70% diesel oil carrier. Bark banding with dikegulac as a commercial practice is contingent upon the development of a more efficient carrier system.

Literature Cited

1. Alvarez, R. G. 1977. Growth regulators. *J. Arbor.* 3:94-97.
2. Backhaus, R. A., R. M. Sachs, and H. Z. Hield. 1976. Tree growth inhibition by bark applications of morphactins. *HortScience* 11:578-580.
3. Hield, H., S. B. Boswell and Stuart Hemstreet. 1977. Eucalyptus tree growth control by inhibitors applied as sprays, injection, cut painting or trunk banding. *J. Amer. Soc. Hort. Sci.* 102:665-669.
4. ________, R. M. Sachs, and R. A. Backhaus. 1978. Bark banding with morphactin to inhibit tree growth. *J. Arbor.* 4:58-61.
5. ________, ________, and Stuart Hemstreet. Growth reduction comparisons of 9 plant regulators applied to *Pinus radiata.* Proc. 4th Annual Meeting Plant Growth Regulator Working Group, Hot Springs, Ark., Aug. 9-11, 1977. p. 277-282.
6. Sachs, R. M., H. Hield, and J. DeBie 1975. Dikegulac: a promising new foliar-applied growth regulator for woody species. *HortScience* 10:367-369.
7. Sachs, R. M., W. P. Hackett, R. G. Maire, T. M. Kretchun, and J. DeBie. 1970. Chemical control of plant growth in landscapes. *Calif. Agr. Exp. Sta. Bul.* 844.

HortScience 13(4):442–443. 1978.

Boron Deficiency and Toxicity Symptoms in *Ficus elastica* 'Decora' and *Chrysalidocarpus lutescens*[1]

R. B. Marlatt
University of Florida, IFAS, Agricultural Research and Education Center, Homestead, FL 33031

Additional index words. India rubber plant, areca palm, nutrition, hydroponics

Abstract. **Boron deficiency symptoms of hydroponically-grown *Ficus elastica* Roxb. 'Decora' included plant stunting, deformation of immature leaves and necrosis of terminal bud. Excessive boron caused the undersides of mature leaves to have brown, circular lesions with chlorotic halos, starting at leaf margins. Affected leaves abscised prematurely. Boron deficiency symptoms of hydroponically-grown *Chrysalidocarpus lutescens* Wendl. included stunted growth, chlorotic mottling and streaking of leaflets and eventual death of immature leaves and terminal bud. Inflorescences bore necrotic fruits and died prematurely. Toxicity symptoms included leaflet mottle chlorosis and premature death and tip-burn of all leaves.**

The India rubber plant, *Ficus elastica* 'Decora', is one of the most common tropical foliage plants produced in Florida. Stock plants are perennials grown out-of-doors in south Florida and are propagated as air-layers before being grown in containers (1). Areca palm, *Chrysalidocarpus lutescens*, another popular house plant, is grown from seeds. Usually several plants are grown in one container for the trade.

Attempts to isolate pathogens from commercially-grown plants with a variety of leaf spots were unsuccessful. Therefore, a hydroponic experiment was devised to determine whether or not such symptoms resulted from a nutritional disorder. Symptoms of boron deficiency and toxicity were the first to appear and apparently have not been previously described.

Procedures were similar to the experiment with rubber plant performed in 1968 (3). The greenhouse containing the experimental plants was covered with shadecloth that limited sunlight to 10.8 klx (1000 ft-c). Greenhouse temp typically ranged from 24 to 32° C with extremes of 21 to 38°.

Containers for the plants consisted of round-bottomed plastic pots with a 3600 ml capacity and a drainage hole in bottom center which was covered with a nylon screen. Pots wer nearly filled with equal volumes of perlite and sharp silica sand. The medium was washed several times with distilled water, twice with 2% HCl at 48-hr intervals and, finally, 5× with distilled water. Rubber plants and palms were planted similarly except that 4 palms were planted in each container, later thinned to 2. One rubber plant air-layer was grown per pot. The experiment began Dec. 1976, and ended Feb., 1978.

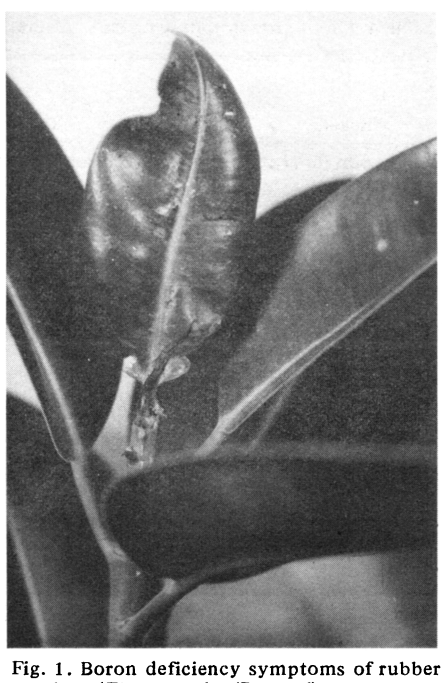

Fig. 1. Boron deficiency symptoms of rubber plant (*Ficus elastica* 'Decora').

Treatments consisted of modifications of Hoagland's solution (2). No boron was added to low-boron treated plants and 28.6 mg/liter boric acid was applied to high boron treatments. Controls received the recommended amount of boron (2.86 mg/liter boric acid). Treatments were replicated 4 times and randomized. Two liters of nutrient solution were applied every 2 weeks to each container; about half drained through. Distilled water (2 liters) was applied to each pot on 3 successive days at 3-month intervals to leach accumulated salts. Soluble salts in the 3rd leachates were less than 300 ppm sodium chloride equivalent. The pH of the media in all treatments was consistently 4.9.

Rubber plant symptoms. Five months after the experiment began; early boron deficiency symptoms appeared. These included stunting of the plant followed by deformation of abnormally small terminal leaves. These bore unusual, transverse splits in the adaxial epidermis. Latex oozed from these splits and dried on the leaf surface. Later symptoms involved necrosis of the terminal bud (Fig. 1). Toxicity symptoms started as occasional brown, circular lesions, with chlorotic halos, located near abaxial leaf margins of mature leaves; Lesions became more numerous, were eventually more widely scattered and were visible on the adaxial surface as dark green spots. Leaves became chlorotic and abscised as lesions became numerous. Immature leaves remained slightly stunted but otherwise normal during the course of the experiment (Fig. 2).

Palm symptoms. Born-deficient palms were stunted. Older leaves expressed mottled chlorosis starting at tips when the plant had 3 to 5 leaves. Narrow, transverse, chlorotic streaks developed

[1]Received for publication Mar. 10, 1978. Florida Agricultural Experiment Stations Journal Series No. *1059*.
The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper must therefore be hereby marked *advertisement* solely to indicate this fact.

Fig. 2. Rubber plant (*Ficus elastica* 'Decora')

Fig. 3. Areca palm (*Chrysalidocarpus lutescens*) showing boron deficiency.

Fig. 4. Boron toxicity of areca palm (*Chrysalidocarpus lutescens*).

interveinally. These streaks became more numerous, coalesced and formed necrotic lesions. Immature leaves and the terminal bud died. Deficiency in an older palm caused stunting and the stem tapered abruptly toward the terminal. The transverse, chlorotic streaks were numerous, often clustered, one distal to another, before coalescing and becoming necrotic (Fig. 3). Flowers and fruits were undersized and died on stunted inflorescences. Born toxicity also caused mottled chlorosis of leaflets. The most mature leaves were first affected and died prematurely. Severe leaflet tip-burn advanced proximally (Fig. 4).

Availability of boron to plants diminishes as pH increases. A pH of 5 to 7 is most conducive to furnishing plants with this element and pH should be kept within this range if boron deficiency is a problem. In an organic medium, such as peat moss, boron is most available between pH 5 to 6, diminishing as pH increases. Boron toxicity most likely results from excessive application in order to remedy a deficiency or irrigating with water containing excessive amounts.

Literature Cited

1. Hartmann, H. T. and D. E. Kester. 1968. Plant propagation principles and practices. 2nd. ed., Prentice-Hall, Englewood Cliffs, N.J.
2. Hoagland, D. R., and D. I. Arnon. 1950. The water-culture method for growing plants without soil. *Calif. Agr. Expt. Sta. Cir.* 347 (Rev. ed.).
3. Marlatt, Robert B. and Paul G. Orth. 1970. Relationship of potassium to a leaf spot of Ficus elastica 'Decora'. *Phytopathology* 60:255-257.