Boron Requirements of Prunes

diagnostic and treatment experiments in Sonoma County show promise in control of brushy branch disease of prune trees

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Normal French prune shoots.

Symptoms of brushy branch declined and fruit yield increased following application of boron to injured prune trees in test plots near Windsor.

Boron deficiency was found several years ago in irrigated orchards of European shipping plum varieties—such as President and Giant—in the Sierra Nevada foothills. The fruit was the only part of the tree that showed injury. Brown sunken areas appeared in the flesh of boron deficient plum fruits and sometimes gum pockets also formed. Injured fruits usually colored up early and dropped from the tree. Symptoms always occurred when the boron content of the leaves was 25 ppm—parts per million—or less, on a dry weight basis. Fruit injury—of the type found in the foothill plum districts—is rarely found in the Sonoma County prune orchards where the injured trees have little or no crop, and the branches die back, resulting in the pushing of lateral buds and production of many side branches. The shoots that are injured often remain partly alive well into the growing season, but the terminals are finally killed. In most cases the bloom on the deficient trees is almost as good as that on the normal trees but most of the blossoms on the low boron trees do not develop into fruit.

In late May of 1956, leaf samples were collected from two nonirrigated prune orchards near Windsor in Sonoma County. Leaves from trees showing brushy branch symptoms contained from 9 ppm to 19 ppm of boron when leaves from normal trees contained 25 ppm to 31 ppm.

Effect of Boron Treatments on Tree Condition and on Yield of French Prunes

10 trees in each treatment 1956	Brushy branch grade* June 19 1956	Brushy branch grade* June 13 1957	Yield 1957 Lbs. per tree
Control	2.7	3.2	11
1 spray June 25	2.6	0.6	111
2 sprays June 25, Aug. 14	2.3	0.5	132
Control	2.0	2.4	36
½ lb. borax Sept. 27	2.2	2.9	34
1 lb. borax Sept. 27	2.5	2.6	20
Control	2.4	2.5	37
1 spray + ½ lb. borax	2.3	0.7	158
2 sprays + ½ lb. borax	1.8	1.4	117
Control	2.5	2.1	67
2 lbs. borax Sept. 27	2.5	1.3	69

* 0—no injury. Good crop. 1—slight injury. Moderate to good crop. 2—moderate injury. Light crop. 3—considerable injury. Practically no crop. 4—serious injury. Practically no crop.

Test Plots Established

As a result of this preliminary evidence, a set of plots was established in one of these orchards. Borax was applied to the surface of the soil on September 27, 1956. One row of 10 trees received one-half pound per tree, another received one pound per tree, and a third was treated with two pounds per tree. In addition, several rows were sprayed with a concentrated boron compound—66% boron trioxide, 181% borax equivalent—at the rate of one pound per 100 gallons of water. Ten trees received a single spray on June 25, 1956, and another 10 trees received the June spray plus a second spray on August 14. A third row of 10 trees was given a soil treatment of one-half pound of borax per tree plus a June spray. A fourth group of 10 trees received the one-half pound soil treatment plus a spray in June and another in August.

Four control rows of 10 trees each were distributed through the experimental

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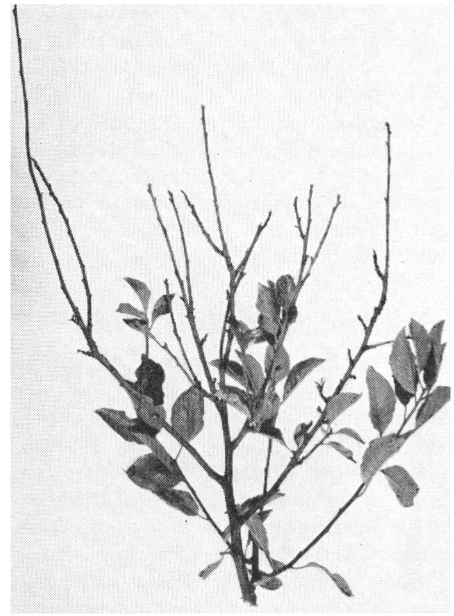

Boron deficiency symptoms in French prune shoots. The dying back of the terminals has resulted in the production of many side branches.

Boron Content of French Prune Leaves

10 trees in each treatment 1956	Boron ppm June 18, 1957
Control	17
1 spray June 25	29
2 sprays June 25, Aug. 14	38
Control	24
½ lb. borax Sept. 27	36
1 lb. borax Sept. 27	44
Control	18
1 spray + ½ lb. borax	45
2 sprays + ½ lb. borax	49
Control	26
2 lbs. borax Sept. 27	66

Effect of Limb Injections of Boric Acid on Yield and Tree Condition of French Prunes

Tree	Grade June 20 1956	Grade June 13, 1957 Treated branch	Grade June 13, 1957 Rest of tree	Yield in lbs. green wgt. Treated branch	Yield in lbs. green wgt. Rest of tree	Size of treated branch
1S4	4	0	3	14.4	0.3	⅛ of tree
1S5	3	0	2	25.0	17.5	⅓ of tree
3S5	4	0	2	36.4	9.7	¼ of tree

Limb injections made May 24, 1956. 2 holes in each branch. 1 gram of boric acid in each hole.

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plot. All rows—treated and control—were protected by guard rows.

Three severely injured trees near the plots received limb injections of boric acid on May 24, 1956. Two holes were bored in each branch, and one gram of boric acid was placed in the bottom of each hole. The injection treatment is used only in diagnosing the trouble.

In another part of the orchard, three trees were given soil treatments—one-half pound, one pound, and two pounds of borax—on June 19, 1956. The treatments were followed by a sprinkler irrigation.

All the trees in the plots were graded on June 19 and 20, 1956 and again on June 13, 1957.

The sprayed trees produced considerably more prunes in 1957 than the adjacent controls and there was a definite reduction in the brushy branch symptoms.

The soil treatments did not significantly increase the yield, but on the basis of experience with other fruit crops in other nonirrigated areas, they are expected to show effectiveness in 1958.

Leaf samples collected on June 18, 1957 were analyzed, and the results showed that the soil treated and sprayed trees absorbed substantial amounts of boron. This preliminary evidence indicates that the one-half pound treatment may be adequate and that the two-pound treatment may result in some injury. However, definite conclusions can not be drawn until after the 1958 results are obtained.

Apparently boron applied to the soil of a nonirrigated orchard in the fall does not get into the tree fast enough to eliminate symptoms the next year. However, the trees that received a soil treatment on June 19, 1956 followed by a sprinkler irrigation were free of brushy branch symptoms in 1957.

The branches that received the diagnostic injections of boric acid were free of symptoms in 1957 while the untreated parts of the same trees still showed injury. In addition, the treated branches produced a much heavier crop of prunes.

Because a single foliage spray in early summer gave good and quick results, such treatment probably should be the first given injured trees. Whether soil or spray treatments should be given later depends on the preference of the grower. However, if no boron is added to the soil, annual foliar sprays will be necessary. From experience in other areas, it is likely that a single soil treatment will be effective for from three to five years. The best rate of treatment for the affected Sonoma County areas involved is not yet known, but approximately 50 pounds of borax per acre appears to be effective. Boron fertilizers vary in strength but the label on the container usually gives a conversion factor, so the exact amount to use may be calculated.

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ASPARAGUS

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The original profile curves plotted for these studies had somewhat convex or concave shapes. But by graphical adjustments—shifting the profiles along the height axis—straight profile curves were obtained from which the zero-plane distances above the ground—the equivalent surface heights—could be read.

In unprotected fields the equivalent surface was 4″–6″ below the asparagus ridge tops, under all wind directions, including winds parallel to the ridges and those perpendicular to the ridges. Snow fences improved the conditions a little by providing a modest lifting of the equivalent surface approximately to ridge heights. However, in fields with interplanted barley the equivalent surface was raised to around 5″ above the asparagus ridges in case of cross-wind direction. But when the wind hit the rows at an angle somewhat less than 90° the protection was still more effective, raising the equivalent surface to about 10″ above the asparagus ridges. The cause of the rise might be the greater number of barley blades which oppose the air motion than in the case of the perpendicular wind. Another reason might be the ability of the barley heads to bend, which tends to lower the equivalent surface more in cross-wind. Even in parallel wind blowing along the rows some valuable protection was obtained because the equivalent surface height was 2″ above ridge tops. The explanation might be in the turbulent structure of the wind with its unsteadiness of direction—always recognizable from the unrest of a wind vane—which intermittently causes the wind to hit the rows under an angle. The larger graph on page 6 shows some curves of velocity change near the ground after the determination of the equivalent surface height.

Calculations by the power law—in which the exponent characterizes the surface roughness—resulted in a roughness increase by about 50% from both the snow fence and the barley row protection methods. The reason that the snow fences looked so competitive with the interplantings could be the different temperature stratification during the snow fence tests—caused by overcast sky—which tends to increase the exponents. Future measurements probably will call for some adjustments. Unfortunately, ridging for white asparagus does not reduce the soil erodibility as does plowing in some midwestern plain states, where heavy clods are brought to the top of the soil. The ridging of white asparagus beds in the Delta area accumulates just the erodible material at the ridge tops. Continuing investigations on increasing soil surface roughness—by supplementary methods to decrease the shear stress of wind at the soil surface—are being conducted in the Delta area.

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needed more often with small than with large machines.

The temperature responses for all three systems—heaters alone, machine alone, and machine plus heaters—are shown in the graph on page 5. Temperature increments are along the direction of natural air drift from the machine. The machine is a single-motor tower 93 b.h.p. arranged to turn slowly—180° in four minutes— when with the drift, and three times as rapidly against the drift. Curves *c* and *a* compare heaters alone with the machine alone. The temperature difference in the orchard—5′–40′ high—was 11°F. The combination curve *b* is for the machine operating concurrently with half the heaters used for heating test *c*. The great advantage of the combination is that the machine often gives adequate protection for the whole night, and in general, the heater-hours of support—when required—amount to less than one sixth those needed without the machine.

The temperature response tests conducted with four types of heaters in an orange orchard in Riverside County were conducted by R. A. Kepner, Professor of Agricultural Engineering, University of California, Davis, and reported by him in University of California Agricultural Experiment Station Bulletin No. 723, available for consultation in most agricultural reference libraries.

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