major problem in the plant growing industry and is a particularly important problem in the production of greenhouse crops. Large-scale production of greenhouse crops generally cannot insure the use of disease-free planting materials for production of healthy plants. Lengthy periods required to produce rooted cuttings or seedlings for the finishing stage of growth increase the opportunity for root infection to occur prior to the planting operation. The importation of pre-finished planting materials from distant sources has also resulted in variable degrees of root disease from shipment to shipment. In overall perspective, most growers should assume all disease-sensitive planting materials are infected to one degree or another with soil-borne pathogens at the time of planting. Sanitation tools can be employed to overcome this pitfall in growing greenhouse crops. The use of hot water soaking for elimination of pathogens can be used for a few types of planting materials. The method is not commonly used for treatment of most types of greenhouse planting materials because of the dangers of injury to plants by high temperatures required to kill plant pathogens. A variety of chemical sanitation tools are widely used for direct treatment of planting materials or as drenching agents for sanitation during the cropping cycle.

## EFFECTIVE USE OF SOIL FUNGICIDES

Over sixty soil fungicides, bactericides, and combination drenches or soaks are available to commercial growers for use in soil-borne disease control programs. The selection of chemicals and strategy for their effective use has been a problem to commercial growers for many years. Chemical products differ in the types of pathogens they control, formulations, rates to apply, and frequency of application necessary to perform satisfactorily. When used properly, chemical control measures can be thought of as short-term crop insurance with predictable expiration dates. When used improperly chemical disease control measures have limited effectiveness as problem-solving tools.

Strategies of disease control involving the use of soil fungicides should be based on an understanding of the limitations of their use. Applications of soil fungicides are most effectively used as sanitation tools in overcoming low populations of soil-borne pathogens. Soil fungicides can be effectively employed for disease control in many types of soilless potting mixtures or as supplemental sanitation tools following preplanting media treatment with various types of steam or fumigants. Proper use of soil fungicides for control of soil-borne disease problems requires the presence of the chemical in the growing medium or on the plant surface at the beginning of the growing cycle. Periodic drenching may be required as a supplemental sanitation tool to maintain vigorous and healthy roots during the growth of the crop. The rationale for use of chemical disease control measures in this manner is based on the fact that root and stem rotting diseases cannot be controlled readily once they appear. Chemical applications are effective for preventing infection by soil-borne pathogens, not as curative measures for disease control.

## GREENHOUSE PRODUCTION TRIALS

Dependable and expedient growing programs are the criteria of success for commercial producers of greenhouse crops. Efficient growing programs are particularly important for greenhouse crop production where operational costs are very high. Unit production costs for tropical and floral crops can account for 75 to 90% of the wholesale value of the plant under optimal growing conditions. Requirements for long production cycles can severely reduce the margin or profit of greenhouse crops because of excessive demands for labor and energy needed to produce salable crops. Production efficiency studies were initiated to determine the influence of commercially available soil fungicides on efficient growing of typical greenhouse crops. The cropping efficiency of *Peperomia griseo argentea* 'Blackie' is an example of production trials with vegetatively propagated plants.

**Propagation efficiency.** Leaves of *Peperomia* 'Blackie' were planted in peat-perlite growing medium infested with millet seed inoculum of *Pythium aphanidermatum* to determine efficient propagation in the presence of a common soil-borne pathogen. Sanitation methods used for propagation included application of soil fungicides at the time of planting and treatment of the growing medium with aerated steam or methyl bromide-chloropicrin prior to the planting operation. Soil fungicides* were applied at recommended rates (excepting Terra-

* Benlate — benomyl, duPont
Captan — Orthocide
Lesan — Dexon, fenaminosulf
Subdue — metalaxyl, Ciba-Geigy
Terrachlor — PCNB, quintozene, Olin Corp
Truban — Ethazol, Malinckrodt

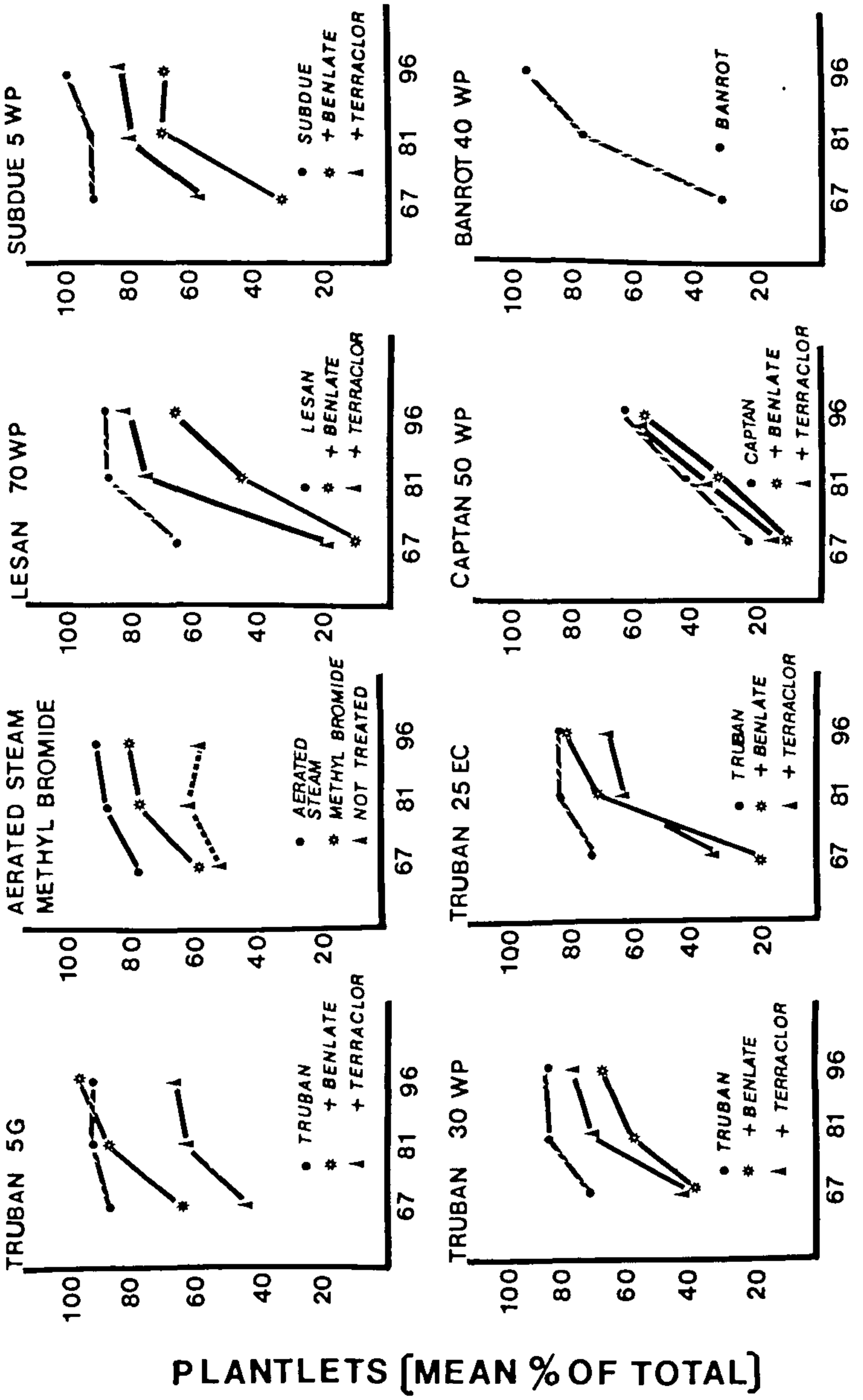


**Figure 1.** Influence of chemical drenches and preplanting medium treatment on plantlet production by vegetative leaf cuttings of *Peperomia griseo argentea* 'Blackie' in peat-perlite growing medium infested wth *Pythium aphanidermatum* inoculum Topical drenches were applied 1 and 45 days following planting Granular Truban 5G fungicide, aerated steam, and methyl bromide were used as preplanting medium treatments

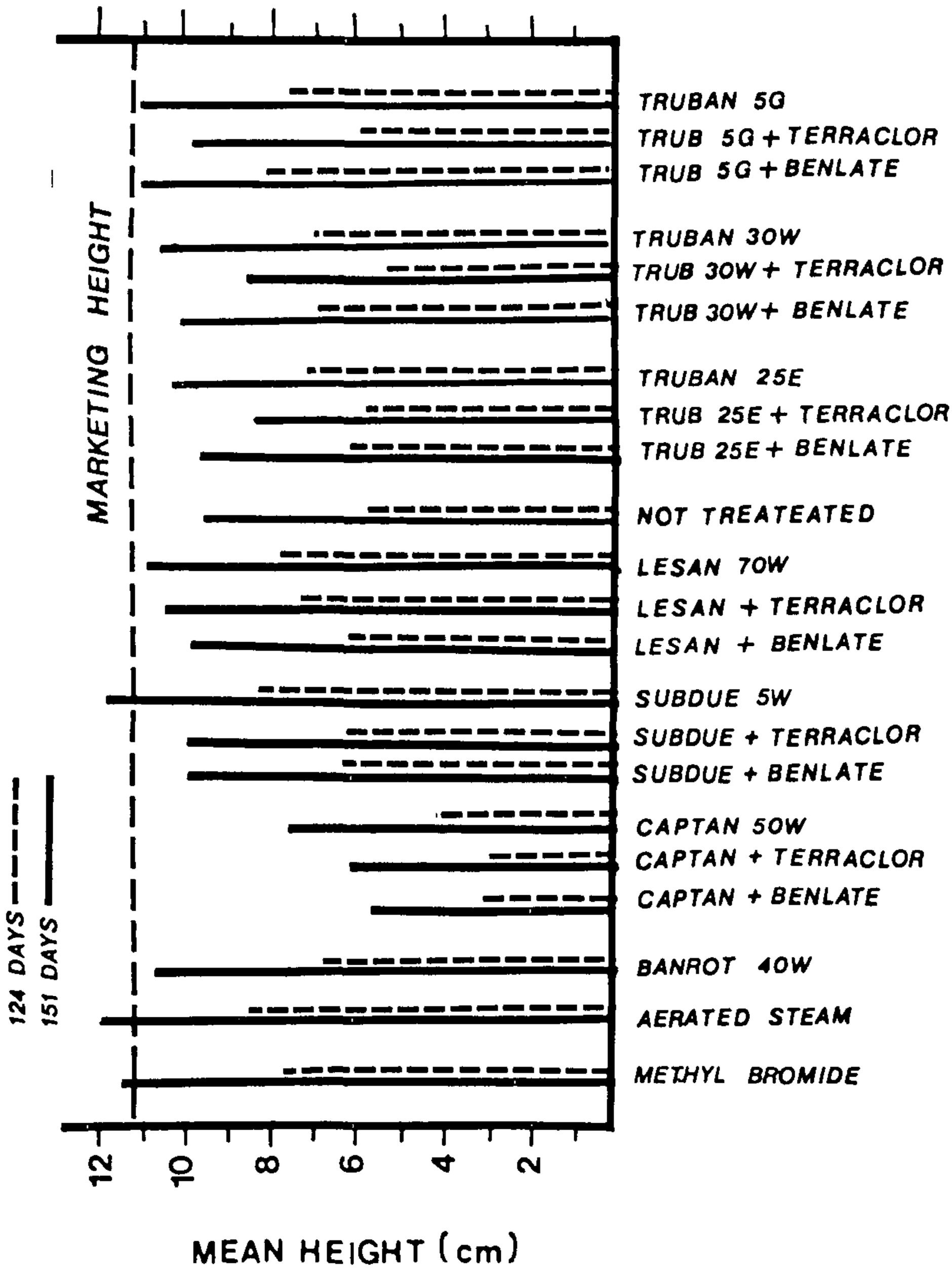


**Figure 2** Production efficiency of *Peperomia griseo-argentea* 'Blackie' raised from vegetative leaf cuttings on production programs indicated Tropical drench applications in the finishing phase were applied at 1 and 45 days after transplanting into 4-inch pots Truban 5G fungicide, aerated steam and methyl bromide were used as preplanting medium treatments

clor used at a 4 oz rate) and applied singly or in combinations for broad spectrum disease control activity. Truban 5G fungicide was incorporated into the growing medium prior to planting as a single application. Other chemical controls were applied as a topical drench immediately after planting and after 45 days. (See Figure 1 for treatment used.) Leaf cuttings were maintained under cultural programs used by commercial greenhouse producers for a 96-day period of study.

Use of Truban 5G, Lesan, and Subdue at recommended rates resulted in production of plantlets comparable to or exceeding plantlet production in growing media treated with aerated steam or fumigation. Plants were produced more efficiently using recommended rates of Truban 5G or Subdue than other chemical control measures or preplanting medium treatments. The use of fungicide combinations resulted in delayed plantlet production when compared to use of chemicals applied singly as a soil drench. Combination soil drenches were generally the least desirable of chemical teratments used for plantlet production studies.

**Finishing-stage growth.** The same sanitation methods were used for transplanting plantlets into 4-in pots for the finishing stage of growth. Soil fungicide drenches were applied 1 and 45 days following transplanting. Truban 5G, aerated steam, and methyl bromide-chloropicrin were used as preplanting medium treatments.

The height of test plants 124 and 151 days following the initial planting of vegetative leaf cuttings was markedly different (Figure 2). Peperomias planted in growing medium treated with aerated steam, methyl bromide, Subdue, Lesan, and Truban 5G reached a marketing height faster than other treatments used. Application of fungicide mixtures resulted in reduced growth of treatment plants when compared to single chemical treatments.

## CONCLUSIONS

Use of an aerated steam-treated or a fumigated growing medium was an effective sanitation measure for eliminating *P. aphanidermatum* from the growing medium prior to initiating the growing cycle. Alternative sanitation treatments of applying the soil fungicides Subdue or Lesan, the broad spectrum drench Banrot, or incorporation of Truban 5G into the growing medium were also effective for efficient production of *Peperomia* 'Blackie' plantlets and market-quality plants. Poor results obtained with captan drenches could be attributed to the long interval of fungicide application used; however, reduced plantlet production compared to untreated control plants suggests

phytotoxicity as a probable cause of the delayed growth observed (Figure 1).

The development of a healthy and vigorous root system is a fundamental requirement for efficient plant growth. Chemical sanitation tools can promote the development of vigorous root systems when used as preventative disease control measures. Greater attention should be given to effects of chemical treatment on plant growth. The elimination of soil-borne disease problems must be accompanied by minimal effects on plant growth to be useful in efficient greenhouse growing programs. Inability of growers to predict requirements to control specific soil-borne pathogens will continue to emphasize the use of broad-spectrum control measures during the cropping cycle. The use of fungicide with control activity will require the use of fungicide combinations. Long-term effectiveness, cost of application, and production efficiency of chemical control programs are important considerations for future research.

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# SOME ASPECTS OF INTERIOR LANDSCAPING

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The Spencer Company entered the horticultural services field in 1959 in commercial landscape management. During the early 1970's we noted the environmental trend and began an indoor plant leasing service, which is now producing about 55% of our gross revenues. In 1977, the landscape division rounded out our services with landscape design-and-build capabilities.

For this presentation, I requested a brief statement from three department managers in our indoor division with regard to the needs you might address in your propagation, growing and shipping operations. These are their memos to me.

## PURCHASING

"In reference to your memo, the problems I have are rather isolated due to our excellent sources in Florida. However, there are certain plants that are almost always difficult to obtain. At certain times of the year, around January, *Dracaena fragrans massangeana* and other *Dracaena fragrans* cultivars