orange, rough lemon, and sweet lime in some interstock-rootstock combinations on the performance of Shamouti [C. sinensis (L.) Osbeck] trees. Israel J. Agr. Res. 18: 193-200.

30. Savage, E. M., W. C. Cooper and R. B. Piper. 1945. Root systems of various citrus rootstocks. Proc. Fla. State Hort. Soc. 58:44-48.

31. Sinclair, W. B. and E. T. Bartholomew. 1944. Effects of rootstock and environment on the composition of oranges and grapefruit. Hilgardia 16:125-276.

32. Singh, J. P. and H. S. Dhuria. 1959. Studies on floral biology of sweet lime (Citrus limettioides Tanaka). Indian J. of Hort. 16:9-20.

33. Smith, P. F., W. Reuther and A. W. Specht. 1949. The influence of rootstock on the mineral composition of Valencia orange leaves. Pl. Physiol. 24:455-461.

34. Weathers, L. G. and E. C. Calavan. 1959. The occurrence of cachexia and xyloporosis in California lemon varieties, with particular reference to old-line Eureka lemon. Plant Disease Rptr. 43:528-533.

35. Woodruff, R. E. and E. O. Olson. 1960. Effects of rootstocks on physical characteristics and chemical composition of fruit of six citrus varieties in Texas. J. Rio Grande Valley Hort. Soc. 14:77-83.

36. Young, R. H. 1963. Climate—cold hardiness—citrus. J. Rio Grande Valley Hort. Soc. 17:3-14.

37. _____. 1963. Freeze injury to young seedlings of citrus cultivars and related species in the Lower Rio Grande Valley. J. Rio Grande Valley Hort. Soc. 17:37-42.

38. _____, E. O. Olson and A. Shull. 1968. Comparative performance of juvenile and old-line Redblush grapefruit. J. Rio Grande Valley Hort. Sos. 22:16-25.

39. _____, A. Peynado and W. C. Cooper. 1960. Effect of rootstock-scion combination and dormancy on cold hardiness of citrus. J. Rio Grande Valley Hort. Soc. 14:58-65.

PROBLEMS ENCOUNTERED IN OVERHEAD IRRIGATION OF CITRUS WITH WATER OF RELATIVELY LOW SALINITY

ERNEST C. LUNDBERG

The Coca-Cola Company Foods Division
Ft. Pierce

ABSTRACT

Salt burn symptoms and leaf loss were noticed on citrus trees in the Indiantown area in April, 1971. This was after an extended dry period in areas under daytime overhead irrigation (14 irrigations from December 2, 1970, to May 26, 1971). The water for irrigation was drawn from the St. Lucie Canal which contained total soluble salts in a range from 510 ppm to 590 ppm.

Leaves were analyzed for Na, Ca, Mg, K and Cl. Ratios of Ca: K + Na are included and discussed.

INTRODUCTION

Extremely dry conditions were encountered this past year which necessitated repeated irrigations to replenish soil moisture in East Coast groves.

On April 21, 1971, some Marsh grapefruit on Macrophylla rootstock in the Hodgson Grove (near Indiantown) were noticed to have severe salt burn symptoms on the leaves. Irregular brownish areas developed on the leaves, usually near the leaf tips. Considerable leaf drop occurred. In checking other varieties near this location, the salt burn symptoms were noted to a lesser degree. In spot checks over the lemon planting on this grove the leaf drop was seen to be very heavy and most of the dropped leaves exhibited a salt burn pattern.

In checking neighboring groves we found the same situation present. The worst leaf burn found was in a section of a grove south of the Hodgson Grove that had been irrigated with low volume overhead sprinklers operated during daylight hours. In all of these groves the source of the irrigation water was the St. Lucie Canal.

LITERATURE REVIEW

Calvert (1) observed salt burn symptoms in several Indian River citrus groves during the severe spring drought of 1965. He reproduced the leaf burn symptoms on Ruby Red grapefruit by sprinkling the trees with artesian water containing 1,000 ppm. total dissolved solids, at the rate of 0.8 gallons per minute (equivalent to 0.07 inch of water per hour) for a period of nine hours. The damage was increased with the increase in evaporation of water from the leaf surfaces.

Harding and Chapman (5) have suggested that leaf chloride contents exceeding 0.25% be considered indicative of chloride toxicity. They found even lower level of chlorides (although not always leading to obvious chloride toxicity symptoms) may still effect the longevity of leaves, and perhaps, lead to reduced yields.

Ehlig and Bernstein (2) found that although foliar absorption of sodium and chloride by citrus leaves from sprinkle irrigation is slower than for some stone fruits, severe injury can occur within one season. They also observed that foliar absorption during the evening was only one-half as rapid as during the day.

Harding (4) found that even in the absence of specific injury symptoms resulting from exces-

sive accumulations of chloride or sodium, salinity may still depress growth and yields. He found when irrigation waters of relatively low chloride and sodium content are used, the specific ion effects and nonspecific growth inhibition usually occur together (this would be total salinity effect).

Goell (3) found in experiments in Israel that Shamouti orange branches that were sprinkle irrigated with saline water, had a reduction in leaf life-span with a rise in salinity and was accompanied by a reduction in the flushing frequency of the axillary buds, and by a reduction in the blossoming capacity. He found that vegetative growth was promoted, but there was a reduction in the total number of buds which flushed, and a tendency to inhibit flowering terminals which could result in the reduction of yield.

Harding, Miller, and Fireman (6) in California, found an appreciable accumulation of sodium and chloride in grapefruit, orange, and mandarin leaves where water used for sprinkle irrigation had total salt content ranging from 491 ppm to 931 ppm.

Loughridge (8) directed attention to the extreme sensitivity of lemon trees to salt.

Pearson (7) working over a period of years in a greenhouse, made an extensive investigation of sodium in relation to the behavior of lemon cuttings in carefully controlled sand and sand-bentonite mixtures. He found that the toxicity of sodium depends upon the balance between the divalent calcium and magnesium and the monovalent sodium and potassium in the plant. Tentatively, a cation ratio for Ca: K + Na has been proposed by him to indicate when injury may be anticipated from the additive effects of Na and K under these conditions. Moderate injury may be anticipated if the Ca: K + Na ratio is much below 2.0, and severe injury occurs when the ratio is below 1.0. He also found that pruning that is severe enough to markedly unbalance the top:root ratio, makes the plant more sensitive to sodium injury. In working with three to six month old lemon leaves, he found that sodium values of less than 0.10% in the dry matter can be considered normal. Values over 0.10% may indicate sodium troubles.

Discussion

We have experienced a most unusual period of dry weather on the East Coast this year. Table 1, shows the rainfall and irrigation from portable volume irrigation guns which fell in the rain gauge in the microclimate study in the Hodgson Grove from November 11, 1970, to July 12, 1971. The variation in the amount of irrigation water in this area as measured by the rain gauge is indicative of the placement of the portable irrigation units and the effect of wind distortion on the stream of water from the irrigation guns.

There were 14 times in the period from December 2, 1970 to May 26, 1971, that irrigation water fell on this area. Table 2, gives the total soluble salts for the water used for irrigation from the St. Lucie Canal on various dates as determined by using a solubridge.

The literature indicates that leaves of citrus trees take up sodium and chloride from sprinkle irrigation if these elements are present in the water used for irrigation. Leaf samples were taken on May 11, 1971, to determine if we had a basis to say we had "salt injury" (Table 3). As seen in the table, the grove area under low volume irrigation (0.12 inch/hr. applied in the daytime) had an obvious excess of sodium and chloride. In this case, it can be assumed that under low volume conditions there will be more salt accumulated on the leaves, since evaporation occurs over a longer period of time.

Both the Valencia orange leaves and the Marsh grapefruit leaves under volume gun irrigation (700 gallons/min.) contain enough sodium to be harmful. In the case of the lemon leaves, the sodium is at a comparatively low level, however, when the Ca: K + Na ratios are calculated, the range is from 1.1 to 2.0. Pearson stated that below a ratio of 2.0 there would be moderate injury, while severe injury would occur below a ratio of 1.0.

Further work will be required to increase our knowledge along these lines. An experiment has been proposed that will involve low volume overhead sprinkle irrigation of lemons with water that has been carefully monitored both quantitatively and qualitatively. High calcium in the leaves is said to help to prevent salt injury, therefore calcium materials will be applied to the soil to test this.

In these situations the factors relating to salt burn are:

1. Repeated irrigations through a prolonged dry period.
2. The continual wind that breaks the water into fine particles which drift and are deposited on the foliage.
3. The winds cause rapid evaporation of the water from the leaf surface which gives a build-up of salt on the leaves.

Reduction of injury in this location may be

Table 1. Rainfall and Irrigation - Hodgson Grove - microclimate station

Date	Rainfall Inches	Irrigation Inches	Date	Rainfall Inches	Irrigation Inches
11-11-70	0.04		4-1-71		0.94
11-15-70	0.06		4-4-71	0.03	
12- 2-70		0.80	4-6-71	0.16	
12- 3-70	0.01		4-16-71		0.60
12- 4-70	0.01		4-26-71	0.20	
12-12-70		0.52	4-29-71		0.52
12-15-70		0.76	5-1-71	0.10	
12-17-70	0.01		5-12-71	0.19	
12-26-70	0.12		5-13-71	0.07	
1-1-71		0.38	5-15-71	2.85	
1-4-71		0.32	5-16-71	4.25	
1-19-71	0.18		5-26-71		1.10
1-25-71		0.94	5-29-71	0.05	
2-8-71	0.58		6-8-71	0.12	
2-10-71		1.35	6-9-71	0.32	
2-13-71	0.32		6-10-71	1.75	
2-23-71	1.60		6-11-71	2.50	
2-26-71	0.11		6-14-71	0.16	
3-2-71		0.74	6-22-71	0.10	
3-7-71	0.15		6-23-71	0.17	
3-14-71	0.15		6-25-71	0.09	
3-15-71	0.11		6-26-71	0.30	
3-16-71		0.54	6-29-71	0.44	
3-17-71	0.05		7-8-71	3.75	
3-18-71		0.50	7-9-71	0.04	
3-27-71	0.09		7-10-71	0.14	
3-30-71	1.10		7-12-71	1.24	

accomplished by night irrigation because less evaporation will occur.

Table 2. Total soluble salts in irrigation water

Location	Date	PPM
St. Lucie Canal	4-14-71	550
	5-13-71	590
	6- 2-71	510

LITERATURE CITED

1. Calvert, D. V., and H. J. Reitz, 1965, Salinity of water for sprinkle irrigation of citrus. Proc. Fla. State Hort. Soc. 78:73-78.

2. Ehlig, C. F. and L. Bernstein. 1959. Foliar absorption of sodium and chloride as a factor in sprinkler irrigation. Amer. Soc. Hort. Sci. Proc. 74:661-670.

3. Goell, A. 1969. Salinity effects on citrus trees. Proc. First International Citrus Symposium, Vol. 3:1819-1829.

4. Harding, R. B. 1963. Water management practices for citrus irrigation with Colorado River water. Amer. Soc. Hort. Sci. Proc. 83:300-308.

5. Harding, R. B., and H. D. Chapman. 1951. Progress report on a study of soil characteristics in forty high performance orange orchards in California. Soil Sci. Soc. Amer. Proc. 15:243-248.

6. Harding, R. B., M. P. Miller and M. Fireman. 1958. Absorption of salt by citrus leaves during sprinkling with water suitable for surface irrigation. Proc. Amer. Soc. Hort. Sci. 71:248-256.

7. Pearson, H. E. 1951. The effects of sodium on citrus. Ph.D. Thesis Univ. Calif. Riverside.

8. Loughridge, R. H. 1901. Tolerance of alkali by various cultures. Univ. Calif. Agri. Expt. Sta. Bul. 133:1-43.

Table 3. Leaf analysis-various types of irrigation

	Sample	Ratio Ca: K + Na	Calcium (Ca)	Analysis on dry basis Magnesium (Mg)	Potassium (K)	Chlorides as CL	Sodium (Na)	Na + CL
Pineapple/RL low volume overhead irrigation	1	2.6	4.80%	0.26%	1.19%	0.77%	0.66%	1.43%
Pineapple/RL low volume gun irrigation	2	4.0	5.73%	0.28%	0.76%	0.64%	0.58%	1.22%
Valencia/RL volume gun irrigation	3	2.8	4.38%	0.17%	1.37%	0.15%	0.18%	0.33%
Marsh gft/Macrophylla volume gun irrigation	5	2.1	3.85%	0.23%	1.69%	0.18%	0.14%	0.32%
Hodgson blk. 6 Lemons volume gun irrigation	6	2.0	3.49%	0.30%	1.69%	0.13%	0.04%	0.17%
Hodgson blk. 24 Lemons volume gun irrigation every 5 days	7	1.6	2.97%	0.35%	1.84%	0.16%	0.04%	0.20%
Lemons along powerline Tract B volume gun irrigation	8	1.1	2.55%	0.26%	2.27%	0.20%	0.03%	0.23%
Hodgson blk. 10 Lemons west outside row volume gun irrigation	9	1.5	2.97%	0.20%	1.95%	0.18%	0.04%	0.22%

Note: Samples taken May 11, 1971

THE MILKWEED VINE - CURRENT RECOMMENDATIONS AND PROMISING NEW APPROACHES

D. P. H. TUCKER AND R. L. PHILLIPS

IFAS Agricultural Research and Education Center
Lake Alfred
and

J. L. JACKSON, JR.

Lake County Extension Agent
Tavares

The strangler vine or milkweed vine, *Morrenia odorata*, has rapidly become a major weed pest in Florida citrus groves. This member of the milkweed family, Asclepiadaceae, is a native of subtropical South America, being found in southern Brazil, Paraguay, north and central Argentina. It is not certain how the plant first came to Florida, however, a specimen is known to have been cultivated in Pasco County in 1939. Presumably seed escaped from this or other cultivated plants. Apparently, the first vines to infest citrus groves were observed in 1957 in Orlando by Mr. Donald Nicholson. In 1959, Mr. Nicholson and Henry Swanson, Orange County extension director, sent a specimen to the herbarium at the University of Florida for identification. To Swanson must go the credit for recognizing the potential of this new weed problem and for publicizing its seriousness. This vine is now widespread in the citrus industry with the greatest populations in Lake, Orange and Seminole Counties. It has spread as far north as Marion County, as far south as Highlands County and is found in areas of the east and west coasts. The vine is found mainly in