# HULLESS PUMPKIN SEED: A NEW CROP FOR ORGANIC PRODUCTION IN QUÉBEC

## PART 1 - Cultivars and Planting Methods

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**Oilseed pumpkins (pumpkins with hulless seeds) have been grown in Eastern Europe for generations. Hulless seeds are packed with omega-6 and omega-9 fatty acids and have high content of zinc and vitamin E. The absence of a hull means less handling is required before consumption or processing and the seeds may be consumed as is or pressed to extract the oil. The fruit can also be sold at the farm or in markets. Production of this type of pumpkin for the snack market or for processing has the potential to spur crop diversification, especially on organic farms.**

The goal of this project undertaken at the Organic Agriculture Innovation Platform (OAIP) research site in Saint-Bruno-de-Montarville was to identify which pumpkin cultivars are most suitable for the conditions found in southwestern Québec. The project also looked at evaluating the effects of various growing practices on insect pests and diseases, and thus on the yield and quality of the fruits and their seeds.

Three hulless pumpkin cultivars (“Kakai”, “Snackjack” and “Styriaca”) were grown in 2009 and 2010 in accordance with various planting and production protocols: light soil vs. heavy soil, direct sowing vs. transplanting, and the use of crop nets or not. For these comparative trials the three cultivars were planted at a density of 15,000 plants/ha.

**Table 1. Characteristics of four hulless seed pumpkin cultivars.**

| CHARACTERISTICS | KAKAI | SNACKJACK | STYRIACA | SNACKFACE * |
|---|---|---|---|---|
| Variety | Open pollination | Hybrid | Open pollination | Hybrid |
| Plant habit | Semi-bush | Bush | Spreading | Bush/Semi-bush |
| Approximate days to maturity | 100 | 90 | 135 | 90-105 |
| Recommended width between rows (m) | 1.4 to 2.1 | <1.8 | 1.4 to 2.1 | <1.8 |
| Recommended spacing within rows (m) | ≥ 0.3 | between 0.2 and 0.3 | ≥ 0.3 | between 0.2 and 0.3 |
| Recommended population (plants/ha) | 10,000 to 15,000 | 16,500 to 18,500 | 10,000 to 15,000 | 16,500 to 18,500 |

* The Snackface cultivar was not evaluated in these trials, but was part of subsequent trials in 2011–2012.


**Three hulless pumpkin cultivars and the seeds harvested.**

## PLANTING METHODS AND SOIL TYPES

The germination rates for pumpkins sown in the field were very low: 2% to 35% in light soil and 30% to 45% in heavy soil, in 2009 and 2010 respectively. Some samples of seeds that did not germinate were sent to the MAPAQ plant protection diagnostic lab, which detected the presence of seedcorn maggots (*Delia platura* and *D. florilega*) as well as the pathogenic agents *Rhizopus sp.* and *Fusarium sp.* As some studies have suggested, the absence of a seed hull makes these seeds highly vulnerable to pathogens and pests, which renders direct sowing of these cultivars more problematic.

Yields were much lower in heavy soil than in light soil. For example, in 2010 the average seed yield for transplanted pumpkin cultivars was 2.76 times greater in light soil than in heavy soil. Generally, pumpkins grow best in light soil. Clay soils are not advisable for growing cucurbits.

Given these findings, only data collected from pumpkin transplanted in light-soil plots, with and without nets, will be presented in detail in this document.

## STRIPED CUCUMBER BEETLE POPULATIONS AND DAMAGE

The striped cucumber beetle (SCB, *Acalymma vittatum*) is the main pest of pumpkin crops. The adult feeds on all aerial parts of the plant and transmits bacterial wilt, a disease that affects the growth and production of marketable fruits.

SCB populations and damage were detected on pumpkin plants grown either with or without insect netting. In plots with nets, the nets were set up during the period of vulnerability to SCB, i.e. between sowing and flowering. A greater number of SCB was observed on plants in 2009 than in 2010 (Figure 1). In 2009 the average number of SCB per plant peaked for plots without nets on June 23, then decreased through the end of the season.

The insect netting helped limit SCB attacks on pumpkin plants at stages where seedlings were most susceptible to defoliation and bacterial wilt. After removing nets, the average number of SCB per plant rapidly reached the same peak as in plots without nets and then followed the same downward trend thereafter.

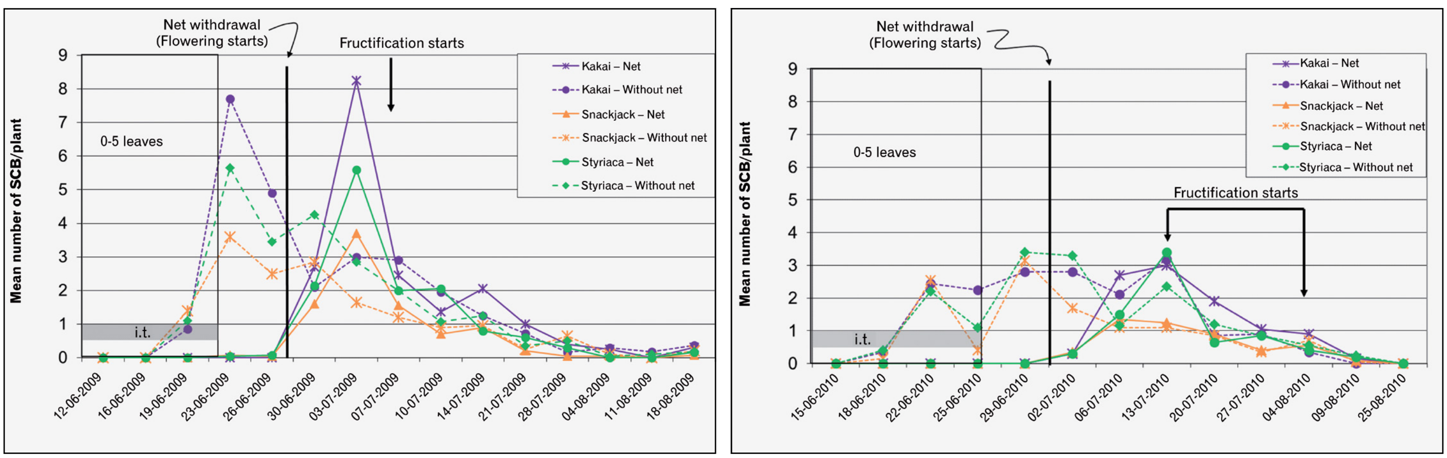


**Figure 1. Populations of striped cucumber beetle on three cultivars of hulless seed pumpkin transplanted in light soil, with or without insect netting, in 2009 and 2010.**

(i.t.: intervention threshold, RAP (Québec Plant Protection Warning Network) - Cucurbits)

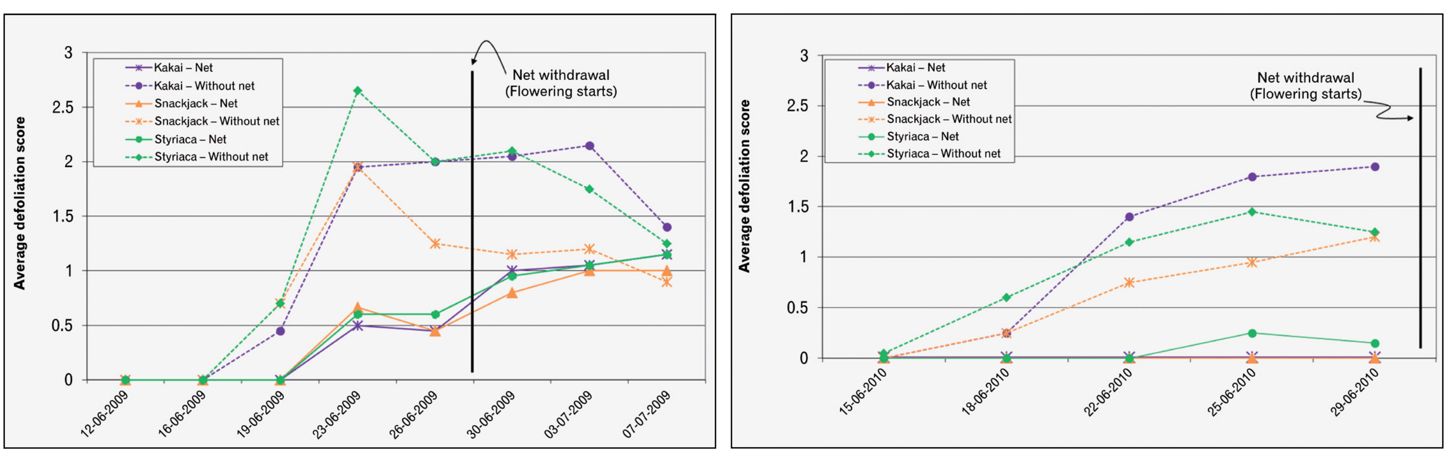


**Figure 2. Defoliation caused by the striped cucumber beetle on three cultivars of hulless seed pumpkin plants transplanted in light soil, with or without insect netting, in 2009 and 2010.**

(0: 0% defoliation (no damage); 1: 1% to 25% defoliation; 2: 26% to 50% defoliation; 3: 51% to 75% defoliation; 4: 76% to 99% defoliation; 5: 100% defoliation (plant death))

The intervention threshold recommended by the Québec Plant Protection Warning Network (RAP) for initiating treatment against the SCB in pumpkins is 0.5 to 1 SCB per plant when plants are between the cotyledon and 5-leaf stages. The impact of the SCB is usually less severe when plants have more than five leaves. For both years studied, in plots without nets, the threshold was reached 10 days after transplanting. Since the project objectives were to evaluate the impact of SCB on pumpkin cultivars, no crop protection treatments were carried out.

The defoliation caused by SCB feeding was also monitored (Figure 2). The rates of defoliation peaked 3 to 7 days after the SCB intervention threshold. In plots without nets, many plants suffered of more than 50% defoliation.

In 2009, in plots with nets, the insects managed to feed through the nets when the plants reached the 5-leaf stage or beyond and caused some defoliation. In 2010, the use of netting hoops did not allow any feeding through the nets.

Once SCB populations dropped off, most defoliated plants resumed normal growth and produced marketable pumpkins.

The "Snackjack" cultivar seemed less appealing to the SCB and suffered less defoliation than the other two varieties. In 2009, "Kakai" attracted more SCB than "Styriaca", but this trend was not observed in 2010. Furthermore, in 2009, the "Styriaca" plants were more defoliated than the "Kakai" ones.

## INCIDENCE OF BACTERIAL WILT

The "Snackjack" cultivar was barely affected by bacterial wilt, either in 2009 or in 2010 (Table 2). On the other hand, the "Kakai" cultivar was the most susceptible to bacterial wilt, with a mortality rate of nearly 50% in 2009, regardless of whether plants were covered by insect netting or not. SCB feeding through nets was probably responsible for the rapid onset of bacterial wilt infections observed in 2009. In 2010, plant mortality rates for the "Kakai" cultivar protected by nets were low (6%) and significantly less than for plants without nets (42%). The nets also significantly reduced mortality due to bacterial wilt in the "Styriaca" cultivar in 2009, while in 2010 mortality rates for "Styriaca", with or without nets, were low and statistically similar.

In short, the "Snackjack" and "Styriaca" cultivars were least attractive to the SCB and exhibited the least defoliation when compared to "Kakai", which helped reduce the overall incidence of bacterial wilt. It is likely that certain cultivars have greater tolerance or resistance to this disease.

**Table 2. Dates of onset of symptoms and percentage of mortality caused by bacterial wilt on plants of three hulless seed pumpkin cultivars, grown with or without insect netting, transplanted in light soil.**

| | | 2009 | | 2010 | |
|---|---|---|---|---|---|
| CULTIVAR | PROTECTION | Date of onset of symptoms | Mortality % | Date of onset of symptoms | Mortality % |
| Kakai | without net | July 8 | 45 | July 6 | 42 a |
| | with net | July 8 | 52 | July 27 | 6 b |
| Snackjack | without net | August 11 | 0 | * | 0 |
| | with net | July 28 | 4 | July 2 | 0 |
| Styriaca | without net | July 8 | 38 c | July 6 | 8 |
| | with net | July 21 | 15 d | July 27 | 2 |

The results followed by letters are significantly different from each other (a, b: P ≤ 0.1 and c, d: P ≤ 0.05).
* No bacterial wilt symptoms were observed.

## FRUIT YIELD

The results for the number of marketable pumpkins and average pumpkin weight closely mirror the anticipated differences between cultivars. In 2009 and 2010, the "Snackjack" cultivar yielded more fruit per hectare than the "Kakai" and "Styriaca" cultivars. On the other hand, the "Snackjack" fruits were smaller, with a lower average weight of 0.88 kg in 2009 and 0.62 kg in 2010 compared to 2.30 kg and 1.56 kg for Kakai and 3.10 kg and 3.61 kg for "Styriaca" in 2009 and 2010, respectively. Fruit yield is an important parameter when pumpkin flesh is intended to be marketed.

**Table 3. Marketable yields of three cultivars of hulless-seed pumpkin transplanted in light soil, with or without crop nets, in 2009 and 2010.**

| CULTIVAR | TREATMENT | FRUIT YIELD (NUMBER/m$^2$) | | FRUIT YIELD WEIGHT (t/ha) | | SEED YIELD (kg/ha) | |
|---|---|---|---|---|---|---|---|
| | | 2009 | 2010 | 2009 | 2010 | 2009 | 2010 |
| Kakai | without net | 0.69 | 0.77 | 15.8 | 12.0 | 337 | 216 |
| | with net | 0.84 | 2.12 | 19.6 | 31.6 | 332 | 807 |
| Snackjack | without net | 2.00 | 2.00 | 18.4 | 13.6 | 714 | 585 |
| | with net | 2.28 | 2.13 | 20.6 | 13.8 | 744 | 577 |
| Styriaca | without net | 0.97 | 1.31 | 28.1 | 39.8 | 448 | 502 |
| | with net | 1.38 | 1.88 | 45.7 | 68.4 | 802 | 912 |

Planting dates: June 4, 2009 and June 9, 2010. Harvest dates: October 13, 2009 and September 14, 2010.

## SEED YIELD

In 2009, in the plots with no nets, the seed yield for the "Snackjack" cultivar was significantly greater than that of the "Kakai", and it also tended to be greater than the "Styriaca" yield, but not significantly so. In plots with nets, the "Kakai" cultivar seed yield was significantly below the two other cultivars. This result is in all likelihood due to early bacterial wilt infections caused by SCB feeding through the nets.

In 2010, in plots without nets, the "Snackjack" cultivar had a seed yield significantly higher than the "Styriaca", which in turn was higher than the "Kakai" yield. But unlike in 2009, in 2010 the "Styriaca" and "Kakai" cultivars benefited from the protection provided by the nets and produced significantly more seeds than "Snackjack".

"Styriaca" is the only cultivar that benefited from the protection provided by crop nets in 2009. However, in 2010 the "Kakai" and "Styriaca" cultivars protected by nets produced significantly more than those without nets. By reducing the impact of SCB on the incidence of bacterial wilt, the crop nets helped boost the seed yield of these two cultivars, which are particularly sensitive to this disease.

## NUTRIENT CONTENT OF PUMPKIN SEEDS

The seeds extracted from the pumpkins were analyzed at the Agriculture and Agri-Food Canada Food Research and Development Centre. The seeds contain mainly fats and proteins (Table 4). The main fatty acids in the seeds were linoleic acid, oleic acid, palmitic acid, and stearic acid. The "Kakai" cultivar seeds contained more oleic acid and less linoleic acid than the other two cultivars. Oleic acid is a monounsaturated fatty acid, while linoleic acid is a polyunsaturated fatty acid. Therefore, the oil extracted from "Kakai" seeds should be the one most resistant to oxidation.

**Table 4. Protein and fat content, and profiles of the main fatty acids found in seeds of the three hulless seed pumpkin cultivars grown in 2010.**

| CULTIVAR | PROTEINS % | LIPIDS % | FAT CONTENT (%) LINOLEIC ACID (C18:2) | FAT CONTENT (%) OLEIC ACID (C18:1) | FAT CONTENT (%) PALMITIC ACID (C16:0) | FAT CONTENT (%) STEARIC ACID (C18:0) |
|---|---|---|---|---|---|---|
| Kakai | 33.2 | 39.5 | 49.1 | 31.3 | 11.8 | 5.4 |
| Snackjack | 32.1 | 42.4 | 53.0 | 26.3 | 12.1 | 5.7 |
| Styriaca | 29.9 | 43.9 | 53.9 | 26.5 | 11.9 | 5.2 |

For more information, visit the IRDA website: Summary sheets entitled *Hulless pumpkin seed: a new crop for organic production in Québec*

■ Part 2 – Weeding Strategies / ■ Part 3 – Economic Feasibility

Progress report for this project: *Organic Production of Pumpkin Seeds as a Functional Food for the Snack Market and for Processing* (only available in French)


## IMPLEMENTATION AND FUNDING PARTNERS

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