

# SOYBEAN PERFORMANCE IN OREGON IN 1999

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## Introduction

Soybean is a potentially valuable new crop for Oregon. Soybean could provide a high quality protein for animal nutrition and oil for human consumption, both of which are in short supply in the Pacific Northwest. In addition, edible or vegetable soybean production could be exported to the Orient and provide a raw material for specialized food products. Soybean is valuable as a rotation crop because of the soil-improving qualities of its residues and its N<sub>2</sub>-fixing capability. Because of the high-value irrigated crops typically grown in the Snake River valley, soybeans may be economically feasible only at high yields.

Soybean varieties developed for the midwestern and southern states are not necessarily well adapted to Oregon's lower night temperatures, lower relative humidity, and other climatic differences. Previous research at Ontario has shown that, compared to the commercial cultivars bred for the Midwest, plants for eastern Oregon need to have high tolerance to seed shatter and lodging, reduced plant height, increased seed set, and higher harvest index (ratio of seed to the whole plant). There is also a need to identify semi-dwarf cultivars that will grow and yield well under high seeding rates and narrow row spacing. Yields also could be increased by increasing the seeding rate from 200,000 seeds/acre to 300,000 seeds/acre if semi-dwarf lines were found adapted to local conditions.

Majid and Jolliff at OSU Corvallis identified a soybean line that would fill pods when subjected to cool night temperatures. Those lines were crossed at Corvallis with productive lines to produce OR-6 and OR-8, among others. At this point, the development moved to Ontario, OR. The later two lines were crossed at our request for several years with early-maturing, high-yielding, semi-dwarf lines by R.L. Cooper to produce semi-dwarf lines with potential adaptation to the Pacific Northwest. Selection criteria at the Malheur Experiment Station included high yield, no lodging, no shatter, low plant height, and maturity within the available growing season. In 1992, 241 single plants were selected from five F<sub>5</sub> lines that were originally bred and selected for adaptation to eastern Oregon. Seed from these selections was planted and evaluated in 1993. A total of 18 selections were found promising and were tested further in larger plots in 1994 and 1995. From 1995 to 1998, varieties were tested using a planting rate of 300,000 seeds/acre. This report summarizes work done in 1999 as part of the continuing breeding and selection program to adapt soybeans to eastern Oregon.

Some of the more promising experimental lines and some commercial lines also were tested at the Central Oregon Agricultural Research Center in Madras, Oregon in 1999.

### Procedures

The 1999 line evaluation trial was conducted on a Owyhee silt loam previously planted to wheat. The herbicide Dual at 1 lb ai/acre was broadcast preplant and incorporated with a bed harrow on May 9. Seed was planted on May 18 at 200,000 seeds/acre in rows 22 inches apart. *Rhizobium japonicum* soil-implant inoculant was applied in the seed furrow at planting. Emergence began on May 25. The crop was furrow irrigated as necessary. Eleven of the single plant selections from 1992, nine cultivars, and OR-6 and OR-8 were planted in replicated plots four rows wide by 25 feet long in 1999. The experimental design was a randomized complete block with four replicates. All plots were cut to 22 feet.

Plant height and reproductive stage were measured weekly for each cultivar. Stand counts were made in 3 feet of row in 1996, 1997, and 1999. Prior to harvest, each plot was evaluated for lodging and seed shatter. Lodging was rated as the degree to which the plants were leaning over (0= vertical, 10= prostrate). The middle two rows in each four-row plot were harvested on October 12 using a Wintersteiger Nurserymaster small plot combine. Beans were cleaned, weighed, and oven dried to determine moisture content. Dry bean yields were corrected to 13 percent moisture. Data were analyzed by analysis of variance. Means separation was determined by the protected least significant difference test. Procedures for the Madras planting were similar except the row spacing was 24 inches and lodging was rated by a different method. Soybean was planted at Madras on May 20. A killing frost occurred on September 27.

### Results and Discussion

Yields for 1999 at Ontario ranged from 27 to 54 bu/acre (Table 1). All of the 1992 single plant selections had yields greater than 40 bu/acre. All of the 1992 single plant selections had less than a 1 rating for lodging (on a scale of 0 to 10), and Minnato, Lambert, Sibley, and Vinton had a lodging rating of 3 and above. All of the 1992 single plant selections reached physiological maturity in 101 days or less. Of the 1992 single plant selections, M92-225, M92-217, M92-330, and M92-350 had seed counts sufficient for the manufacturing of tofu (< 2,270 seeds/lb) in 1999 (Table 2). The cultivars M92-217, M92-330, OR-8, Evans, and Sibley had seed counts of less than 2,270 seeds per lb every year that seed counts were made. Several lines combine early maturity, comparatively high yields, no shatter, and no lodging (Table 3). The lines M92-225 and M92-237 have light hilum color and made reasonable tofu in food quality tests in 1999.

Yields of all lines dropped starting in 1995, when the planting rate was increased from 200,000 to 300,000 seeds/acre (Table 4). The drop in yield may be due to the increase in seeding rate. A higher seeding rate could lead to a plant height increase and more lodging. In 1999, the seeding rate was reduced to 200,000 seeds per acre. However,

plant populations in 1996 and 1997 were not different from 1999 (Table 5). Plant populations were below the target of 300,000 plants per acre in 1996 and 1997 and 200,000 plants per acre in 1999.

In Madras in central Oregon, all the experimental lines except M92-220 matured in time for a harvestable yield (Table 6). Of the commercial cultivars, only Agassiz and Glacier matured before a killing frost. On average yields were lower and seed sizes were smaller at Madras compared to Ontario.

Table 1. Performance of soybean cultivars, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Cultivar	Days to maturity <sup>1</sup>	Days to harvest maturity <sup>2</sup>	Lodging	Shatter	Height	Yield	Seed count
	-- days from emergence --		0-10 <sup>3</sup>	percent	cm	bu/acre	seeds/lb
M92-085	94	107	0	0	76	48.6	2,455
M92-213	94	107	0	0	83	53.5	2,284
M92-217	101	107	0	0	87	47.7	2,149
M92-220	101	107	0	0	85	42.8	2,336
M92-223	101	113	0.6	0	115	39.9	2,456
M92-225	86	94	0	0	74	49.3	2,169
M92-237	94	107	0.1	0	104	44.8	2,547
M92-239	94	113	0.5	0	98	43.4	2,346
M92-314	94	113	0	0	80	47.5	2,302
M92-330	86	94	0.3	0	85	45.4	2,113
M92-350	86	101	0	0	86	42.4	2,218
OR-6	92	97	0.5	0	105	42.6	2,327
OR-8	107	113	1.6	0	110	40.1	2,223
Agassiz	94	101	0.3	0	100	43.9	2,230
Evans	101	107	0.8	0	117	40	2,187
Glacier	94	101	0.8	0	91	45.5	2,309
Gnome 85	94	101	1.3	0	107	41	2,003
Lambert	101	113	3	0	100	47.5	2,270
Minnatto	113	120	5.5	0	100	31.8	3,405
Proto	101	107	0.8	0	92	33.3	2,199
Sibley	107	113	3.5	0	110	41	2,226
Vinton	113	120	6	0	120	27.6	1,759
Mean	98	107	1.2	0	97	42.7	2,296
LSD (0.05)			1.5	NS		6.8	132

<sup>1</sup> Pods yellowing, 50 percent of leaves yellow.

<sup>2</sup> Stems dry enough to be combined, 95 percent of pods brown.

<sup>3</sup> 0 = none, 10 = 100 percent lodging.

Table 2. Seed counts for soybean cultivars for 4 years, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Cultivar	1994	1995	1996		1999	average
			seeds/lb			
M92-085	2,392	2,188	2,030	2,455	2,266	
M92-213	2,304	1,995	2,084	2,284	2,167	
M92-217	1,976	2,033	2,000	2,149	2,040	
M92-220	2,660	2,213	1,974	2,336	2,296	
M92-223	2,273	2,017	1,930	2,456	2,169	
M92-225	2,825	2,353	2,195	2,169	2,386	
M92-237	2,449	2,142	2,049	2,547	2,297	
M92-239	2,041	1,946	2,227	2,346	2,140	
M92-314	2,119	2,113	1,962	2,302	2,124	
M92-330	2,063	2,037	2,195	2,113	2,102	
M92-350	2,580	2,219	2,168	2,218	2,296	
OR-6	2,803	2,205	1,985	2,327	2,330	
OR-8	2,083	2,059	2,055	2,223	2,105	
Agassiz	2,372	2,166	1,984	2,230	2,188	
Evans	2,232	2,152	1,972	2,187	2,136	
Glacier				2,309	2,309	
Gnome 85	2,463	2,167	2,040	2,003	2,168	
Lambert	2,347	2,126	1,934	2,270	2,169	
Minnatto				3,405	3,405	
Proto				2,199	2,199	
Sibley	2,066	1,845	1,828	2,226	1,991	
Vinton				1,759	1,759	
Mean	2,336	2,110	2,034	2,296	2,194	
LSD (0.05)		155	116	132		

Table 3. Maturity (days from emergence), lodging (0-10), and height (cm) of soybean lines, 1994 -1999, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Cultivar	1994			1995			1996			1997			1998			1999		
	Mat.	Lod.	Ht.	Mat.	Lod.	Ht.	Mat.	Lod.	Ht.	Mat.	Lod.	Ht.	Mat.	Lod.	Ht.	Mat.	Lod.	Ht.
M92-085	93	2	102	106	0	95	105	6	70	100	0	80	115	0	56	107	0	76
M92-213	107	0	70	123	0	80	105	0	80	112	0	100	128	0	70	107	0	83
M92-217	107	0	68	115	0	75	105	0	86	112	0	80	137	0	55	107	0	87
M92-220	107	4	102	123	0	80	115	2	80	112	0	85	121	0	60	107	0	85
M92-223	107	0	65	115	0	65	115	0	70	114	4	110	132	3	55	113	0.6	115
M92-225	93	5	92	106	0	80	90	1	76	100	0	60	115	0	42	94	0	74
M92-237	100	5	106	106	0	95	90	0	88	100	0	70	115	0	49	107	0.1	104
M92-239	107	0	67	106	0	55	105	0	85	112	0	65	128	0	46	113	0.5	98
M92-314	100	0	80	106	0	55	90	0	74	112	0	80	137	0	56	113	0	80
M92-330	100	1	101	98	2	95	90	0	74	100	0	65	115	0	46	94	0.3	85
M92-350	107	7	106	106	8	105	90	9	79	100	0	100	115	0	64	101	0	86
OR-6	100	9	107	106	2	100	98	9	97	112	3	85	115	8	60	97	0.5	105
OR-8	120	10	96	129	7	100	126	7	78	120	8	105	137	7	74	113	1.6	110
Agassiz	102	7	105	123	5	100	98	6	76	112	3	70	132	6	62	101	0.3	100
Evans	107	9	105	123	8	110	126	8	70	120	8	100	137	10	69	107	0.8	117
Glacier																		
Gnome 85	102	8	105	123	6	100	105	8	90	112	7	100	132	9	72	101	1.3	107
Lambert	107	9	112	129	6	85	126	7	81	112	6	105	132	9	71	113	3	100
Minnatto																		
Proto																		
Sibley	114	10	110	125	8	90	126	7	75	120	9	60	137	9	42	113	3.5	110
Vinton																		
Mean	104	5	94	115	3	87	106	4	79	110	3	84	127	3	58	107	1	97

Table 4. Yield of soybean cultivars in 6 years (hail depressed yields in 1998), Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Cultivar	Yield						Average 1994-1997	Average 1994-1999
	1994	1995	1996	1997	1998	1999		
	bu/acre							
M92-085	63.3	48.7	41.2	50.0	29.4	48.6	50.8	46.9
M92-213	61.2	43.4	52.3	49.9	26.9	53.5	51.7	47.9
M92-217	35.7	49.3	48.8	55.2	25.3	47.7	47.3	43.7
M92-220	62.0	49.6	46.3	54.6	47.4	42.8	53.1	50.5
M92-223	45.6	55.3	34.5	45.5	20.9	39.9	45.2	40.3
M92-225	62.8	49.1	51.7	43.7	27.8	49.3	51.8	47.4
M92-237	63.1	50.6	42.1	48.5	31.9	44.8	51.1	46.8
M92-239	47.8	42.2	44.4	42.0	23.5	43.4	44.1	40.6
M92-314	63.2	48.9	57.8	49.2	28.6	47.5	54.8	49.2
M92-330	57.8	51.1	55.0	44.8	41.8	45.4	52.2	49.3
M92-350	63.6	55.2	43.0	49.9	34.9	42.4	52.9	48.2
OR-6	58.2	28.2	25.3	43.6	33.1	42.6	38.8	38.5
OR-8	66.3	34.0	22.1	34.2	13.6	40.1	39.2	35.1
Agassiz	62.4	36.3	38.6	46.0	21.7	43.9	45.8	41.5
Evans	68.6	13.2	14.2	29.9	25.0	40.0	31.5	31.8
Gnome 85	67.0	32.6	25.3	41.8	23.9	41.0	41.7	38.6
Lambert	69.6	31.7	29.4	53.6	35.2	47.5	46.1	44.5
Sibley	64.3	24.0	18.4	29.7	14.8	41.0	34.1	32.0

Table 5. Plant population for soybean cultivars for 3 years, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Cultivar	Plant population		
	1996	1997	1999
	plants/acre		
M92-085	184,533	121,664	120,780
M92-213	155,587	139,769	143,550
M92-217	72,366	153,528	92,070
M92-220	130,259	129,630	141,570
M92-223	47,038	115,870	148,500
M92-225	57,893	134,699	141,570
M92-237	47,038	134,699	145,530
M92-239	123,022	142,665	137,610
M92-314	155,587	144,114	100,980
M92-330	115,786	138,320	104,940
M92-350	173,678	137,596	132,660
OR-6	188,152	133,521	153,450
OR-8	159,205	132,527	164,340
Agassiz	155,587	118,767	111,870
Evans	94,076	127,457	103,950
Glacier			179,190
Gnome 85	126,641	118,767	124,740
Lambert	249,663	137,596	188,100
Minnatto			288,090
Proto			162,360
Sibley	115,786	131,803	99,990
Vinton			149,490
Mean	130,661	132,944	142,515
LSD (0.05)		NS	22,361

Table 6. Performance of soybean cultivars, Central Oregon Agricultural Research Center, Oregon State University, Madras, Oregon, 1999.

Variety	Flowering date	Stage on 9/25/99	Maturity	Yield	Seed Size	Lodging
	DAP*			bu/acre	seeds/lb	1-5**
M92-085	65	7	-	39	3,088	3.5
M92-220	67	6.5	-	-	-	-
M92-225	67	7.6	-	36	3,131	3
M92-237	62	7	-	32	3,197	3.1
M92-314	61	6.9	-	26	3,088	2.5
M92-330	72	7.7	-	41	2,441	1.8
M92-350	61	7.8	-	37	2,655	2.1
Agassiz	67	7	0	42	3,266	4.5
Evans	66	6.3	0.6	-	-	-
Glacier	69	7	0.8	37	2,735	4.3
Lambert	66	6.2	0.8	-	-	-
Minnatto	62	6.2	0.7	-	-	-
Proto	68	6.6	0.6	-	-	-
Vinton	67	5.5	1.8	-	-	-
mean		6.8		35.9	2,929	3.1
LSD (0.05)		0.4		7.4		1.7

\*Day after planting

\*\*1-5: 1= 0-20% lodged, 5= 80-100% lodged