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THE SALINITY PROBLEM IN GROWING AVOCADOS

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INTRODUCTION

The salinity problem, leaf tipburn, continues to plague avocado growers in San Diego County. A marked improvement in orchards, however, has been noticed since 1956 when extensive work was begun on the salinity effect on avocado trees in the county. Changes in irrigation systems, in methods of water application, and in the timing of irrigations have helped reduce tipburn.

Each year since 1956 additional work has been done on orchards throughout the county which has contributed to a better understanding on how to irrigate avocado trees to reduce tipburn. In 1956 the emphasis was on the timing of irrigation and methods of application. In 1957 and 1958 the emphasis was on the use of tensiometers in relationship to irrigating avocados and trying to use these instruments in such a way as to help reduce the salinity injury. During 1959 and 1960, work was done to correlate the amount of salts in the water, in the soil, and in the leaves, with the amount of tipburn present. In 1961 and 1962, work was conducted in two orchards where three levels of irrigation water were used and correlated with the amount of chloride accumulation in the soil and the amount of tipburn present.

METHODS AND PROCEDURES

In 1956 an irrigation project was started to find out if a shorter interval between irrigations, compared to the usual two to three-week interval used then, would reduce or eliminate tipburn on avocado trees. (3) Orchards selected for the project were on the basis of the amount of leaf burn present. These orchards were all on 14 to 21-day irrigation schedules. The amount of tipburn observed in these orchards was severe. Since many other orchards evidencing this leaf burn condition were on the longer intervals schedule, it was thought possibly a seven-day interval might prove beneficial in reducing tipburn.

In this initial project, monthly soil samples were taken at six inch levels to a depth of two feet. The total salt content, as measured by the electrical conductivity of the soil solution, was the measure of the salinity as correlated with the degree of tipburn. Results indicated that total salts were not as important in relation to tipburn, as possibly one individual salt, namely, chloride. The findings the first year showed that a more frequent and lighter leaching of the soil should be done every four to six weeks to flush out the accumulation of salts from the rootzone. Even though the tipburn was reduced there were still other factors causing tipburn to occur.

Tipburn is thought to be caused by a number of factors, (a) Accumulation of salts in the soil, (b) Soil differences, (c) Rootstock differences, (d) Varietal differences (rootstock and/or scion). (2) (e) Inadequate amounts of water, (f) Methods of water application.

During the years 1957-1959, monthly measurements were made on soils from four orchards to determine the salinity content in relation to tipburn. In addition, over 100 tensiometers were used with 13 growers in an attempt to find out how to use tensiometers in scheduling irrigations and help reduce the incidence of tipburn. Results of these investigations showed that each irrigation should be based on the rate of change of the twelve inch instruments. (9 It was noticed that the 12-inch instruments reached twenty (20) centibars in approximately five days, and the reading within the next two to three days rapidly climbed to the 40 to 50 centibar range. It is the rate of change during peak water use that is important and provides a good guide as to when to irrigate. After three years of study the amount of tipburn was reduced, but the problem was far from being solved.

TABLE 1.

SALINITY SURVEY - 1960

ORCHARD LOCATION	WATER ANALYSIS pH	WATER ANALYSIS Total Salts E.C.	WATER ANALYSIS Chlorides P.P.M.	LEAF ANALYSIS* Chloride - % (Sept.)	DEGREE OF TIPBURN	SOIL TYPE
Escondido	7.0	1,024	156	0.84	Mod. to Severe	Vista Sandy Loam
Rincon Springs	7.5	256	25	0.26	None	Classification unknown. Deep, sandy, rocky, alluvial
Pauma Valley	7.4	371	61	0.25	None	"
Fallbrook #1	6.8	960	137	0.37	Slight	Vista Sandy Loam
Fallbrook #2	6.9 6.3	413 623	75 71	0.24	None	Vista Sandy Loam Fallbrook Fine Sandy Loam
Fallbrook #3	8.4	700	100	0.55 (Hass)	Slight	Vista Sandy Loam
Vista	7.9	580	79	0.63	None	Vista Sandy Loam Fallbrook Fine Sandy Loam
Carlsbad	8.2	1,000	234	0.83	Mod. to Severe	Carlsbad Loamy Fine Sand Las Floras " " "
Leucadia	8.2	778	108	0.40	Slight	Elkhorn Loamy Sand

* Range of chloride percentage - 0.33% (no tipburn) to 1.36% (severe tipburn) (1)

In 1960, nine orchards were selected to have complete soil analysis. Salinity and nutrient content of the soils and leaves were determined periodically, some elements every month and others every three months. The orchards selected were in various areas of the county having different water quality, growing under different climatic conditions and in some cases, different soil type. (See Table 1). As the table indicates, the degree of tipburn, the chloride percentage in the leaves, and the quality of water used varied considerably. The lowest chloride content water was in Rincon Springs, which totaled 25 parts per million, and resulted in no tipburn. The extreme of the orchards was the Carlsbad location where tipburn was severe and the quality of water was poor. The chloride content was 234 parts per million. In Fallbrook Orchard No. 1 the chloride content was 137 parts per million. In the past a large proportion of the leaves in this orchard showed bad to severe tipburn. Switching to a more frequent irrigation and using additional water for leaching, the amount of tipburn was reduced

considerably. Charts I and II show the accumulation of chlorides in the soil of the two orchards, Rincon Springs and Fallbrook Orchard No. 1, during 1960.

In 1961 and 1962, the Fallbrook Orchard No. 1 and the Rincon Springs orchard were further studied on a comparison of three water regimes. (5) In each orchard, tensiometers were placed at 12 and 24-inch levels in three rows of trees. In both orchards the irrigation plan was based on tensiometer readings of 20 in one row, 40 in another row and 60 and above in the third row. These three irrigation regimes constituted the wet (20), the moderately wet (40), and dry (60) treatments. Charts III and IV show the accumulation of chlorides in the soil of these two orchards beginning in April 1961, which followed one of the driest winters on record, and continuing through the year until April 1962. Only the results of the moderately wet (40 reading) treatment have been reproduced for the comparison. It will be noticed that chlorides were relatively high in the Fallbrook orchard where high chloride water was used, but relatively low in the soil of the Rincon Springs orchard where water with low chloride content was used. In April 1962 the soil chlorides were much lower in Fallbrook Orchard No. 1 as compared to the previous year. Rainfall was around 17 inches in Fallbrook and Rincon Springs area during the fall of 1961 and 1962 and the effect of leaching by the good rains may be observed.

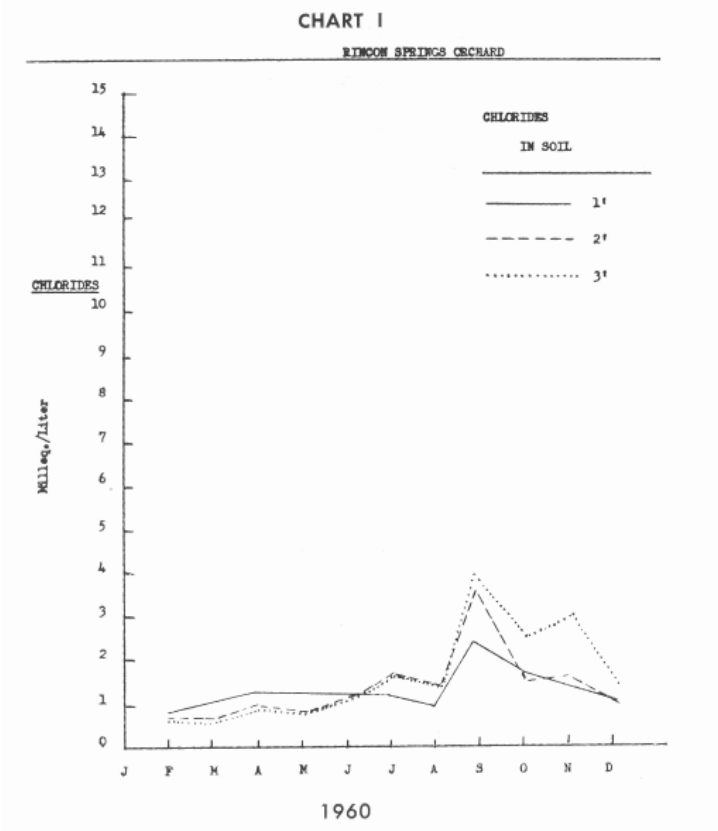


CHART II

FALLBROOK #1 ORCHARD

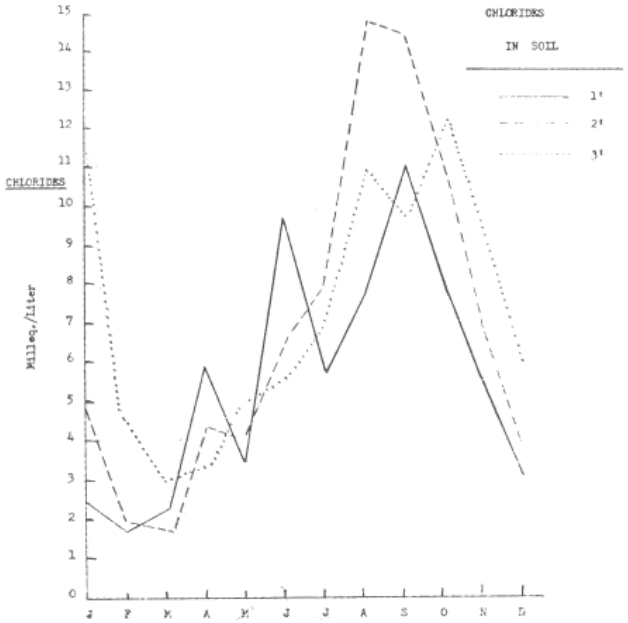
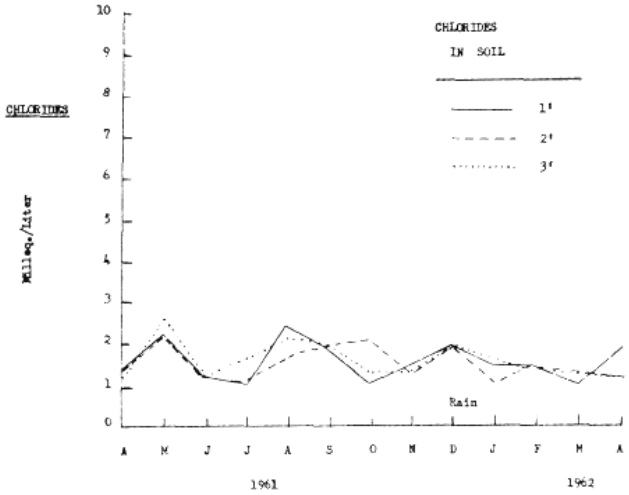
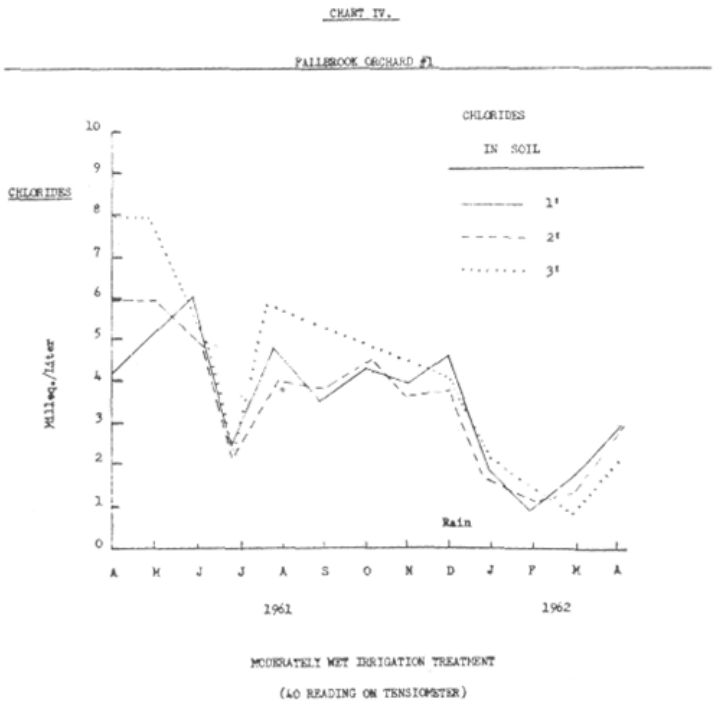


CHART III.

RINCON SPRINGS ORCHARD



MODERATELY WET IRRIGATION TREATMENT
(40 READING ON TENSIOMETER)



RESULTS

In summary, the following can be stated. 1) Total salinity does not seem to be as important a factor as the accumulation of the individual chloride ion. 2) Chlorides in the soil are highest during the September to November periods. 3) The percentage of chloride in the leaves will likewise be highest during the fall and winter. 4) Chlorides move readily with water and therefore leaching is an effective method of removing these salts from the rootzone. 5) The higher the chloride content of the irrigation water, the more frequent the irrigation should be and the more water should be used. The first eighteen to twenty inches of soil should be moist at all times. In this way the chlorides are maintained in a dilute state. Every four to six weeks a good flushing of the soil should be done through the application of additional water during the regular irrigation run. This could mean one and a half to two times the normal frequent irrigation application. 6) Irrigation during the fall months (September-November) is very important. Soil chlorides are highest and the climatic conditions are usually hot, dry, and windy. This combination places serious stress upon the trees. Having sufficient water available for the trees during this period will reduce the risk of damage to the tree and possible loss of fruit.

CONCLUSIONS

Avocado trees seem to have an affinity for chlorides. The undesirable effect of chloride injury is to reduce the bearing leaf surface resulting in early dropping of foliage and thereby lessening the potential of the tree to produce fruit. (10) Chloride injury does not usually become evident until sufficient build-up in the leaf causes death to the cells and

the leaf tip. (7, 8) It is not known whether chloride will accumulate in other parts of the tree. There have been cases where trees suffering extreme tipburn have been put on an excellent irrigation program, and the accumulation of salt in the soil has been reduced, and yet in the following year tipburn is still evident on the leaves. This might indicate the possibility of a carryover of chlorides in the tree.

Irrigation of avocado trees is very difficult. Irrigation should be given first priority on the cultural program of an orchard. There is no substitute for a good irrigation program. Careful consideration should be given to the application of water both in the amount and timing. Water quality should be known. If the amount of chlorides goes over 100 parts per million, be extremely careful in how the water is used. Proper operation of the irrigation system is also an important part of an efficient irrigation program. Periodic checks should be made for pressure changes in the line, improper operating heads, leaks, and any other factors which would affect the operation of the system. The system should be operating as perfectly as possible. This means constant attention, not only at the beginning and end of an irrigation run, but during it. Time spent on evaluation of an irrigation program, and using every means to improve the program, will surely pay good dividends in the long run.

LITERATURE CITED

(1) Ayers, A. D., D. G. Aldrich & J. J. Coony. Sodium and Chloride Injury of Fuerte Avocado Leaves. California Avocado Society Year book 1951. 35: 174-178.

(2) Embleton, T. W., et al. Chloride and Avocado Rootstocks. California Avocado Society Yearbook 1961. 45: 110-115.

(3) Gustafson, C. D. Irrigation of Avocados in San Diego County. California Avocado Society Yearbook 1957. 41: 68-70.

(4) Gustafson, C. D. Irrigate Avocados Frequently. California Citrograph 1957. 42: 291-293.

(5) Gustafson, C. D. and A. W. Marsh. Unpublished data.

(6) Gustafson, C. D. Avocado Irrigation and Tensiometers. California Avocado Society Yearbook 1961. 45: 19-22.

(7) Haas, A. R. C. Relation of Chlorine Content to Tip-Burn of Avocado Leaves. California Avocado Association Yearbook 1928. 12:57.

(8) Haas, A. R. C. Accumulations of Salts in the Tips of Avocado Leaves in Relation to Tip-Burn. California Avocado Association Yearbook 1935. 19: 105.

(9) Marsh, Albert W., and C. D. Gustafson. Orchard Irrigation. California Avocado Society Yearbook 1958. 42: 30-33.

(10) Trask, Elwood E. Some Factors Affecting the Accumulation of Chlorides in Avocado Soils. California Avocado Society Yearbook 1960. 44: 38-39.