

soil. The timing of the transplanting is no more critical than for other media. Cuttings may be held in the rooting chamber for three months or so after rooting and will continue to grow without additional feeding.

We intend to carry this research further, working to gain more control of heating and watering, and to develop a better insulating material to hold the cuttings. With such additional refinements, this "air-rooting" can point the way to discovering more about the "how" and "why" of conventional rooting and lead to improved practices in the commercial field.

PERCY EVERETT: Bruce, we again thank you for your very able presentation.

Now we come to a man, Wes Humphrey, who has helped in so many different ways in putting on this program. I have found this to be true of the Agricultural Extension Service wherever we go. When people come and ask me about certain problems they're having, and I certainly don't know many of the answers, I always refer them to their Agricultural Extension Service. Often they are quite ignorant of the fact that there is such a service. I'm really concerned that this should be so. Wes, will you take over now and tell us about the use of CO₂ in growing and propagating plants?

FOLIAGE PLANTS RESPONSE TO INCREASED CO₂

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Higher daytime temperatures are used for foliage plant production which results in longer daytime periods when greenhouses are closed compared to many other greenhouse crops grown in southern California. A closed greenhouse during the light period offers an opportunity to utilize CO₂ injections for growth stimulation. A study was conducted to determine if foliage plants would respond to elevated levels of CO₂ in the atmosphere during the daylight period when the ventilators were closed. This was done in cooperation with Bob Weidner at Buena Park Greenhouses, Inc., Brea, California.

Two 18-foot-long greenhouse sections were used, one in each of two separate greenhouses. Each section was isolated by a polyethylene film curtain at each end of the 18-foot length and sheets of polyethylene film were tacked inside the remaining glass area except for the ventilator area. Temperature, light, irrigation and nutritional levels were maintained as nearly alike as possible in both units.

The study was conducted from February to June, 1966, using a variety of foliage plants. CO₂ was added in one of the sections from a dry-ice convertor furnished by Pure Carbonic Co. Levels of CO₂ were measured by the use of a Beckman non-

dispersive infra-red analyzer, provided through the cooperation of Beckman Instruments, Inc., Fullerton, California.

The level of CO₂ maintained in the elevated section while the ventilators were closed, i.e. when daytime temperatures were below 80-82°F., varied between 750 to 1800 parts per million. The daily addition of CO₂ varied with the season. For example, in March it averaged four hours per day while in May it was 5.75 hours per day. Another way to look at this would be that in April a total of 130 hours of increased CO₂ was maintained out of a total of 416 daylight hours. The CO₂ level in the other unit was at or near the ambient air level at all times.

Two principal types of measurements: length of leaves and numbers of leaves per plant, were used to determine whether any growth differences occurred between the section in which CO₂ was added and the regular section. *Fatsia japonica* plants, treated with additional CO₂, had close to a 25 per cent increase in length of the largest trifoliate leaf on each plant when measured 15 weeks from seeding date. With plants of *Deifenhachia picta superba*, started as unrooted tip cuttings, an approximate 20 per cent increase in the number of leaves was evident in two months on the plants in the CO₂ unit over the non-CO₂ unit plants. Another type of plant which responded with increased growth in the CO₂ unit was the *Bromeliads*. *Guzmania pecocki* showed 16 per cent additional growth in the CO₂ section when leaf measurements were compared.

Additional observations indicated that when unrooted cuttings were placed in the respective units, those in the CO₂ unit developed larger root systems. It was noted also that there was a tendency for some of the species to elongate more in the CO₂ unit than in the non-CO₂ unit. The light conditions were very similar. Temperature differences were practically nonexistent. It is expected that the elongating was due to crowding with the additional growth in the CO₂ unit.

I should caution you in interpreting the above growth differences to mean total difference in growth. This is not the case. What we were actually comparing is just as indicated—various aspects of the growth difference rather than total over-all growth differences.

You may be interested in the difference in cost in operating these two units. The cost of the addition of the CO₂ averaged 46c per day for the total greenhouse area of 1330 cubic feet, based on 120 day's use. This would figure out to be 0.4c per square foot of bench area per day.