Drought Survival of Ponderosa

pine seedlings treated with simulated dew survive by month nontreated controls in greenhouse tests

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The ability of ponderosa pine seedlings to survive in dry soil—so dry that associated grasses and herbaceous vegetation die—may be due to an ability to absorb moisture through its leaves. Coulter pine can and does remove measurable quantities of water vapor from the air during extended periods of drought. However, it is not known whether this mechanism is of survival value.

To explore the possibility that ponderosa pine seedling survival on dry soil might result from a similar ability to remove moisture from the air, a series of greenhouse experiments was initiated. The basic mechanism may also be operative in plants of agricultural importance.

Each night of the experiment, the tops of pine seedlings—growing in soil too dry to support sunflower plants—were exposed to an artificial dew. Their survival was compared with that of an equal number of seedlings serving as a control and whose tops were not exposed to dew.

Twenty ponderosa pine seedlings—two years old—were lifted from the nursery, planted in one-gallon cans and allowed to grow until their root systems filled the lower portion of the soil mass. Three sunflower plants were then started in each can and allowed to develop until approximately eight inches tall. Watering was then discontinued.

Within two weeks the soil had reached the ultimate wilting point throughout the can and the sunflowers had wilted and died. The pine seedlings, on the other hand, continued vigorous and healthy. The dead sunflowers were clipped off and each can, which now contained only the pine seedling, was sealed by placing over the top of the can a plastic envelope through which the seedling protruded. A water-tight seal around the stem was made by several turns of a fine copper wire and a heavy wrapping of electrical scotch tape. The bottom edge of the plastic envelope was sealed to the can with additional tape.

Ten of the 20 sealed-in plants were set aside as controls and received no further treatment. The other 10 were placed every night under a mist spray which in effect simulated dew. The weight of each sealed can was taken initially and periodically thereafter, principally as a check for leaks.

As the pine seedlings died, they were removed and the date recorded. The per cent of soil moisture per inch of depth within each can was determined. To ascertain whether the seedlings were actually alive during the experiment, one can was removed every two weeks from the spray treatment, water added, and the subsequent death or revival of the seedling noted. One month after the completion of the experiment, all these plants to which water was added were still alive.

Results of Test

The results presented in the accompanying tables lead to several conclusions. First, ponderosa pine seedlings are able to survive longer on dry soil than are sunflower plants. Second, a fine mist spray at night, which in effect should be comparable to dew, greatly lengthens the time pine can survive on soil at the ultimate wilting point of sunflower. Third, the pine seedlings can reduce the soil moisture below the point at which the sunflower wilts and dies, irrespective of whether the pine seedling received dew at night or not.

The mechanism by which the survival time of those seedlings receiving spray at night was lengthened is still not clear. The initial survival after the death of the sunflower can be attributed to continued moisture absorption from the soil. However, survival after the death of the pine seedlings which did not receive dew at night must be attributed to the effect of dew. Possibly this continued survival is the result of a resaturation each night of the exposed tissues. On the other hand, the reverse movement of water into the top of the plant, down the stem, and out of the roots into the surrounding soil cannot be ruled out entirely. However, if it did occur, very little water entered the soil since it was not detected by the periodic weighings.

Additional experiments now under way will be reported at a future date.

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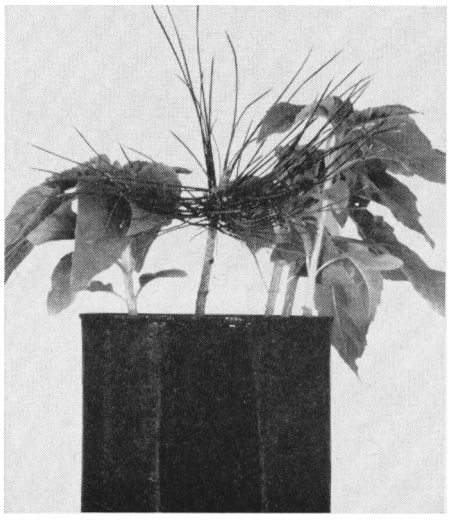
Pine seedling and sunflower plants in open can just before watering was discontinued.



Soil Moisture in Lower Half of Can

	Average %	Range %
At death of sunflowers	1.5	1.2–1.7
At death of control pines	.8	.6–1.1
At death of pines receiving dew	1.0	.8–1.1

Survival of Pine Seedlings After Death of Sunflowers

	Average days	Range
Control	22	20–32
Receiving dew at night	48	39–60

Pine seedling sealed in can after sunflower plants had wilted, died, and were removed.