NORTHWEST CROPS & SOILS PROGRAM

Impact of Planting Date and Variety on Soybean Yield - 2019

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2019 IMPACT OF PLANTING DATE AND VARIETY ON SOYBEAN YIELD

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In 2019, the University of Vermont Extension Northwest Crops and Soils Program investigated the impact of planting date and variety on soybean yield and quality at Borderview Research Farm in Alburgh, VT. Soybeans can be grown for human consumption, animal feed, and biodiesel. Livestock farmers are interested in producing more of their own grains and as a result, soybean acreage in Vermont is increasing. Given the short growing season in Vermont, it is important to understand optimum planting dates to obtain the highest yields. In an effort to support and expand the local soybean market throughout the northeast, the University of Vermont Extension Northwest Crop and Soils (NWCS) Program, as part of a grant from the Eastern Soybean Board, established a trial in 2019 to determine optimal planting dates for soybeans that maximize yield and quality in our northern climate.

MATERIALS AND METHODS

The soil type at the Alburgh location was Benson rocky silt loam. The seedbed was prepared using a moldboard plow and then disked prior to seeding. The previous crop was industrial hemp. The plot design was a randomized block with split plots and four replications. The main plots were five planting dates and the split plots were two varieties with varying maturities (Tables 1 and 2).

Table 1. Soybean varieties evaluated in Alburgh, VT, 2019.

Variety	Company	Traits	Maturity group
SG0975	Seedway, LLC	RR2Y	0.9
SG1776	Seedway, LLC	RR2Y	1.7

RR2Y – Roundup Ready 2 Yield soybeans contain genes to increase the number of 3, 4, and 5-bean pods per plant.

Table 2. Soybean trial specifics for Alburgh, VT, 2019.

	Borderview Research Farm Alburgh, VT
Soil types	Benson rocky silt loam 8-15% slope
Previous crop	Industrial hemp
Tillage operations	Moldboard plow and disc
Plot size (feet)	5 x 20
Row spacing (inches)	30
Replicates	4
Starter fertilizer (gal ac^{-1})	5 gal ac^{-1} 9-18-9
Planting dates	17-May, 23-May, 31-May, 7-Jun, 13-Jun
Harvest date	15-Oct

Plots were planted on 17-May, 23-May, 31-May, 7-Jun, 13-Jun with a 4-row cone planter with John Deere row units fitted with Almaco seed distribution units (Nevada, IA). Starter fertilizer (9-18-9) was applied at a rate of 5 gal ac^{-1}. Plots were 20' long and consisted of two rows spaced at 30 inches. The seeding rate was 185,000 seeds ac^{-1}. Plots were monitored for pest and disease pressure throughout the season. On 27-Aug plots were assessed for severity of infection with downy mildew (Peronospora manshurica), bacterial blight (Pseudomonas syringae pv. glycinea), and damage from Japanese beetles. These were the only pests

and diseases observed in the trial. Assessments were made by inspecting each plot and assigning a rating from 0 to 5, where 0 equated to damage/infection not present and 5 equated to infection or damage present on 100% of leaf area.

On 15-Oct, the soybeans were harvested using an Almaco SPC50 small plot combine. Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN). They were then weighed for plot yield, tested for harvest moisture and test weight using a DICKEY-John Mini-GAC Plus moisture and test weight meter. Soybean oil was extruded from the seeds with an AgOil M70 oil press on 14-Nov, and the amount of oil captured was measured to determine oil content and oil yield.

Yield data and stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were considered random effects, and treatments were treated as fixed. Treatment mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$). Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among hybrids is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. Where the difference between two hybrids within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two hybrids. In this example, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these hybrids did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these hybrids were significantly different from one another.

Hybrid	Yield
A	6.0
B	7.5*
C	**9.0***
LSD	2.0

RESULTS

Weather data was recorded with a Davis Instrument Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 3). Overall the season began cooler and wetter than normal but became hot and dry in the middle of the summer. July brought above normal temperatures and little rainfall. The longest period without rainfall in July lasted 12 days. This dry period, which occurred around the time of pod formation, may have negatively impacted soybean plant growth and productivity. However, these warm conditions did provide optimal Growing Degree Days (GDDs) through the season with a total of 2211 GDDs accumulated Jun-Sep, 197 above normal.

Table 3. Weather data for Alburgh, VT, 2019.

Alburgh, VT	June	July	August	September	October
Average temperature (°F)	64.3	73.5	68.3	60.0	50.4
Departure from normal	-1.46	2.87	-0.51	-0.62	2.22
Precipitation (inches)	3.06	2.34	3.50	3.87	6.32
Departure from normal	-0.63	-1.81	-0.41	0.23	2.72
Growing Degree Days (base 50°F)	446	716	568	335	146
Departure from normal	-29	76	-13	17	146

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

Impact of Variety x Planting Date Interactions

There was a significant variety x planting date interaction for test weight indicating that the maturities responded differently in terms of test weight when planted on different dates. Generally, as planting dates become later, farmers must modify varieties to fit the length of the growing season. Hence, with later planting dates generally shorter season varieties begin to outperform longer season types. This trend was not observed this year as the 1.7 maturity group variety produced soybeans with higher test weight than the 0.9 maturity group variety at most planting dates including the later ones (Figure 1). The highest test weight was obtained by planting the late maturing variety on the third date and the early maturing variety on the fourth planting. A similar trend was observed in our 2018 trial.

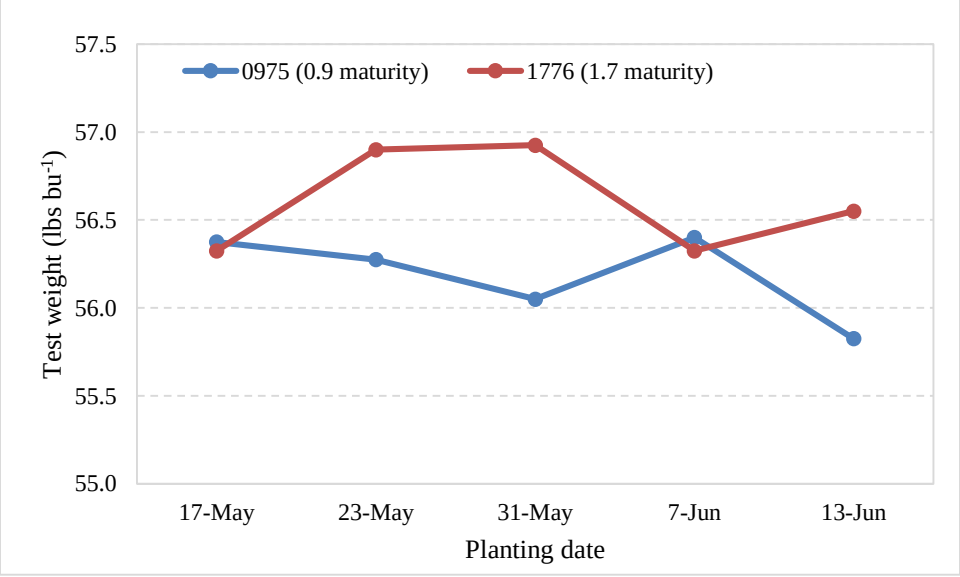

Figure 1. Soybean variety x planting date interaction for test weight, 2019.

Impact of Variety

The two soybean maturities performed significantly different in terms of yield, test weight, and oil yield, but were statistically similar in all other harvest characteristics (Table 4). Moisture at harvest averaged 15.2% and did not differ statistically, indicating that both the longer and shorter season varieties reached similar maturity by the time of harvest. Both required some drying prior to storage. Similarly, populations were low

for both varieties likely due to variable weather conditions following planting. Test weights varied slightly between varieties with the later maturing variety producing seed with a test weight of 56.6 lbs bu^{-1}, 0.4 lbs bu^{-1} higher than the early maturing variety. However, both were below the target of 60 lbs bu^{-1} likely due to low rainfall throughout the growing season leading to reduced seed fill. Yields also varied statistically between the two varieties. The late maturing variety, 1776, yielded 3915 lbs ac^{-1} or 65.3 bu ac^{-1}. Overall, this was 757 lbs ac^{-1} more than the early maturing variety. Because the varieties had similar oil contents, oil yield was significantly higher in the later maturing variety, which produced 34.6 gal ac^{-1}, 5.5 gal ac^{-1} more than the early maturing variety.

Table 4. Harvest characteristics of soybeans by variety, 2019.

Variety	Maturity group	Population	Harvest moisture	Test weight	Yield @ 13% moisture		Oil content	Oil yield	
		plants ac^{-1}	%	lbs bu^{-1}	lbs ac^{-1}	bu ac^{-1}	%	lbs ac^{-1}	gal ac^{-1}
SG0975	0.9	119645	**15.2**	56.2	3158	52.6	**6.98**	194	29.1
SG1776	1.7	**132132**	15.3	**56.6**	**3915**	**65.3**	6.74	**230**	**34.6**
LSD (p = 0.10)		NS	NS	0.231	466	221	3.68	28.4	4.28
Trial Mean		125888	15.2	56.4	3291	3567	59.0	212	31.9

The top performing variety is indicated in **bold**.
NS- Not statistically significant.

Varieties also differed in defoliation due to Japanese beetles (Table 5). Overall the damage due to Japanese beetles was low, averaging <40% of the leaf area. The early maturing soybean variety had a statistically higher rating than the later maturing variety. This may be due to the stage of maturity and therefore the attractiveness to the beetles at the time the Japanese beetle population expanded. Yields were higher in the later maturing variety; however, it is not clear that the Japanese beetle defoliation impacted these yields.

Table 5. Disease and insect pressure of soybeans by variety, 2019.

Variety	Maturity group	Downy mildew	Bacterial blight	Japanese beetles
		0-5 rating scale†		
SG0975	0.9	1.00	**0.000**	1.90
SG1776	1.7	**0.90**	0.000	**1.35**
LSD (p = 0.10)		NS	NS	0.179
Trial Mean		0.95	0.000	1.63

†0 to 5 rating, where 0 equated to damage/infection not present and 5 equated to infection or damage present on 100% of leaf area.
The top performing variety is indicated in **bold**.
NS- Not statistically significant.

Impact of Planting Date

Harvest moistures ranged from 14.7% to 15.6%. Statistically, there was no difference in soybean moisture contents at harvest between the five planting dates. Test weights ranged from 56.2 to 56.6 lbs bu^{-1}. There was no significant difference in test weight between planting dates, and all produced soybeans with test weights below the industry standard of 60 lbs bu^{-1}. Planting date significantly impacted soybean yield (Table 6). Soybean yields ranged from 3249 to 3993 lbs ac^{-1} or 54.2 to 66.5 bu ac^{-1}. The seed yield was significantly higher for the planting dates of 31-May and 7-Jun, and the yields were almost 10 lb bu^{-1} more

than any of the other three planting dates (Figure 2). The five planting dates performed statistically similar in oil content and oil yield.

Table 6. Harvest characteristics of soybeans by planting date, 2019.

Planting date	Population	Harvest moisture	Test weight	Yield @ 13% moisture		Oil content	Oil yield	
	plants ac^{-1}	%	lbs bu^{-1}	lbs ac^{-1}	bu ac^{-1}	%	lbs ac^{-1}	gal ac^{-1}
17-May	126324	**14.7**	56.4	3249	54.2	6.86	195	29.3
23-May	**133584**	15.3	**56.6**	3391	56.5	**7.59**	226	34.0
31-May	129228	15.4	56.5	**3993**	**66.5**	6.80	**234**	**35.3**
7-Jun	121968	15.6	56.4	3793*	63.2*	6.69	224	33.7
13-Jun	118338	15.4	56.2	3259	54.3	6.37	180	27.1
LSD (p = 0.10)	NS	NS	NS	349	5.82	NS	NS	NS
Trial Mean	125888	15.2	56.4	3567	59.0	6.86	212	31.9

The top performing planting date is indicated in **bold**.
Within a column, planting dates with the asterisk (*) did not differ significantly from the top performer.
NS- Not statistically significant.

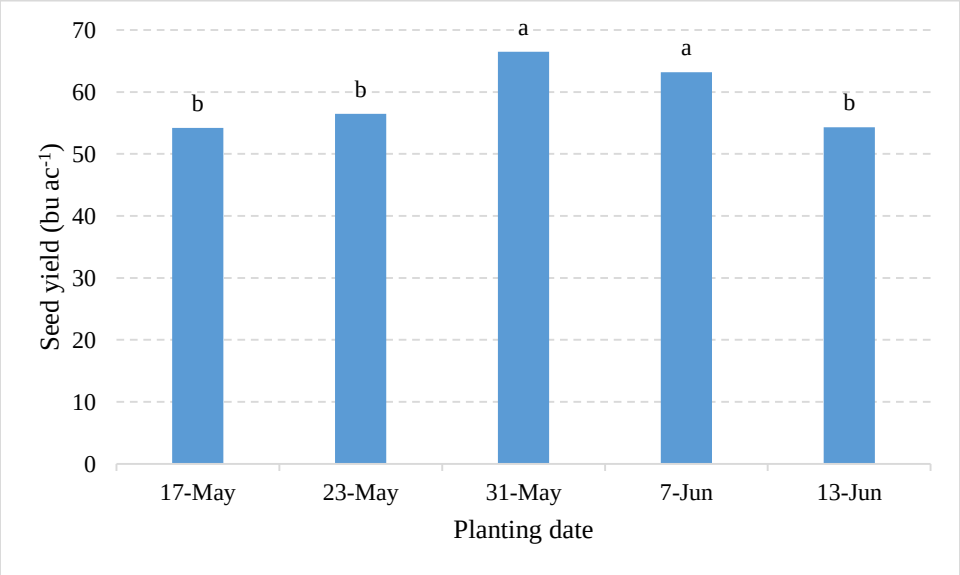

Figure 2. Soybean yield across five planting dates, 2019.
Treatments that share a letter were statistically similar.

Planting dates differed significantly in downy mildew severity, but not in Japanese beetle defoliation (Table 7). The severity of downy mildew, on a 0-5 scale, ranged from 0.375 in the first planting date to 1.25 in the fourth planting date. The later planting dates at the end of May to mid-June had higher downy mildew severity than the earlier planting dates.

Table 7. Disease and insect pressure of soybeans by planting date, 2019.

Planting date	Downy mildew	Japanese beetles
	0-5 scale†	
17-May	**0.375**	1.63
23-May	0.875	1.50
31-May	1.13	1.75
7-Jun	1.25	1.75
13-Jun	1.13	**1.50**
LSD (p = 0.10)	0.264	NS
Trial Mean	0.95	1.63

†0 to 5 rating, where 0 equated to damage/infection not present and 5 equated to infection or damage present on 100% of leaf area.
The top performing variety is indicated in **bold**. NS- Not statistically significant.

DISCUSSION

Soybean yields were significantly impacted by planting date with the highest yields observed when soybeans were planted at the end of May and first week of June. Cool temperatures and wet conditions experienced in early May likely impacted soybean yields from these planting dates. There was no significant difference in oil content or oil yield between planting dates. Soybean yield was also significantly impacted by maturity group, with the later maturing variety having higher test weight, yield and oil yield. However, the early maturing variety produced soybeans with a significantly higher oil content.

Soybean planting dates have been evaluated since 2017 in Vermont. Interestingly in 2017, soybeans planted in May yielded lower than those planted in mid-June. In 2018, soybeans planted in the last two weeks of May had the highest yields. Overall, these data indicate that a soybean maturity range from 0.9 to 1.7 can mature in Vermont even when planted into mid-June. Early season planting should only occur if weather and soil conditions are advantageous for soybean germination and growth. Further research over additional years and environments will help develop optimum planting date ranges for Vermont.

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