

## **Estimating California Avocado Production**

**Avi Crane**

California Avocado Commission, 1251 E. Dyer Road, Suite 200, Santa Ana, CA 92705  
USA

***Abstract.*** The California avocado industry, which produces an average annual crop of 159 million kg, provides an income for 6,500 growers of California avocados and for numerous others in related fields, such as: packers, farm managers, harvesters, university researchers, transportation services, and advertising and promotion. All preharvest planning activities, development of harvest strategy, packing house schedules, and marketing/advertising schedules are formulated based on the crop estimate. In 1985, the crop volume was grossly overestimated by 40 percent. This inaccurate estimate resulted in a tremendous financial loss to many of the growers due to the uneven spread of shipments that year. Much of the state's crop was harvested early in the season in anticipation of a large crop. By the last quarter, fruit was in short supply.

In July of 1985, the California Avocado Commission set out to devise an on-going program that would increase the accuracy of the avocado industry's annual crop estimates. This action was prompted by the disastrous consequences of a 40% overestimation of the crop volume in 1984-85. Estimating the production of avocado trees, which have extreme fluctuations in yields from year to year, demands extensive knowledge in growing these trees.

The Commission's database of crop estimates now includes annual yields from over 9,700 ha, over a third of the entire acreage. Aerial surveys have assisted in arriving at correct acreage figures for each growing area. Despite alternate-bearing characteristics of the avocado tree and weather-related damage from freezes, heat, and wind, the ACE program has provided for an accurate crop estimate range of within 11.5%.

In July of 1985, the California Avocado Commission set out to devise an ongoing program to increase the accuracy of the annual California avocado crop forecast and, therefore, aid in maximizing grower returns. The computer-based program is called the Avocado Crop Estimating (ACE) Program. This program allows for the tabulation and analysis of grower estimates from throughout the State. After five seasons and numerous enhancements, this program has proved its accuracy in projecting the annual avocado crop volume.

In 1985, the data available to assist in this effort was limited. While total industry yields were recorded for the past 20 years, no yields by district were available. The first long-term goal was the collection of data that, in the future, could be used to develop a model that would scientifically project the avocado yields. A substantial record of weather conditions, the main determining factor in agriculture yields, was required before any attempt could be made to build a model. This information includes yearly and monthly rainfall, temperature extremes, and wind factors. In addition, information concerning average yields in the various avocado growing areas of the state would be required to analyze the effect of the diverse weather patterns on the crop volume. A program was needed that would allow the collection and interpretation of yields from groves throughout the industry.

While desiring to begin collecting the information required to develop a model in the future, the immediate objective was to build a program that would allow for the accurate estimate of the yield today. An attempt was made to incorporate features into the program that would also allow for the building of a data base that, later, could be used in the long-term model previously mentioned. At this time, estimates from throughout the state were needed to arrive at the on-coming season's estimate. There were two main objectives: (1) to collect the data from as many sources as possible in order to arrive at an estimate based on a statistically sound percentage of the industry, and (2) to collect the information in a format that would provide for the development of a computer program to estimate the state yield based on the average yield from each individual growing area.

Due to the exceptionally diverse avocado yields based on climate, soil, and temperature conditions, an essential element in this program was the division of the state into as many different avocado-producing entities as possible. After considering a number of options such as county parcel numbers, telephone prefixes and street addresses, it was concluded that the most workable division was the grove zip code. Although not the perfect solution for a division based on soil and weather differences, the zip code is a concept that all the growers know and can feel comfortable using. Through the use of the zip code (equivalent to postal code), the calculation of yield by county throughout the state is possible.

The next objective was to obtain estimates from as many groves as possible. Out of a desire to obtain input from a large number of acres with as few participants as possible, growers who farm large parcels were contacted as well as the various farm managing organizations in the industry. In reaching these farm managers and managing companies, estimates from 7,287 ha of the industry's then 29,960 ha were obtained. In addition, an estimate form was included in our monthly periodical that is sent to all 6,500 California avocado growers. This effort assisted in obtaining estimates from 600 growers who farm 3,644 ha. All the participants submitted estimates according to zip code, variety and yield per acre.

The first survey is sent out to the entire grower list on August 1. On September 15, the last pre-season update is sent to those who responded to August 1 survey. The initial

crop estimate is formulated by October 15. This information is not publicized. It is shared only with the Commission Board and those growers who participated in the survey. Periodic updates are conducted throughout the crop year.

The next step was to develop a computer model to analyze the input and provide for a simple procedure to request updates from each participant. This model needed to accept input by zip code, variety and yield from each participant. A system was developed that could compile the information provided to the Commission from the participants in the program. The program needed the ability to divide each county by zip code, variety, and acreage. The dBase software (registered with Ashton-Tate) was found to be ideal for this purpose. As there was no overlapping of zip codes and counties (outside of a single case between Ventura and Santa Barbara Counties), each zip code was assigned to a county. In addition, each variety was entered by county and area planted in each county.

The dBase program has an adequate file capacity to handle the numerous counties and acreage figures by variety. The system was developed to average the estimates submitted by zip code and arrive at an average yield per hectare by variety for each county. This figure would then be multiplied by the number of hectares of each variety in each county and a county total would be obtained (Table 1). The individual county production would be summarized in a state total (Table 2).

Table 1. California 1990/91 estimated avocado crop yield per acre for selected counties <sup>z</sup>.

County	Hectares	Estimated Yield (kg/ha)		
		Pre-freeze <sup>y</sup>	Post-freeze <sup>w</sup>	% decrease
San Diego	13,083	3,705	3,117	16%
Riverside	3,462	3,946	3,964	none
Ventura	5,871	3,589	1,960	45%
Santa Barbara	4,160	5,914	2,628	56%
Statewide	27,530	4,270	2,895	32%

<sup>z</sup> all varieties

<sup>y</sup> based on 6,774 ha (24%)

<sup>w</sup> based on 8,198 ha (29%)

Table 2. California avocado crop estimate for the 1989/90 crop year based on estimates in the ACE program.

Variety	Total bearing ha	Total ha surveyed in estimate	Percent of bearing ha	Estimated yield (kg/ha)	Forecast of total yield (kg)
Hass	22,658	8,408	37.09%	3,515	79,642,347
Fuerte	1,314	475	36.15%	1,170	1,536,697
Bacon	1,299	383	29.51%	4,224	5,486,165
Zutano	1,255	189	15.06%	1,728	7,064,547
Other	1,074	483	44.95%	1,728	1,856,343
Total	27,600	9,938	36.00%	3,463	95,586,101 <sup>z</sup>

<sup>z</sup> actual 1989/90 volume was 94,330,519 kg.

After entering the first estimates and running the program, few problems with the software arose. Although a few input errors were discovered upon checking the raw data printout, additional modifications to the program were needed in order to compare the individual estimators with each other. Supplemental reports were developed to facilitate these comparisons. These comparisons were done on a zip code, county, and statewide basis. In this way, comparison of the statistical deviation from the norm for each estimator was possible. For example, if in zip code 92390, Rancho California, the high and the low yields fell in a 10 percent range of each other, it was assumed that this was the actual on-tree yield for this area. However, if in zip code 93066, Somis, the estimates submitted were both extremely high and low, then further checking into the yield for this zip code was required.

For additional analysis, the two efforts were separated into the Field Team comprised of the growers farming large acreage and the farm management firms, and the Survey Team including those growers who responded to the survey in the monthly grower magazine. Typically, those growers farm smaller acreage.

The Field Team provided for a quick turnaround time when there was a need to develop the opening estimate or to update the estimate after a weather problem (such as a freeze). This effort allowed the coverage of considerable acreage with a minimum number of participants. The Survey Team, on the other hand, required a more complex effort to obtain original information or update current information. The Survey Team needed to be incorporated into the effort due to the fact that a majority of the industry's groves were small and could have a different yield than the larger operations.

As the program progressed, it became important to distinguish between the growers who were relatively new to the business and those who had maintained yield records for many years. The participants were requested to provide information on past crops. More than 100 participants responded by providing information about their groves yields during the past 5 years. These participants were, and remain, the backbone of the third effort called the bellweather or Dow Jones groves. Using the forecast model developed

in dBase, the data regarding past yields was entered and a comparison to actual industry yields of each year was possible. This effort provided additional ability to monitor the difference in yield projections between three efforts: the Field Team, the Survey Team and the Dow Jones Team. The ability to analyze the input was further enhanced by the capacity to manipulate the data and create comparison reports.

The result of the first year's efforts was remarkable. The original crop estimate came within four percent of the actual volume. This was a marked improvement over previous years and gave confidence to the validity of the system. The program was further enhanced as the development of the following year's estimate was underway.

During the first year, it became apparent that while the goal was to reach accuracy regarding the total crop, the individual county estimates were extremely important. Throughout the season, it is advantageous to know in which county the remaining crop is located. At the end of the season, the northern districts are able to hold their fruit longer due to favorable weather conditions. Knowing the volume remaining in these areas is essential in developing the short-term marketing plans for that part of the season.

The freeze of 1987 verified the importance of an on-going crop estimate program in that an updated estimate was available to the industry three weeks after the freeze. That estimate, however, was required to be raised three months later. Although the estimate of the freeze damage was correct, a larger crop remained on the non-damaged trees than previously estimated. Two lessons learned in 1987 were:

- (1) The three-month period between the October and January updates is too long. Had an update taken place earlier, an increase in the crop would have been noticed and the post-freeze update would have accounted for this increase.
- (2) Even though officially only one figure is provided for the crop estimate, the Commission needs to maintain a constant range of 10 percent to work with during the year due to the fact that unpredictable weather conditions can have both an adverse effect (freeze) or a positive effect (allow for the sizing of fruit).

### **Acreage Surveys and AMRIC**

The development of the crop estimate program at the California Avocado Commission has eminently increased the accuracy of crop forecasting in California. However, two other areas are of importance in obtaining accuracy.

An accurate inventory of the California avocado acreage is essential to obtain an accurate, statewide projection from sample groves. Since 1985, the California Avocado Commission has invested over US \$250,000 to conduct annual acreage surveys to maintain an accurate inventory of the state's avocado acreage.

The California Avocado Commission operates a telecommunications network called AMRIC (Avocado Marketing Research Information Center). AMRIC connects all major California avocado packing houses to a central computer. On a daily basis, each packing house submits inventory, shipments and price data to the Commission. This data is compiled into one industry report. AMRIC provides for a more stable avocado market. The crop estimating program is closely linked to AMRIC which provides for a weekly analysis of actual shipments versus projections.

## **Conclusion**

The avocado crop estimating program at the California Avocado Commission has developed strongly since 1985. Now "officially" called the ACE Program (Avocado Crop Estimating), it has achieved the confidence of the industry. While the information is not 100% accurate, it is the best information available.