Leaf Burn on Sprinkled Citrus

factors affecting leaf absorption of sodium and chloride from water sprinkler-applied to citrus and avocados studied

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Leaf burn and defoliation on the lower part of the tree found in the fall of 1955 in several citrus orchards in Riverside County—recently converted to the lowhead type of sprinkler irrigation—led to a preliminary survey of citrus and avocado orchards in the county. Leaf burn on the skirts of sprinkled citrus orchards was found in the Hemet, La Sierra, Corona, and Coachella Valley areas. Varieties included grapefruit, Valencia and navel orange, and tangerine. Sprinkled avocado orchards did not show the marked burn on the tree skirts found in citrus. In some cases, a white salt residue was found on the citrus leaves on the portion of the tree that was wetted during sprinkling. The upper part of the tree which received no water spray during irrigation showed no burn or defoliation.

In the survey, leaf samples were taken from the lower 3′ to 4′ of trees showing leaf burn on that portion of the tree wetted during sprinkling. Samples were also taken from the upper portion of the same trees where no leaf burn occurred and where no water was sprayed during sprinkling. The same age leaf was obtained from each sampling site.

All leaves in a given sample were individually washed and rinsed with distilled water. Therefore, the differences found in chemical composition cannot be associated with any material remaining on the outside surface of the leaf. Analyses of the leaves showed relatively small amounts of sodium and chloride in upper normal leaves and relatively large amounts of sodium and chloride in lower burned leaves of the same tree.

Leaf burn usually results when either sodium or chloride exceeds 0.25%. Leaves from the skirts of trees in affected orchards all had elevated amounts of sodium or chloride, or both—as compared with leaves from the upper tree area—whether leaf burn was apparent or not.

In none of the cases was excess boron found in the leaves. With other elements such as calcium, magnesium, and sulphur there were little differences between the amounts found in the citrus leaves from the upper and lower parts of the tree. Generally, potassium was lower in leaves which were higher in sodium.

The analyses of the leaves from furrow-irrigated trees adjacent to sprinkled trees in a grapefruit orchard at Hemet showed no excessive amounts of any of the elements.

Analyses of avocado leaves showed little differences in the amounts of the various elements found in leaves from the upper and lower portions of the same trees.

The water used on the grapefruit orchard at Hemet is very similar in composition to untreated Colorado River water which is used widely in the Coachella Valley and can be considered a reasonably good agricultural water. The

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Valencia tree, La Sierra, shows almost complete defoliation of lower part of tree to the height wet by sprinkler-irrigation water.

***Right*—Young grapefruit tree, near Hemet. The lower part of the tree shows salt deposit on leaf surface, leaf burn, and partial defoliation where wet by sprinkler-irrigation water.**

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total dissolved solids are 768 ppm—parts per million—with 95 ppm sodium and 75 ppm chloride. The percentage of sodium to total bases is 37.

The water used on a Valencia orange orchard at La Sierra has 903 ppm of total dissolved solids including 131 ppm chloride and 190 ppm sodium. Its sodium percentage of 64 is fairly high. The use of this water in citrus production would usually require careful management practices with the occasional use of gypsum.

The water used on a navel orange orchard at Corona has 824 ppm of dissolved solids including 117 ppm chloride and 69 ppm sodium. The percentage of sodium to total bases is 30. This water is also of medium salinity and with good soil drainage and occasional leaching, good citrus production has been maintained in the past.

These three irrigation waters are representative of the quality of waters used in sprinkled orchards where leaf burn on tree skirts has been found.

Soluble salts in the soil of the sprinkled section of the Hemet grapefruit orchard are slightly higher than the furrow-irrigated area. However, in both sections the total water soluble salts are quite low and the leaf burn and excessive amounts of sodium and chloride in the leaf of the sprinkled section cannot be associated with excessive sodium and chloride in the soil. Many excellent citrus orchards with no leaf symptoms and excellent production have similar amounts of soluble salts in the soil.

The sprinkling practices of the three locations have varied somewhat. At the Hemet orchard, alternate middles were irrigated every seven days during the summer period. In this way a given location received water every two weeks. The duration for each irrigation was nine hours, with an estimated three acre-inches applied.

The La Sierra Valencia orchard was irrigated more or less on demand, as indicated by the condition of a cover crop. Usually the sprinkling interval was every two to three weeks. In the summer the shorter interval was usually used. Sprinklers were run for about two hours with an estimated two acre-inches of water.

The navel orchard at Corona maintains a 10-day irrigation schedule during most of the summer period. Sprinklers were usually run about five hours although on occasion the period extended to eight hours. Lowered water pressures sometimes resulted in longer runs. It was estimated that about one and one-half acre-inches of water were applied at each irrigation.

The information obtained in this study is of a preliminary nature but it does show that citrus leaves wetted by sprinkler-applied water can absorb sodium and chloride in sufficient quantities to cause severe leaf burn and defoliation.

At the time of this report, absorption of sodium and chloride had been found in orchards of interior citrus districts of Riverside County. In all cases the waters used were of medium salinity with dissolved solids in the range of 700 to 900 ppm. The amounts of sodium in the irrigation waters have ranged between 70 and 190 ppm, while chloride ranged between 75 and 120 ppm. There is no indication that other elements such as calcium or sulfur from sulfates have been absorbed.

It is established that such materials as zinc and nitrogen are absorbed by citrus leaves from sprays, so it is not surprising to find that sodium and chloride can also be absorbed.

There was no evidence obtained in this study that sodium or chloride absorbed on the lower sprinkled leaves was translocated to the leaves of the upper tree which received no spray. It was found, however, that small twigs behind burned leaves had larger amounts of sodium and chloride than twigs from the upper part of the tree where leaf burn did not occur.

It is reasonable to conclude that water quality is one very important factor in the problem of leaf burn, but local climatic influences must be considered. At present, leaf burn in citrus due to sodium and chloride absorption from sprinkler-applied water has been found in interior, warmer districts where humidities are lower than in costal areas. Observations also indicate that trees directly exposed to prevailing winds show more severe burn than interior trees of the same orchard. The windward side of trees in some cases shows greater damage than the lee side of the same tree. The effect of the type of sprinkler and the frequency of sprinkling are not known.

It appears that any factor which increases the rate of evaporation is likely to be important. However, additional study is needed on this problem of sodium and chloride absorption by citrus leaves.

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elements. Furthermore, an appreciable increase in nitrogen has generally resulted in an increase in frost damage.

Against this background, the present practice in California of autumn fertilization of annual range with nitrogen raises questions as to the hazard from frost injury following such application.

To study the frost hazard to range annuals under known conditions, controlled freezing tests were conducted at Davis on soft chess and annual ryegrass during the winter of 1955–56. The grass was seeded thickly in 4″ clay pots and permitted to grow in the greenhouse four to six weeks before it was moved outdoors. Difference in nitrogen level was obtained by watering half of each planting weekly—after the two-leaf stage was reached—with a dilute solution of urea nitrogen. The effect of this differential treatment was shown clearly before the freezing trials. Response to this nitrogen was evidenced by a deep green leaf coloration, this differing markedly from the paler control plants receiving no supplemental nitrogen. The high density of planting hastened the symptoms of low nitrogen supply.

At ages between six and 14 weeks after planting, 30 pots—15 controls and 15 treated—were embedded in dry sand to the pot rim to delay the freezing of soil at depth, and were subjected to one hour at 28° F air temperature followed by 16 to 24 hours at 20° F. The younger plants required the longer freezes to develop differential response. After each freeze, thawing was permitted before returning the plants outdoors. Such exposure killed leaf tissue, evidenced by a severe frost burn, and resulted in some plant mortality.

Survival—as well as the amount of regrowth made by living plants—was determined two weeks after a freeze. The soft chess and the annual ryegrass responded in like manner.

Following a freeze, reduced mortality and greater regrowth were evidenced by plants receiving nitrogen compared to the controls. Under the conditions of the tests, the added nitrogen did not result in increased frost injury. Survival of such plants was as much as 32% greater than in the controls and averaged 15% higher for all tests.

Vigorous regrowth of the plants receiving nitrogen was visible within a week following the freeze. Little regrowth occurred on the control plants. Quantitative measurement of this growth was made by clipping and drying the green tissue produced during the 14 days subsequent to freezing. Up to four times as

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