

Potential for Double Cropping Soybeans in the Columbia Basin

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Introduction

Washington State's renewable fuel standard was designed to increase biofuel use with standards that start at 2% and ramp up to 5% for biodiesel. The state of Washington has suggested that the ramp up will come from feedstock produced from Washington's growers. Although Washington farmers have extensive experience growing grain crops and biomass for ethanol production, there is little experience for growing oilseed crops. In addition, many oilseed crops have not proven to be profitable. Washington farmers will be hesitant to grow an oilseed crop until agronomic information is established and available.

Double cropping soybean may have an excellent potential for oilseed production under irrigation in the Columbia Basin. Double-cropping soybean after wheat has grown in popularity in the southern part of the mid-west and southeastern US. Advantages to growing and keeping a crop on the land all year include controlling soil erosion and spreading annual fixed costs over two crops. The idea is to increase gross return with relatively low increases in production costs. In Washington growers often take first cut alfalfa or a single cut of timothy hay and then establish a second crop such as sweet corn or silage corn. Soybean could also be a profitable second crop.

Materials and Methods:

Three experiments were located at Columbia Basin College in Pasco, Washington. Four soybean varieties of different maturities were selected for planting based on yield data results in 2007. Maturity groups included an early 0, late 0, mid I and a late I. Seed for the varieties was provided by Wilber-Ellis and planted on twelve dates. The first study was planted in late May through June to determine potential for double cropping early crops. Two additional studies were planted on six dates beginning in early July through the first week in August to determine potential following wheat. One of the later studies was planted following wheat planted in the spring and rotovated prior to planting the soybean entries. Experiments were planted using a randomized complete block design with four replications and analyzed using a two-factor (planting date and varieties) analysis of variance.

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Entries were planted in seven-row plots with rows 7.5 inches apart. Plots were 5 x 20 feet with the entire plot harvested for yield with a Wintersteiger research plot combine. Plots were harvested on September 19 for the early test and on October 29 for the late planted tests. Moisture was measured using a Dickey-john Tri-Grain™ moisture tester. Test weight was measured using a Quart Cup 26 weighing apparatus sold by Seedburo Equipment Co. Yields are recorded as bushels per acre (60 pounds per bushel) adjusted to 13 percent moisture content. Mature plant height and lowest pod height were measured in inches on October 6. Mature plant height was the average length from the soil surface to the top of the main stem. Lowest pod height was a measure from ground to the lowest pod on the stem and can give an indication of harvest loss during combine operations. Varieties which produce pods lower to the ground are more susceptible to yield loss during harvest. Lodging was rated at maturity on a 1 to 5 scale with 1=most plants erect, 2=plants slightly leaning, 3= all plants moderately leaning, 4=all plants severely leaning, and 5=most plants down. Maturity was scored from 3 to 8 with 3=**Beginning pod** – pods are 3/16 inch at one of the four uppermost nodes, 4=**Full pod** – pods are 3/4 inch at one of the four uppermost nodes, 5=**Beginning seed** – seed is 1/8 inch long in the pod at one of the four uppermost nodes on the main stem, 6=**full seed** – pod containing a green seed that fills the pod capacity at one of the four uppermost nodes on the main stem, 7=**Beginning maturity** – one normal pod on the main stem has reached its mature pod color, and 8=**Full maturity** – 95% or more of the pods have reached their full mature color. For each trait measure, LSD (least significant difference) was calculated. The significance level used to calculate the LSD was 5 percent. Unless two entries differ by more than the LSD for individual traits, difference for that trait should not be considered.

Results and Discussion

Experiment 1: Evaluation of early planting dates and maturity group effect of soybean varieties for double cropping in the Columbia Basin.

Results for entries in the first experiment are shown in Table 1 sorted by yield. Yields ranged from 21.9 to 84.9 bushels/acre for Integra 96170R and Integra 98150R, respectively. Significant differences were observed for yield, lowest pod height, mature plant height, lodging and maturity. No significant differences were found for test weight and percent moisture. The maturity group I variety, Integra 98150R, had significantly higher yields across planting dates than the earliest and latest maturing varieties in the test (Table 2). As expected, yields declined significantly as planting was

delayed (Table 3). The average yield for the four varieties in the test ranged from 77.3 to 35.7 bushels/acre for the earliest planting date to the latest planting date, respectively. The data indicates that for each day that planting is delayed there is a yield loss of about 1.2 bushels. However, the data also indicates that excellent yields can be obtained on soybean planted as a double crop through mid June. Soybeans appear to be suited to follow the first cutting of alfalfa and timothy in the Columbia Basin.

Experiment 2 and 3: Evaluation of late planting dates and maturity group effect of soybean varieties for double cropping in the Columbia Basin.

To determine if soybean could be double cropped with wheat, experiment 2 and 3 were established with planting dates bracketing mid July when wheat is often harvested from irrigated acres in the Columbia Basin. Experiment 2 was planted with no previous crop growing through the spring while Experiment 3 was planted following wheat. Results for entries are reported in Table 4 and Table 7 for experiment 2 and 3 respectively. Even though the tests were analyzed separately, it did not appear that soybean following wheat had a negative effect on yields. The two highest yielding entries, Integra 96081R and Integra 109R001 were the same for both tests planted on the first late planting date in July. There were significant differences for varieties across planting dates in both experiments (Tables 5 and 8). Even though most studies in areas where soybeans are typically grown indicate that the best performing full season soybean should be grown when double cropping with wheat, our data indicated that the earlier maturing variety, 109R001, performed the best in the late planted experiments as compared to experiment 1. Yields declined significantly as varieties were planted at later dates (Tables 6 and 9). The data indicated that planting soybean after the first week in July would be risky for the Columbia Basin. To be successful, an early maturing variety of wheat would need to be identified along with an early harvest.

Conclusion

Double cropping soybean following early crops such as first cut alfalfa or timothy could be a solution for growing an oilseed crop under irrigation in the Columbia basin. More research is needed prior to double cropping with wheat.

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Table 1: Early planting dates and maturity group effect on soybean varieties at Pasco, WA

Date	Maturity	Variety	Yield bu/A at 13% Moisture	Lowest Pod Height	Mature Plant Height (inches)	Lodging	Maturity on 10-6-08	Test Weight	Percent Moisture
23-May	1.5	Integra 98150R	84.9	7.3	36.3	1.3	8.0	54.5	10.1
30-May	1.5	Integra 98150R	81.3	7.3	33.9	2.0	8.0	55.8	10.1
23-May	0.8	Integra 96081R	80.9	5.5	35.5	1.8	8.0	55.5	10.0
23-May	0.0	Integra 109R001	75.2	2.5	28.8	1.0	8.0	55.5	10.0
30-May	0.8	Integra 96081R	70.3	5.3	35.5	2.5	8.0	55.0	10.7
30-May	0.0	Integra 109R001	69.8	4.0	29.5	1.0	8.0	55.8	10.0
23-May	1.7	Integra 96170R	68.4	4.8	39.5	3.5	7.3	55.5	9.8
6-Jun	1.5	Integra 98150R	67.9	7.1	34.0	1.8	7.8	55.5	10.2
13-Jun	1.5	Integra 98150R	64.2	5.5	33.3	2.3	7.5	55.5	10.5
6-Jun	0.8	Integra 96081R	64.1	6.5	35.8	2.5	8.0	56.8	9.9
6-Jun	0.0	Integra 109R001	61.5	4.8	30.3	1.3	8.0	55.3	10.1
30-May	1.7	Integra 96170R	56.2	6.5	39.4	3.3	7.0	57.5	10.2
13-Jun	0.0	Integra 109R001	54.5	3.1	29.8	1.5	8.0	55.8	10.1
20-Jun	1.5	Integra 98150R	54.4	6.4	33.0	2.3	6.5	56.3	10.3
13-Jun	0.8	Integra 96081R	54.4	5.1	31.5	3.0	7.8	56.5	9.9
6-Jun	1.7	Integra 96170R	52.5	6.4	36.3	3.3	7.0	56.8	10.2
20-Jun	0.8	Integra 96081R	49.8	6.5	30.8	2.5	7.8	55.0	9.8
20-Jun	0.0	Integra 109R001	46.8	2.3	29.8	1.5	8.0	55.8	10.3
13-Jun	1.7	Integra 96170R	45.0	7.5	35.5	3.3	7.0	57.3	10.1
27-Jun	1.5	Integra 98150R	42.3	6.6	33.5	2.3	6.3	55.5	9.9
27-Jun	0.8	Integra 96081R	41.2	5.6	31.8	2.3	7.3	55.3	10.7
27-Jun	0.0	Integra 109R001	37.5	3.8	28.6	3.0	8.0	55.5	9.9
20-Jun	1.7	Integra 96170R	36.5	6.4	36.3	3.3	6.0	58.3	10.3
27-Jun	1.7	Integra 96170R	21.9	6.6	35.0	2.5	6.0	55.3	10.8
		Mean	56.0	5.5	33.5	2.3	7.5	55.9	10.2
		LSD 5%	5.33	0.86	1.7	0.5	0.2	NS	NS
		CV %	16.6	27.0	8.8	37.4	3.8	2.7	5.8

Table 2: Soybean varieties across early planting dates

Variety	Yield bu/A at 13% Moisture	Lowest Pod Height	Mature Plant Height	Lodging	Maturity on Oct. 6, 2008	Test Weight	Percent Moisture
Integra 109R001	57.5	3.4	29.4	1.5	8.0	55.6	10.0
Integra 96081R	60.1	5.8	33.5	2.4	7.8	55.7	10.2
Integra 98150R	65.8	6.7	34.0	2.0	7.3	55.5	10.2
Integra 96170R	46.8	6.4	37.0	3.2	6.7	56.8	10.2
Mean	57.6	5.5	33.5	2.3	7.5	55.9	10.2
LSD.05	13.47	2.11	4.15	1.20	0.40	NS	NS

Table 3: Early planting dates across varieties

Seeding Dates	Yield bu/A at 13% Moisture	Lowest Pod Height	Mature Plant Height	Lodging	Maturity on Oct. 6, 2008	Test Weight	Percent Moisture
23-May	77.3	5.0	35.0	1.9	7.8	55.3	10.0
30-May	69.4	5.8	34.6	2.2	7.8	56.0	10.2
6-Jun	61.5	6.2	34.1	2.2	7.7	56.1	10.1
13-Jun	54.5	5.3	32.5	2.5	7.6	56.3	10.2
20-Jun	46.9	5.4	32.4	2.4	7.1	56.3	10.1
27-Jun	35.7	5.7	32.2	2.5	6.9	55.4	10.3
Mean	57.6	5.5	33.5	2.3	7.5	55.9	10.2
LSD.05	11.00	NS	3.39	NS	0.33	NS	NS

Table 4: Late planting dates and maturity group effect on soybean varieties at Pasco, WA

Date	Maturity	Variety	Yield bu/A at 13% Moisture	Lowest Pod Height	Mature Plant Height (inches)	Lodging	Maturity on 10- 6-08
2-Jul	0.8	Integra 96081R	58.3	5.8	22.6	1.0	6.8
2-Jul	0.0	Integra 109R001	52.0	3.4	21.1	1.0	8.0
2-Jul	1.5	Integra 98150R	49.9	4.8	25.9	1.0	6.3
9-Jul	0.0	Integra 109R001	43.8	3.3	18.3	1.0	7.3
9-Jul	0.8	Integra 96081R	41.7	3.9	20.0	1.0	6.0
2-Jul	1.7	Integra 96170R	36.1	4.8	25.1	1.0	6.0
16-Jul	0.0	Integra 109R001	29.8	2.8	18.5	1.0	6.0
9-Jul	1.5	Integra 98150R	24.4	3.6	19.9	1.0	6.0
16-Jul	0.8	Integra 96081R	19.6	3.5	17.5	1.0	5.8
9-Jul	1.7	Integra 96170R	14.5	4.8	25.3	1.0	5.8
23-Jul	0.0	Integra 109R001	13.9	3.3	15.9	1.0	6.0
16-Jul	1.5	Integra 98150R	8.6	3.4	17.3	1.0	5.5
16-Jul	1.7	Integra 96170R	4.9	4.3	22.9	1.0	5.3
23-Jul	0.8	Integra 96081R	3.2	2.8	16.3	1.0	5.0
23-Jul	1.5	Integra 98150R	2.3	3.1	14.4	1.0	5.0
30-Jul	0.0	Integra 109R001	2.0	2.5	11.5	1.0	5.0
6-Aug	0.0	Integra 109R001	0.7	3.5	9.8	1.0	4.8
30-Jul	1.7	Integra 96170R	0.6	4.1	16.9	1.0	4.5
30-Jul	0.8	Integra 96081R	0.5	3.1	10.5	1.0	4.3
23-Jul	1.7	Integra 96170R	0.4	4.8	12.5	1.0	3.3
6-Aug	1.7	Integra 96170R	0.2	4.6	10.0	1.0	3.0
6-Aug	0.8	Integra 96081R	0.1	4.4	8.8	1.0	3.8
30-Jul	1.5	Integra 98150R	0.1	3.9	10.0	1.0	3.8
6-Aug	1.5	Integra 98150R	0.1	4.9	8.3	1.0	3.0
Mean			17.0	3.9	16.6	1.0	5.2
LSD 5%			2.82	0.58	1.3	0.0	0.3
CV %			28.9	26.2	13.3	0.0	8.6

Table 5: Soybean varieties across late planting dates

Variety	Yield bu/A at 13% Moisture	Lowest Pod Height	Mature Plant Height	Lodging	Maturity on Oct. 6, 2008
Integra 109R001	23.7	3.1	15.8	1.0	6.2
Integra 96081R	20.6	3.9	15.9	1.0	5.3
Integra 98150R	14.2	3.9	15.9	1.0	4.9
Integra 96170R	9.4	4.5	18.8	1.0	4.6
Average	17.0	3.9	16.6	1.0	5.2
LSD.05	6.90	1.43	3.11	NS	0.64

Table 6: Late planting dates across varieties

Seeding Dates	Yield (bu/acre)	Lowest Pod Height	Mature Plant Height	Lodging	Maturity on Oct. 6, 2008
2-Jul	49.1	4.7	23.7	1.0	6.8
9-Jul	31.1	3.9	20.8	1.0	6.3
16-Jul	15.7	3.5	19.0	1.0	5.6
23-Jul	5.0	3.3	15.8	1.0	5.1
30-Jul	0.8	3.6	11.1	1.0	4.1
6-Aug	0.3	4.3	9.2	1.0	3.6
Average	17.0	3.9	16.6	1.0	5.2
LSD.05	5.64	1.16	2.54	NS	0.52

Table 7: Late planting date and maturity group effect on soybean following wheat at Pasco, WA

Date	Maturity	Variety	Yield bu/A at 13% Moisture	Lowest Pod Height	Mature Plant Height (inches)	Lodging	Maturity on 10-6-08
2-Jul	0.0	Integra 109R001	61.4	3.3	22.8	1.0	8.0
2-Jul	0.8	Integra 96081R	56.2	4.8	22.6	1.0	7.0
2-Jul	1.5	Integra 98150R	44.1	5.1	24.8	1.0	6.3
9-Jul	0.0	Integra 109R001	42.1	3.0	18.1	1.0	7.0
9-Jul	0.8	Integra 96081R	33.5	3.3	21.0	1.0	6.0
16-Jul	0.0	Integra 109R001	31.2	3.0	19.0	1.0	6.0
2-Jul	1.7	Integra 96170R	28.6	4.5	25.6	1.0	6.0
9-Jul	1.5	Integra 98150R	22.7	4.5	21.3	1.0	5.8
23-Jul	0.0	Integra 109R001	14.9	2.5	16.3	1.0	5.5
9-Jul	1.7	Integra 96170R	12.5	4.0	22.5	1.0	5.3
16-Jul	0.8	Integra 96081R	11.9	3.3	17.3	1.0	5.3
16-Jul	1.5	Integra 98150R	6.3	4.0	18.0	1.0	5.3
23-Jul	0.8	Integra 96081R	3.5	3.5	17.4	1.0	5.3
16-Jul	1.7	Integra 96170R	3.1	4.3	20.0	1.0	5.3
30-Jul	0.0	Integra 109R001	3.1	3.0	13.5	1.0	5.3
23-Jul	1.5	Integra 98150R	1.0	3.5	16.8	1.0	4.8
30-Jul	0.8	Integra 96081R	0.7	2.5	12.5	1.0	4.3
6-Aug	0.0	Integra 109R001	0.6	4.0	9.8	1.0	4.3
23-Jul	1.7	Integra 96170R	0.4	4.0	17.0	1.0	4.5
30-Jul	1.5	Integra 98150R	0.1	3.5	11.1	1.0	3.8
6-Aug	1.5	Integra 98150R	0.1	3.8	9.3	1.0	3.0
30-Jul	1.7	Integra 96170R	0.1	4.0	12.9	1.0	4.0
6-Aug	1.7	Integra 96170R	0.1	4.3	9.8	1.0	3.0
6-Aug	0.8	Integra 96081R	0.0	4.0	9.0	1.0	3.8
Mean			15.8	3.7	17.0	1.0	5.2
LSD 5%			2.96	0.56	1.2	0.0	0.3
CV %			32.7	26.1	12.4	0.0	8.8

Table 8: Soybean varieties across late planting dates following wheat

Variety	Yield bu/A at 13% Moisture	Lowest Pod Height	Mature Plant Height	Lodging	Maturity on Oct. 6, 2008
Integra 109R001	25.5	3.1	16.6	1.0	6.0
Integra 96081R	17.6	3.5	16.6	1.0	5.3
Integra 98150R	12.4	4.1	16.9	1.0	4.8
Integra 96170R	7.5	4.2	18.0	1.0	4.7
Average	15.8	3.7	17.0	1.0	5.2
LSD.05	7.24	1.37	NS	NS	0.64

Table 9: Late planting dates across varieties following wheat

Seeding Dates	Yield bu/A at 13% Moisture	Lowest Pod Height	Mature Plant Height	Lodging	Maturity on Oct. 6, 2008
2-Jul	47.6	4.4	23.9	1.0	6.8
9-Jul	27.7	3.7	20.7	1.0	6.0
16-Jul	13.1	3.6	18.6	1.0	5.4
23-Jul	4.9	3.4	16.8	1.0	5.0
30-Jul	1.0	3.3	12.5	1.0	4.3
6-Aug	0.2	4.0	9.4	1.0	3.5
Average	15.8	3.7	17.0	1.0	5.2
LSD.05	5.91	1.12	2.41	NS	0.53