

**WEATHER** Forecasts for California's citrus crop has returned to the State as much as \$135,-000,000 in a single year. Its delivered value in the wholesale markets has been as much as \$167,000,000. Large as these returns appear, they are offset to a large extent by the heavy costs of production. Weather conditions play a very important part in the growing of the crop. Freezes in winter, unseasonably high temperatures in spring and summer, desert winds with extremely low humidity, and sometimes long-continued periods of rainy or foggy weather, all may seriously damage trees or crops. The California citrus grower probably is more "weather conscious" than any other producer of agricultural products.

California citrus growers do not suffer losses from adverse weather without a fight. Miles of windbreaks protect the groves in the windy districts from the full effects of heavy winds, and orchard heating for the protection of trees and fruit from the winter freezes has reached its highest development here.

Only the grower who keeps his grove in the best possible condition can get the largest return on his investment. Pest control is one of the most necessary of all orchard practices, and also is one of the major items in the expense of growing citrus crops. The total acre treatments per year in southern California alone are in the neighborhood of 125,000 and cost the growers approximately \$3,000,000. An additional \$3,000,000 is the estimated annual loss through damage to crops by pests in groves not treated, or treated with unsatisfactory results.

#### Relation of Weather to Spraying and Dusting

Control of pests is accomplished by fumigating with hydrocyanic acid gas, spraying with various materials, or dusting the trees with finely divided sulphur. Any of these methods may cause damage to fruit and trees if applied during or immediately preceding periods of adverse weather. In the coastal area fumigation is not begun until the temperature drops to 70° to 80° F. in the evening and in the interior not until the temperature drops to 80° to 85° F. Fumigation is discontinued whenever the tents become damp with dew. A heavy dropping of fruit also may occur if fumigation is done immediately before temperatures below freezing occur in the orchard, or before the onset of strong east winds from the interior, accompanied by excessively low humidities.

The degree of spray injury due to adverse weather depends on the spray material used, but excessively high temperatures or low relative humidities during or immediately following spray application in southern California citrus districts cause damage no matter what material is used. Some spray materials formerly used rather extensively in citrus groves have been eliminated almost entirely because of danger of weather injury. Definite data on which to base the limits of safety with regard to both temperature and humidity for various spray materials are not yet available, but the establishment of a number of temperature- and humidity-recording stations throughout the southern California citrus districts undoubtedly will bring this question much nearer to a solution.

The present policy is to stop all spraying with oil when the temperature is expected to rise above 100° F. or the relative humidity to fall

below 20 percent within 2 days. Lime-sulphur sprays are considered more dangerous in southern California, and their use is discontinued in that area when temperatures above 90° F. or relative humidities below 25 percent are in prospect. Damage caused by spraying with oil following the application of sulphur dust, in extreme cases as long as 2 months previously, often is intensified by high temperatures. Some lemon groves which received sulphur dust followed 2 weeks later by oil spray during the summer of 1934 lost in excess of 65 percent of their fruit and also suffered severe damage to foliage during the hot spell of July 25 to 27. Four or five days of favorable weather following treatment with sulphur dust or spray usually is enough to avoid danger, although injury has followed dusting even after two or three weeks in some cases.

### Temperature Range for Sulphur Dusting

Results secured from sulphur dusting are doubly dependent on weather conditions. In order to control the pests for which it is applied, air temperatures must be high enough to cause fuming of the sulphur particles, but if the temperature rises too high, burning of fruit occurs. In this case also it is not possible to name definite temperature limits, but generally speaking, sufficient fuming for control will not take place at temperatures below 80° F., and damage is likely to begin at temperatures above 100°. Relative humidities below 25 percent increase the amount of damage at any given temperature.

The Weather Bureau during the summer of 1934 began issuing special pest-control weather forecasts from its station at Pomona for the benefit of citrus growers in five southern California counties. Invaluable cooperation in the project has been given by pest-control operators, county agricultural commissioners, and farm advisers, and the Citrus Experiment Station of the University of California at Riverside. Daily forecasts of maximum temperature and relative humidity for a 48-hour period are made for 7 different points in the 5 counties. This is necessary because of the wide differences in temperature and humidity within relatively short distances, owing to differences in topography and distance from the ocean.

During the summer months changes in day temperatures in southern California citrus districts are due almost entirely to fluctuations in the strength of the sea breeze which blows inland from the Pacific Ocean. Any interference with the normal influx of cool air from the Pacific causes the land areas to heat up very rapidly; and conversely, a resumption of the normal sea breeze during the progress of a hot spell causes a rapid lowering of temperatures in the interior. The entire area is occupied throughout the summer period with marine air of high specific humidity, and relative humidity is always high except during periods of unusually high temperature. The forecasting of these summer hot spells is difficult because the balance between the forces causing the sea breeze and those tending to oppose it is easily upset.

During the spring and fall months the forecasting of day temperature and humidity in this area is considerably less difficult, because atmospheric changes take place on a larger scale and are more positive

in their action. During these periods the damp marine air over southwestern California is often replaced by much drier continental air, sometimes resulting in the relative humidity falling low enough to cause damage to crops with only moderate temperatures prevailing.

#### Forecasts Broadcast Daily

The forecasts are broadcast from radio station KNX at Hollywood, Calif., at 12.14 p.m. each day, a time requested by fruit growers and pest-control operators to allow them to listen during the noon luncheon period. They also are placed on the teletype circuit maintained by the California Fruit Growers Exchange about 11.40 a.m., and thus made available to all the field offices of that organization. Many telephone calls and a few personal calls for the forecast are made to the Pomona office at an earlier hour.

On receipt of a forecast of temperature or humidity conditions which might cause damage, pest-control operations are suspended until the conditions moderate. Sulphur-dusting operations are not begun during the spring months until a period of day temperatures above 80° F. is forecast, and operations are discontinued when temperatures above 100° or relative humidities below 20 percent are forecast. Periods with temperatures satisfactory for dusting work in spring sometimes occur only at long intervals and last only a few days. Utilization of the forecasts makes it possible to make all preparations for the application of the dust beforehand.

Information regarding humidity conditions is also utilized in determining at what time of night dew will begin to form on the trees. Fumigating is done at night and must be discontinued as soon as moisture begins to form on fruit or foliage.

#### Forecasts Utilized by Walnut Growers

While these special forecasts were first requested by citrus growers, the walnut growers of southern California are making use of them in their harvesting operations. A sudden change to high day temperatures and low humidity during the harvest season causes the walnut hulls to dry rapidly and cling to the walnuts, preventing them from dropping to the ground. As a result the nuts hang in the trees too long and develop color in the kernel, causing a reduction in grade.

During cool, damp weather the speed of the harvest is often governed by artificial dehydration capacity. If the nuts are removed from the trees and left in sacks or bins under these conditions, they are likely to depreciate in condition rapidly due to heating and development of mold. At the beginning of a period of hot dry weather there may be large quantities of walnuts ready to be harvested, but still hanging on the trees because the dehydrator cannot handle them fast enough. On the receipt of a forecast of high temperature and low humidity, all the mature nuts on the trees are removed and stored until they can be handled by the dehydrator, since the danger of heating and molding is greatly lessened with low humidity.

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