NON-GM SOYBEAN VARIETY TESTING UNDER ORGANIC CONDITIONS

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Organic and food-grade soybeans have been experiencing high, stable demand from local and international markets. This is because the vast majority of food-grade soybean buyers (such as Japan) are demanding clear-hilum non-GM (genetically modified) varieties. Additionally, organic farmers cannot plant GM seeds or use synthetic herbicides or fertilizers. The majority of organic and food-grade soybeans are produced in Ontario and Quebec, where non-GM soybean acreage accounts for 25% and 30% of total soybean acreage, respectively. When we compare this to Manitoba, where about 0.75% of soybean acreage in Manitoba is non-GM, there is certainly room to expand acreage. With the continued effort to introduce new short-season non-GM varieties and gain production knowledge, farmers in Manitoba can take advantage of the market opportunity.

One of the main challenges for organic farmers in particular is reliable, appropriate varietal performance data. Organic farmers looking to conventional trials for soybean yield data have a hard time relating what they see back to their own farm. While organic farmers face the same challenges as conventional farmers (crop nutrient requirements, disease, insect, and weed pressure), the way they combat these problems is very different. Some strategies include the use of nitrogen-fixing cover crops, increased seeding rates, careful rotation planning, and tillage practices. How different soybean varieties respond to these different management strategies has never been evaluated before in Manitoba.

The aim of this study was to evaluate the performance of 12 non-GM soybean varieties on organic farms across southern Manitoba (varieties and seed sources are listed in Table 1). The study consisted of eight trials conducted at five sites across Manitoba from 2014 to 2015. The sites included the organic land at the Ian N. Morrison Research Farm in Carman, as well as four organic farms in St. Pierre-Jolys, Somerset, Woodmore, and one transitional farm in Elie, Manitoba. Soybeans were seeded at a rate of 220,000 seeds/acre, with 12-inch row spacing. Weed control involved a pre-emergence tine harrow and one inter-row cultivation pass approximately one month after seeding.

Woodmore, Manitoba, August 31, 2015

One variety characteristic under evaluation was weed competitiveness. One of the biggest challenges in organic farming – if not the most challenging – is weed control. Organic farmers rely on tillage, late seeding, higher seeding rates, and crop rotation to control weeds. Varietal choice is another important aspect of weed control, so having varieties that are shown to be competitive with weeds is important. However, soybeans are not competitive with weeds at early growth; the presence of weeds' impact on final yield run from emergence to 60 days after emergence (approximately at stage R-5). Weed interference can result in yield losses of up to 55%. In this study, we chose to practice minimal weed control (as mentioned above) to give the varieties a good chance of performing, while giving us the ability to assess their relative weed competitiveness.

Organic soybean yields were comparable to conventional non-GM soybean yields at different sites, ranging from 45 bu/ac to 22 bu/ac. (Table 2). The weed species, weed density, soil type, weather, and soil nutrients varied widely across sites causing inconsistent outcomes. For example, an early killing frost at Somerset in 2014 reduced yield of some varieties dramatically, and only two of the earliest maturing varieties (Tundra and SK0007) were able to reach maturity by September 12, 2014. This outcome demonstrates the need for more early-maturing non-GMO varieties in Manitoba. Another

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Table 1. Average days to maturity, plant height, pod height, protein and oil content, and seed source.

All data is presented as an average across all site-years.

	Average					
Variety	Days to Maturity	Plant Height	Pod Height	Protein Content	Oil Content	Source
Tundra	102	53	14	41	19	Semences Prograin, Quebec
OAC Prudence	106	55	15	43	20	SK Foods, North Dakota
SK0007	106	58	13	43	19	Robert Wiens, Domain, Manitoba
Toma	108	63	13	42	21	Semences Prograin, Quebec
DH 863	109	60	13	46	18	SG Ceresco, Quebec
OAC Petrel	109	60	13	43	20	Sevita International, Ontario
DH 401	110	64	15	46	17	Sevita International, Ontario
Jari	111	73	15	46	18	Elite Le Coop, Quebec
Savanna	112	60	15	42	20	Homestead Organics, Ontario
Auriga	116	65	14	41	20	Elite Le Coop, Quebec
Krios	116	59	14	45	18	Elite Le Coop, Quebec
SVX14T0053	117	58	14	44	19	Sevita International, Ontario

Table 2. Yield indices of 12 non-GM soybean varieties at eight site-years.

Variety	Average		Carman		Elie	St. Pierre-Jolys	Somerset		Woodmore	
	2014	2015	2014	2015	2014	2014	2014	2015	2014	2015
Tundra	87	96	93	97	90	81	106	105	103	85
OAC Prudence	82	100	87	105	91	99	97	98	83	93
SK0007	85	100	97	98	97	71	95	110	95	95
Toma	127	112	102	117	N/A	106	N/A	103	N/A	111
DH 863	90	98	93	96	107	91	90	93	111	106
OAC Petrel	91	95	82	94	110	112	121	102	83	93
DH 401	127	92	106	88	N/A	101	N/A	93	N/A	99
Jari	128	97	111	92	N/A	98	N/A	102	N/A	102
Savanna	103	113	119	120	114	102	118	100	114	113
Auriga	98	93	111	92	90	134	113	92	99	95
Krios	92	97	92	97	103	115	84	95	105	98
SVX14T0053	89	106	105	104	99	91	77	105	108	110
Average Yield bu/ac	26.6	31.7	36.1	45.2	34.1	29.2	14.3	22.17	26	27.7

Varieties should only be compared within each column. Yield index is the percentage of the average yield of all varieties grown in a test area (refer to the bottom of each column for that site-year's average yield).

example of inconsistency can be seen in 2015, where the same area (Somerset) experienced heavy wild mustard and wild oat pressure, causing below-average yields.

Within each site, traits associated with higher yielding varieties were: total soybean biomass accumulated, height, and maturity rating (agronomic qualities can be found in Table 1). Historically, the longer a soybean takes to mature, the higher the yield. This is because the soybean has more time to accumulate biomass throughout the season and transfer that biomass to the seed, resulting in higher yields. At the majority of sites, later maturing varieties did yield better than early maturing varieties, however, this was not consistent. While varieties like Savanna and Toma performed above the average yield at all sites, Auriga and SVX14T0053 performed inconsistently. This could possibly relate to the varieties' abilities to compete or withstand weed presence. Since longer-maturing varieties usually yield more than early, we wouldn't be surprised if Tundra and SK0007 (the earliest maturing varieties) were outperformed by the later-maturing varieties. But at the majority of sites, this was not the case. The earlier maturing varieties performed the same if not better than the average at some sites, especially at Somerset in 2015, where weed pressure was very heavy. This is good news for farmers, especially in areas where the risk of an early September frost is high.

Because non-GM soybeans are usually grown for the local and export food markets, oil and protein are very important as they increase your ability to market soybeans for the food market. If the soybeans are of low protein and oil, or poor quality (immature green seeds due to frost, for example), the soybeans will often be down-graded and sold for feed, which commands a lower price. The general minimum protein threshold for food-grade soybeans is around 35% on a dry matter basis (approx. 40% at 13.5% moisture). All the varieties tested were bred for the food market, so hitting that higher protein content threshold should not be an issue for the varieties tested. The protein content ranged from 41% (Tundra) to 46% (Jari, DH401, DH863) on a dry matter basis, and all varieties consistently met food-grade protein content.

It's important to keep in mind that the days to maturity reported is an average across all sites tested, which ranges from +/- 1.5 days reported in Table 1. Days to maturity is also affected by the season in which the varieties were grown, and 2015 was an abnormally warm year which hastened maturity. In general, for farmers in shorter seasons (around 99–105 days to maturity), SK0007 is a very good option. The variety is vigorous at early growth, able to compete and tolerate weeds, and has very good pod height. For farmers in the mid-season range (approximately 105–112 days to maturity), Jari and Toma stand out for having high yield potential, being highly weed competitive, and having relatively stable performance across a wide range of environments. Savanna yielded very well across all sites, however, the length of season required is not advisable for many Manitoba growers at this time due to the high frost risk. ■