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

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twig terminals. Leaf size was normal. Dieback of 1965 growth was largely masked; however, many buds that may not have been contacted by the spray showed vigorous shoot growth.

Unless the tree is headed high and low-hanging limbs are removed before an MH30T spray, the trees will require pruning at least once during the growing season.

Plot 2 (July 1965, 5000 ppm MH30T) results showed the terminal 15 to 30 buds of shoots on the trees were much slower in emerging. This presented a ragged appearance in early March, compared with unsprayed trees. Many of the buds in this treatment were still dormant or dead by March 25. The more basal growth was rapidly expanding. The general appearance of these trees was unthrifty, compared with the trees receiving 2500 ppm in July, and nonsprayed trees.

By late June, the general appearance of the trees was still unthrifty. Many bare twigs or twigs with stunted and weak leaf growth were evident. Otherwise, the trees were much like those treated with 2500 ppm in July—short, dark green, and bunchy shoot growth with a few long and vigorous shoots.

Plot 3 (September 1965, 2500 ppm MH30T) sprayings appeared more decisive than either of the July sprays. Many shoots had two to ten dormant terminal buds. The leaves and shoots behind these buds were fully expanded and apparently not affected by the spray. Late in March, many leaves were yellowed. Shoot length was controlled, but the overall tree appearance was ragged.

By late June, shoot growth was short, dark green, and apparently healthy. Approximately 30% of the shoot terminals were showing new growth. Shoots from unsprayed buds were growing vigorously. Shaded growth showed much dieback. The effects of this treatment appeared to be intermediate between the 2500 ppm and 5000 ppm July treatments.

Plot 4 (September 1965, 5000 ppm MH30T) treatments were the most severe. Dieback of much of the 1965 growth was apparent in early March. Growth in the unsprayed inside centers of the trees was ungainly in late March, and these trees had not regained their normally full appearance by the first of June.

By late June, the trees still had an unthrifty appearance, with many bare twigs and long straggly growth, and some new vigorous growth from apparently unsprayed buds. Leaf size was noticeably smaller than normal. This treatment (judging by its effect on tree conditions and appearance) appears the least desirable.

A quantitative, or qualitative, characteristic from which to measure and compare MH30T treatments was not found, mainly because of the nature of growth of the Chinese elm. It was also impractical to get the desired details from a field plot of this kind because these were seedling-propagated trees, managed differently by respective homeowners—adding to the chances of variability within the plot.

The effects of all of the July and September sprays of MH30T were similar in controlling the next season's growth up to the third week in June. The differences came in the amount of dieback of 1965 growth and in time of growth emergence in 1966. These two effects were most noticeable in the 2500 ppm July spray. Increasing tree damage was observed in the 2500 ppm September, 5000 ppm July, and 5000 ppm September sprays. Some buds on the perimeter of the sprayed trees were missed, although spray applications were considered satisfactory. This may have resulted from a leaf covering the bud during spraying.

Field observations would indicate that MH30T is not translocated in Chinese elms, as unsprayed lateral buds grew vigorously even though terminal bud growth was retarded. Other research has shown that maleic hydrazide will translocate to all parts of the plant, but may undergo a chemical change or be in too low a concentration to retard growth.

The value of MH30T sprays in Chinese elms might be enhanced by: (1) Raising the height of the lowest lateral branches to 8 or 10 feet; then there might be 3 or 4 feet of hanging new growth before it becomes objectionable. (2) Pruning the new growth a month before a July spray. (3) Giving greater attention to thoroughly wetting the young leaves and the undersurfaces of mature leaves (because they are the best avenues of chemical penetration), and using high-pressure sprayers, yielding a fine mist. (4) Applying spray in the early morning or late afternoon when the relative humidity is high, allowing more chemical to be taken into the plant.

Pruning in the late spring, followed by an MH30T spray, should be tried before it can be recommended. Research on stone-fruit trees has shown that this is the time of year when pruning is most devitalizing to the tree. This also may be true of Chinese elms. The effects of applying a growth-retardant spray soon after a spring pruning are unknown.

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The material for these tests was supplied by the U. S. Rubber Company, manufacturers of MH30T. Edward Bradley, U. S. Rubber Company research and development representative, assisted with the tests.