



ORGANIC SOYBEAN PRODUCTION IN ATLANTIC CANADA

Interim Research Report E2007-30

INTRODUCTION

Organic soybean production has not been widely adopted in the Maritimes despite growing demand in the food and feed markets. Challenges in organic soybean production include finding organically suitable seed, finding varieties with appropriate heat unit requirements, weed control, and marketing. In this bulletin we provide a brief review of considerations for organic soybean production, and summarize preliminary results of organic varietal trials conducted in the Maritimes in 2006.

Soybeans are an ancient Japanese crop that has been adapted to grow in many different regions around the world. Its high protein content (40-45%) has made it desirable for both animal feed and human food. It also has a high oil content making it useful for both food and industrial applications. Soybean production for biofuels is also a very important market. The oil from the soybeans are extracted and then mixed with diesel in low concentrations to allow for a renewable source of energy.

SOYBEAN VARIETIES

Your selection of soybean varieties should be based on both your market and local growing conditions. Important characteristics to consider include: heat requirements (days to maturity), protein and oil contents, hilum color, bean size and shape, yield, branching, resistance to diseases and lodging, and height to the lowest pod.

Soybeans vary widely in their heat unit requirements; select a suitable variety for your location and management practices (e.g. if you seed late to allow weed control). Growing a long season bean in a short season climate could result in a crop that will not mature.



Organic soybean fields in Prince Edward Island (A. Hammermeister)

Protein and oil content influence the suitability of the soybean for different uses, and their characteristics. For example, a high protein to oil ratio will result in a firmer tofu and a low protein to oil ratio will be a silky tofu. Another part of the bean that is important to tofu producers are the L2 and L3 lipoxygenase isozymes. These compounds are responsible for the beany aroma and flavour in soymilk and tofu. Crop breeders are now working on ways to reduce the amount of these compounds in certain varieties.

The hilum is the point on the seed where it connects to the pod. The color at this point is important for food grade uses because the hilum color can stain the seed. Hilum colors may be clear, imperfect yellow, yellow, brown or black. The seed in turn may cause the milk and meal of the soybean to have gray shades. Most

consumers find a gray color in their products less appealing. Processors prefer different sizes and shapes of soybean for different uses. Round beans are preferred over kidney shaped and larger beans are better for tofu. Be sure to ask your buyer if they have a preference.

Soybean varieties can vary in how quickly they emerge; however, seedbed preparation, seeding depth and soil conditions are important for good crop establishment. Soybean branching is in part a varietal trait, but is also influenced by seeding rate and row spacing. Branching varieties will close the canopy faster, making them more competitive with weeds. However, branching varieties may have lower pods and less even maturity. Pod height is an important consideration for harvestability. Pods higher off the ground are more likely to be harvested and less likely to be stained.

Mud tagging is a term used to describe the condition of the beans after a moist dirty harvest. Juices from lush weeds at harvest, or otherwise damp conditions, make the beans sticky, causing them to collect dust during harvest. Staining and mud tagging caused by weeds during harvest can reduce marketability and price significantly. Recent research conducted by AAFC in Ottawa has shown that moisture availability during the early pod development stages (stages R4-R5) is the most important factor affecting yield. Weed competition for moisture at this stage could have a large yield impact. Harvesting beans under dry conditions and after the plants including weeds have died will minimize mudtagging and staining.

SOYBEANS AS FEED

For feed purposes, protein and oil affect nutritional and energy values. Soybeans are the number one source of protein used in animal feeds. Higher oil levels reduce the amount of dust in the feed. Compounds in the soybean called trypsin inhibitors and urease make the beans undigestible for monogastric animals and ruminants. Heat processing the beans will break down these compounds and increase digestibility without damaging the feed quality. Two common methods are roasting or extruding. Roasting requires the beans to pass through hot air to raise the temperature to 160°C. It is also very important that the beans are held at or close to

the roasted temperature for a period of time which is called steeping. Extruded beans are heated by friction of pushing the beans through a very small hole. This produces two products; soybean meal and soybean oil.

VARIETY AND ROW SPACING TRIALS

Preliminary research has been conducted by the Organic Agriculture Center of Canada (OACC) to find out how certain varieties grow under organic management in the Maritimes. Of particular interest are the suitability of varieties for organic production and the importance of row spacing. Nine varieties (Table 1) were grown in replicated small plots in PEI and NS. Small plots were established at two sites in PEI; one with 15-cm rows and one with 30-cm rows, based on grower preference. Replicated plots for both narrow and wide row spacing treatments were located at the Brookside research field in Truro, NS, which allowed direct comparison of row spacing at this site only.

Table 1. 2006 Characteristics of Varieties and Seeding Rates for Organic Soybean Variety Trial

Variety	Heat Unit Rating (CHU)	Hilum Colour	TKW (g)	Seed Rate ² 15 cm (kg ha ⁻¹)	Seed Rate ² 30 cm (kg ha ⁻¹)
OAC Prudence ¹	2450	Y	200	125	108
Ugo ²		Y	193	121	104
OAC Atwood ²	2600	Y	183	114	98
Barren ²		B	161	101	87
AC Glengarry ¹	2600	IY	165	103	89
OAC Champion ¹	2650	IY	192	120	103
Windfall ²	2750	IY	251	157	135
NK S08-80 ¹	2750	Y	213	133	114
OAC Vision ³	2250	B	151	94	81

²Assuming 80% establishment rate, 43 seeds m⁻² in 30-cm rows and 50 seeds m⁻² in 15-cm rows

¹Seed from Homestead Organics (ON)

²Seed from MeadowBrook Farms (PE)

³Eliminated from trial due to poor seed germination

Y- yellow IY - imperfect yellow, B - brown

Table 2. 2006 Preliminary Soybean Variety Trial Results grown under Organic Conditions

Variety	Emergence	Height to First Pod		Days to Maturity (30-cm row)	Yield (kg ha ⁻¹)	
		Site A&B	Site B&C		Site A&B	Site B&C
		15-cm row	30-cm row		15-cm row	30-cm row
OAC Prudence	3	8	5	120	2097bc	2370bc
Ugo	2	7	4	125	1583cd	1442e
OAC Atwood	2	6	8	127	1199d	1249e
Barren	2	8	4	120	1827cd	1399e
AC Glengarry	3	10	7	130	2379ab	2829ab
OAC Champion	3	11	11	133	2685a	2975a
Windfall	2	9	7	120	1718cd	1720de
NK S08-80	2	10	9	133	2057bc	2184cd
OAC Vision	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Emergence Rating: 0 – no emergence, 1 - poor emergence, 2 - cotyledons emerged, 3 - cotyledons parted
a-e Yield values within the same column and followed by the same letter are not statistically different.

Note: Yields for the two row spacings should not be compared because they were measured at different sites
n.d. Results for OAC Vision are not reported here, as the seed used for the trial was poor.

Soybeans are considered a heat loving plant, typically planted after the frost free day in the spring, around the first of June. This later planting makes it very important for the soybean plants to emerge and grow quickly. Emergence was rated 10 days after planting (Table 2). When seedlings establish and emerge quickly, they are expected to be more competitive with weeds. AC Glengarry, OAC Champion and OAC Prudence appeared to establish more quickly than the other varieties.

Typical weed control in organic soybeans has relied on the use of a good crop rotation and planting in a weed-free field. In addition to these practices, we tested the use of wider row spacing (30-cm) for one treatment to allow for interrow cultivation. The row width used will depend largely on the variety grown, as some varieties will establish and branch more quickly than others. The choice of appropriate row spacing will influence weed competition. The soybeans were seeded at 54 seeds m⁻² at 30-cm row spacing and 63 seeds m⁻² at 15-cm row spacing. Assuming an 80% germination and emergence rate, this would correspond to 43 seeds m⁻² in 30-cm rows and 50 seeds m⁻² in 15-cm rows. Both treatments were fingerweeded at pre emergence, first trifoliolate and second trifoliolate (trifoliolate - a stage of growth of soybean plants where three leaves branch off the main stem). The 30-cm spacing was then cultivated twice more to further disturb the weeds. The varieties

Prudence and NKS-080 were certified organic seed. The variety OAC Vision was seeded; however, the seed used was not good and results are not presented as they were not representative of actual yield potential.

Height to the first pod was measured; if the first pod is higher off the ground, yield will be higher and staining or mud tagging can be reduced. When compared at the same site, the lowest pod was approximately 2 cm higher off the ground in the 15-cm rows than in the 30-cm rows. This result is expected, as the plants stretch upwards to when planted close and competing for light. Plants will tend to be bushier in wide rows. The varieties also differed in height to the lowest pod (Table 2). Ugo and Barren were especially low to the ground in 30-cm rows; OAC Champion and NKS08-80 were notably higher off of the ground at both row spacings.

Time to maturity is critical in selecting soybean varieties. The short growing season of the Maritime region limits the grower to shorter season crops. Soybeans planted with narrow row spacing will mature earlier than wider rows because the plant will produce fewer branches. Days to maturity is calculated from the date of planting until 95% of the pods are brown. Harvest is usually suggested about a week after maturity. The varieties tested ranged from 120 to 130 days to maturity at the 30-cm row spacing (Table 2). Once the beans mature, the beans dry

down and can go into storage. Soybeans should be stored at 13 -14% moisture. Harvesting as close to that moisture content as possible will minimize drying costs, however, care must be taken to avoid damaging the seed during harvest and handling if below 15% moisture.

The 2006 soybean variety trial showed interesting preliminary results. The most common varieties grown by PEI soybean growers were among the lowest yielding in the trial. OAC Champion and AC Glengarry yielded well at all sites. These preliminary results are only from one year, and OACC will continue this research in the 2007 season.

When compared at the same site (Brookside Site in Truro, NS), the average yield of all varieties was significantly higher for the 15-cm rows at 2271 kg ha⁻¹ than the 30-cm rows which produced 1614 kg ha⁻¹. Research has consistently shown that narrower row spacing produce higher yields, but these trials are typically conducted under weed-free conditions. The results from this trial would suggest the same may be true in organic systems. Planting in narrow rows does not permit mid-season weed control between rows; a clean field, good seed bed conditions, and timely weeding with tine harrows or rotary hoes are critical when planting at narrow spacing.

SUGGESTED REFERENCES

Canadian Organic Growers. 2001. Organic Field Crop Handbook 2nd ed.

Ontario Ministry Agriculture, Food and Rural Affairs. 2002. Agronomy Guide For field Crops. Accessed at: www.omafr.gov.on.ca/english/crops/pub811/p811toc.html

University of Illinois at Urbana-Champaign. 2003. Specialty Soybean Fact Sheets. Accessed at: web.aces.uiuc.edu/value/factsheets/soy.htm

ACKNOWLEDGEMENTS

Farmer Cooperators:

David Bunnett (Bunnett Family Farms, NB)
Mark Bernard (Barnyard Organics, PE)
John Hardy (Soy Hardy, PE)

Technicians: Roxanne Beavers, Margaret Graves, Jody Nelson, Lloyd Rector and Paula Schofield.



Height to the lowest pod will influence soybean yield (A. Hammermeister)

THE BOTTOM LINE...

Soybean varieties should be carefully selected based on local environmental conditions, row spacing, end use, and other characteristics that buyers require. Wide rows allow weed control but incur a yield penalty.

FUNDING

Nova Scotia Department of Agriculture
New Brunswick Department of Agriculture,
Fisheries and Aquaculture
Prince Edward Island Department of Agriculture,
Fisheries and Aquaculture
AAFC Career Focus Program

CREDITS

Andy Hammermeister, Mark Bernard and
Roxanne Beavers (ed.)



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada

For more information:

Visit oacc.info or contact us at
P.O. Box 550 Truro, NS B2N 5E3
Tel: (902) 893-7256
Fax: (902) 896-7095
Email: oacc@nsac.ca



Nova Scotia
Agricultural
College