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Studies on

Wind Protection Efficiency

of slatted fence windbreakers

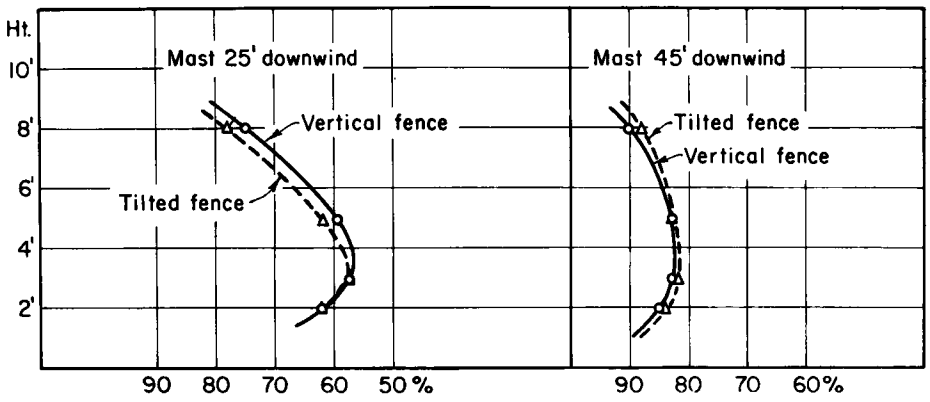
The adverse effects of wind—chilling of dairy cows, poultry, and other livestock during cold weather, soil erosion and air pollution, scarring of citrus fruits such as lemons, and on fire control—are often economic factors in California agriculture.

Construction of a windbreak requires —in addition to knowledge of wind pressures involved—knowledge of various materials and of geometrical designs for efficient reduction of wind velocity.

Tests of the efficiency of utility slat fences—snow fences or shade fences—in lowering wind velocity were made at Davis with slats of various widths and spacing. Full scale tests were made because of the large size and height of structures required, especially for orchard protection. Results of previous tests by other workers were seldom applicable because of different circumstances; some tests were in wind tunnels, others in open fields, and various sizes and types were used.

A 50′ long, 6′ high snow fence made of 2″ slats at ¾″ intervals was set at an angle with the ground, instead of the customary vertical mounting, to see whether—besides structural advantages —there also is increased efficiency, in analogy to the reported higher efficiency of tilted solid walls over vertical solid walls, which is due to streamline lifting and prevention of eddy separation at tilted solid walls.

The test fence, with 2″ slats at ¾″ intervals, had a percent open space—



Velocity in percent of outside wind velocity along two masts on lee side of a 6′ snow fence, 25% pervious, average of 5 tests in April, 1959.

perviousness—of about 25%. Three masts with four anemometers each, at the 2′, 3′, 6′, and 12′ levels above the ground, were placed at distances of 25′, 45′, and 65′ from the side of the fence chosen as the lee side. A fourth mast, similarly instrumented, served as a reference station on the windward side. The anemometers, calibrated in a wind tunnel, were the lightweight cup type as used by the Weather Bureau. The wind direction during the test operations was between normal to the fence line and 25° toward the northwest. The fence, oriented east-west, was first set perpendicularly on the ground and then sloping at 65° with the ground, away from the wind.

No wind protection was found at the farthest—65′—mast in either position of the fence. There was practically no difference between the two positions of the fence. At 25′ from the fence the vertical fence seemed a little better, but at 45′ the situation was reversed. The close agreement between the curves when plotted on a graph may indicate that any possible advantage from tilting the windbreak is cancelled by a loss in height of about 10% for a 65° angle. In addition, the chances of eddy separation are greatly reduced in both cases by the porosity of the windbreak.

The maximum wind reduction occurred near the 3′ height, or in the case of the 6′ fence, at half the height of the windbreak. For that reason, all anemometers were placed at a height of 2′ in the second experiment on slat fences 4′ high but with different percents of open space. The fences were maintained perpendicular to the ground surface.

In the second experiment, seven anemometers were installed on the lee side and two on the windward side, in a line perpendicular to the center of a 64′ length of the fencing. They were spaced 16′ apart in a line, so the seventh downwind anemometer was 112′ from the fence. The two upwind instruments served as references.

Fences with three types of spacing

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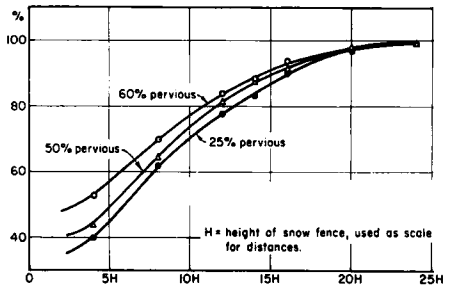
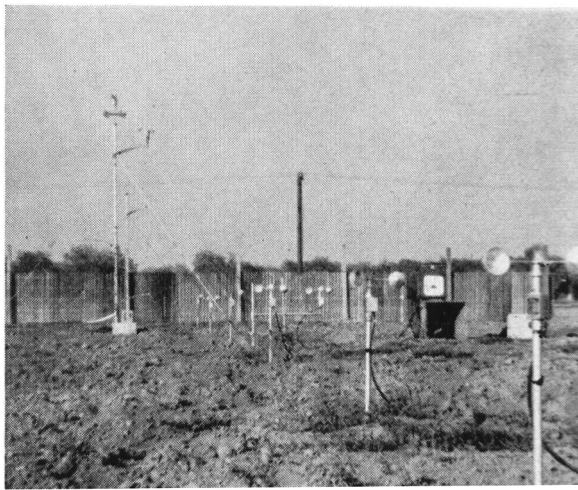
Wind velocities on downwind side of snow fences in percent of outside velocity.



Placement of anemometers perpendicular to a slatted windbreak fence.



Growth of stalk cells in cultures is apparent in two or three weeks, and within six months the tissue may increase in weight up to 26,000%. Cultures of stalk tissue from lemon have been maintained for more than a year and seem to possess unlimited growth potential, if transplanted at intervals. The enlarged sac portion of the vesicle develops less readily in cultures and its growth seems to depend on the presence and growth of the stalk.

Juice vesicle cells can grow and multiply on an almost entirely inorganic medium. This fact allows a study of the fundamental function of each chemical constituent of the nutrient medium in the development and nutrition of juice vesicle tissue.

Indoleacetic acid and gibberellic acid increase the growth of citron rind disks in culture. Either substance stimulates cell division when applied alone, and the two used together are additive in effect.

High temperature limits growth of tissues in cultures. Tissue disks grow much less at 90°F than at 77°F. The most favorable temperature conditions and the limiting temperature range for specific tissues are being determined.

Compared with the rate of growth in complete darkness, strong fluorescent light up to 400 foot candles appears to exert a slight depressing effect on the growth of rind tissue.

Such laboratory studies on tissue cultures may help to interpret various phenomena of fruit growth in the orchard.

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WIND

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were compared: one, with 60% perviousness, 1½″ slats at 2″ spacing; another, with 50% perviousness, 2″ slats spaced at 2″; and the third, with 25% perviousness, had 2″ slats at ¾″ spacing.

The anemometer results were recorded continuously, but only periods when the wind was perpendicular or nearly perpendicular—10° off—to the fence line were used for the comparison. The average of four tests showed a close similarity of results. In all three surveys the wind velocity at the distance of 100′ downwind from the fence approached 100% of the upwind velocity, and more than 90% of the upwind velocity was beyond 60′ downwind from the fence. Nearer the fence the downwind velocities separated according to fence perviousness, but not a great deal.

The plotted curves of the downwind velocities should not cross on a graph because the three fences used did not represent extreme cases of perviousness. Only when a solid wall—known to protect very well immediately behind it but not at all beyond distances of ten times the wall height—is compared with a rather pervious obstacle, whose protection is mild near the fence, can the curves be expected to cross.

The rather small spread of the plotted velocities might suggest that the most pervious type of slatted fence windbreak —when lower cost and possibly less structural support because of lesser wind pressure are considered—should be the most reasonable for wind protection.

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Wilbor O. Wilson, Professor of Poultry Husbandry, and Lee Femling, Gerald Henderson, David van Rest, and C. R. Miller, Department of Engineering, University of California, Davis, assisted in the slatted fence windbreak experiments.

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TORTRIX

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the closeness of the fruits and feed from within this protection.

The orchard chosen for the trials suffered considerable damage from orange tortrix during 1958. In the winter of 1958–59, the larvae found feeding within mummified fruit on the trees were so numerous they indicated a potentially damaging population for the fruit season.

Orange Tortrix Test Plots in Yellow Newtown Pippin Apples. Watsonville, 1959.

Material	Dosage per acre*	Infested fruit %
TDE	10.6 lbs. 50% WP**	0.5
Sevin	7.6 lbs. 50% WP	1.8
Methyl Trithion	10.6 lbs. 25% WP	6.5
Ethion	10.8 lbs. 25% WP	10.3
Ethyl Guthion	7.7 lbs. 25% WP	11.3
DDT	10.4 lbs. 50% WP	15.3

* Application dates: May 5, June 11, July 28.
** WP: Wettable powder.

Materials chosen for trial—Guthion, Sevin, Ethion, and Trithion—had shown promise in previous codling moth trials. TDE was used as the standard insecticide and DDT was used as a check because it is not effective against orange tortrix. The ethyl formulation of Guthion, rather than the methyl form, and the methyl form of Trithion instead of the standard ethyl formulation were used.

Each treatment was applied to four trees with two replications in a randomized block plot design. Materials were applied with a conventional high pressure rig and orchard spray guns at an average of 500 gallons per acre per spray.

In an attempt to time the treatments, bait pans and a light-trap were used to capture adults, but so few were trapped the sprays were timed according to the local standard codling moth schedule.

At harvest, the test plots were evaluated by examining 300 fruits per replicate picked at random from the treated trees. Fruits with typical orange tortrix feeding scars were recorded as infested.

TDE gave the best control in the Watsonville experiment and Sevin was the only one of the other compounds that yielded commercial control. Ethyl Guthion, Methyl Trithion, and Ethion did not prevent damage in excess of the generally accepted economic level of 5% infested fruit.

During the experiment, the compounds were studied for their effectiveness on other pests. Ethyl Guthion and Ethion provided good control of European red mites, but it was necessary to add an acaricide to the other materials for the June 11 spray.

A light infestation of codling moth was noted on the fruit treated with Methyl Trithion and Ethion. None of the other plots showed any codling moth damage. Apple aphid and woolly apple aphid were present, but infestations remained at a low level because of extremely hot weather during June and July. The DDT and the TDE plots were the only ones to show a potentially damaging aphid population, and an aphicide was added to the June 11 treatment.

Fruit treated with Methyl Trithion showed russet spots on the skin beneath the dried spray droplets, but injury was superficial. None of the other compounds gave adverse effects.

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