

Project Number 75-P

Title: Environmental Variables and Almond Production

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I OBJECTIVES AND GOALS The objective of the project is to use environmental variables, especially temperatures and precipitation, to develop a crop forecasting model. Timing, intensity, and duration of temperatures and precipitation are important in all aspects of nut development, from long before bloom until near ripening. Humidity and wind are often of importance locally. Temperatures (highs, lows, averages, departures from normal) are obtained from a number of Central Valley stations beginning in September and evaluated in terms of the influence on almond production. Precipitation totals for days and for longer periods are gathered and translated into their effect at the time and later. Humidity and wind data are more difficult to gather and comprehend but these phenomena are of only limited extent or importance. Frost damage is also a factor during some years.

The goal of the project is to develop a method that will use environmental information to develop an accurate and early assessment of the crop potential.

II ABSTRACT Environmental data (precipitation, temperature, humidity, wind) are collected for each crop year, beginning by September. These are evaluated in terms of plant response, by variety if possible. Frost damage was a problem in 1975; the spacing of stations and unreliability of data will force at least some field checking to measure damage. Forecasts are prepared for each of several areas and then combined for the state forecast. My conclusion is that the project shows real promise; the method was able to respond quickly and accurately in April to the frost damage. The late June forecast was very good, also. An early and accurate assessment of the crop can provide information upon which to base marketing strategy. An accurate April-June forecast can allow more assured marketing activity and avoid the pro-rate problem of 1972.

III EXPERIMENTAL PROCEDURE The 1975 forecast was begun in September of 1974.

The fall. The fall of 1974 was warm, with virtually all stations in the almond growing areas having about 21 days above 90° F and about 5 days above 100° F in September. Precipitation was generally well below normal in the fall and early winter. The total impact was negative; many orchards had been severely stressed, bud development was poor, and the trees were in generally poor shape entering dormancy. For these reasons, by late December 1974 and again on January 12, 1975, I stated that the potential of the 1975 crop had fallen to 214.7 million pounds. While this seems to be a large tonnage, it indicated a statewide yield of only 876 pounds per acre, down from the 1000 pounds per acre of 1974.

The early spring. February and March were generally wet and cool. Weather was good for bees for all or part of several days at bloom in the south and for shorter periods in the Sacramento Valley. There were significantly fewer flowers than in 1974, however, and it appeared also that an abnormal number dropped as the petals fell. Conventional wisdom has it that nut set was poor because of unfavorable weather at pollination; there are some examples of this but there were more pervasive factors. At the end of this early spring period, I lowered my estimate of the crop potential to 195.7 million pounds.

The late spring. Late spring was varied, especially April. There was, for example, over twice as much precipitation in Bakersfield as in Davis. Denair received more than Chico. Temperatures did not follow

"normal" patterns, either. In April Denair had several nights colder than Red Bluff; two were colder than Shasta Dam and colder than any other almond growing area reported in Climatological Data. It should be mentioned that official low temperatures are usually a few to several degrees above reality. Temperatures at the very end of March, around April 2, and again around April 18, were low enough to kill a lot of the young nuts, perhaps a total of 30 million pounds.

At the end of April the first forecast was prepared for the Crop Reporting Service. Two separate approaches were used in making the forecast. In each case there was, of course, a problem in working from 1973 acreage data.

The first approach involved putting together the environmental variables of the fall, winter, and spring for each of the counties and arriving at a forecast for each county. This gave several problems, especially in the San Joaquin Valley where some areas had few almonds or none at all. I went ahead and worked this out for my own interest and arrived at a figure of 185 million pounds. This method had not been attempted in just this fashion before, so I had little confidence in it. Also, in April people in the almond industry were thinking in terms of a harvest of 140-155 million pounds.

The second time through involved the temperatures in the fall and winter; the precipitation regime through fall, winter, and spring, the pollution period, and the killing frosts. This latter was the most difficult. It was impossible to field check the areas; similarly, it was not possible from the weather data available then (some more, but

not enough, became available later) to determine the effects of the low temperatures. The weather analysis then and the analysis of county data this winter will help in later forecasts, of course. Forecasts were again prepared for each of the San Joaquin counties and added together with the figure obtained for the Sacramento Valley and for the remainder of the state. This figure (181,872,000 lbs.) was from 4,750 acres more than the figure given by the Crop Reporting Service, so I arbitrarily subtracted 4,000,000 pounds from the forecast. Because of the very different nonpareil-mission balance for 1975, I subtracted 7,782,000 pounds, leaving the April 30 forecast at 170,000,000 pounds.

The June 25 forecast[†] was a continuation of the April effort. There were no wide variations from normal in May and early June. Temperatures were a little low early in the period and days were a little above normal for a few days in June. The generally favorable conditions caused me to raise the June forecast to 173,000,000 pounds.

IV RESULTS The results of the year's work are encouraging. The method seemed able to quickly and fairly accurately respond to the deteriorating conditions between September 1, 1974 and April 20, 1975.

	Phillips	Crop Reporting Service
December 1974	214,720,000	
January 12, 1975	214,720,000	
April 30, 1975	170,000,000	
May 10, 1975		170,000,000
June 10, 1975		170,000,000
June 25, 1975	173,000,000	
July 10, 1975		165,000,000

I am not pleased with all aspects of the 1975 forecast; it is, after all, in error by at least 5 per cent. More confidence should have been given the objective data (Section III). The figure obtained in late April should have been about 175 million pounds, and increased to about 178 million pounds in late June. There is comfort in the fact that the June forecast moved in the correct direction from the April forecast and that the final forecast was more accurate than any others that I am aware of.

V DISCUSSION I think the inescapable conclusion is that environmental variables can be used to indicate the crop potential in fall and winter and to then give a good forecast in spring and early summer. The interpretation of environmental data is a problem as is the translation of these data into pounds per acre forecasts.

There seems to be promise of further work along the lines developed during the past two years. Four different formats seem available for the development and release of forecasts.

1. A continuation of the present project.
2. The same project but report directly to the Almond Control Board.
3. A confidential report prepared each month for the Almond Control Board with an estimate of the crop potential including the statistical probability of various conditions that would reduce the potential.
4. A report identical to the one above but using a grower response card (or field men opinions) as a check on the forecast prepared from environmental data.