rectness of the propagation department reports. The group, with new understanding of the importance of its work, responded by exercising greater care in reporting what it had previously perceived as useless information.

By January, 1982, management was able to report to the group that the September through December production had increased by 233,033 units over the same 4-month period the previous year. In addition, a higher percentage of the cuttings taken had rooted, the quality of the liners had improved, and there were fewer weeds in the propagation areas.

The group had correctly identified and dealt with the problems that were impeding efficiency. The changes they had made in their procedures were as simple as assuming responsibility for ordering supplies before they ran out and cooperating within the department on the use of carts and other equipment. A team spirit had developed as the group became more aware of overall goals, while at the same time, individual efficiency had increased.

As production schedules were met, the group used slack times to visit other nurseries and observe their propagation techniques. This produced lively discussions of the strengths and weaknesses of our program and seemed to heighten the group's awareness of their position in the company and the industry.

We feel the program was very beneficial and have implemented it to a more limited degree in other areas of the nursery.

IMPROVED TECHNIQUES USED IN PRODUCING BUDDED CITRUS NURSERY TREES FOR COMMERCIAL FRUIT PRODUCTION

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Since the introduction of citrus fruit to the Western world by Spanish explorers, citrus trees have been produced by squeezing out the seeds and planting them in the ground. The trees grew slowly and were usually 10 to 20 years old before reaching a fruitful maturity.

In the late 19th century grafting and budding techniques began to be used by some growers to reproduce quantities of desirable fruit types. Other advantages soon became apparent as growers now had the abilities to improve cold hardiness,

adapt trees to poorer soil types, and also produce larger quantities of better quality fruit without several years' wait for scion maturity.

Satisfied with these developments, growers and researchers spent the next several decades improving fruit quality by developing new cultivars and rootstocks, using cross pollination techniques.

With the invention of the orange concentrate process the Florida citrus industry rapidly grew in size and so did the demand for citrus trees. Nurserymen, in an effort to fill this growing demand, soon resorted to the improved production methods of more irrigation, more intensive fertilization, and other cultural practices that made the trees grow faster but seriously increased the risk of cold injury. When fuel oil for outdoor heating began to increase in price, it became apparent that new growing techniques would soon be required. The improvements made in the last ten years are the text of this paper.

In modern citrus production the rootstock holds equal importance with the scion cultivar. The best rootstock cultivars are screened for freedom from various pathogens, assigned registration numbers, and distributed to the industry for further multiplication.

When the mature seed fruit is harvested, it is run through a device with rapidly spinning fingers that tears the fruit apart and exposes the seed and pulp within. A flood of water carries the resulting seed-pulp slurry into a rotating cylinder screen which separates peel from the seed and sends the peel out a conveyor to the dump.

The loose seed is collected, along with small pulp bits, and placed in a digester tank for cleaning. This process, developed about ten years ago by Drs. Barmore and Castle, University of Florida, is simply a speeded-up fermentation or rotting process, which destroys all the solids and leaves the seed coat intact.

Simply put, the process is as follows: A large 50 gal. tank is constructed. The bottom is removed and a gate valve placed in the bung for seed removal when the process is complete. About 40 gallons of equal parts seed slurry and water are added to the tank. Two ounces of "Kleerzyme 200", a pectolytic enzyme from the wine-making industry are added, with about 8 oz. of sodium bicarbonate, to bring the pH to 4.5. An agitator provides continuous stirring and a heating element brings the temperature to 85°F. Within 8 to 12 hrs. the digestion is complete. Clean seeds are removed, dipped in a fungicide, and dried with warm air. When dry, the seed is packaged

(in 2-lb. quantities) and placed in cold storage at 34° to 38°F. Viability has been maintained for up to 2 yrs. by this method.

For planting, the seed is removed from cold storage and soaked in water at 90°F for 16 to 18 hrs. Planting consists of single seeding in 3 and 5 in. deep "Speedling" trays with suitable soil mix such as Pro-Mix. Planted trays are then moved to a greenhouse at 90° to 95°F. for seed germination. When 80 to 90% of the seedlings have emerged (20 to 30 days), temperature is reduced 10°F. Liquid fertilization is commenced immediately on transfer to the greenhouse.

Seedlings are of satisfactory size to transplant to greenhouse Citripots in about 80 to 90 days from planting. About 30 days are allowed for hardening off before transplanting in the open field.

At a height of 6 to 7 inches the seedling is ready for transplanting to a larger Citripot. Soil temperature is maintained at 80° to 85°F and fertilization is provided weekly in irrigation water. Depending on cultivar, 60 to 90 days are required for the seedlings to achieve a size for budding, ⅛ to 3/16-in. caliper.

The greenhouse Citripot is a 4-in. square × 14-in. deep plastic pot with a hole of approximate diameter of 2½ in. on the bottom for air pruning of roots. The volume of approximately 3 qts. is adequate for one year's intensive greenhouse growth.

For budding, a very small bud is used with the inverted T-bud method. Wraps remain on for 14 to 21 days, followed by a 5-day resting period after unwrapping. Various methods of forcing the bud can be used, but we find the most suitable is to roll or bend the top of the seedling just above the bud down beside the pot, then wedge the pots together to hold the top down. Bud eyes emerge a little slower, but once out, seem to grow faster without the shock of lopping.

Once growth from the new bud has reached a height of 6 to 7 in., a small steel stake is placed in the pot for training a straight trunk. The stake stays with the tree when planted in the grove. A label stating scion and rootstock, and all identification numbers, as well as the budding date, is attached immediately after budding so that the identity of each plant is never lost.

When seedlings are placed in the greenhouse for budding, they become part of an assembly-line growing process so that, as they grow, they are moved slowly across the greenhouse on a dolly and track system devised for this type production. At the end of the growing period, about 8 to 9 months later, the plants are graded for shipping sizes and moved on the same

dollies into a truck for delivery to the final purchaser.

The controlled greenhouse environment has proved to be quite a satisfactory method of citrus tree production, enabling the nurseryman to increase or decrease available light in the summer and alter temperature and humidity during the winter. The total production time of 10 to 14 months from seed compares quite favorably with the 30 to 36 month production time required for 100% field production. In addition, the serious danger of extreme cold is eliminated, although the problem of cooling-power failure does exist to some extent in the summer months. Total production costs favor the greenhouse plants over the field grown, with the big advantage being removal of cold hazards.

The greenhouse or Citripot tree has many advantages over bare-root production that are quite beneficial to the citrus grove owner. The primary advantage is that, since the plants are in containers, they can be held in a shaded holding area or barn for several days before planting, allowing the citrus grower to use his own, usually cheaper, labor for transplanting. Transplant shock is eliminated and a simple hole dug with a post hole digger is suitable for planting. The tree is mudded in from a water tanker and, with low volume irrigation, does not have to be watered again. Dry fertilization can be done the same day and, thereafter, with irrigation water. The pot in which the plant has been grown is inverted over the tree to provide protection from hungry rabbits, sand blasting, and sunburn. Some research indicates a small degree of cold protection from the inverted pot.

Field performance of trees produced in a controlled environment have equalled or exceeded conventionally-produced outdoor, bare-root citrus trees. The fact is strongly confirmed by the large number of growers now insisting on purchasing only the greenhouse-grown trees.