ment? How much replication did you have?

BARRY EISENBERG: Thirty plants in each group. That is what I started with. Then I took 5 that were showing the best characteristics out of any of them to use as the samplings.

VOICE: Has it ever been used in large replication?

BARRY EISENBERG: This is the San Fernando valley of California that we are talking about — just north of Los Angeles. Summer temperatures are 85° to 110°F. We used direct rooting with oleanders and we have tried it during the winter months with some of the junipers and we did it also with all of our perennials — Marguerite, Shasta Daisy, etc. We have had real good success with direct rooting, but the owner of the operation is hesitant to change methods because he has been successful using Jiffy Pots. This seems to be the biggest drawback. Everyone is already satisfied with what they are doing. In the San Fernando area everything they are growing they are selling anyway. So why change?

MYCORRHIZA EFFECTS FOLLOWING SOIL FUMIGATION

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Fumigation of citrus nursery soils has come into general use during the past 10 or 15 years. The increasing difficulty of finding suitable citrus soil which is free from harmful nematodes and phytophthora fungus has made it necessary to treat nursery sites in order to grow disease-free plants.

The first attempts at soil fumigation of seed bed soil at our Thermal, California nursery resulted in a near disaster. Citrus seed planted in either methyl bromide or Vapam-treated soil sprouted and grew normally at the start, but when the seedlings reached a height of 3 to 4 inches, growth stopped or was retarded in large areas of the beds. In some small areas of varying size the seedlings grew normally. Similar stunting of citrus seedbeds has been observed following soil fumigiation in Spain, Peru, Venezuela, and Florida.

Studies made at the Citrus Research Center of the University of California at Riverside showed a deficiency of phosphorus as well as some of the micronutrients in the stunted plants. A pro-

gram of preplant application of 1200 lbs. of phosphorous per acre resulted in improved growth. In fact, plants of some rootstocks, such as Rough lemon and troyer citrange, responded with 80% to 90% of normal growth; but others, such as sweet and sour orange, only grew to 40% or 50% of normal size.

Samples of roots of the affected plants were sent to Dr. J.W. Gerdemann at the University of Illinois, who had made studies of the effect of mycorrhiza fungus on growth of woody plants. The stunted plants were found to be non-mycorrhizal.

In every case, the healthy plants were mycorrhizal. This led to trials of field inoculation. The first effort in our Thermal nursery was made on *Citrus amblycarpa* Ochse by Harold Lembright of Dow Chemical Company with inoculum supplied by Dr. Gerdemann. This inoculum had been grown on Sudan grass roots. The plants inoculated were growing in methyl bromide-treated soil that had not received the heavy application of phosphorus fertilizer. These trial plants had been transplanted from fumigated seed beds which had received the heavy phosphate fertilization, but had failed to grow after transplanting. The inoculation was made six months after transplanting by mixing the mycorrhiza culture into the top two inches of soil around the plants. The result was spectacular. The inoculated plants started to grow normally while the untreated remained dormant or died (see Figure 1). Also, taking soil from around healthy plants in fumigated seed beds and working it into the soil around stunted plants in the same seed bed has consistently resulted in a quick growth response.

Subsequent experimental data obtained under controlled conditions has confirmed the dependence of citrus on mycorrhiza for adequate nutrition. Fumigation or other soil treatments usually reduce and may completely eliminate the natural occurring mycorrhiza. Spots in fumigated seedbeds where the plants grow normally result from failure of the fumigation to destroy the mycorrhiza.

The question remains, how can lack of mycorrhiza in fumigated nursery soils be overcome? One method is the inoculation of the citrus seed. Work by Dr. Gerdemann and Dr. John A. Menge with seed inoculation has resulted in successful growth of seedlings in fumigated soil with normal levels of fertilization. Mycorrhiza-inoculated seed of sour orange, *Citrus aurantium* L. grew normally in fumigated soil, while noninoculated seed showed greatly depressed growth (Figure 2). The inoculation of seed seems to be a promising approach to a solution of the problem.

The successful use of mycorrhiza in citrus nurseries may suggest its application to other tree crops.

Figure 1. Mycorrhiza inoculation of *Citrus amblycarpa* Osche. Trees on left noninoculated. Trees on right with black band on wrapper inoculated with mycorrhiza culture by mixing into top 2 inches of soil 6 months after transplanting.

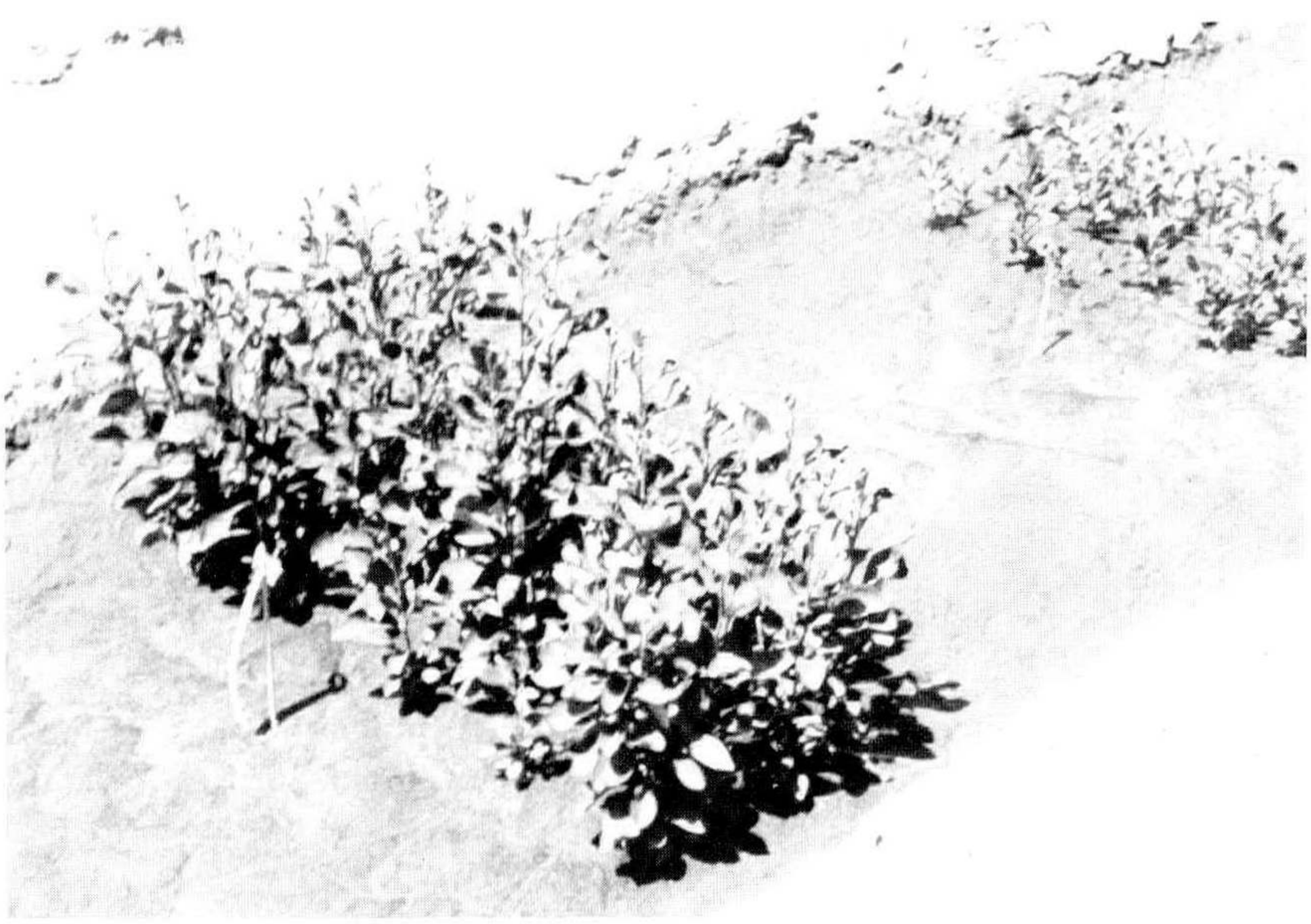

Figure 2. Inoculation of Sour orange seedlings (*Citrus aurantium* L.) with a culture of mycorrhiza. Plants on left from inoculated seed. Plants on right from noninoculated seed. Grown in fumigated soil.