

Report to the Oregon Processed Vegetable Commission

1988

1. Project Title: Broccoli breeding
2. Project Leader: J. R. Baggett
3. Project Status: Continuing, indefinite
4. Project Funding for Reporting Period: \$5,000.00
5. Objectives:

Develop broccoli varieties for processing in western Oregon stressing:

- a) Elongate habit with highly exerted heads easily accessible for harvest.
- b) Openly branched heads with heavy, clean stem for easy trimming and separation into spears or chunks.
- c) Medium fine, firm, uniform florets of good color and which are retained after freezing.
- d) Early to midseason maturity, concentrated high yield potential.
- e) Clubroot and downy mildew resistance if possible.

6. Report of Progress:

- a) An early observation trial was planted April 27 to evaluate our 1987 field crosses, some selected hand greenhouse crosses left over from 1987, and a limited number of commercial varieties. This trial provided the first opportunity to estimate the number of self-pollinated inbred parent plants in the field crosses (experimental hybrids). Subjective scores and notes as well as percent self for 1987 field crosses are shown below (1987 field crosses are assigned 1988 code numbers):

88-1 (HS161-3 x S366) 100% crosses. Heavy heads; uniform maturity; see 88-2.

88-2 (S366 x HS161-3) ? Score 3.5. Medium head (5-6"); slightly yellow color; poor exertion; florets fairly uneven.

88-3 (HS161-1 x S240-5) 80% crosses. See 88-4.

88-4 (S240-S x HS161-1) 73% crosses. Score 3.5-4. Segmented but usable for processing. Florets fine, even. Good exertion. 7+".

88-5 (HS161-3 x S352) 100% crosses. Score 3.0. Early heads small, coarse; later heads looked fairly good. Fair exertion. 5+".

- b) A yield trial was direct-seeded July 5, using 30 foot plots, rows 18" apart. Eight OSU experimental F₁ hybrids and three commercial hybrids

were replicated four times in a randomized complete block design. Harvests were made weekly, but a few very early or very late heads and non-usable culls were not harvested. Heads were trimmed to 6 1/2 inches prior to weighing.

OSU 88-1 (HS161-3 x S366) was the highest yielding hybrid in the trial and had the largest amount, 7.3 tons, which was 73% of the total yield of 10.1 tons/acre, in a single harvest (Table 1). By comparison, Gem yielded 8.6 tons with 5.0 tons (58%) in the largest harvest. While OSU 88-1 produces compact, heavy heads of good form and has fair head exertion, the color is too light for quality processed broccoli. The parent lines have been tested in many cross combinations and generally produce hybrids of light color, depending on the second parent of the particular cross. This is especially true of S366.

Equal to Gem in production was OSU 87-2 (HS161-5 x S350), which looked promising in 1987 but which had lighter stem color in 1988. Likewise, OSU 88-3 (HS161-1 x S240-5) and 88-4 (S240-5 x HS161-1), which are repeat crosses of OSU 86-3 and 86-4, looked very good for head exertion and dome head shape, but were somewhat light in stem color and down somewhat in yield.

The most promising hybrids for exerted heads with good floret and stem color were 87-3 (S240-1 x HS179) and 87-5 (S240-5 x HS179). These hybrids are among the best we have ever observed for exertion and picking efficiency, but head size and stem diameter are not adequate for high yields. The main challenge of this breeding program is to find combinations with other inbreds crossed with HS179 that will produce higher yields or to develop new inbred lines with high exertion and better yield potential.

Commercial varieties Cruiser and Brigadier yielded well in this trial; Cruiser had poor color and poor head exertion. Brigadier had short plants and very poor exertion, bad yellow head undercolor, and tended to have dead florets.

- c) The main planting for evaluation of inbreds, field and experimental hybrids, commercial varieties, and segregating populations for selection purposes was made July 12-15, somewhat late because of problems with land availability. Table 3 lists the best OSU experimental hybrids with subjective scores and notes. These hybrids will be candidates for field crossing to produce larger quantities of seed, especially if the particular parents used show general promise. All hybrids with HS179 get G (good) or VG (very good) comments for head exertion and usually have good stem color. However, because the inheritance of these characteristics appears to be quantitative and mostly additive, some crosses of HS179 with short and/or light colored parents have less than ideal stem exertion and/or color. Exceptional looking crosses for exertion and color were 88-64 (HS179-1 x S233-1), 88-66 (HS179-1 x S240-1), 88-84 (HS179-1 x S310), and their reciprocals. Of these, 88-64 appeared to have better size potential than 87-3 and 87-5, the hybrids included in the yield trial. Other HS179 crosses were omitted from Table 3 because of scores below 3.5.

Other hybrids which appear to offer possibilities for processing use are 88-100, 88-102, 88-120, 88-130, and reciprocals. S233-1, the parent of two of these hybrids, will be explored thoroughly as a parent in more experimental crosses in 1989. Several crosses listed in Table 3 will be selected for field crossing.

Plants from a number of the highly exerted experimental crosses were saved and propagated to produce F₂ seed in the greenhouse for selection purposes. F₂ populations from similar 1987 selections and F₃ populations from 1986 selections were planted for selection of exerted types, possibly with larger heads or heavier stems. About 100 single plants were selected and propagated for greenhouse self-pollination.

Commercial varieties. Observation of commercial hybrids are shown in Table 4. Most of those grown were short, poorly exerted, had poor floret and stem color, and though often heavy and concentrated in yield, did not appear to have promise for processing in Oregon.

Those receiving a score of 3.5 were Baccus, Arcadia, Citation, XPH 5168, Bonanza, Hi Caliber, Cruiser, XPH 5167, and Sunre 8015. However, the table will show that most of these were poor or mediocre for color or exertion or both. Hi Caliber, XPH 5167, and Sunre 8015 should be tried for processing. It is possible that some of the varieties observed would have better processing characteristics earlier in the season.

7. Summary:

Hybrids involving high exertion inbred HS179 continued to look promising for processing because of easy hand harvest or mechanical harvest potential and excellent color of floret and stem. Head size, uniformity, heaviness of stem, and net yield may be inadequate, so a major thrust of the program is identification of other hybrid combinations with good exertion and better yield, and development of new high exertion inbreds with better yield characteristics. F₁ plants from a number of experimental F₁ hybrids were saved for production of F₂ (segregating) seed and possibly 100 selections were taken in F₂ and F₃ populations from previous F₁ generations. The highest yielding hybrid in a replicated trial was OSU 88-1, which has poor processing potential because of color, followed by Gem. No other commercial varieties observed appear to have promise for processing because of poor color and poor exertion, although many are uniform and high yielding.

8. Signatures:

Submitted by:

Redacted for Privacy

Project Leader //

Date

Approved by: /

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Date

Table 1. Broccoli Yield Trial, Oregon State University, Corvallis, Oregon, 1988¹.

Variety	Source	Total No. Heads/Acre	Total Tons/Acre	Lbs./Head	No. Harvests	Avg. Tons/ Weekly Harvest	Tons Largest Weekly Harvest	Notes
86-4	OSU	25410	6.3	0.50	3	2.1	3.3	Tight segmented dome
87-2	OSU	25289	8.6	0.68	3	2.9	5.1	Light stem color, heavy stems
87-3	OSU	23716	5.2	0.44	3	1.7	3.5	Long deep branches, good stem color, too small?
87-5	OSU	21780	4.2	0.39	3	1.4	3.2	V. good exsertion and stem color, good florets, too small?
88-1	OSU	26499	10.1	0.77	3	3.4	7.3	Poor stem color, fair exsertion, light yellow undercolor, v. good head type
88-3	OSU	19239	5.9	0.62	3	2.0	2.6	Heads tight segmented and deep branched, florets even, stem color fair
88-4	OSU	16698	5.2	0.62	3	1.7	2.3	Same as 88-3
88-5	OSU	27709	7.9	0.57	3	2.6	6.3	Very uniform, compact, sl. pointed dome, good floret color; some early heads coarse
Gem	Asgrow	28677	8.6	0.60	3	2.9	5.0	Long, deep branches, good stem color, uneven florets
Cruiser	Royal Sluis	26257	7.2	0.55	3	2.4	5.3	Uniform gray green color, uniform florets, poor exsertion
Brigadier	Peto	24563	7.8	0.64	3	2.6	4.8	Fine florets, bad yellow undercolor showing, some dead florets, v. poor exsertion, short plants
LSD at 5%		1439	1.6	0.95				

¹Direct-seeded July 5 in 30' plots, 18" between rows, thinned to 10" between plants; 900 lbs/A 12-29-10 broadcast at planting time with 300 lbs. N side-dressed as ammonium nitrate on August 13.

Table 2. Pattern of Maturity in Broccoli Hybrids, Corvallis, Oregon, 1988.

Variety	T/A for week of:				
	9-12	9-19	9-26	10-3	10-10
86-4			3.3	1.8	1.2
87-2			5.1	2.7	0.8
87-3		0.9	3.5	0.8	
87-5		0.2	3.2	0.9	
88-1			7.3	2.4	0.4
88-3			2.1	2.6	1.2
88-4			2.0	2.3	0.9
88-5		0.4	6.3	1.1	
Gem	2.4	5.0	1.2		
Cruiser	0.7	5.3	1.2		
Brigadier		2.1	4.8	0.9	

Table 3. Selected OSU experimental broccoli hybrids, Corvallis, Oregon, 1988¹.

Code	Parentage	Mat. Date	Score ²	Head Diam.	Florets	Stem Color	Exser- ³ tion	Notes
88-1	HS161-3 S366	10-18	4.0	8"	even	P	F	Light yellow undercolor; v. uniform; not good processing broccoli, possibly fresh market; high yielding, 88-1 is 100% hybrids, 88-2 is 35% hybrids
88-2	S366 HS161-3							
88-3	HS161-1 S240-5	10-28	3.5-4.0	5-6"		F	G	Tall plant; head quite segmented; not very uniform; about 75% hybrids
88-4	S240-5 HS161-1							
88-5	HS161-3 S352	10-11	3.5-4.0	5"	sl. coarse	P	G	Compact head; probably too small for processing; good form; uniform; 100% hybrids
88-20	HS143 S350	10-20	3.5-4.0	5-7"	even	F	F-G	Uniform umbrella shape
88-21	S350 HS143							
88-37	S310 HS161-1	10-13	3.5-4.0	5-6"	medium	F	G	Firm dome
88-64	HS179-1 S233-1C	10-11	3.5-4.0	6-8"	even, sl.	VG	VG	Deep-branched head
88-65	S233-1C HS179-1				coarse			
88-66	HS179-1 S240-1	10-6	3.5+	4-5"		VG	VG	Segmented dome; good processing type but may be too small
88-67	S240-1 HS179-1							
88-76	HS179-1 S240-11-8	10-13	4.0	8"	sl. uneven	F-G	G	Segmented head
88-77	S240-11-8 HS179-1							
88-80	HS179-1 S269	10-20	3.5+	7-8"	fine	F-G	G	Segmented head, fair stem diameter
88-84	HS179-1 S310	10-1	4.0-	5-6"	medium, even	G	VG	Deep branched head; v. good form; too small?
88-85	S310 HS179-1							
88-86	HS179-1 S315-1	10-13	4.0	6-8"		F	VG	Heavy stem, good size and weight; good form
88-87	S315-1 HS179-1							
88-88	HS179-1 S351	10-6	3.5-4.0	5-6"+	coarse	F	G	Flat head; good stem diameter; excellent form
88-98	S233-1A S315-1	10-6	3.5-4.0	6-9"	medium	P	F	Good form, size and weight, but poor color
88-99	S315-1 S233-1A							
88-100	S233-1A S350	10-20	4.0	7-9"	medium, even	G	G-VG	Heavy dome with good segmentation, good size and weight; slight yellow rosettes; looks good for processing
88-101	S350 S233-1A							
88-102	S233-1B S315-1	10-6	4.0	6"	sl. loose	F	F-G	Compact umbrella; good floret color; good stem weight
88-103	S315-1 S233-1B				but even			
88-120	S240-10 S315-1	10-13	4.0	8-9"		F	F	Possible processing broccoli
88-121	S315-1 S240-10							
88-128	S240-11-8 S315-1	10-13	4.0	5-8"		F-P	F	Good size and weight but poor processing prospect because of color
88-129	S315-1 S240-11-8							
88-130	S240-11-8 S350	10-20	3.5-4.0	9"	fine, sl. uneven	F	G	Segmented dome; heavy, good size
88-152	S315-1 S352	10-15	4.0	7"	medium, even	G	G	Good blue-green floret color
Gem		9-30	3.0	5-7"	uneven	G	G	Segmented; leaves around head

¹ Direct seeded July 12 in 3' rows, thinned to about 16" between plants. Codes 88-1, 88-2, 88-3, 88-4, and 88-5 are field crosses made in 1987. All other hybrids were hand made in the greenhouse.

² General score, 1-5 scale, 5 best.

³ Exsertion refers to protrusion of heads above foliage for easy cutting.

Table 4. Commercial Broccoli Variety Observations, Corvallis, Oregon, 1988¹.

Variety	Source ²	Mat. Date	Score ³	Head Diam.	Florets	Uniformity	Early Planting		Notes ⁵
							Head Stem Color	Exser- ⁴ tion	
Baccus	1	7-7	2.0	4"	uneven	G	G		Early; similar to Galaxy but smaller, more compact
Embassy	1	7-20	3.0	8"	medium, even		F	F-P	Florets open while head still compact
Galaxy	1	7-8	2.5	4-5"	uneven	G	F		Some yellow undercolor
XPH 5004	1	7-15	2.5	5-6"	medium, even	F	F		Compact; has 2 white-flowered rogues in 14 plants
Early Dawn		7-8	2.5		coarse, open	P			Compact, some very late plants
XPH 5168	1	7-10	3.0	6-8"	coarse, even	VG	P	VP	Short and heavy; getting DF
BUX 5BR18	2	7-10	2.5	6"	coarse, even	G	F	P	Compact
Bonanza	2	7-7	2.5	4"	coarse, even			P	Compact
Arcadia	3	7-24	3.5	9-10	fine, even			P	Big, heavy; SG; yellow umbrella
Brigadier	4	7-19	2.5	7"	medium, uneven		P	F	Short plant
Citation	5	7-21	3.5	6-7"	coarse, uneven		F	F	DB; heavy stem
Gem	1	7-15	2.0	5"	medium, uneven		G	F	Tall, bad SC
Hi-Caliber	5	7-19	3.0	6"			P	F-G	Good form but poor color
Pirate		7-27	3.0	6"			F	VP	SC; SC
PSX 21584	4	7-22	2.5	6"			P	VP	Short plant; compact
Green Valiant	6	7-22	1.5	6"			P	VP	Bad SC and yellow undercolor
Packman	4	7-13	3.5	6-7"	coarse, uneven		P	VP	Heavy heads; fibrous
Premium Crop	6	7-17	2.0	7"	medium, even		P	VP	Big, heavy heads
Saga	6	7-17	2.5	7"	medium, even		P	P	
Skiff	7	7-15	2.0	6-8"	fine, even		P	F-P	Yellow undercolor
Vantage	8	7-15	2.5	5-6"	medium, uneven			G	Florets discolored; DB; some heads quite SC
Cruiser	7								
Mariner	4								
XPH 5157	1								
Symphony	1								
Sunre 8010	8								
Sunre 8014	8								
Apex	8								
Sunre 8007	8								
Sunre 8015	8								
Prima 70	9								

¹Direct seeded April 27 for early planting, July 18 for late planting in 3' rows, thinned to about 18" between plants.

²Sources: 1 = Asgrow, 2 = Burpee, 3 = Sakata, 4 = Peto, 5 = Harris-Moran, 6 = Johnny's, 7 = Royal Sluis, 8 = SunSeeds, 9 = Daehnfeldt.

³General score, 1-5 scale, 5 = best.

⁴Exsertion refers to protrusion of heads above foliage for easy cutting.

⁵Abbreviations used in notes: SC = sunken centers, SG = segmentation, DB = deep branched, DF = dead florets.

Table 4. Commercial Broccoli Variety Observations, Corvallis, Oregon, 1988¹ (cont.)

Variety	Source ²	Mat. Date	Score ³	Head Diam.	Florets	Uniformity	Late Planting		Notes ⁵
							Head Stem Color	Exsertion ⁴	
Baccus	1	9-28	3.5	6-8"	sl. coarse		F	P	Compact head
Embassy	1	10-7	2.5	5-6"	medium, coarse, even	G	F	P	V. compact head; stiff plant; heavy stem
Galaxy	1	9-30	3.0	6-8"	uneven		F	P	SG
XPH 5004	1								
Early Dawn									
XPH 5168	1	9-30	3.5	6-9"	medium, rough	G	F	P	V. short plant but head held above foliage; good yield, some DF
BUX 5BR18	2	9-30	3.0	6-8"	medium, uneven		F	F	Branched; plant somewhat SG
Bonanza	2	9-28	3.5	6-8"	medium		G	P	
Arcadia	3	10-13	3.5	6-8"		G	P	P	Tall plant; heavy head; yellow undercolor
Brigadier	4								
Citation	5	10-11	3.0	6"	coarse	G	P	F	Heavy dome; leaves in head
Gem	1	9-30	3.0	5-7"	uneven		G	G	SG; leaves around head
Hi-Caliber	5	10-9	3.5	6-7"	coarse	G	G	F	SG; heavy heads; leaves in head, may be good processing
Pirate									
PSX 21584	4								
Green Valiant	6	10-13	2.5	6-8"		G	P	P	Bad yellow floret color
Packman	4								
Premium Crop	6	10-9	2.5	6-7"	even	G	P	P	Compact; light floret color
Saga	6	10-7	2.0	6"	fine, sl. rough	F	VP	P	Yellowish heads
Skiff	7	10-13	3.0	8"		G	F-P	P	Short plant; flat top; heavy heads; good yield
Vantage	8	10-7	3.0	5"	uneven	F	P	F	Sl. rough; yellow undercover
Cruiser	7	10-7	3.5	6-8"	uniform	G	F	F	Tight SG dome; compact; heavy stem; light floret color
Mariner	4	10-9	2.5	6-7"		G	P	P	Compact; heavy stem; poor floret color
XPH 5157	1	9-26	3.5	8-10"	large, even	VG	F	F-P	Short plant but heads held above foliage; good yield
Symphony	1	10-7	3.0	6-7"	medium, uniform	P	F	F-P	Compact head; stiff, heavy stem; medium flower color; 1 early white-flowered rogue
Sunre 8010	8	10-10	2.0	5-6"	medium	F	P	P	Dome; heavy stem; light color; DF; SG
Sunre 8014	8	10-7	2.5	6-7"		F	P	F	Gets loose and open without getting coarse; DF
Apex	8	10-13	2.0	6"		G	F	P	Yellow-green florets; SG
Sunre 8007	8	10-20	2.5	5"		G	P	P	Vigorous plant; heads covered with leaves
Sunre 8015	8	10-7	3.5	7-9"		F	F	F	DB; SG; heads appear quite yellow; good yield; might process
Prima 70	9	10-7	3.0	4-5"	medium coarse, even	G	F	P	Heavy stem