

Wind Protection for Asparagus

comparative tests of snow fences and interplanted barley for effectiveness in lifting windstreams of high velocity

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Frequent strong winds over the Delta islands west of Stockton cause soil erosion and air pollution.

The two-fold problem is the result of a complex of favoring factors: the dry summer; the physical lightness and fine structure of the predominantly organic soils; the bare, clean cultivated nature of the major crop—white asparagus—during April, May, and June; and, the high speed of the prevailing winds blowing through the Carquinez Straits into the Delta.

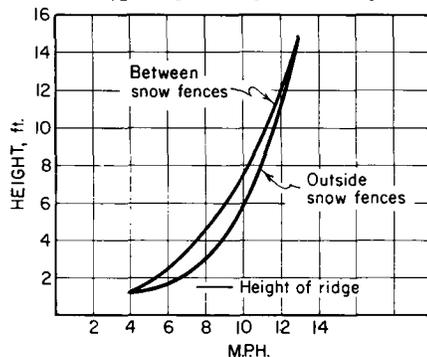
During the spring—when there is a lack of ground cover—the Delta area experiences the highest frequency of critical wind velocities. A three-year wind survey—from March to September—revealed the peak occurrence of strong wind to be in May. The secondary maximum occurs in March but usually it is not important because the soil is still sufficiently wet.

Low Windbreaks Tested

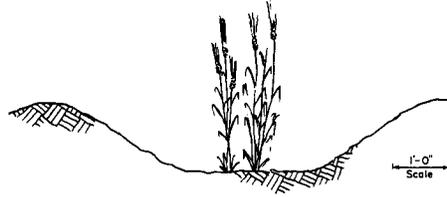
Two of the many wind erosion control measures tried were attempts to modify the wind structure over bare ridged asparagus fields by means of low temporary windbreaks spaced at close intervals in the field. In one method, snow fences were installed at intervals of 10 asparagus rows. The other method consisted of planting fast growing barley between the ridged asparagus beds.

To determine the effectiveness of the two types of low windbreaks—under various field and wind conditions—vertical wind profiles were measured. A 15' mast for anemometers—wind gauges—was mounted on a lightweight trailer so

Rindge Island wind profiles April 11, 1957 over bare 1½" ridges 4:30 p.m. to 5:30 p.m.



Sketch of asparagus ridges with inter-row planting of two rows of barley per strip.



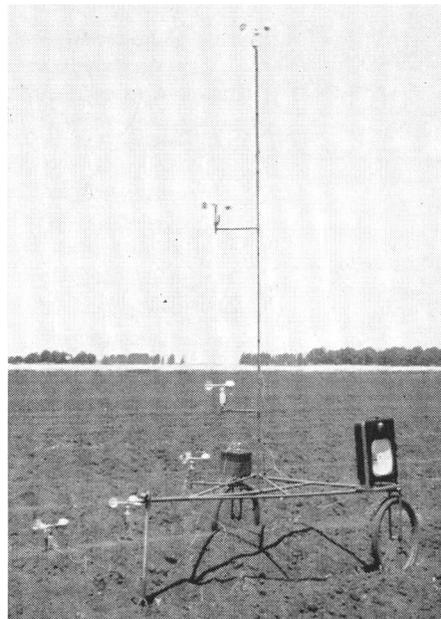
Number of Hours with Wind Velocity Equal or Greater Than 15 mph at 6' Height on Rindge Island

	Mar.	Apr.	May	June	July	Aug.	Sept.
1955	85	87	10	0	1
1956	59	25	52	34	6	3	0
1957	48	31	59	32	0	0	0

it could be readily moved to several test sites during a dust storm. For each site a 30-minute observation period was used to find the average wind velocity at each height along the mast.

The graph at the lower left shows a comparison of a wind profile in the open with one in 1½ acres protected by four lath-type snow fences 4' tall and 200' long spaced at distances of 70'. Because the fencing was erected on asparagus ridge tops the total height was about 5½' above bottom surface. At the 15' height, both places had the same velocity, closer

Light weight trailer carrying anemometers to measure wind velocity.



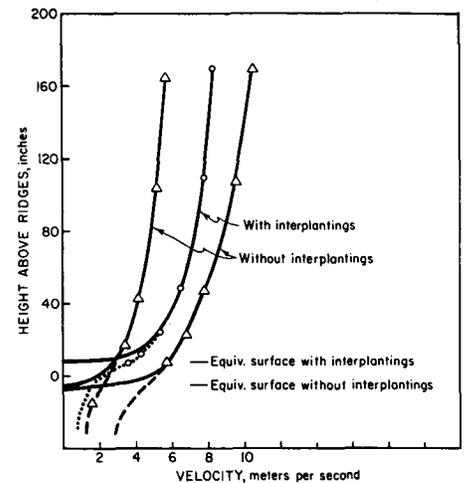
to the ground the wind speed between the third and fourth fences—35' from each fence row—was reduced, but only by a small amount. Beneath the ridge height both places unexpectedly had equal velocities. The explanation must be sought in the crowding of the wind streamlines above and around the ridges. It is evident that snow fences installed at 70' distances were not successful at the soil surface but a closer spacing would not be economically feasible.

Effectiveness

Wind profiles permit the determination of the effects of soil surface roughness and surface drag on windstreams. Calculations in this study were complicated by the uncertainty about the average surface location owing to the particular surface configuration caused by the ridges, by inter-row planting and by the additional variable of the wind angle to the ridges. Determination of the zero-plane was important because its location is a parameter for the effectiveness of the protecting devices. The height of the zero-plane indicates how much it was lifted above bottom surface and therefore lessened the wind impact on the ground. According to one law for wind increase with height—the power law—the wind profile measurements should form a straight line when plotted on double logarithmic paper if the plotting is done for the correct zero-plane height.

Concluded on page 13

Wind profiles over asparagus ridges.



PRUNES

Continued from page 8

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

Continued from page 6

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 mid-western 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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FROST PROTECTION

Continued from page 5

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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