Each chapter reflects considerable, careful research on the part of each of the authors, Virginia Mas (the free lance writer), R. P. Larsen, W. H. Upshall, J. B. Mowry, and E. S. Degman. Many fascinating episodes connected with the origin of each of the varieties, are revealed. Valuable lists of strains and new varieties bred from the original major varieties are tabulated by most of the authors.

The chapter on rootstocks by R. F. Carlson is a very important part of this book, since the performance of the scion variety is so strongly affected by the nature of the rootstock.

"North American Apples" is concluded very appropriately and effectively with a chapter entitled "Apple Orchards of Tomorrow," by H. A. Rollins.

This book is a "must" for the apple grower—commercial, amateur, teacher and student. Order it soon, directly from Michigan State University Press, Box 550, East Lansing, Mich. 48823.

—G. M. Kessler

Shuksan, a New Winter Hardy Strawberry for the Pacific Northwest*

B. H. BARRITT, C. D. SCHWARTZE AND R. A. NORTON**

Shuksan, a new strawberry cultivar, is being introduced by Washington State University because it has shown exceptional winter hardiness in northwestern Washington, where the standard cultivar, Northwest, frequently suffers severe mid-winter cold damage. Shuksan fruit has received high ratings for freezing and preserves, and is adapted to fresh fruit marketing. In field trials, it has shown a low incidence of fruit rot, resistance to red stele, high tolerance to common viruses, good berry size and high productivity. It is suggested for trial throughout the Pacific Northwest and wherever these characteristics may be of interest.

Shuksan, formerly WSU 1239, was a seedling from the cross WSU 685 X Columbia made by C. D. Schwartze in 1962. It was selected by him in 1965 for further evaluation. Prior to field planting the cross was screened for resistance to red stele, *Phytophthora fragariae*, in the standard greenhouse bench test, using a mixture of red stele infested field soils. All highly resistant survivors of this test, including Shuksan, were propagated in a screenhouse to produce virus free plants for field planting and future propagation.

Greenhouse bench tests with selected red stele soils (unpublished) indicate that Shuksan is resistant to red stele races A-1 and A-3. Its reaction to other red stele races has not been determined.

Fig. 1. Fruit cluster of Shuksan.

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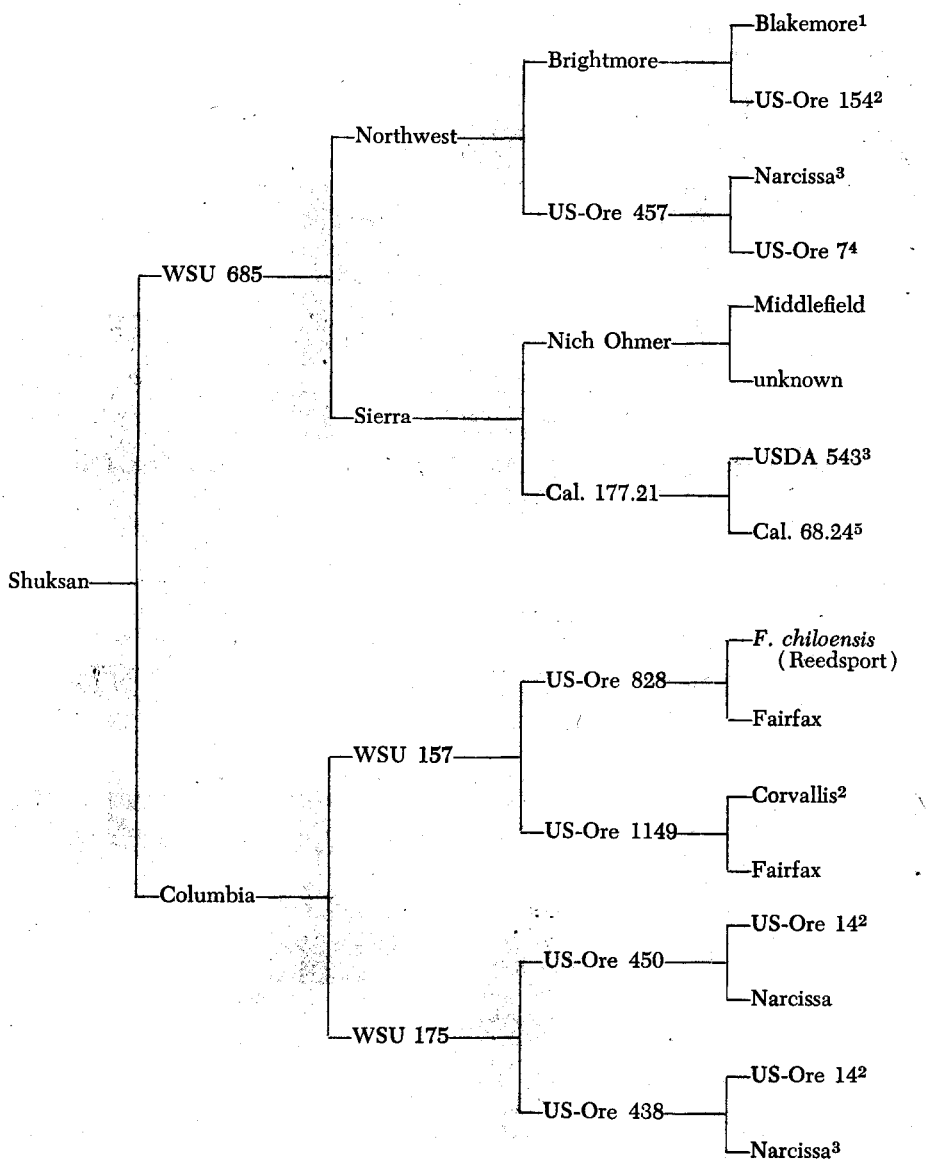

[1]Missionary × Howard 17
[2]Ettersburg 121 × Marshall
[3]Royal Sovereign × Howard 17
[4]Ettersburg 121 × Wilson
[5]USDA-634 (Royal Sovereign × Howard 17) × NY-4626 (Marshall × Howard 17)

Fig. 2. The pedigree of the Shuksan strawberry.

Table 1. Parent analysis of the Shuksan strawberry.

Howard 17	18.8%
Ettersburg 121	15.6
Marshall	14.1
Royal Sovereign	14.1
Nich Ohmer	12.5
Fairfax	12.5
F. chiloensis (Reedsport)	6.3
Missionary	3.1
Wilson	3.1

The complete pedigree (Fig. 2) shows that Shuksan's parents and grandparents all originated in the Pacific states. The parent analysis (Table 1) shows the importance of Howard 17, Ettersburg 121, Marshall and Royal Sovereign in its early ancestry. The only known source of red stele resistance in the pedigree is *Fragaria chiloensis* (Reedsport clone) collected by G. F. Waldo on an Oregon beach. However, an unidentified clone of *F. chiloensis* was believed to have been used in the breeding of Ettersburg 121 (Darrow, 1966).

In addition to yield trials and processing evaluation at Puyallup, Shuksan has been field tested by R. A. Norton at the Northwestern Washington Research and Extension Unit, Mt. Vernon, by P. C. Crandall at the Southwestern Washington Research Unit, Vancouver, by R. M. Bullock at the North Willamette Experiment Station, Aurora, Oregon. Grower-processor field trials have been conducted since 1968 in Washington and Oregon. Harvest data are presented for matted row and hill system plantings at Puyallup (Tables 2 and 3) and a matted row planting at Mt. Vernon (Table 4). Fruit size determinations (the number of berries per pound) were made at each picking and the average of all pickings is presented in the Mt. Vernon data (Table 4). At Puyallup,

Table 2. Two-year yield, fruit size and fruit rot data for Shuksan and 6 other strawberry cultivars planted in 1966 and maintained in the hill system at Puyallup, Washington.

	1967			1968		
Cultivar	Tons/acre	Number berries/lb.	% Fruit rot	Tons/acre	Number berries/lb.	% Fruit rot
Shuksan	10.7a[1]	39a	9a	8.5a	64a	13a
Northwest	10.2a	61c	17ab	7.2ab	72a	37c
Columbia	9.7a	74d	11a	7.3ab	87b	14a
Siletz	9.7a	73d	19b	7.1ab	91b	31bc
Hood	7.2b	53bc	17ab	5.8bc	75a	20ab
Cheam	6.0bc	48ab	41d	3.4c	70a	56d
Marshall	4.6c	55bc	28c	...	...	...

Table 3. Two-year yield, fruit size and fruit rot data for Shuksan, Northwest and Hood strawberry cultivars planted in 1968 and maintained as matted rows at Puyallup, Washington.

	1969			1970		
Cultivar	Tons/acre	Number berries/lb.	% Fruit rot	Tons/acre	Number berries/lb.	% Fruit rot
Shuksan	8.5a[1]	38a	12a	10.9a	51ab	4a
Northwest	7.2ab	38a	44c	10.4a	55b	12b
Hood	5.8b	37a	27b	10.4a	46a	7a

[1]Means within a column sharing the same letter are not significantly different ($P = .05$).

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	10.2a	61c	17ab	7.2ab	72a	37c
	9.7a	74d	11a	7.3ab	87b	14a
	9.7a	73d	19b	7.1ab	91b	31bc
	7.2b	53bc	17ab	5.8bc	75a	20ab
	6.0bc	48ab	41d	3.4c	70a	56d
	4.6c	55bc	28c			

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	7.2ab	38a	44c	10.4a	55b	12b
	5.8b	37a	27b	10.4a	46a	7a

[1]Means within a column sharing the same letter are not significantly different (P = .05).

average berry weight figures are weighted averages similar to those described by Moore (4). Fruit rot data show the percentage of harvested fruit which was diseased, principally due to *Botrytis cineria*. Generally, Shuksan was not significantly different from Northwest in yield or berry size. Fruit rot causes serious yield reductions with Northwest if rains occur during harvest. Shuksan, like its pollen parent, Columbia, has consistently shown a high level of resistance to fruit rot (Tables 2, 3 and 4).

Virus tolerance of Shuksan, as measured by uniformity of vigor and plant height in the matted row, has been high in semi-commercial grower trials in Washington and Oregon. At Mt. Vernon, in a variety trial with a uniformly high level of virus infection, Shuksan was as field-tolerant to virus complexes as Northwest and Cheam, and considerably more tolerant than Hood, Puget Beauty and Marshall.

Shuksan is not as mildew resistant as Hood, Columbia, Puget Beauty, Siletz or Cheam, but is similar to Marshall, and not as susceptible as Northwest.

An important factor contributing to the release of Shuksan is its winter hardiness. In recent years, the Northwest cultivar has been severely damaged by low mid-winter temperatures in the northwest corner of Washington and in adjacent British Columbia. In the test winter of 1968-69, −10°F. caused severe injury to Northwest plants, resulting in negligible regrowth in 1969. In contrast, Shuksan plants showed good growth in 1969, and produced a modest crop (3). Shuksan was comparable in hardiness

Table 4. Two-year yield, fruit size and fruit rot data for Shuksan and 4 other strawberry cultivars planted in 1967 and maintained in a matted row at Mt. Vernon, Washington.

	1968			1969		
Cultivar	Tons/acre	Number berries/lb.	% Fruit rot	Tons/acre	Number berries/lb.	% Fruit rot
Shuksan	7.4b[1]	42a	4.8a	5.7a	37a	1.0a
Northwest	9.9a	43a	7.3a	4.5ab	40a	0.4a
Hood	5.6bc	47a	8.7a	3.4ab	43a	1.1a
Cheam	4.9c	46a	23.5b	3.7ab	42a	2.7ab
Pudget Beauty	5.2c	47a	8.4a	2.7b	42a	6.6b

[1]Means within a column sharing the same letter are not significantly different (P = .05).

Table 5. Subjective taste panel ratings of frozen Shuksan and Hood strawberries in comparison with the Northwest cultivar from 4 Pacific Northwest locations.[1]

	Flavor				Appearance				Color				Texture			
Cultivar	A[2]	V	M	P	A	V	M	P	A	V	M	P	A	V	M	P
Hood	+[3]	+	+	+	+	−	+	+	−	−	−	−	−	−	−	−
Shuksan	+	−	+	+	+	+	+	+	−	−	−	+	+	+	+	+

[1]Portion of a table previously published in the Annual Report of the Oregon Horticultural Society 61:110-113, 1970.

[2]A—North Willamette Experiment Station, Aurora, Oregon; V—Southwestern Washington Research Unit, Vancouver, Washington; M—Northwestern Washington Research and Extension Unit, Mt. Vernon, Washington; P—Western Washington Research and Extension Center, Puyallup, Washington.

[3]+, rated better than Northwest; −, rated poorer than Northwest.

to Cheam, a recent winter hardy introduction from the Canada Department of Agriculture Research Station at Agassiz, B. C. (2).

Processing evaluation of Shuksan in comparison with Hood and Northwest has been conducted at Puyallup by E. R. Wolford and J. W. Nelson at the U.S.D.A. Fruit & Vegetable Products Laboratory (5, 6, 7). Subjective evaluation of sliced 4+1 frozen packs of Shuksan, Northwest and Hood from four locations showed that Shuksan was superior to Northwest in flavor, appearance and texture, but was slightly darker and less glossy (Table 5). Shuksan's firm texture is a major factor in its superiority over Hood and Northwest in the frozen pack. Comparisons by 170 tasters of preserves made from Shuksan and Hood did not clearly indicate a preference (7). Preserves of Shuksan and Hood darken more slowly than those of Northwest and therefore have a longer shelf life.

Shuksan is a large-fruited midseason cultivar which ripens with Northwest. Primary berries have a broad wedge shape with shallow furrowing, while later berries are uniformly conic and lack furrows (Fig. 1). The infrequent occurrence of fasciated scapes with rosette or irregular shaped fruits has been noted. External color is bright red and glossy and the yellow-red seeds are slightly indented. Its firm flesh and abrasion-resistant skin contribute to its good shelf life. The calyx is broad and usually reflexed on primary fruits and more flattened on later fruits. Shuksan does not cap as readily as Hood, and in most locations is comparable to Northwest.

The response to Shuksan from commercial growers in northwestern Washington has been encouraging. Yield and fruit size from five acre blocks have been very comparable to the Northwest cultivar. Preliminary commercial processor evaluation indicates that furrowed berries and the occasional irregular shaped berry do not appreciably alter frozen pack quality.

The name Shuksan is taken from Mt. Shuksan, a prominent peak in a region of northwest Washington state recently designated as North Cascade National Park.

Approximately 2,000,000 plants of Shuksan will be available from Washington Certified Plant Growers for 1971 spring planting.

Acknowledgments

It is a pleasure to acknowledge the technical assistance of Louis Torre and H. Y. S. Loo in the development and early evaluation of Shuksan.

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