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THE RECOVERY OF THE AVOCADO TREE AFTER THE 1922 FREEZE

KNOWLES RYERSON
Agricultural Extension Service, Los Angeles County

Following the freeze of January, 1922, Mr. Hertrich of the Avocado Association, made a careful survey of the various avocado plantings in Southern California in order to note the effect of the cold weather on different varieties. His complete report was given at the spring meeting in May, 1922. I have been requested to make a similar survey this year to note the condition of trees a year later and the degree of recovery made. The report for Ventura was submitted by Dr. Manning, and for Orange County by Mr. Dutton. The speaker personally visited most of the plantings in Los Angeles County. The results can be quite briefly summarized and individual reports will not be attempted.

There are three general types of frost injury recognized: injury to the blossoms, injury to the fruit, and injury to the tree itself, including foliage and branches. By far the most serious is the injury to the tree, and it is this phase that is covered by the report. There were at least three gradations of injury to trees in 1922. The first may be termed moderate and resulted in defoliation and killing of wood up to one inch in diameter; in the second grade of injury the wood was frozen back into the main branches or even to the trunk itself; and in the third or most seriously injured group the trees were frozen back to the bud union and in extreme cases to, or even below, the surface of the ground.

The moderately injured trees have all recovered, are blooming heavily and setting fruit. Except for some small dead branches that have not always been removed, they bear no evidence of ever having been injured by the frost.

Trees frozen to the main branches and in many cases to the trunk have also recovered in a remarkable manner. Practically all varieties, including the more tender Knight group, have sent out vigorous new growth during the past year, which is now blooming in most cases, and upon which considerable fruit is apparently setting. The healing is very rapid even where large frost cracks and wounds are present. The avocado seems to be able to regenerate bark in an exceptional manner. Many of the trunks frozen last year present a rough, corky appearance at the present time. The dead bark is being pushed out by new bark which has formed underneath. Examinations begun shortly following the freeze and continued up to the present time reveal unusual activity in the cambium layer of the avocado. The new white cells grow rapidly throughout the injured bark and healing takes place far more quickly and completely than it does in citrus trees. In spite of the rapid recover}', however, where large areas have been killed to the heart wood, it is very doubtful whether healing from the sides can take place fast enough to offset the very rapid decay of the soft central wood. Even where the healing

is completed, the presence of relatively large sections of dead and decayed wood in the center of limbs or trunks is a permanent menace, and severe breakage is likely to result in the future.

In most cases where trees were frozen back to the bud union, new vigorous shoots are starting from the stock. In a few isolated cases, new buds from the former scion have risen at the point of union and give promise of remaking the tree without rebudding.

Handling Frozen Trees

It is not too early to discuss the handling of frozen trees in anticipation of the future. Disastrous cold waves have occurred periodically in the past and are likely to continue to occur in the future. Their lessons should be heeded and necessary precautions taken. Some suggestions in regard to the handling of frost injured trees may be made at this time, based upon observations during the past year. Defoliated trees should be whitewashed immediately to prevent sunburn. Pruning should be delayed until dying back has ceased and healthy new growth has commenced. The avocado throws out an abundance of young sprouts on defoliated limbs, most of which should be left the first season. This is necessary to provide as great a leaf surface as is possible, in order to feed the root system, defoliation having served as a severe pruning. Where the new shoots become too crowded, they may be judiciously thinned or pinched back in order to direct growth into fewer limbs desired for the new framework branches. Much of this work can be done after the first season however. Large wounds should be cleaned, dead and dying wood removed, and a disinfectant such as bordeaux paste or cyanide of mercury applied. Disinfection should be followed by the painting over of the surface with a waterproof covering such as one of the asphaltum paints. If the painted surface is exposed to sunlight it should be whitewashed since the dark paint absorbs heat and causes burning. These wounds should be followed up frequently during the season and treated in order to keep them completely covered and to check any decay which may start. Examination of many badly frozen trees at the present time indicates that decay has proceeded quite far in spite of the efforts at healing around the edges.

It is best to allow all shoots to grow the first season in order to aid in restoring balance with the root system and to supply it with nourishment. Only shoots from vigorously growing stocks should be budded. From so great a shock many trees have not recovered sufficiently to produce shoots strong enough to work over. It is doubtful if many will ever make satisfactory trees. The cuts left on removal of large sized trunks permit the entrance of heart rot fungi unless unusual care is given. Healing is very slow because of the weakened condition of the tree.

Factors Affecting the Severity of Freezing

There are a number of factors which affect the severity of the injury sustained by avocado trees, of which some are particularly evident. Leaving the consideration of the inherent relative hardiness of varieties out of the discussion, those trees survived the frost best which were in a vigorous and healthy condition. This involves, first, good rootstocks. Trees which had a poor union of stock with scion showed greater susceptibility to frost injury than trees of the same variety under similar environmental conditions which had good union. Probably the most important factor affecting the vigor of avocados and the consequent resistance to frost injury is that of soil moisture. The

vigor and health of practically all our fruit trees is markedly affected by fluctuations in soil moisture, particularly of those which are evergreen. Alternate wetting and drying have a decidedly weakening effect. The practice of withholding moisture in the fall, supposedly to harden off the avocado tree, cannot be recommended as a sound practice. Trees which have received a uniform supply of moisture from irrigation throughout the growing season up to the winter rains, came through the winter in much-better condition than those from which water had been withheld. With the latter practice, by which growth is checked through withholding water in the fall, trees are ready to start with the first fall or early winter rain and are then in sappy condition when cold weather strikes. The optimum condition is that in which the supply of moisture in the root zone of the trees is adequate throughout the entire season without any wide fluctuations. The tree then goes through its normal growth cycles unhampered by detrimental practices and enters the winter in a much better condition to withstand cold.

Mechanical injuries and girdling also have a decidedly weakening effect upon the limbs and trunks affected and greatly lower their resistance to frost. This should be borne in mind where girdling is practiced. Greater care should be taken in the cultural operations in avocado groves in order to avoid injury to trunks and branches. Heavy pruning during the fall also leaves the trees more subject to frost injury. Young trees, the branches of which had been removed to the height of three or four feet above ground were much more severely injured than those, the branches of which had been allowed to hang down and protect the trunk. Severe wind storms preceding cold weather, especially when they cause partial defoliation, weaken the trees markedly and directly contribute to severe frost injury. Where possible these factors should be taken into consideration when locating groves and necessary protection from wind provided as far as possible.

Reducing Losses

In reducing the losses from frost injury to the avocado industry, the selection of varieties is one of the first things to be taken into consideration. Both the hardiness of the tree itself, the season of bloom and the time of fruiting of each variety are important. The ideal tree should be one which will withstand temperatures as well as the Fuerte or the thin skinned Mexican varieties, which blooms after all danger of frost is past and which matures its fruit during the winter by the time the cold weather sets in. Most of our Guatemalan varieties mature two to six months after the coldest season. While the fruit itself may not be injured, much damage has resulted in the past from the freezing of the stems and consequent dropping of the fruit. Some of the new varieties, such as the Ward and the Button mature eight to twelve months after blooming, so that the bulk of the crop is off before coldest weather. The fact that some varieties already exhibit this tendency toward early maturity indicates the possibility of developing others through selection and breeding. No additional word need be given in this discussion concerning the relative hardiness of varieties since that was well covered in the reports of last year. One of the hopeful signs along the line of frost resistant varieties has been the behavior of some of the seedlings raised from locally originated Guatemalan fruits. Some of these have shown themselves to be much more hardy than their parents. One of particular interest is a seedling of the Murrieta on the Garcia place at Duarte. It came through the cold weather of 1922 untouched, has made a fine tree, when budded, and the first fruits that have matured indicate that it will be a winter bearer. Its bearing and

fruiting habits cannot be ascertained withy certainty until several seasons have passed.

Where it is desired to grow some of the more tender varieties, greater use will undoubtedly be made of the higher hill slopes above the colder belts, the additional cost of handling being offset to some extent by a reduction in the investment required for frost protection.

With the development of the industry much more attention must be paid to protection from frost in most avocado districts by the standard means of orchard heating. Comparatively little heating has been done except where nursery stock has been involved. Even with the hardier Mexican varieties which will stand as much cold as the orange, it is only sound business practice to protect the trees from frost injury just as is done in the citrus industry. The use of large capacity heaters sufficient to last during several days of cold weather is recommended. Gambling on the weather is always hazardous and with a tree as valuable and as susceptible to injury as is the avocado, orchard heating is justifiable insurance.

In looking over the situation as it now stands, the damage to the avocado industry from the freeze in 1922 has proved less severe than was anticipated. The trees have recovered in a remarkable manner even where rather severely injured. The frost served to reveal some very definite facts with regard to the relative hardiness of different varieties and the factors affecting the severity of injury as well as methods for minimizing it. These lessons were greatly needed by the industry and should aid us considerably in avoiding greater losses in the future.