

Nursery Seedlings

improved methods of production possible with control of damping-off disease

Kenneth F. Baker

New mechanized production techniques are being developed and adopted in the growing of seedlings because the damping-off disease now can be practically eliminated in commercial nurseries.

The proper treatment of the soil, and of seed in some cases, coupled with reasonably careful handling to avoid recontamination, is becoming an integral part of production of vegetable seedlings for farm planting, and of bedding stock for sale in flats.

To free the soil of pathogens, it should be uniformly steamed to 180° F for 30 minutes, preferably in the flats to be used. Seeds which carry organisms that cause either damping-off or diseases of mature plants should be treated to kill the parasites.

Careful utilization of these basic procedures has made possible striking improvements in mechanization of pepper seedling production in a southern California nursery and some of the methods developed should be applicable to other types of crops.

Methods of Handling Soil

The soil mixture consists of: 1. A light sandy loam as free as possible of fine clay; 2. Canadian peat, and 3. commercial fertilizer, blood or fish meal.

Natural manures or leaf mold usually are not used. Such a simple mixture is dependable, can be duplicated, does not break down under steaming, is practically free of excess soluble salts and has desirable characteristics of drainage, aeration, and breaking away from the roots on pulling.

The soil components are conveyed from the various storage piles by a moving belt, are blended in a large concrete mixer and brought to the proper moisture level before being dumped into a mechanical flat filler. The filled flats are placed on wooden pallets and transported to the soil pasteurizer and through the various steps by a fork-lift truck.

Methods of Seed Treatment

Although the *Rhizoctonia* fungus is carried internally in pepper seeds, it can be killed by a simple hot-water treatment without reduced germination. The seed is placed in cheesecloth bags which should

not be more than half full, and is then immersed in a deep sink or tub containing at least 30 gallons of water held at 125° F.

The temperature is most easily maintained by allowing hot water—140° F—150° from a water heater—to trickle in during treatment, with frequent thorough stirring for uniformity. The bags should be kneaded early in the treatment to get rid of air bubbles. After 30 minutes they should be removed, quickly submerged in cold water until cool, and then drained.

The seed is spread out in thin layers on screens to dry either outdoors in warm weather or in a heated room with fans, but drying must be completed within 12 to 20 hours.

Planting and Germination

Because the number of plants is not reduced by disease, seed is sown in place in the flats by a patented vacuum-plate

planting machine. For the same reason, it is possible to maintain the flats at a high moisture level during germination.

Immediately after the seed is planted in the flat and covered, first with thin tissue paper and then sterile sand, it is rather heavily watered. All of these processes are handled by machines at the rate of 150 flats per hour. These flats then are stacked and moved into a closed room held at fairly constant temperature and high humidity. Under these moist conditions the seeds germinate uniformly and shed the seed coats without the sticking or binding common under dry conditions.

The flats are removed from the germination room and placed on greenhouse benches just after emergence, but before the seedlings elongate.

Greater uniformity and percentage of germination is thus obtained while avoiding the laborious watering required for seed flats. The greenhouse benches are not used during the seven- to 14-germination period, and are available for plants which require light. This method of germinating seed flats under conditions free of pathogens is now successfully used by several nurserymen and seedsmen in California and the mid-West. It has been found useful when a single variety is sowed in numerous flats but not when several varieties are involved, because of differences in germination rate. This

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Olive Yields

studies underway to determine causes and correction of irregular bearing

H. T. Hartmann

Reduced yields of oil olives the year following the season when the fruit is harvested late—in January and February—were indicated by studies made in Tulare County several years ago.

To expand the studies, an experimental plot was established in 1947, in Butte County.

Trees were harvested October 21, 1947, and January 2 and February 23, 1948.

Oil content determinations were made of fruit samples harvested on these different dates. It was found that as the harvest was delayed the oil content increased.

These same trees will be harvested at approximately the same dates for several years and yield records and oil determinations will be obtained. This should show the extent to which late harvest depresses yields.

The first visible cause of a poor crop—nonbearing, irregular bearing, or alternate bearing—is the excessive production of staminate or male flowers which do not develop into fruit but drop soon after bloom. Two approaches are being tried at this time to overcome this trouble.

One is girdling branches in December; the other is applying hormone sprays in early spring. When the plots are harvested this season, the value of girdling and hormone sprays in olives will be known and a complete report will be made.

Variety Studies

A variety collection has been established for variety studies and in contemplation of an olive breeding program.

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SAMPLING

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is formed by the drop must be large enough to allow the fruit always to fall through and not bridge over—but no larger. Thus, the size or shape of a fruit has no influence on its being taken in the sample.

Second, the drops—apparently scattered over the conveyor—are in lines. By means of controls under the conveyor any one line or any combination of lines can be opened. Thus anywhere from one to 15 drops can be operated. In percentage terms, anywhere from 0.5% of the lot to 8% can be obtained in steps of approximately $\frac{1}{2}\%$. Any combination of percentages that might be wanted by an organization can be built into the machines. A remarkably high and uniform degree of accuracy can thus be obtained in the sample.

Research Method

The development of the machine represents an example of coöperation in research. The Division of Agricultural Economics, in coöperation with Ventura County packing houses, worked out the requirements for such a machine. The initial design, construction, and tests were carried out by the Division of Agricultural Engineering in its shops at Davis.

Recently a Ventura County citrus growers committee contracted with a commercial machinery company to construct a pilot model under the supervision of the Division of Agricultural Engineering.

It is believed that an important step has been made in sampling and immediate installation is being planned by a number of lemon packing houses.

The investigation thus far has been limited to lemons but the ideas suggested appear to be equally applicable to many other products such as oranges, apples and tomatoes. In consequence it is hoped that marketing and processing companies will be able to offer their growers a more

exact equity than in the past and yet achieve large-scale efficiency in their operations.

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method saves the labor of transplanting from a seed flat, eliminates the hazard of spreading virus diseases by handling during transplanting, and the seedlings do not sustain the usual 10- to 14-day setback from root injury.

Growing and Hardening of Plants

Because of freedom from disease, the seedlings may be grown safely in greenhouses at high humidity and temperatures of 80° F, and with high levels of soil moisture and fertility. Probably constant-level watering or subirrigation could be used with still greater reduction of labor. About 50 days are required from seeding to hardening off, compared to about 80 days for the usual method.

The flats are moved outdoors for two to three weeks to harden the plants, during which time most of the leaves are shed

and the stems become tough and wiry.

The plants are pulled from the flats by hand and, after the soil is shaken from the roots, placed in celery crates for delivery to the field. Experience indicates that such plants are suitable for machine planting, that they start rapidly, and that the root systems are at least as good as those of seedlings pricked out of seed flats.

Healthy Plants Produced

The total effect is to produce healthier plants more dependably and quickly, with less labor and expense. Because the plants are free of virus diseases and such organisms as root-knot nematode and the Rhizoctonia, Pythium, Phytophthora, or Sclerotinia fungi which cause root, stem, and fruit decay, and of Verticillium which causes wilt, the hazard of introducing them to uninfested fields is eliminated. Because of the savings effected by these improved methods, it is probable that the plants can now dependably be grown in greenhouses as cheaply as they can with uncertainty in outdoor seedbeds.

It cannot be too strongly emphasized that the success of this method depends on using soil and seed freed of pathogens, and on rigorous sanitation, and that without these conditions losses actually may be increased.

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ing as many of the old scaffold branches as possible to reestablish a satisfactory framework branch system. Because of the vigorous growth of its new shoots a skeletonized lemon tree soon becomes top-heavy.

The deheaded lemon trees studied were the most desirable from a commercial standpoint because of their structure and because they produced almost as much fruit as the skeletonized trees. More extensive studies of the response of lemon trees to severe pruning are now in progress.

Recommendations Premature

This report is not intended to advocate severe pruning of crowded trees, since it is unlikely that trees which are unproductive because of other limiting conditions would respond in the same manner as would trees which are limited merely by crowding.

While field experiments now underway with crowded old trees already have given promising results, much more work will be necessary before definite recommenda-

tions can be made regarding a rehabilitation program.

Pruning experiments are also in progress to determine whether trees can be prevented from getting too large and at the same time continue to produce profitable crops of high-quality fruit.

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Right. Skeletonized lemon, photographed two years after pruning. Note the undesirable two-stage effect. **Left.** A deheaded lemon tree two years after pruning.

