

Although these projections are subject to error, they do reflect that the olive industry faces a production potential substantially greater than previously experienced. If that occurs, there may be serious marketing and price problems for growers. Production such as that projected, with no changes in consumer acceptance of canned olives, will have serious price impacts if carry-overs of canned olives are also high (table 2 and figure 3). If production exceeds or is below the mean production and carry-over stocks remain proportionately the same, grower prices would be different from those projected.

Prices at the projected levels do not portend prosperous times for typical olive growers, inasmuch as production costs per ton are near the projected prices.

Regardless of past experiences, the California olive industry faces a potential for production and inventory carry-overs at levels not often experienced previously. This should tax the ingenuity of growers

and processors to work toward marketing solutions that provide reasonable solutions. Taking a long-run review, several potentials appear promising.

1. *Removal of marginal acreage and varieties.* This adjustment by itself is not expected to alleviate the large productive capacity that exists, however, in the newly planted groves. Although mostly low-grade and cull olives are used for oil crushing, it is doubtful that replacing imported olive oil with the Mission cultivar grown in California is practical because of the extremely low farm prices that prevail for olives for crushing.

2. *Continued research* to find ways to reduce the cyclical production pattern. Many agricultural industries collect research funds through marketing orders to partially finance such production research.

3. *Minimizing of the impact of cyclical production* and the adverse effect on widely changing grower prices and available supplies to consumers. Some industries use

a market reserve program to achieve such stability. However, even with an off-year, production may equal or exceed tonnage produced in on-years before the new plantings are bearing. Thus, this proposal may be adaptable for short-run problems, rather than for coping with large tonnages over the longer period.

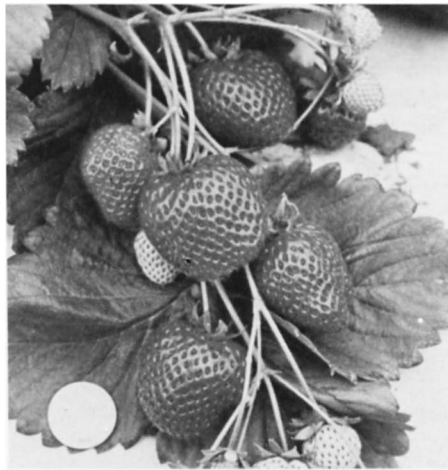
4. *Financing of market expansion programs* to increase consumption of olives to reflect more closely production capabilities. Such market expansion programs need to be developed with great care to assure results for growers.

5. *Continuing efforts to replace a part of the imported Spanish-style olives* with California production, using technology available to pit and mechanically stuff Spanish-style olives.

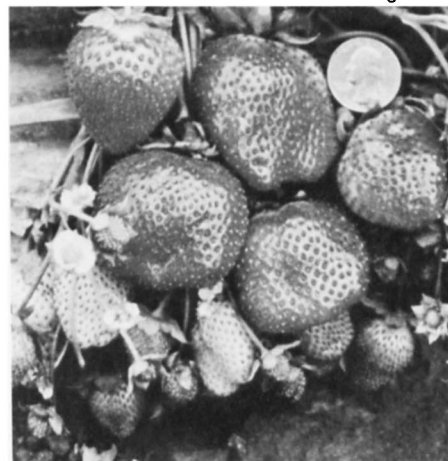
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Day-neutral types:

'Aptos'



'Brighton'



Six new strawberry varieties released

Royce S. Bringhurst □ Victor Voth

Before 1945, California produced only enough strawberries for its own needs. Most commercial production was concentrated on the East Coast. With large-scale introduction in 1945 of varieties developed at the University of California, production in this state began to expand rapidly, and today California supplies 75 percent of the nation's fresh and frozen strawberries.

Continuing improvement in strawberry varieties suitable for growing in the state has had a major impact on the industry in terms of shelf life, flavor, appearance, and overall consumer acceptance. We have now completed the development of six new varieties (announced in the November-December 1979 issue of *California Agriculture*) which could fill important production gaps and further improve yields and berry flavor.

Three of the new varieties—'Douglas', 'Pajaro', and 'Vista'—are intended for commercial fruit production and are "short-day" types. The other three—'Aptos', 'Brighton', and 'Hecker'—are "day-neutral" types and are likely candidates for home gardeners, as well as of possible interest commercially.

Research on the commercial types came partly out of a need for earlier, high-quality winter planting varieties for southern California, and 'Vista' and 'Douglas' seem to be particularly promising. 'Brighton' and 'Hecker' may also prove useful in producing early fruit.

'Hecker'



There has also been a need for improved summer-cropping varieties for the Central Coast, particularly those suitable for winter planting. 'Douglas' and possibly 'Pajaro' ('Pajaro' may be better for summer planting) show promise. All of the new winter-planted, day-neutrals are of interest.

Day-neutral types

The day-neutrals differ from other so-called "everbearers" and from the standard, short-day types in that they can be programmed to produce fruit approximately 3 months after planting, even during the winter months, if favorable growing temperatures and other favorable climatic conditions prevail.

All three new day-neutrals are third backcross generation derivatives from a male *Fragaria virginiana* glauca plant collected at the head of the Big Cottonwood Canyon in the Wasatch mountains near Salt Lake City, Utah. The day-neutral trait came from the wild strawberry. All were selected in 1971-72 at the U.C. Wolfskill Experimental Orchards near Winters.

The day-neutrals are compared with each other here for the most part since they are the first of their kind and standard "short-day" types are referred to only as needed.

The plants of each are smaller than those of the standard 'Tioga', and those of 'Hecker' are particularly small. All runner well in the nursery and runner substantially in fruit plantings during summer. All runner plants produce flowers and fruit in contrast to those of short-day cultivars.

Leaves of 'Aptos' and 'Hecker' are about the same color as those of 'Tioga', while those of 'Brighton' are lighter and distinctly more yellow.

Day-neutrals are less susceptible to Verticillium wilt than such highly susceptible California cultivars as 'Tioga' and 'Tufts'. The reaction was moderately resistant (wilting, followed by recovery for most plants) in two inoculation tests. 'Hecker' may be the best of the three in this regard.

As for fruit characteristics, ascorbic acid, soluble solids, and skin color for the day-neutrals are also compared with those for 'Tioga.' 'Aptos' and 'Hecker' are both particularly high in ascorbic acid, while 'Brighton' is about the same as 'Tioga.' The difference in soluble solids was not significant in our measurements, although 'Brighton' may be lower.

The skin colors of 'Tioga', 'Brighton', and 'Hecker' are essentially the same dark reddish orange while that of 'Aptos' is darker, more red, and tends to be dull when overripe. The skin of 'Brighton' is



Short-day types:

'Douglas'

particularly glossy with an almost artificial shellac-like sheen.

'Aptos' and 'Hecker' are equal or superior to presently-grown California short-day cultivars in flavor and dessert quality. 'Brighton' is not as good as 'Aptos' or 'Hecker' in our judgment.

Short-day types

'Douglas', 'Pajaro' and 'Vista' are compared here with the three most important established University of California cultivars: 'Aiko', 'Tioga' and 'Tufts'.

Plants of 'Vista' and 'Douglas' are both larger than 'Tioga'; 'Pajaro' is smaller. Leaflets of 'Douglas' are exceptionally large, while those of 'Pajaro' and 'Vista' are not much larger than 'Tioga'.

'Tioga' leaves (the standard) are a moderate olive green, while 'Douglas' leaves are distinctly lighter (less green), 'Pajaro' leaves are about as dark as those of 'Tioga' but slightly less yellow and leaflets of 'Vista' are lighter in color and less yellow than 'Tioga' leaves.

Leaves of occasional plants of 'Pajaro' exhibit a yellow "streak" or "stripe," similar to occasional plants of the once-important 'Shasta' variety. This probably can be eliminated or minimized by selection in the nursery.

'Aiko', 'Douglas' and 'Pajaro' (in ascending order) produced much fewer runners in counts made during the 1979 fruiting season of a summer planting at Watsonville than did 'Tioga', 'Tufts' or 'Vista', reflecting normal behavior in these cultivars. 'Tioga' generally runners much less than 'Tufts' particularly when both are planted at recommended times ('Tioga', earlier than 'Tufts') and 'Aiko' runners much less than either in fruit plantings, regardless of planting date.

We emphasize that the above involves *fruit production plantings during the fruiting season* and the fewest runners possible is desirable at that time. All three new cultivars generate ample runners and all tend to yield more marketable plants than does 'Tioga,' other things being equal.



'Pajaro'



'Vista'

The three new cultivars are as susceptible to Verticillium wilt as 'Tioga', 'Tufts' and 'Aiko', according to standardized inoculation tests and field experience suggests that all three are highly susceptible to Red Stele (*Phytophthora fragariae*).

The fruit of 'Douglas' does not differ significantly from 'Tufts' or 'Tioga' in ascorbic acid content but 'Pajaro' and 'Vista' have significantly greater amounts than 'Tufts,' and they contain less than 'Aiko'. The differences in soluble solids among the six cultivars were not significant.

'Tioga' fruit is a dark reddish orange. 'Douglas' fruit is similar to that of 'Tufts' in general appearance, but distinctly redder than 'Tioga', 'Tufts' or 'Aiko,' and 'Vista' fruit is about the same color as that of 'Tioga'.

The fruit of the three new cultivars are equal or superior in flavor and dessert quality to that of the fruit of the cultivars they are intended to replace or supplement. This assessment is based upon our experienced judgment and that of numerous individuals who have sampled the fruit and commented.

Planting systems will be stressed and for clarification: The designation "winter planting" (of short-day types) involves high elevation nursery plants dug in mid to late October and planted at the fruiting site by about November 1. In south and, to a lesser extent, in central coastal California winter plantings grow throughout the winter and consequently produce marketable fruit as early as February.

The designation “summer planting” refers to the California strawberry planting system involving plants dug the previous winter and stored until planted from July to about September 1, depending upon the cultivar and location. Summer plantings (of short-day types) commence fruiting as much as one month later than winter plantings but generally yield up to about twice as much per plant, and the difference can be offset only partially by increasing the plant density in winter plantings.

Performance of day-neutrals

Performance of the day-neutrals in California growing areas depends upon the planting system employed. Investigations with the day-neutrals were focused upon two objectives: early cropping in the south coast and summer cropping in the central coast.

Results have shown that acceptable quality fruit can be produced on the day-neutrals much earlier than from standard short-day types in southern California by using the summer planting system (described above for short-day types), involving plants held in cold storage for about 8 months. Considering yield alone, ‘Hecker’ is the best adapted to this type of exploitation and ‘Aptos’ is a poor third.

Winter-to-spring planting of fresh dug plants from low elevation nurseries has proven the most interesting. In central coastal California the potential for yielding a great deal of fruit over as little as a 7- or 8-month period after planting is clearly evident for all three day-neutrals. All behaved similarly, although the production patterns varied somewhat. Earlier or later planting causes fruiting to start equivalently earlier or later and in many cases changed the pattern of production throughout the season. Plant nursery origin had little effect, high elevation plants did not out-perform low elevation plants in contrast to the short-day types.

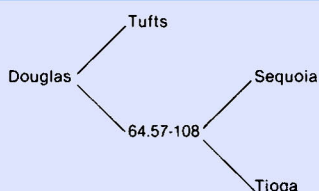
‘Brighton’ fruit with few exceptions was consistently larger than that of ‘Aptos,’ and ‘Hecker’ fruit was always smaller than either.

According to penetrometer measurements, firmness was almost equal for the three day-neutrals, but ‘Aptos’ usually proves to be best in handling tests and ‘Hecker’ the least satisfactory.

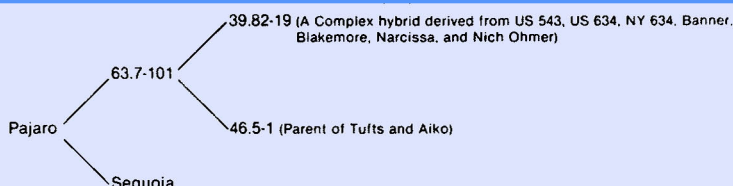
None of the three day-neutrals is without serious faults, but they may prove to be useful as interim varieties when used about the same as we have used them successfully in experimental plantings. All should be considered as candidates for use by home gardeners of California.

Pedigrees of New Releases

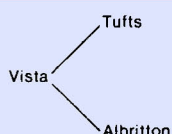
‘Douglas’
(Named for the late Malcolm B. Douglas, manager of the California Strawberry Advisory Board)



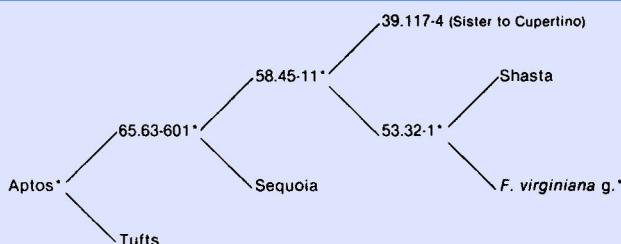
‘Pajaro’
(for Pajaro Valley, major strawberry-producing area in Santa Cruz County)



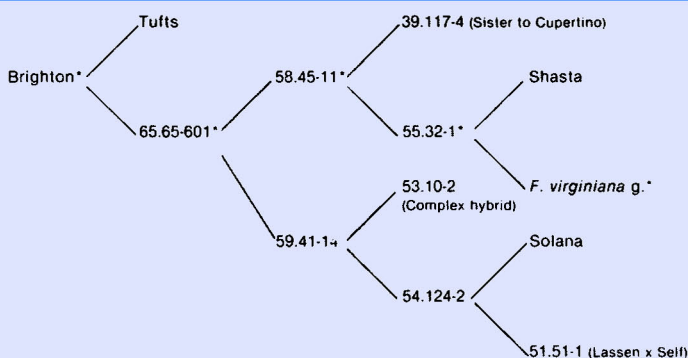
‘Vista’
(for city of Vista, San Diego County)



‘Aptos’
(for city of Aptos, Santa Cruz County)



‘Brighton’
(for Brighton Valley of Big Cottonwood Canyon, Utah, source of wild strawberry *Fragaria virginiana* glauca)



‘Hecker’
(for Hecker Pass, Santa Cruz County)



*Indicates source of day-neutral trait.

TABLE 1. Plant and Leaf Characteristics of Six New Strawberry Cultivars, with 'Tioga' as the Standard (= 100) in Relative Comparisons.

Cv.	Rel. plant size	Leaf color*	Terminal Leaflets				Bract Leaflets		
			Rel. size	Teeth ½ blade	L/W Index	Petiole Rel. L.	Percent with†		Rel. length
Tioga	100	2.5GY4/3	100	11	1.20	100	100	100	100
Tufts	96	7.5GY5/7	102	13	1.15	67	100	60	182
Aiko	77	7.5GY4/4	85	10	1.13	117	60	0	129
Short-day									
Douglas	104	2.5GY6/8	117	10	1.07	75	30	0	218
Pajaro	87	5.GY4/3	102	10	1.17	92	50	10	171
Vista	109	5GY5/6	104	12	1.11	58	100	60	159
Day-neutral									
Aptos	74	2.5GY4/3	90	10	1.18	71	?	?	?
Brighton	77	10Y5/5	106	11	1.04	109	?	?	?
Hecker	68	2.5GY4/3	75	8	1.11	77	?	?	?

*Nickerson color fan, Munsell Color Company, Baltimore, MD.

†On winter and summer plantings, Watsonville, 1978.

TABLE 2. Isozyme Patterns for Three Enzyme Systems and Some Fruit Characteristics of the Six Strawberry Cultivars Compared with 'Tioga.'*

	Short-day						Day-Neutral		
	Tioga	Tufts	Aiko	Douglas	Pajaro	Vista	Aptos	Brighton	Hecker
Isozymes									
PGI	A1	A2	A4	A3	A4	A6	A4	A4	A1
LAP	B1	B3	B3	B3	B3	B3	B3	B3	B1
PGM	C3	C4	C2	C1	C1	C5	C3	C4	C4
Fruit traits									
Ascorbic acid†	40	45	60	42	54	53	57	46	59
Soluble solids	8.8	8.4	8.8	9.1	8.4	8.8	8.0	7.2	8.0
Skin color**	7.5R4.5/13	7.5R5.5/12	7.5R5/13	6R4/12	5R4/12	7.5R4.5/12	5.5R4.5/13	7.5R4/11	7.5R4/11

*Phosphoglucosomerase (PGI), leucine amino peptidase (LAP) and phosphoglucosomutase (PGM).

†Differences highly significant.

**Nickerson color fan, Munsell Color Company, Baltimore, MD.

TABLE 3. Yield, Fruit Size and Firmness from Winter-Spring Plantings of Fresh-Dug Day-Neutral Plants at Watsonville for 1979 at 26,806 Plants per Acre, and Summer Planting at Santa Ana for 1978-79 at 29,270 Plants per Acre.

WAT.	Winter	Yield in Grams/Plant to:				Total yld.		Size	
		6/7	7/19	8/30		G/Pl	T/A	G/Fr	Firm
Aptos	12 Jan.	124	496	434		1054	31	20.5	5.1
Aptos	6 Feb.	147	464	425		1035	31	21.4	5.3
Brighton	12 Jan.	120	533	360		1013	30	21.6	4.4
Brighton	6 Feb.	91	489	349		929	27	22.9	4.8
Brighton	6 Mar.	81	277	365		723	21	20.8	4.5
Hecker	12 Jan.	89	407	383		879	26	16.9	5.0
Hecker	6 Feb.	54	450	380		883	26	18.6	5.0
Hecker	6 Mar.	30	284	367		681	20	15.0	5.7
S. A.	Set	Yield in Grams/Plant to:				Total yld.		Size	
		12/16	1/20	3/3	3/31	4/28	G/Pl	T/A	Firm
Aptos	5 Aug.	60	297	90	55	304	807	27	13.7
Brighton	5 Aug.	116	290	59	93	239	796	26	15.8
Brighton	8 Sept.	24	24	142	132	314	636	21	10.4
Hecker	5 Aug.	243	269	52	206	360	1129	37	13.3
Hecker	8 Sept.	35	35	265	307	276	919	30	8.3

Differences within columns are highly significant except for firmness.

TABLE 4. 1978-79, Yield in Grams/Plant and Tons/Acre, Appearance, Size and Firmness in Short-Day Winter Planting at Santa Ana at 52,293 Plants Per Acre and Summer Planting at Watsonville at 17,424 Plants per Acre.

	Yield Grams/Plant		Yld	Ap.	Size	Firm
	Early	Total	T/A			
S.A. Winter						
Tioga	128	701	40	4.1	14.9	5.6
Tufts	132	658	38	5.2	17.9	5.3
Douglas	179	783	45	5.3	22.0	4.6
Pajaro	119	523	30	5.2	21.8	5.7
Vista	156	786	45	5.2	18.6	5.5
Wats. Summer						
Tioga	1187	2288	44	3.1	15.7	5.6
Tufts	1121	1931	37	3.4	18.1	6.0
Aiko	964	2158	41	3.3	17.6	6.0
Douglas	1016	2078	40	3.8	20.8	5.7
Pajaro	853	1793	34	4.2	20.9	6.9
Vista	801	1584	30	3.2	17.3	5.5

Differences within columns are highly significant.

Performance of short-day types

Again, performance varies with the planting system, the year and variation in cultural practices.

Yield capacity is a constant trait if consistent cultural and environmental conditions prevail. According to our data, 'Douglas' and 'Vista' are heavy yielding types, although production patterns vary considerably. 'Pajaro' yields less, but this is offset, at least partially, by the high quality, well-shaped fruit, particularly apparent at Watsonville where cullage was low. For *earliness* in winter plantings, 'Douglas' was almost always the earliest of all the cultivars compared here and 'Vista' was next.

The fruit size of individual strawberry cultivars under standardized California cultural conditions varies with the plantings system and environmental conditions, but differences among cultivars tend to be constant in relation to each other. Thus, the average fruit size of 'Douglas', 'Pajaro' and 'Vista' is always larger than 'Tioga' fruit. 'Vista' fruit tends to be about as large as 'Douglas' and 'Pajaro' early in the season, but the size falls off more as the season advances, hence the smaller average size at all locations except Fresno where 'Douglas' was the smallest of the three.

As determined by penetrometer readings firmness is a relatively constant trait. As measured in this way, 'Pajaro' is the firmest and 'Douglas' the least firm. 'Pajaro' was consistently as firm as 'Tioga', or better. However, 'Pajaro' fruit tended to "check" badly under intense winter rain conditions in southern California.

Appearance ratings are usually correlated highly with fruit size, other things being relatively equal, but color, finish, seed position, regularity, and uniformity of shape and ability to tolerate rough handling at harvest also enter into the rating. 'Pajaro' consistently scored high and when size is a dominant component, 'Tioga' scored lower than any of the three new cultivars.

Patent information

United States plant patents are pending on all six new releases and information on licensing, etc., may be obtained by writing to: Roger G. Ditzel, Patent Administrator, University of California, Office of the Board of Patents, 491 University Hall, Berkeley, California 94710.

Royce S. Bringham is Professor of Pomology at U.C., Davis, and Victor Voth is a Pomologist at the Experiment Station, Santa Ana. The financial support of the California Strawberry Advisory Board is gratefully acknowledged.