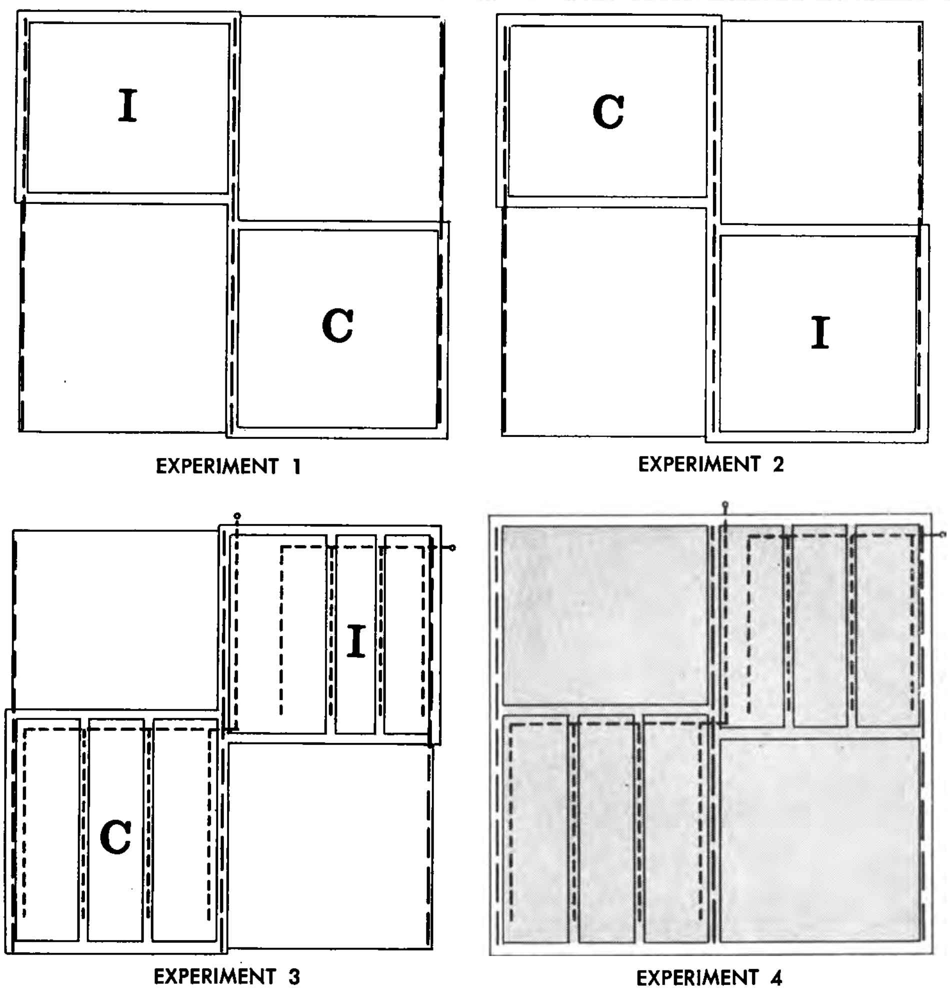
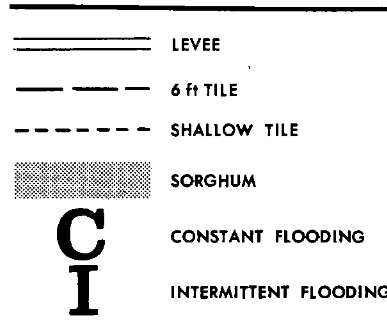
A Comparison of
for Reduction of

Sorghum in photo above was grown in leaching ponds to examine effectiveness of shallow tile as crop developed (exp. 4).

Shallow tile, photo below to left, step 1—preparation with trenches opened and placement of 3 inches of pea gravel in bottom before laying tile (exp. 3). Shallow tile, photo below to right, step 2—Shallow 2-inch tile system assembled above ground, in preparation for installation in trenches (exp. 3).



In these tests, more salt was removed per unit of time by constant flooding than with intermittent flooding — indicating this treatment would be preferred where land values are higher or water is inexpensive. However, intermittent irrigation removed more salt per unit of water applied—indicating that where water is expensive, or land values low, this would be the better treatment. The shallow tile increased the rate of salt removal from the first and fourth foot of soil in the intermittent treatment, and for all depths except the fourth foot, under the constant flooding treatment. For soils having a less permeable layer at shallow depths, the use of shallow drain lines in addition to deep lines will increase the leaching of the soil and will help salinity control.



Deep and Shallow Drain Tile Soil Salinity in Imperial Valley

F. E. ROBINSON · J. N. LUTHIN

Shallow tile, photo below to left, step 3—tile system placed in trench and covered with 3 inches of gravel and back filled (exp. 3). Shallow tile, photo below, center, step 4—water placed in ponds (exp. 3). Shallow tile, photo below to right, step 5—water collected from shallow tile in sump and pumped through meter to measure volume (exp. 3).

EXCESS SALT accumulation in soil can restrict growth of many crops and inhibit germination of others. Salt may accumulate from saline water tables or from concentration of the salt which is contained in irrigation water. In January 1965 a series of experiments was initiated in a heavy clay soil in the Imperial Valley to determine the best means of salt removal. Diagrams of four of these experiments are shown.

Flooding comparison

Experiment 1 compared constant flooding with a two-week periodic flooding. These two treatments were applied to 0.344-acre plots drained by 6-ft-deep tiles on two borders. Positions of the constant and intermittent treatments were reversed in the second experiment, after allowing the salt to accumulate over a summer fallow period. Saturation extracts of soil to a 5-ft depth were taken before and after treatment to determine their effectiveness. Tables 1 and 2 show these values.

An earlier experiment had indicated the presence of a less permeable layer at the approximate depth of subsoiling. Therefore, it was thought that shallow drain tile might provide an important supplement to the already existing deep

TABLE 1. SOIL SATURATION EXTRACTS BEFORE AND AFTER LEACHING IN EXPERIMENT 1 IN MMHO/CM (MEAN OF 6 SAMPLES)

Soil depth	Constant ponding[1]			Intermittent ponding[2]		
	Before	After	Decrease	Before	After	Decrease
Feet						
0–1	12.31	3.20	9.11	8.12	2.72	5.40
1–2	9.32	5.32	4.00	6.26	3.95	2.31
2–3	9.81	7.60	2.21	7.02	5.29	1.73
3–4	9.73	9.30	0.43	6.60	6.13	0.47
4–5	12.40	10.59	1.81	8.41	6.35	2.04

[1] 7.97 acre feet per acre.
[2] 1.97 acre feet per acre.

TABLE 2. SOIL SATURATION EXTRACTS BEFORE AND AFTER LEACHING IN EXPERIMENT 2 IN MMHO/CM (MEAN OF 6 SAMPLES)

Soil depth	Constant ponding[1]			Intermittent ponding[2]		
	Before	After	Decrease	Before	After	Decrease
Feet						
0–1	5.19	2.20	2.99	5.19	3.06	2.13
1–2	5.44	3.15	2.29	7.24	5.62	1.63
2–3	6.25	4.21	2.25	8.13	6.96	1.17
3–4	6.99	5.50	1.39	8.80	8.75	0.05
4–5	6.76	5.60	1.17	9.88	7.88	2.00

[1] 6.211 acre feet per acre.
[2] 3.234 acre feet per acre.

TABLE 3. SOIL SATURATION EXTRACTS BEFORE AND AFTER LEACHING IN EXPERIMENT 3 IN MMHO/CM (MEAN OF 6 SAMPLES)

Soil depth	Constant ponding[1]			Intermittent ponding[2]		
	Before	After	Decrease	Before	After	Decrease
Feet						
0–1	13.28	3.76	9.53	13.80	3.20	10.60
1–2	10.52	5.88	4.64	6.77	5.37	1.40
2–3	10.11	2.03	3.09	7.97	6.18	1.79
3–4	10.64	7.59	5.05	8.72	6.29	2.44
4–5	9.03	5.33	3.70	7.45	5.54	1.91

[1] 7.578 acre feet per acre.
[2] 3.300 acre feet per acre.

TABLE 4. CHANGE IN SOIL SALINITY PER ACRE FOOT OF WATER APPLIED IN 3 EXPERIMENTS (MMHO/CM/ACRE FEET)

Soil depth	Constant ponding tests			Intermittent ponding tests		
	1	2	3	1	2	3
Feet						
0–1	1.14	0.48	1.26	2.69	0.66	3.21
1–2	0.50	0.37	0.61	1.13	0.50	0.42
2–3	0.28	0.36	0.41	0.85	0.36	0.54
3–4	0.50	0.22	0.40	0.24	0.00	0.74
4–5	0.23	0.19	0.49	1.02	0.65	0.58

drainage system. As shown in the diagrams, experiment 3 had a layout of 3-ft-deep, 2-inch-slotted plastic tile superimposed above the deep tile. Here again the constant and intermittent flooding treatments were applied. Salinity and quantity of effluent were monitored daily from the shallow tile. Saturation extracts were taken prior to, and after, treatment as shown in table 3.

Roots

Experiment 4 was initiated to determine whether shallow tile will be plugged by root systems. Because of their closeness to the surface it might be expected that rooting could cause a problem. Sorghum seed was broadcast and a sprinkler system set up. Sprinklers allowed the area to be irrigated without removing the levee system. It is of interest to note, however, that a rate of 0.085 inch per hour was applied for 3 days continuously to sorghum one month old whereas the calculated intake rate in the previous experiments was .067 inch per hour. Ponding on the surface was not appreciable but the shallow tiles were running at approximately one cubic foot per minute. This experiment is still in progress. The area will be planted to alfalfa following the sorghum.

Table 4 shows a comparison of the salinity change per acre foot of water applied to each experiment.

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A 2500 ppm MH30T spray applied in July appeared to give satisfactory growth control in Chinese elms the following year, at least up to the later part of June—and with less detrimental effects to the trees than other sprays tried. Better results in the use of MH30T sprays on Chinese elms may come from raising the height of branching to 8 to 10 ft above the ground, and pruning the trees a month before applying the growth-retardant spray.

Chinese elm, *Ulmus parvifolia*, is a popular landscape tree and is used extensively as a street tree in many cities throughout California. This tree, as well as the closely related species, Siberian elm, *Ulmus pumila*, has many attributes, but requires annual pruning once or twice during the growing season. Because of the high cost of keeping branches above "walkway" height, chemical growth control with MH30T (maleic hydrazide) has been suggested and tried by many cities in California—with varied effectiveness.

To gain more information in the field use of this chemical, a series of tests was conducted in cooperation with the Alameda County Agricultural Extension Service office and the City of Hayward which has about 1,000 Chinese elms as street trees. This report covers an evaluation of the test applications of MH30T applied in July and September 1965, although applications were also made at other times. Several cities have reported that late summer–early fall spraying of this semi-evergreen tree with MH30T would reduce vigorous shoot growth the following spring without serious damage to the general appearance of the trees. If possible, this reduction in spring growth could save one or more earlier prunings.

Growth pattern

Chinese elms typically make two to three flushes of growth per year. Each flush consists of two to five long, whippy shoots, originating from buds near the end of the previous flush. Each flush may average 18 inches in length, giving the tree its typical, loose, willowy appearance. In 1966, the first flush started about February 15, the second started about June 15. By June 23 growth was 18 to 36 inches. New growth quickly becomes a problem if it comes from branches 8 ft or less from the ground.

Time of bud break and early growth of Chinese elms in the Hayward area are not uniform, and vary from branch to branch and from the basal to the distal end of the branch: both appear to be earliest from buds that matured early the previous year. Chinese elms apparently have a naturally uneven growth as new shoots and leaves emerge.

Test methods

The trees were pruned the winter before the treatment. The single-tree treatments were replicated five times and applied as follows:

Treatment and rate ppm MH30T plus .25% X77 spreader	Month 1965	Rate/100 gals water
(1) 2500	July	87 ounces MH30T plus 33 ounces X77
(2) 5000	July	173 ounces MH30T plus 33 ounces X77
(3) 2500	September	87 ounces MH30T plus 33 ounces X77
(4) 5000	September	173 ounces MH30T plus 33 ounces X77

A top-perimeter spray was put on from a "skyworker," and the low "skirts" of the tree were sprayed from the ground. A conventional spray tank was used. There was adequate agitation in the tank and a pump pressure of 200 psi.

Plot 1 (July 1965, 2500 ppm MH30T) results showed up to 50% of twig dieback measuring 1 to 4 inches of late-1965 growth in February and early March. Of the twigs that had not died back, from two to ten buds had not swollen by March 7. The basal buds had swollen to ¼ inch or had grown and the leaves on these shoots had fully expanded. The overall appearance of the trees was acceptable by March 25. Growth was dark green, uniform, and compact, with few noticeable latent or dead twigs.

By June 23, growth from the sprayed buds was short, dark green, healthy; shoot length was retarded, but new growth was starting on about 40% of the