'Rainier', a Dual Purpose Strawberry Cultivar for the Pacific Northwest[1]

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'Rainier', a strawberry cultivar introduced by Washington State University, has attributes that suit it to traditional preserve manufacture and frozen pack as well as fresh market. In the Pacific Northwest, processing is still the major outlet for strawberries. However, with the importation of inexpensive fruit for processing, many growers are seriously considering the more lucrative fresh fruit markets. The 'Northwest' cultivar, the mainstay of the processing industry for two decades, is too soft and does not have sufficient shelf life for use on the fresh market. 'Rainier' is a cultivar capable of meeting the demands of fresh fruit marketing as well as making an excellent processed product.

A new cultivar for the Pacific Northwest must be objectively compared with 'Northwest'; but, in addition, comparisons should be made with three other cultivars introduced in recent years for Pacific Northwest growers: 'Hood', introduced by USDA-Oregon State University (8), 'Shuksan', introduced by Washington State University (1) and 'Totem', introduced by the Canada Department of Agriculture Research Station, Agassiz, B. C. (3). 'Hood' ranks second in Pacific Northwest acreage and is prized for its attractiveness and suitability for preserves, but is not as satisfactory as 'Northwest' for freezing. 'Shuksan', with outstanding winter hardiness, has become a leading cultivar in northwest Washington where 'Northwest' has frequently been killed by low winter temperatures. 'Totem' is replacing 'Northwest' acreage in southwest coastal British Columbia because of its winter hardiness, red stele root rot resistance and better adaptation to the fresh market.

Origin. 'Rainier' is a seedling from the cross of 'WSU 685' ('Northwest' x 'Sierra') x 'Columbia' made in 1962 by C. D. Schwartze and was tested as WSU 1232. The parent analysis and complete pedigree have been published with the introduction of a sister seedling 'Shuksan' (1). Seedlings of the cross were screened for resistance to red stele root rot, caused by *Phytophthora fragariae* Hickman, in greenhouse benches containing a composite of red stele infected soils prior to field planting in 1964. 'Rainier' was selected in 1965 by C. D. Schwartze, and advanced testing began in 1966 at Puyallup and regionally in 1967. 'Rainier' has subsequently been included in replicated yield trials at Everson, Mt. Vernon and Vancouver, Washington, and Aurora, Oregon. 'Rainier' has been in commercial grower trials throughout western Washington and the Willamette valley in Oregon since 1969.

Methods. Marketable fruit yield and the percent of cull fruit were determined by harvesting both sound and rotted fruit. Fruit rot was caused primarily by *Botrytis cinerea* Pers. ex. Fr. The weight of 25 fruits at each harvest was adjusted according to the proportion of the crop picked at each harvest to obtain seasonal mean fruit weights (6). Puncture force determinations were made on 3 fruits at each harvest date with a Chatillon Push

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Pull Gauge (Model 516-500) with a 3/16 inch diameter head. The force needed to puncture the skin and flesh was recorded in oz, and adjusted according to the proportion of crop harvested at each picking to obtain a seasonal mean puncture force. Field designs were randomized complete blocks with four blocks of 10 plants, each spaced two feet apart within the row. The 1966 planting was handled in the hill system and the 1968, 1970 and 1971 plantings were maintained in matted rows.

Comparative performance. At Puyallup from 1967 to 1972 marketable fruit yields for 'Rainier' have been similar to 'Hood' and slightly lower than 'Shuksan' and 'Northwest' (Table 1). In two years of comparisons between 'Rainier' and 'Totem', marketable yields were similar (Table 1). In regional trials at Aurora, Oregon, and Mt. Vernon, Washington, 'Rainier' yields have been equal to or slightly higher than 'Northwest' while at Vancouver, Washington, yields have been lower than 'Northwest'.

Fruiting characteristics. Long fruit clusters extend beyond the crown and the ripe fruit rests on the soil. The number of fruits per cluster is less than with 'Northwest' or 'Hood' because of a reduced number of tertiary fruits and the virtual absence of quaternary fruits. In 1971 the typical number of fruits per cluster for 'Northwest' was 15.3, for 'Hood' 9.2, for 'Shuksan' 8.0 and for 'Rainier' 6.5.

The seasonal mean fruit weight for 'Rainier' over a six year period has been significantly larger (P=.05) than for 'Northwest' in 9 of 12 experimental plantings (seven plantings are list-

Table 1. Marketable yield, fruit size and percent culls for 'Rainier' and four other strawberry cultivars from 1967 to 1972 at Puyallup, Washington.

Year planted	1966		1968		1970		1971	7-Trial
Year harvested	1967	1968	1969	1970	1971	1972	1972	mean
				Marketable yield (tons/acre)				
Shuksan	10.7a[1]	8.5a	8.5a	10.9a	8.4a	10.0a	8.7a	9.4
Northwest	10.2a	7.2ab	7.2ab	10.3a	8.1a	7.3b	8.0ab	8.3
Rainier	8.6a	7.3ab	6.9ab	9.6a	7.9a	8.6ab	6.5c	7.9
Hood	7.2a	5.8b	5.8b	10.3a	7.5a	10.5a	7.8ab	7.9
Totem	—	—	—	—	7.2a	9.7ab	7.4b	
				Seasonal mean fruit weight (g)				
Totem	—	—	—	—	17.6a	14.8a	16.5a	—
Rainier	10.5ab	8.1a	12.6a	11.1a	18.6a	13.9ab	14.3b	12.7
Shuksan	11.6a	7.1ab	11.9a	10.3ab	16.7b	13.5ab	13.9b	12.2
Hood	8.6bc	6.0b	12.3a	11.6a	16.9ab	14.0a	14.0b	11.9
Northwest	7.5c	6.3b	11.9a	8.9b	15.4b	12.2b	14.2b	10.9
				Percent culls				
Shuksan	9a	13a	12a	4a	10a	14a	12a	11
Totem	—	—	—	—	17b	16a	17a	—
Hood	17a	20a	27b	7a	20b	15a	16a	17
Rainier	18a	21a	25b	4a	19b	20a	18a	18
Northwest	18a	37b	44c	12b	22b	30b	30b	28

[1]Numbers within a column which share the same letter are not significantly different (P=.05).

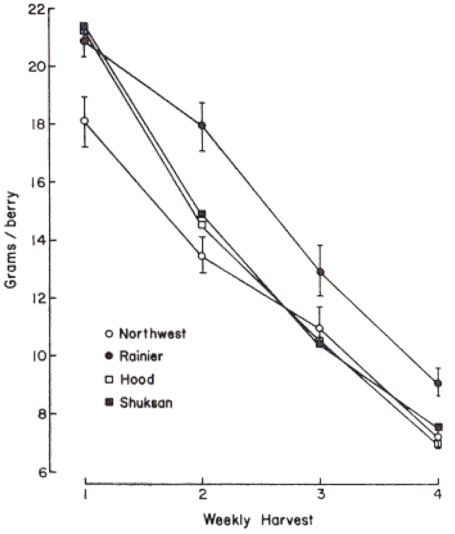

Figure 1. Mean berry weight at weekly harvest intervals for 'Rainier', 'Shuksan', 'Hood' and 'Northwest'. (Vertical brackets for 'Rainier' and 'Northwest' are standard errors.)

ed in Table 1). 'Rainier's' large fruit size is maintained throughout the picking season, having larger fruit than 'Northwest' at each picking (Fig. 1). In 1972 the mean weight in grams per ripe fruit for 'Rainier' and 'Northwest' at the primary position was 33.0 and 24.1, at the secondary position 18.5 and 15.3, and at the tertiary position 10.8 and 10.3, respectively.

The fruits of 'Rainier' are very large with smooth wedge-conic shaped primary fruits and conic later ripening fruits (Fig. 2). The fruit is extremely attractive with bright red abrasion resistant skin and slightly sunken yellow seeds. The internal color is bright red throughout. The calyx (cap) is large with narrow pointed sepals. The cap is appressed and difficult to remove. It is much more difficult to cap than 'Puget Beauty', 'Hood' and 'Totem' and slightly more difficult than 'Shuksan' and 'Northwest'.

The mean picking date for 'Rainier' at Puyallup has been two to three days later than 'Northwest' and 'Shuksan', four to six days later than 'Hood' and 'Totem' and seven to nine days later than 'Puget Beauty'.

Vegetative characteristics. 'Rainier' plants are very vigorous with large leaf blades and long petioles. A unique feature of the leaf is its twisting petiole that frequently turns the leaf blade partially upside down giving the illusion of wilting. 'Rainier' produces fewer runner plants than 'Hood', 'Shuksan' or 'Northwest' although adequate runners are produced for propagation and matted row culture.

Winter hardiness. 'Rainier' has an intermediate level of winter hardiness. It withstood the severe 1968-69 winter in northwest Washington better than 'Northwest' but suffered more severe damage than 'Shuksan' or 'Cheam' (4).

Disease resistance. 'Rainier' has shown a level of virus tolerance equal

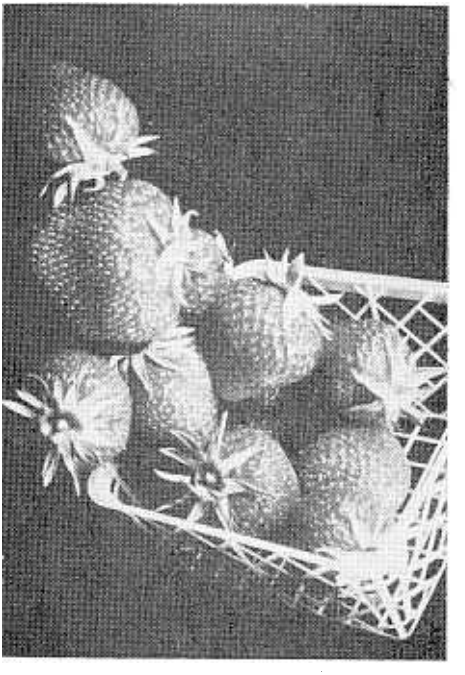

Figure 2. The 'Rainier' strawberry.

to or greater than 'Northwest', 'Totem' and 'Shuksan', and much greater than 'Hood' and 'Marshall' (5).

'Rainier' foliage is resistant to powdery mildew.

Although 'Rainier' was developed as a cultivar resistant to the red stele root rot fungus it does not have resistance to all races found in the Pacific Northwest. In the majority of commercial trial plantings red stele root rot has not been a problem with 'Rainier'.

'Rainier' has shown an intermediate level of susceptibility to fruit rot (Table 1). At Puyallup it has been more susceptible than 'Shuksan' or 'Columbia' but not as susceptible as 'Northwest' or 'Cheam' (2).

Fresh fruit adaptation. 'Rainier's' low incidence of fruit rot and its skin and flesh firmness (Table 2) contribute to its extremely good shelf life. Its color remains bright for long periods in cold storage. In addition to its general attractiveness after cold storage, its very large size adds to its fresh market appeal.

Processing quality. The frozen 4+1 slice pack is outstanding with color quality equal to 'Northwest' and flavor, appearance and texture far superior to 'Northwest' (Table 3). The frozen slices retain their firmness and shape after thawing. The thawed fruit is aromatic with excellent flavor balance. For preserves 'Rainier' has an equally high rating and is very comparable to the industry standard 'Hood'. 'Rainier' fruit has higher soluble solids, higher titratable acidity, higher pH and higher anthocyanin content than 'Northwest' but lower ascorbic acid content. In relation to 'Shuksan', 'Rainier' has lower soluble solids, lower titratable acidity, lower ascorbic acid content, higher pH and higher anthocyanin content (7).

'Rainier' is recommended for planting where strawberries are grown for processing or for fresh market in western Washington and Oregon and southwestern B. C. However, two factors may limit 'Rainier's' usage for processing and make it predominately a fresh market cultivar: one, it is difficult to cap and two, it has a late ripening season, a time when many strawberry growers are anxious to begin harvesting 'Willamette' red raspberries. 'Rainier' is probably not suited for mechanical harvesting, where there may be just a single harvest, because of its long ripening season and the difficulty with capping.

Naming and availability. The name 'Rainier' is taken from Mt. Rainier, the volcanic peak that dominates Mt. Rainier National Park in the Washington Cascade mountains. It is fitting

Table 2. Seasonal mean puncture force (oz.) determinations for 'Rainier' and seven other strawberry cultivars at Puyallup, Washington.

Year planted Year harvested	1970 1971	1970 1972	1971 1972	1971 1972	Mean
Totem	10.8a[1]	10.3ab	11.5a	11.8ab	11.1
Shuksan	10.2ab	10.6a	11.0ab	12.4a	11.1
Hood	9.9abc	9.7abcd	11.1ab	10.8bc	10.4
Rainier	9.8abc	10.2abc	10.0abcd	10.9bc	10.2
Puget Beauty	8.1de	9.1bcd	11.0ab	10.7c	9.7
WSU 1142	9.2bcde	9.2bcd	9.9bcd	9.9c	9.6
Northwest	8.6cde	8.7d	8.7d	10.9bc	9.2
WSU 1019	7.9e	9.0cd	9.8bcd	10.0c	9.2

[1]Values within a column which share the same letter are not significantly different (P=.05).

Table 3. Subjective taste panel ratings over 4 years for frozen 4+1 sliced strawberries of 'Hood', 'Shuksan' and 'Rainier' in comparison with Northwest' (from data supplied by E. R. Wolford and J. W. Nelson, USDA Fruit and Vegetable Products Laboratory, Puyallup).

Cultivar	Flavor				Appearance				Color				Texture			
	1968	1969	1970	1971	1968	1969	1970	1971	1968	1969	1970	1971	1968	1969	1970	1971
	=[1]	=	−−	=	+	=	=	−	=	−	−−	−−	−	−−	−−	−
	=	=	=	+	=	+	=	++	−	−	−	=	++	++	++	++
	+	++	+	++	++	++	+	++	=	=	−−	=	++	++	++	++

[1]++, rated much better than 'Northwest'; +, better than 'Northwest'; =, equal to "Northwest'; −, below 'Northwest'; −−, much below 'Northwest'.

to name a cultivar after a National park during 1972, the 100th anniversary of the National park system.

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