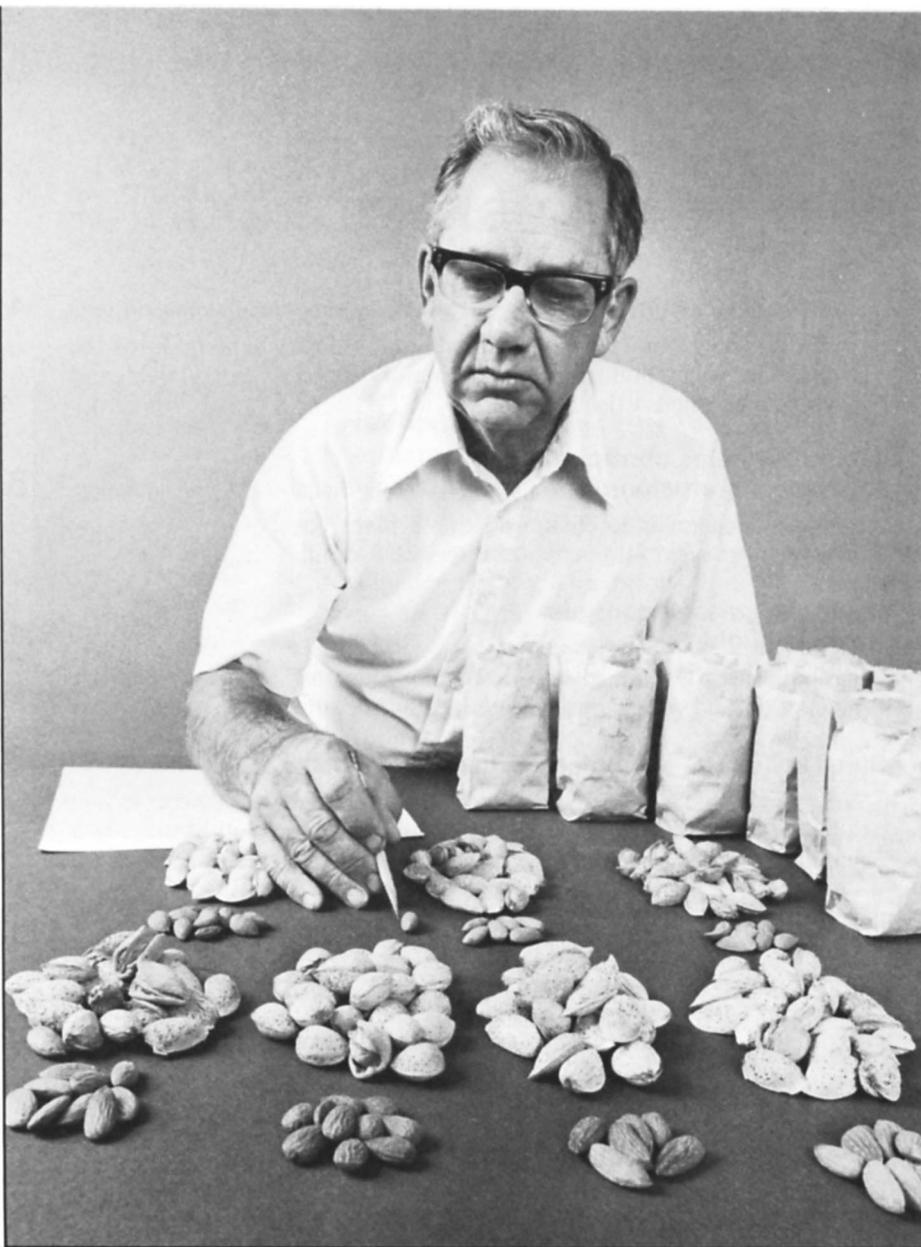


Almond

Tracy Borland



U.C. pomologist Dale Kester checks samples of almond varieties evaluated.

California almond growers have experimented with many varieties, some of which turned out to be unsatisfactory after extensive plantings were made. Information on performance has come with time in commercial orchards, and some varieties have been replaced as newer substitutes became available. Until a new variety is established, it can create marketing problems, partly because of the difficulty in handling small quantities of individual varieties separately, and partly because the product may be inferior.

Lacking in past evaluation efforts has been a uniform system of evaluation (as distinct from description) that takes into account all factors of both production and marketing. Development of a variety evaluation schedule was begun in early 1979, combining contributions of marketing and production managers, University of California Cooperative Extension specialists, farm advisors, researchers, growers, and others associated with the almond industry.

The schedule compares almond varieties as to field and market characteristics, using five widely grown varieties as standards—Nonpareil, Merced, Mission, Peerless, and NePlus Ultra. The evaluation process has been extended to six additional varieties—Butte, Carmel, Fritz, Price Cluster, Ruby, and Thompson. These six varieties have been planted in recent years, and considerable marketing and orchard experience is now available on their performance. Their selection does not imply recommendation for planting or that other newer varieties are not suitable. Plans are to extend this procedure to additional varieties.

Procedure

Field and marketing performance of the varieties was separated into four major categories: (A) tree characteristics, (B) tree and nut resistances, (C) nut characteristics—raw product, and (D) nut characteristics—processed product. These were subdivided

variety evaluation

Dale E. Kester □ Warren C. Micke □ Donald Rough □ Dale Morrison □ Robert Curtis

into a total of 40 individual characteristics to which numerical ratings were given permitting the quantitative comparison of evaluation judgments.

In some cases, characteristics could only be estimated and are so labeled. The procedure gives selection indexes for each category separately. These scores can be combined to produce an evaluation index for each of the broad categories and also totaled to provide an overall score for the variety. (A more detailed description of the specific categories and overall procedures will be published elsewhere.)

Ratings are based on performance: the better a variety performs in any category, the higher the rating. Although a high total for a variety is significant, it is not necessarily conclusive; each item should be considered separately in applying this system to a variety. The lowest rating given an established variety in any category is one (1). A zero (0) rating is a disqualification. For example, if a vigorous tree produced abundant supplies of fine-looking *bitter* kernels, the variety would be given a zero rating for flavor and discarded.

Most ratings, while subjective, are based on opinions and experience of experts in their respective fields. The marketing categories were initially developed by Almond

Board personnel in consultation with a panel of marketing specialists in the industry. The tree categories were developed by University personnel. The present figures are the composite opinions of not one but various individuals representing a broad cross-section of experience in the industry.

Acreage and production figures provided were used to calculate an average yield per acre for each variety. However, these data could be biased depending on the acreage of the variety that had reached full bearing and the conditions under which it was grown. Although the figures giving the five-year yield per acre may reflect actual orchard experience with these varieties, these data may not reflect the actual yield potential of the varieties because of the relative cross-pollination efficiency of various variety combinations.

Results and discussion

Evaluation scores for the five standard varieties are relatively precise, although opinions may differ about individual ratings. Scores for the six newer varieties are probably best for category A, tree characteristics, and least complete for category B, tree and nut resistances. In marketing, evaluations of

category C, nut characteristics—raw product, are fairly complete. Those of category D, nut characteristics—processed product, are not as certain, because some of these varieties are in too small a volume to be handled separately.

In the following discussion of variety scores, the number in parentheses after each name is the total score for all characteristics.

Nonpareil (167). Nonpareil rated highest overall with a score of 167 out of 228, which attests to its value both in the orchard and in the marketplace. Shell seal reduced its score but the variety was good to excellent in other tree characteristics. Susceptibility to noninfectious bud failure (BF), limb breakage, mites, worms, shot hole, hull rot, and *Cercospora* also reduced the score. Nonpareil, which rated high in most raw and processed product categories except salt/flavor adherence and inshell use, provides a standard for the industry.

Merced (132). Merced had a low overall score, comparable to that of NePlus Ultra, primarily because of specific problems in tree and resistance characteristics, including

TABLE 1. Acreage and Production of Eleven Almond Varieties Included in Evaluation Schedule

Item	Nonpareil	Merced	Mission	Peerless	NePlus Ultra	Butte	Carmel	Fritz	Price Cluster	Ruby	Thompson
Acreage, 1979											
Bearing	181,982	23,939	47,382	7,301	21,093	323	8,153	151	2,931	747	9,899
Nonbearing	16,747	1,305	3,100	488	1,878	76	6,096	257	1,875	156	518
Production, 1979 (1,000 lb)	219,177	31,939	57,101	5,151	20,275	594	10,041	41	2,297	1,020	10,466
Production per acre (5-yr average, 1975-79)	1,050	1,027	837	642	758	Heavy*	Above avg.*	†	Below avg.*	1,007	967
Production per acre, 1976-79											
High	1,312-'77	1,334-'79	1,205-'79	706-'79	961-'79	†	†	†	†	1,365-'79	1,346-'76
Low	691-'78	467-'78	434-'78	571-'78	460-'78	†	†	†	†	478-'78	608-'78

*Indications only—based on 1976-78 figures plus 1979 crop data.
†Not available.

ripening and harvesting difficulties, susceptibility to BF, worms, gum, and salt, and other characteristics. For most raw and processed product categories, the kernels rated better than Mission, Peerless, or NePlus Ultra. Merced is readily blanchable and is the principal variety in the California group.

(To protect the integrity of Nonpareil and avoid adulteration by blending of minor varieties, the California category was developed several years ago, combining kernels of Davey, Merced, Thompson, and similar varieties. The ability of a variety to be blanched is a prerequisite for this group.)

Mission (143). This variety was rated high in tree and resistance categories with some weaknesses in sensitivity to salt, herbicide injury, and *Ceratocystis*. Late maturity may be a problem in harvesting. Its resistance to worm damage is an important asset. As a raw and processed product, it was rated down because of doubles, appearance, inability to blanch and other factors. Mission is generally restricted to sale as an unblanched roasted product, but with its good flavor in this product, it does not at present lack a market.

Peerless (152). Peerless had a relatively good overall score—higher than Merced, Mission, and NePlus Ultra—because of its relatively good tree and resistance characteristics. Weaknesses come largely from sensitivity to frost and shot hole. It has low productivity in meat pounds per acre. Hulling problems relate to potential damage to the shell, reducing its inshell value. Ratings for the raw and processed product were somewhat low, because it is largely judged as an inshell variety only, with other uses limited.

NePlus Ultra (130). This variety had the lowest overall score. In tree characteristics it rated similarly to Merced, with some advantage in ease of harvest and resistance to worms. Both raw and processed product characteristics were rated low.

Butte (148). The overall score was in the range with Mission and Peerless because of Butte's relatively high ratings in total tree characteristics. Resistance categories are not clear, but Butte is susceptible to brown rot and mites. As a raw product, it was rated better than Mission, Peerless, and NePlus Ultra and about with Merced. Its relatively

good roasted flavor makes it a candidate as a Mission substitute, although it also blanches moderately well.

Carmel (148). This variety had a good overall score, the same as Butte and considerably higher than Merced, for which it has been substituted in recent plantings. Tree and resistance characteristics were comparable to those of Nonpareil with advantages in early production and less worm damage. It showed weaknesses in BF, limb breakage, brown rot, and *Verticillium*. Nut characteristics were unclear, partly because its elongated shape is not completely compatible with current categories. With enough volume for separate handling, its score may increase. In general appearance it is comparable to Merced. It was not rated high as a processed product.

Fritz (135). The overall score was relatively low but slightly above that of Merced and NePlus Ultra. Fritz equaled Nonpareil in tree characteristics because of productivity and good tree growth habits. Very late ripening is a detriment. Resistance characteristics are not well known. Nut qualities were rated low for both raw and processed products as a result of double kernels and general poor appearance. Blanching is satisfactory, so Fritz has some utility in the California group.

Price Cluster (143). This variety had a moderate overall score slightly lower than Butte and Carmel. The tree characteristics score was somewhat lower than that of Nonpareil because of some concern on overall productivity, and earliness and consistency of bearing. Shell seal is about the same as Nonpareil. Tree resistances are favorable on the basis of current information. Nut characteristics were not rated high because of a tendency to doubles, general poor appearance, and poor shell. Processed qualities are like those of Merced, but there is less experience with Price Cluster in the marketplace. It blanches well and thus can be used in the California category. Overall, Price Cluster rates slightly below the Carmel, which it competes with or supplements as a pollinizer for Nonpareil.

Ruby (142). This variety has been grown for a time as a pollinizer for Mission. Its overall score was close to Mission's, with

similar tree characteristics. It appears to be less sensitive to salt and herbicides but more to brown rot. Its late harvest may be a problem. The nuts rated with those of Mission as a raw product but somewhat better as a processed product. Thus, Ruby apparently can be marketed as a Mission, but since it blanches well, it might be used in various other manufacturing items.

Thompson (145). This variety has been grown for a number of years for pollinizing Mission, but some major tree problems have developed and growers have shifted to other pollinizer varieties. These problems are reflected in the scores for tree and resistance characteristics showing harvesting difficulty, poorly sealed shells, gummy kernels, and sensitivity to worm damage. As a raw and processed product the kernels were given good ratings although not as high as Nonpareil.

Conclusions

Comparison of the 11 varieties by this evaluation index reveals that none incorporates the best tree and market characteristics. That does not mean that various combinations of these varieties cannot be grown profitably by California growers. However, it does indicate that further improvement in almond varieties is possible.

Furthermore, the analysis shows that for many varieties important information is still lacking in some characteristics, particularly tree resistances and qualities of the processed product.

The evaluation method adopted here is useful in making quantitative comparisons of varieties and can allow a uniform system of evaluation to be used by various segments of the industry.

Dale E. Kester is Professor, Department of Pomology, and Warren C. Micke is Pomologist, Cooperative Extension, University of California, Davis. Donald Rough is Farm Advisor, University of California Cooperative Extension, San Joaquin County. Dale Morrison is Director of Research, and Robert Curtis is Associate Director of Research, Almond Board of California, Sacramento.

TABLE 2. Evaluation Schedule — Field and Marketing Characteristics of Eleven Almond Varieties

Characteristics*	Nonpareil	Merced	Mission	Peerless	NePlus Ultra	Butte	Carmel	Fritz	Price Cluster	Ruby	Thompson
A. TREE CHARACTERISTICS											
1. Potential productivity (1-10)	8	7	7	6	7	8	8	7	7	7	8
2. Pruning and training (1-5)	4	3	5	4	2	4	4	4	4	4	4
3. Early production (precocity) (1-5)	3	5	4	3	4	4	5	3	3	3	4
4. Consistency of bearing (1-5)	4	3	4	4	3	4	4	4	3	3	4
5. Uniformity and rapidity of ripening (1-5)	4	2	3	4	3	4	4	3	4	4	3
6. Ease of knocking (1-5)	4	1	3	5	4	3	4	4	4	4	1
7. Ease of hulling (1-5)	3	2	4	1	3	3	3	3	3	3	3
8. Shell seal (1-5)	2	2	5	5	3	3	3	3	2	5	2
Subtotal — A. Tree Characteristics (45)	32	25	35	32	29	33	35	32	30	33	29
B. TREE AND NUT RESISTANCES											
9. Bud failure (BF) (1-5)	3	2	5	4	5	5	4	5	5	5	4
10. Limb breakage (1-5)	2	4	5	4	3	4	2	4	4	4	4
11. Frost (blossoms) (1-5)	5	3	3	2	3	3†	3†	3†	3†	3†	3†
12. Freedom from gummy nuts and corky-growth (1-5)	5	2	3	5	3	4	4	4	4	4	1
13. Salt injury (1-5)	4	2	1	4	3	3†	3†	3†	3†	3†	2†
14. Herbicide injury (1-5)	5	3	2	4	5	3†	3†	3†	3†	3†	3†
15. Worm damage (1-10)	4	2	10	10	6	8	9	5	6	8	3
16. Mites (1-5)	2	2	4	3	2	2	3	2	3	3	3
17. Brown rot (1-5)	4	3	3	3	2	2	2	3	4	2	3
18. Shot hole (1-5)	2	2	3	2	1	3	3	3	3	3	2
19. Hull rot (1-5)	2	2	5	4	3	3†	3†	3†	3†	3†	3†
20. Crown rot (<i>Phytophthora</i>) (1-5)	2	2	4	2	2	2†	2†	2†	2†	2†	2†
21. Verticillium wilt (1-5)	3	4	4	3	3	3†	2	3†	3†	3†	3†
22. <i>Ceratocystis</i> (1-5)	2	3	1	3	3	3†	3†	3†	3†	3†	2†
Subtotal — B. Tree and Nut Resistances (75)	45	36	53	54	44	48	46	46	49	49	38
C. NUT CHARACTERISTICS — RAW PRODUCT											
I. SHELLED NATURAL											
1. General appearance (1-10)	10	7	6	7	5	7	7	6	7	6	8
2. Color (lightness) (1-5)	5	3	2	3	2	2	3	2	3	3	4
3. Freedom from doubles (1-10)	10	8	4	6	4	9	9	6	5	7	8
4. Freedom from shrivels and deformity (1-5)	4	3	3	3	2	3	3	2	3	3	4
5. Smoothness (1-5)	5	4	3	3	3	3	4	3	4	3	4
6. Resistance to machine damage (1-5)	5	4	2	1	4	3	4	3	4	3	4
7. Raw flavor (1-5)	4	3	4	1	2	3	3	3	3	4	4
8. Ability to go into major market classes (1-5)											
a. Nonpareil	5										
b. California group		5		4	3	1	3	2	4	1	5
c. Mission			5			4		1		3	
9. Special use (1-3)											
a. Long kernels	1				1		1				
b. Flat kernels	1										
c. Extra large	1	1			1						
d. Extra small			1			1		1			
II. INSHELL											
10. Inshell (1-10)	1	1	5	8	4	4	5	2	1	2	1
Subtotal — C. Nut Characteristics — Raw Product (63)	52	39	35	36	31	40	42	31	34	35	42
D. NUT CHARACTERISTICS — PROCESSED PRODUCT											
III. BLANCHED											
11. Ease of blanching (1-10)	10	8	1	7	7	6	6	7	8	4	10
12. Splits (1-5)	5	4	1	4	3	2	2	2	4	3	4
13. Slivered (1-5)	5	3	1	4	3	2	2	2	3	3	3
14. Color (whiteness) (1-5)	3	3	1	3	3	2	3	3	3	3	4
IV. MANUFACTURING STOCK											
15. Slicing (1-5)	5	4	2	3	3	3	3	3	4	3	4
16. Flavor — roasted (1-5)	3	4	5	3	2	4	4	3	3	3	4
17. Appearance — roasted (1-5)	5	3	4	3	2	4	3	3	3	4	4
18. Salt/flavor adherence (1-5)	2	3	5	3	3	4	2	3	2	2	3
Subtotal — D. Nut Characteristics — Processed Product (45)	38	32	20	30	26	27	25	26	30	25	36
Total Field (120)	77	61	88	86	73	81	81	78	79	82	67
Total Marketing (108)	90	71	55	66	57	67	67	57	64	60	78
GRAND TOTAL (228)	167	132	143	152	130	148	148	135	143	142	145

*The higher the rating, on a scale of 1 to 3, 1 to 5, or 1 to 10, the better the variety's performance.
†Estimated.