'Redgem' and 'Bountiful' Strawberries

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'Redgem' and 'Bountiful' are new strawberry (*Fragaria ×ananassa* Duch.) cultivars released from the Cooperative U.S. Dept. of Agriculture (USDA)–Oregon State Univ. (OSU) Breeding Program at the Horticultural Crops Research Laboratory, Corvallis, Ore. The Pacific Northwest region is primarily a processing market for junebearing strawberries (Lawrence, 1989). Qualities necessary for the processing industry include fruit uniformly red externally, bright and fully red internally, firm fruit texture after thawing, an easily removable calyx, and highly productive plants that are virus tolerant. Additionally, field resistance to red stele (*Phytophthora fragariae* Hickman) is highly desirable. Currently, 'Totem' is the leading cultivar in the Pacific Northwest (Daubeney et al., 1991, 1993). Before 'Totem', 'Hood' and 'Benton' were widely grown. Field testing of 'Redgem' and 'Bountiful' has been principally in Washington and Oregon research plots and grower trials. 'Redgem' has a mid-late season, dual purpose,

good-flavored fruit that can be used for processing or local fresh market and home gardening. 'Redgem' is especially suited for individually quick-frozen (IQF) processing, i.e., entire fruits are frozen. 'Bountiful' fruit is brightly colored and possesses good processing qualities. It is suitable for machine harvesting with potentially high yields of late-season, ripe fruit from single harvests.

Origin

'Redgem', tested as ORUS 4459, was selected in 1972 from the cross 'Benton' × ORUS 3596 (Fig. 1). 'Bountiful' originated from the cross 'Linn' × 'Totem' (Fig. 2) and was selected in 1972 and tested as ORUS 4688.

Yield data were obtained from replicated 1- and 2-year-old plots at Aurora, Ore., in 1987–88, and incompletely replicated plots at Puyallup, Wash., in 1985–87. Disease testing occurred in the USDA red stele testing program at Corvallis and in field trials at Aurora

and Corvallis. Chemical property and sensory evaluations were performed by the Food Science and Technology Dept. at OSU.

Performance and description

Redgem. 'Redgem' is slightly earlier than 'Totem'. The productivity of 'Redgem' was less than that of 'Totem' at Puyallup and comparable to that of 'Totem' at Aurora. In 1988 at Aurora, a severe frost injured exposed flowers, lowering yields of 'Totem' (Table 1). In machine-harvested trials at Aurora in 1978, 'Redgem' had 82% recoverable fruit, which was statistically different ($P \leq 0.05$) from 'Hood', which had 63%. The percentage of recoverable, capped fruit was similar for 'Redgem' and 'Hood'. In 1974 and 1975, respectively, the machine-harvestable crop at Aurora was 12.5 t·ha⁻¹ and 10.8 t·ha⁻¹ for 'Redgem'; 'Totem' yielded 11.0 t·ha⁻¹ in the same trial. These yields were within the range obtained from hand-harvested trials in 1985–88 (Table 1). The overall fruit quality was rated average (4.7 to 5.0) for consumer acceptability in 1978 (1 = very poor; 5 = average; 9 = superior). The average fruit weight of 'Redgem' was lower than that of 'Totem' at Puyallup (Table 1).

'Redgem' plants are vigorous and produce many runners. The scape is moderately erect, much the same as for 'Benton', but the flowers remain within the canopy during bloom so that frost damage has not been a problem in the Pacific Northwest region.

'Redgem' fruit is uniform, with a blunt conic form and a smooth fruit surface similar to that of 'Benton'. The calyx is appressed, but easy to remove. The external color is a bright uniform red, while the internal color is a light red similar to that of 'Benton', but lighter than that of 'Totem'. Sensory panels in 1978 rated machine-harvested 'Redgem' frozen and sliced fruit as nonsignificantly lighter in color than 'Hood' (5.0 vs. 5.2). However, sensory panels in 1988 rated 'Redgem' frozen slices slightly lower than 'Totem' for color, texture, and appearance (Table 2). Anthocyanin content of 'Redgem' was 284 mg·g⁻¹ and of 'Totem' 749 mg·g⁻¹ from fruit harvested in 1988 at Aurora. Compared to 'Totem', preliminary data on preserves made from 'Redgem' in 1978 show superior color stability over 12 months of storage at 21°C under lighted conditions, and retention of the initial flavor.

Soluble solids concentration (SSC) ranged

Fig. 1. Pedigree of 'Redgem'.

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Fig. 2. Pedigree of 'Bountiful'.

from 8.6% for early to 8.9% for midseason 'Redgem' (Table 2). Over several years, the total acid values for 'Redgem' were 0.8% to 0.9%, the same as for 'Totem', and the pH of both cultivars averaged 3.0 to 3.5, which is acceptable to the processing industry. 'Redgem' had ascorbic acid concentration from 55 to 74 mg/100 g fruit compared to 63 to 90 mg for 'Totem' (Table 2).

In Washington, 'Redgem' was similar to 'Totem' in susceptibility to preharvest fruit rot caused by *Botrytis cinerea* Pers. ex Fr. (Table 1). 'Redgem' ratings for vigor in production fields were similar to those for 'Benton' or 'Totem', which are regarded as virus tolerant in the region. Powdery mildew disease [*Sphaerotheca macularis* (wallr. ex Fr.) Jacz. f. sp. *fragariae*] for 'Redgem' was slightly more severe than for 'Benton' or 'Totem'. 'Redgem' was evaluated at Corvallis for several years in bench tests for susceptibility to a field composite of red stele, obtained and maintained by additions of infected field soil. 'Redgem' demonstrated an acceptable level of resistance, slightly less than 'Benton', which has excellent resistance.

Bountiful. The yields of 'Bountiful' at Aurora from 1987 to 1988 were similar to those of 'Totem' or exceeded them (Table 1). 'Bountiful' was 2 to 4 days later than 'Totem'. At Puyallup, in incompletely replicated selection trials, the yields of 'Bountiful' and 'Totem' were about equal in 1985 and 1986; in 1987, 'Totem' yielded more than 'Bountiful' (Table 1). In 1991 at Puyallup, 'Bountiful'

yielded 25.5 t·ha⁻¹ and 'Totem' 20.6 t·ha⁻¹ (P.P. Moore, personal communication). In 1978 machine-harvested trials at Aurora, 72% of the total yield was recovered, statistically different than 63.4% for 'Hood', and 75% of the fruit was capped.

The average fruit weight of 'Bountiful' was slightly less than 'Totem' at Puyallup, Wash., but not at Aurora, Ore. (Table 1). The fruit of 'Bountiful' was variable in size at Abbotsford, B.C., in 1984 (H.A. Daubeney, personal communication).

'Bountiful' plants have a low spreading habit and are less erect than 'Benton' or 'Totem' plants. 'Bountiful' freely forms runners and can be grown by hill or matted row culture. Although some of its flowers are exposed outside of the leaf canopy during bloom, some risk of frost injury is avoided due to a later bloom period than 'Totem'.

'Bountiful' fruit are conic in shape. The calyx is appressed and easily removed when picked. Externally, the fruit is a bright red. Internally, the fruit is a uniform full red but not as dark as 'Totem'. In 1988, the anthocyanin content of 'Bountiful' fruit harvested at Aurora was 397 mg·g⁻¹ as compared to 'Totem' at 749 mg·g⁻¹. 'Bountiful' is suitable for slice-and-freeze processing. Firmness scores were similar to those for 'Totem' (Table 1). Preserves made from 'Bountiful', evaluated by a sensory panel in 1989, were rated as superior, in preliminary data, to those made from 'Totem' in the freshly made product and that stored for 12 months.

Sensory panels in 1988 preferred the color of 'Bountiful' (5.3 to 5.8) over that of 'Totem' (4.7 to 5.0) for frozen sliced fruit from grower trials (Table 2). The ratings for internal color were 5.5 for 'Bountiful' and 5.3 for 'Totem'.

'Bountiful' values for SSC ranged from 7.9% to 8.6% compared to 'Totem' at 8.9% to 10.5%; total acids concentration (1.0% to 1.2%) also was higher than that of 'Totem' (0.8% to 0.9%). The pH of 'Bountiful' fruit was 3.15 to 3.20, which is desirable for processing. Ascorbic acid content for 'Bountiful' was 63 to 72 mg/100 g of fruit (Table 2).

'Bountiful' was more susceptible to preharvest fruit rot than 'Totem' in Oregon and Washington (Table 1). Production field vigor was rated "good" for 'Bountiful', and it is considered to be equally as tolerant to virus diseases as 'Benton' and 'Totem' in Oregon. 'Bountiful' field ratings for powdery mildew disease severity had scores equivalent to 'Benton' and 'Totem'. In bench tests to a field composite of red stele at Corvallis, 'Bountiful' was more susceptible than 'Totem' and 'Benton', but its red stele resistance was within acceptable limits.

Adaptabilities and uses

'Redgem' meets the requirements for a mid-late season, IQF, preserve or fresh-market fruit. The fruit is acceptably firm for IQF or preserves and is extremely easy to cap. Contributing to 'Redgem's' successful IQF processing is uniform color and shape of the fruit. Stored preserves retain internal color. 'Redgem' has good resistance to the races of red stele found in the USDA bench test, field tolerance to viruses, and reasonable resistance to preharvest fruit rot. 'Redgem' appears to be well adapted in Washington and Oregon, but further testing is needed in British Columbia.

'Bountiful' has suitable firmness and thawed slice integrity for processed fruit. High SSC, low pH, and intermediate anthocyanin values contribute to a consumer-acceptable processed product. Red stele resistance in USDA bench tests indicated that 'Bountiful' could be grown in fields where red stele is located. 'Bountiful' performed well across the entire Pacific Northwest region.

Table 1. Yield characteristics of 'Totem', 'Redgem', and 'Bountiful' strawberries in Puyallup, Wash. (1985–87), and Aurora, Ore. (1987–88).

State and cultivar	Marketable yield (t·ha ⁻¹)				Fruit rot (%) ²				Wt/fruit (g) ³				Fruit firmness (N) ⁴			
	1985	1986	1987	1988	1985	1986	1987	1988	1985	1986	1987	1988	1985	1986	1987	1988
Washington^a																
Redgem	15.7	24.7	16.5		5.3	0.6	1.6		11.4	6.7	7.7		1.3	2.5	2.0	
Bountiful	21.8	32.4	37.8		20.4	6.3	13.1		15.6	9.3	9.5		2.3	2.0	2.0	
Totem	17.9	35.1	45.5		3.5	0.8	3.7		18.9	11.6	10.3		2.0	2.7	2.0	
Oregon^a																
Redgem			21.5 b ^u	17.4 a			13.0	---			12.2	11.2			1.6	2.2 b
Bountiful			26.6 a	21.5 a			9.3	11.0			13.9	11.9			2.4 a	3.0 a
Totem			15.7 c	1.0 b			3.2	6.9			13.0	10.0			2.2 a	2.9 a

²Fruit rot expressed as percentage of rotted fruit over total yields of the season.

³Weight/fruit is the average of 20 fruit at two harvests.

⁴Force required to push a 5-mm-diameter plunger to a depth of 6 mm. Mean of 20 fruit each at two harvests, as measured by a Hunter Spring Mechanical Force Gauge (series L; Ametek, Hatfield, Pa.).

^aNorth Willamette Research and Extension Center, Aurora. Marketable yield is based on 3.8-m-long plots, with plants spaced 0.38 m in the row.

^bWestern Washington Research and Extension Center, Puyallup—incompletely replicated trials. Marketable yield is based on 6-m plots, with plants spaced 0.38 m in the row.

^uMean separation within columns by Duncan's multiple range test, $P \leq 0.05$. Differences in fruit rot and weight were not significant.

Table 2. Sensory and chemical properties of early and midseason hand-harvested 'Redgem', 'Bountiful', 'Redcrest', and 'Totem' strawberries (1988) (Food Science and Technology Dept., Oregon State Univ., Corvallis).

Cultivar	Season	Fresh fruit ^z			Frozen sliced—sensory scores ^y				
		SSC	pH	Ascorbic acid (mg/100 g)	Overall quality	Color	Texture	Appearance	Flavor
Redgem	Early	8.6	3.30	74	3.8	3.7	4.1	3.9	4.8
	Mid	8.9	3.50	55	4.6	5.0	4.8	4.3	5.1
Bountiful	Early	8.6	3.15	72	5.4	5.8	5.3	5.4	4.8
	Mid	7.9	3.20	63	4.9	5.3	5.1	4.8	4.3
Redcrest	Early	8.8	3.05	80	5.6	6.2	5.4	5.8	4.9
	Mid	9.7	3.35	67	5.2	5.4	5.2	4.9	5.3
Totem	Early	8.9	3.30	91	4.5	4.7	4.8	4.3	4.6
	Mid	10.5	3.75	63	4.8	5.0	4.8	4.7	4.8
LSD _(0.05)					0.75	0.80	0.75	0.65	0.90

^zPanel of 12 judges using 9-point preference scale: 9 = outstanding, 5 = average, and 1 = very poor.

^yIncomplete sampling; statistical analysis not performed.

Availability

The names and addresses of propagators with certified 'Redgem' and 'Bountiful' plants will be supplied on request by Chad E. Finn, USDA Horticultural Crops Research Laboratory, 3420 N.W. Orchard Ave., Corvallis, OR 97330.

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