SOYBEAN PERFORMANCE IN ONTARIO IN 2009

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Introduction

Soybean is a potentially valuable new crop for the Pacific Northwest (PNW). Soybean can provide raw materials for biodiesel, high-quality protein for animal nutrition, and oil for human consumption, all of which are in short supply in the PNW. In addition, edible or vegetable soybean production can 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 nitrogen (N_2)-fixing capability. Because high-value irrigated crops are typically grown in the Snake River Valley, soybeans may be economically feasible only at high yields. The most common rotation crop in the Treasure Valley is irrigated winter wheat, so soybeans need to be competitive in value with winter wheat. Through breeding, selection, and the development of appropriate cultural practices, we have succeeded in achieving high yields. Since these soybean lines are non-GMO (genetically modified organism), they can also be used in organic food and feed programs.

Soybean varieties developed for the midwestern and southern states are not necessarily well adapted to Oregon's lower night temperatures (problems with pod fill), lower relative humidity (problems with seed shatter), and other climatic differences. Previous research at Ontario, Oregon has shown that, compared to the commercial cultivars bred for the Midwest, plants for eastern Oregon need to have 1) high tolerance to seed shatter, 2) reduced plant height and lodging, 3) increased seed set, and 4) higher harvest index (ratio of seed to the whole plant).

M. Seddigh and G.D. Jolliff at Oregon State University, Corvallis, identified a soybean line that would fill pods when subjected to cool night temperatures. This line was crossed at Corvallis with productive lines to produce 'OR 6' and 'OR 8', among others. At this point, the development moved to Ontario, Oregon. At our request these two lines were crossed with early maturing high-yielding semi-dwarf lines by R.L. Cooper (USDA, Agricultural Research Service, Wooster, OH) to produce semi-dwarf lines with potential adaptation to the PNW. Selection criteria for F_2 and subsequent lines at the Malheur Experiment Station (MES) included high yield, low lodging, zero shatter, shorter plant height, and maturity in the available growing season. We specifically chose seed lines with clear hilum so that off colors would not contaminate possible food products. Also, we selected for light seed coat and seed color to allow the widest possible food product manufacture.

In 1992, 241 single plants were selected from 5 F_5 lines that were originally bred and selected for adaptation to eastern Oregon. Seed from these selections was planted and evaluated in 1993; 18 F_6 selections were found promising and selected for further testing in larger plots from 1994 through 1999. Through these years of breeding and selection we successfully reduced plant height, reduced plant lodging, and increased yields. Of the 18 lines, 8 were selected for further testing.

In 1999, selections from one of the advanced MES lines were made by P. Sexton at the Central Oregon Agricultural Research and Extension Center (COAREC) in Madras, Oregon to help maintain germplasm true to type. Sixteen of these selections made in Madras were chosen for further testing. In 2000, we made further selections from six of our 1992 MES lines and from OR-6 to help maintain germplasm true to type.

Starting in 2005, a new planting configuration was used. The old planting configuration had one plant row on a 22-inch bed. The new planting configuration has 3 rows on a 30-inch bed. Our objective is to provide a more uniform distribution of the plants over the soil surface. The more uniform plant distribution resulted in higher yields, perhaps due to improved access to light, nutrients, and water for individual plants. The new planting configuration retains the same seeding rate of 200,000 seeds/acre as the old configuration.

This report summarizes work done in 2009 as part of our continuing breeding and selection program to adapt soybeans to eastern Oregon and includes the added yield enhancements achieved by changing the planting configuration. Our soybean reports from the last decade are available at our station web site: http://www.cropinfo.net. A search function on the home page will conveniently find all of our recent reports dealing with soybeans by using the key word “soybean”.

Materials and Methods

The 2009 trial was conducted on an Owyhee silt loam previously planted to wheat. In the spring of 2009, the field was disked twice, moldboard plowed, groundhogged twice, and bedded to 30-inch rows. On May 14, Outlook® herbicide was applied at 18 oz (0.84 lb ai)/acre and incorporated during planting.

Five commercial cultivars, 4 older lines selected at MES through 1992, and 34 lines selected in 1999 and 2000 were evaluated; these 43 selections were arranged in a randomized complete block design with four replicates. Each plot was four beds wide (30-inch beds) by 25 ft long. The seed was planted on May 14 at 200,000 seeds/acre in 3 rows on each 30-inch bed using a plot drill with disk openers. The rows were spaced 7 inches apart (Fig. 1). *Bradyrhizobium japonicum* inoculant (Cell-Tech, EMD Crop BioScience, Brookfield, WI) was applied to the seed before planting. Emergence started on May 25. Emergence was poor because the field dried too quickly and replanting occurred on June 12. The replanted seed emerged on June 18.

The field was furrow irrigated when the soil water tension at 8-inch depth reached 50-60 centibars (cb). To understand how to irrigate using soil water tension as an irrigation criteria, see our extension brochure (Shock et al. 2005). Soil water tension was monitored by six granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co., Riverside, CA) installed in the bed center at 8-inch depth. Sensors were automatically read three times a day with an AM-400 meter (Mike Hansen Co., East Wenatchee, WA).

The field was sprayed with Basagran® at 1 lb ai/acre and Volunteer® at 0.19 lb ai/acre on June 19 for weed control. On July 30, lygus bug population was estimated by taking three 180° sweeps with a sweep net in three locations in the field. We found an average of 0.8 lygus bugs/sweep so the field was not sprayed.

Plant height and reproductive stage were measured weekly for each cultivar. 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 beds in each four-bed plot were harvested on October 12 using a Wintersteiger Nurserymaster small-plot combine. Beans were cleaned, weighed, and a subsample was oven dried to determine moisture content. Moisture at the time of analysis was determined by oven drying at 100°C for 24 hours. Dry bean yields were corrected to 13 percent moisture. Variety lodging, yield, and seed count were compared by analysis of variance. Means separation was determined by the protected least significant difference test.

Results and Discussion

Yields in 2009 ranged from 33.3 bu/acre for ‘909’ to 59.2 bu/acre for ‘305’ (Table 1). Several lines had seed counts sufficient for the manufacturing of tofu (<2,270 seeds/lb). Despite the low yields in 2008 and 2009, several lines averaged 60 or more bu/acre over the last 5 years (Table 2). Yields in 2008 were lower than average due to late planting. Yields in 2009 were lower than average due to the need for replanting and the consequential late emergence.

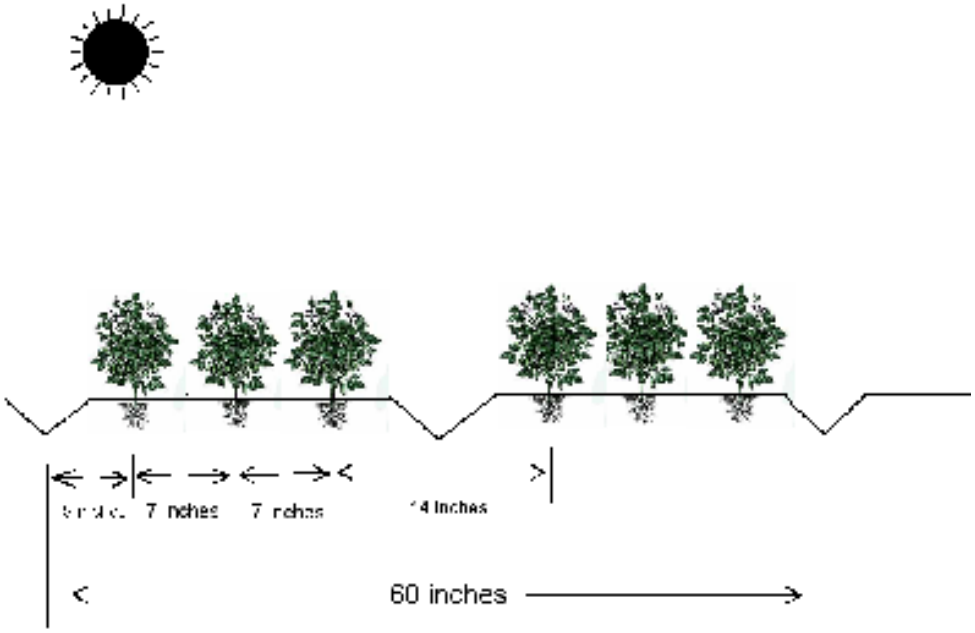

Figure 1. Soybean planting configuration used in 2005-2009, Malheur Experiment Station, Oregon State University, Ontario, OR.

Summary

We have found over the years that high soybean yields can be achieved in the Treasure Valley by employing varieties selected for the environment, high planting rates, modest fertilization, use of *Bradyrhizobium japonicum* inoculation, proper May planting dates, appropriate irrigation, and timely control of lygus bugs and spider mites.

References

Shock, C.C., R.J. Flock, E.B.G. Feibert, C.A. Shock, A.B. Pereira, and L.B. Jensen. 2005. Irrigation monitoring using soil water tension. Oregon State University Extension Service. EM8900 **http://extension.oregonstate.edu/catalog/pdf/em/em8900.pdf**

Table 1. Performance of soybean cultivars in 2009 with a late planting date. Cultivars are ranked by yield, Malheur Experiment Station, Oregon State University, Ontario, OR.

Cultivar	Origin	Days to maturity	Lodging	Shatter	Height	Seeds/lb	Yield	Plant population
		days from emergence	--- 0-10 ---		cm	seeds/lb	bu/acre	plants/acre
305	M92-220	89	1.5	0.0	82.8	2,381	59.2	133,428
107	M92-085	82	2.3	0.0	93.3	2,204	58.0	141,394
103	M92-085	82	1.0	0.3	85.8	2,277	57.6	94,927
307	M92-220	89	0.7	0.0	87.0	2,372	57.4	109,531
M16	M92-330	82	3.5	0.0	90.8	2,201	55.8	136,747
M9	M92-330	89	2.7	0.0	90.5	2,117	55.5	143,386
308	M92-220	89	0.7	0.0	80.3	2,329	55.4	134,756
303	M92-220	82	3.0	0.0	82.3	2,403	55.4	129,445
M15	M92-330	82	3.7	0.0	85.0	2,244	54.0	142,722
M92-225		82	1.5	0.0	93.0	2,157	53.7	134,756
601	M92-314	92	0.0	0.0	83.5	2,272	53.3	117,497
104	M92-085	82	3.5	0.0	92.8	2,206	52.9	152,679
608	M92-314	82	2.0	0.0	81.8	2,102	52.7	165,956
M92-220		92	2.7	0.0	89.3	2,482	52.6	136,084
M3	M92-330	82	1.3	0.0	86.3	2,343	52.3	130,773
M12	M92-330	82	2.3	0.0	95.8	2,210	52.1	138,075
313	M92-220	89	2.3	0.0	86.8	2,273	51.9	120,152
101	M92-085	82	2.3	0.0	86.3	2,092	50.7	134,092
311	M92-220	82	1.3	0.0	84.3	2,412	49.8	120,816
M1	M92-330	82	1.5	0.0	90.8	2,190	49.7	161,973
514	M92-237	92	6.7	0.0	84.8	2,412	48.1	150,024
309	M92-220	89	1.7	0.3	82.8	2,396	47.9	142,722
108	M92-085	82	3.0	0.0	88.3	2,232	47.3	149,360
M13	M92-330	82	2.0	0.0	91.5	2,336	47.2	144,049
312	M92-220	89	1.3	0.0	86.3	2,303	47.2	138,739
106	M92-	82	3.7	0.0	92.8	2,244	46.6	135,420

	085							
Gnome 85		92	6.5	0.5	92.0	2,271	46.4	104,884
511	M92-237	92	3.5	0.0	92.5	2,238	46.2	140,066
M92-085		82	2.7	0.0	93.8	2,225	45.3	148,696
Korada		92	4.0	0.0	90.3	2,328	44.4	139,403
OR-8		92	6.3	0.0	91.8	2,074	43.0	122,143
Evans		82	3.5	0.5	83.3	2,246	41.4	98,246
OR-6		89	8.0	0.0	71.0	2,221	39.8	130,109
M2	M92-330	82	1.0	0.0	90.0	2,287	39.0	102,892
Lambert		82	8.0	0.0	70.0	2,370	37.1	148,032
Sibley		92	6.0	0.5	88.0	1,976	35.8	126,126
905	OR-6	82	5.0	0.0	87.0	2,245	35.3	102,229
909	OR-6	89	7.5	0.0	72.3	2,260	33.3	128,118
Average		86	3.1	0.1	86.5	2,251	48.7	129,207
LSD (0.05)			2.4		12.1	155	9.7	28,007

Table 2. Performance of soybean varieties from 2005 to 2009. Cultivars are ranked by average yield, Malheur Experiment Station, Oregon State University, Ontario, OR.

Cultivar	Yield					Average 2005 - 2009				
	2005	2006	2007	2008	2009*	Yield	Days to maturity	Height	Lodging	Seed count
	---------- bu/acre ----------					bu/acre		cm	0-10	seeds/lb
M12	70.4	70.0	69.8		52.1	65.5	95	101	6	2,221
103	73.7	72.4	64.1	58.9	57.6	65.3	94	91	4	2,288
107	76.6	74.2	62.5	53.6	58.0	65.0	94	89	4	2,315
M15	73.9	68.4	64.8	57.3	54.0	63.7	95	89	5	2,286
M1	73.0	70.6	68.0	54.7	49.7	63.2	94	91	4	2,259
101	74.4	70.2	62.7	57.0	50.7	63.0	94	94	4	2,215
303	67.7	67.0	61.8		55.4	63.0	95	96	6	2,435
608	70.2	68.0	66.3	57.3	52.7	62.9	95	91	5	2,290
305	64.2	66.6	61.2		59.2	62.8	99	92	5	2,431
307	64.3	70.0	67.4	54.1	57.4	62.6	97	90	4	2,423
M16	69.1	69.6	69.0	49.4	55.8	62.6	94	97	4	2,337
M9	73.9	68.2	63.8	50.2	55.5	62.3	95	94	4	2,303
M13	67.9	66.6	65.6		47.2	61.8	95	101	5	2,263
104	70.9	66.6	67.2	51.2	52.9	61.8	94	93	5	2,308
308	64.6	65.2	61.6		55.4	61.7	102	88	4	2,400
313	62.5	68.4	63.2		51.9	61.5	99	92	5	2,392
312	68.4	71.8	64.3	55.5	47.2	61.4	97	90	4	2,416
511	65.0	70.2	64.0		46.2	61.4	105	103	6	2,438
106	72.0	70.4	64.7	52.8	46.6	61.3	94	84	4	2,275
514	68.6	66.6	59.6		48.1	60.7	102	100	7	2,384
M3	69.6	72.2	61.5	47.8	52.3	60.6	94	96	4	2,359

M92-220	63.4	68.8	57.4		52.6	60.6	100	92	5	2,424
M92-085	71.9	64.4	66.5	53.1	45.3	60.2	94	93	4	2,299
M92-225	68.0	66.0	65.8	47.5	53.7	60.2	94	91	4	2,328
108	70.5	65.8	66.9	50.4	47.3	60.2	94	91	4	2,354
311	68.1	67.4	54.1		49.8	59.8	97	90	5	2,425
Lambert	73.3	81.9	66.9	39.0	37.1	59.6	99	96	8	2,351
309	67.5	66.2	56.6		47.9	59.5	99	91	4	2,411
Gnome	65.4	75.4	69.2	40.6	46.4	59.4	99	90	8	2,294
85										
M2	62.0	70.0	65.7		39.0	59.2	97	90	5	2,235
Korada	67.8	70.6	61.1	51.7	44.4	59.1	99	92	5	2,331
601	65.6	66.4	50.7		53.3	59.0	100	87	4	2,351
Evans	69.3	71.0	66.7	40.3	41.4	57.7	97	91	7	2,336
OR-6	65.1	72.2	62.9	47.0	39.8	57.4	95	94	8	2,313
905	71.1	66.2	55.0		35.3	56.9	95	96	8	2,384
OR-8	57.8	69.6	65.8	44.6	43.0	56.1	105	91	8	2,111
M4	73.0	72.6	64.8	46.4		64.2	94	88	4	2,278
909	70.8	66.2	49.1		33.3	54.9	99	91	9	2,296
Sibley	56.2	66.8	63.3	40.1	35.8	52.4	105	86	8	2,073
Average	68.4	69.2	63.1	50.0	47.9	60.8	96.9	92.3	5.3	2,324

*Late planting date due to stand establishment failure.