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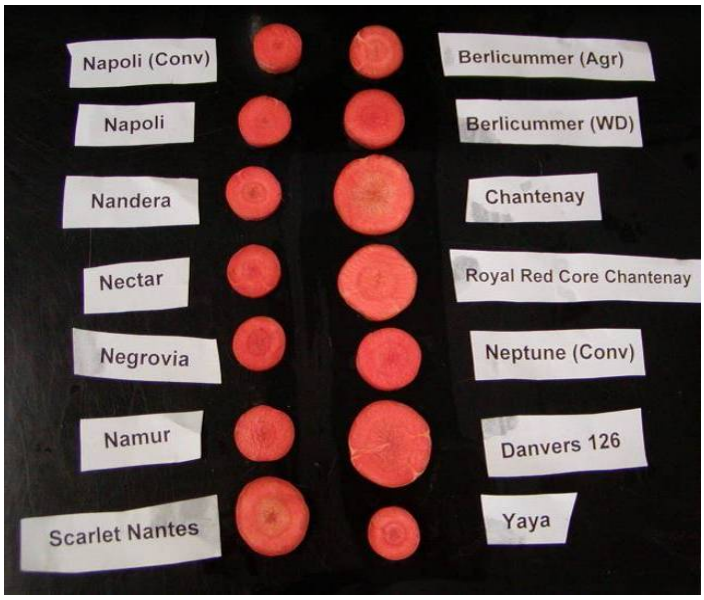
MARITIME ORGANIC SEED TRIALS: CARROTS

Final Research Report E2008-31

BACKGROUND

Certified organic farmers are required to use organically grown seed when it is available for the crop they are growing. The organic seed sector is growing, and every year new cultivars are being released for vegetable crops. However, organic seed has not been available for many of the favourite cultivars grown by Maritime market gardeners and commercial growers. In collaboration with Maritime farmers in 2006 and 2007, the Organic Agriculture Centre of Canada conducted a research program to explore the current state of organic seed for vegetable crops. As taste is an important factor for consumers choosing organic food, a taste test of raw carrots was conducted.

The **objective** of this project was to evaluate existing and novel cultivars of organically grown carrot seeds to identify the best currently available cultivars for organic production.



Carrot cultivars were grown from organic seed and compared to conventional standards

Table 1. Organically produced and non-organic standard carrot cultivars tested in this trial

Cultivar	Characteristics
Organically Produced Seeds	
Napoli OG[1]	F1 (55 d), nantes type, fresh market
Yaya[2]	F1 (56 d), nantes type, fresh market
Chantenay[1]	OP (65 d), chantenay type, all purpose
Nandera[3]	F1 (65 d), nantes type, fresh market- 2007
Negovia[2]	F1 (70 d), nantes type, all purpose- 2007
Royal Red Core Chantenay[4]	OP (70 d), chantenay type, all purpose
Danvers 126[4]	OP (70 d), storage
Scarlet Nantes[1]	OP (70 d), nantes type, all purpose
Namur[3]	F1 (70 d), nantes type, all purpose- 2007
Nectar[3]	F1 (75 d), nantes type, storage- 2007
Berlicummer 1[5]	OP (75 d), improved nantes, storage
Berlicummer 2[4]	OP (75 d), improved nantes, storage
Dragon[6]	OP (75 d), red-purple flesh- 2006
Non-Organic Standards	
Napoli[1]	F1 (55 d), nantes type, fresh market
Neptune[1]	F1 (65 d), imperator, storage

Seed source: [1]Vesey's Seeds (PE), [2]Johnny's Selected Seeds (ME), [3] Bejo Seeds Inc. (USA), [4]Agrestal Organic Heritage Seeds (ON), [5]William Dam Seeds (ON), [6]Stellar Seeds (BC)

WHAT WAS DONE

The organic carrot seed trial was conducted at four farms in 2006, five farms in 2007 and at the Brookside Organic Research Site in Truro, NS in both years. The cultivars tested represented a wide array of maturity and uses (fresh, all purpose, and storage) and were obtained from 5 different commercial seed companies and a seed breeder. Two conventional cultivars were seeded as a standard with which to compare the organic cultivars: Napoli and Neptune, donated by Vesey's Seeds, are popular in the Maritimes for fresh market and storage, respectively. Yaya was available as organic seed in 2007 so was analyzed with the organic cultivars.

The new organic hybrid cultivars Nectar, Nandera, and Namur (Bejo) and Negovia (Johnny's) were tested in 2007 alone. The carrots were seeded in June using an Earthway Seeder with the light carrot plate, to represent market gardening methods and to distribute the small seed volume for each cultivar. One challenge this presented was that the seeder was not able to be calibrated when seed size varied. Consequently, differences were observed in plant density at emergence related to unintended differences in seeding rate. Trials were planted and harvested by OACC technicians, and maintained (bed preparation, weeding) by the farmers at each site.

Carrot cultivars were planted in a random order in 10-m long rows, with a guard row on either side of the planting. Row spacing varied between sites to reflect grower practice; at most sites it was 50-60 cm. At harvest, two 1-m sections of row for each cultivar were hand-harvested. Sites were visited twice (3 weeks apart) to collect yield samples of earlier and later maturing cultivars. Carrots were graded to Canada No. 1 market standard. Any carrots that had insect damage, cracks, disease, or diameter smaller than 0.75" or length shorter than 4.5" (4" for Chantenay-type) were considered culls. Total and marketable yield were determined for each cultivar. Average length was determined from a random sample of six carrots. Colour and shape uniformity were judged on a scale of 1-10. Mean carrot weight was calculated by dividing total yield by the number of carrots harvested. Analysis of variance was completed with SAS using the mixed procedure, with year and site as blocks; LS Means was used for means comparison. The design was unbalanced and there were some different cultivars tested in each year (noted in Table 1).

For the taste test, surveys ranking carrot preference were performed at 4 farmers' markets (2 each per year). Each carrot was tasted by 10 individuals at each market. Carrot data was pooled for all trials and analyzed using non-parametric ANOVA and means comparison tests, excluding carrots grown for only one season.

PRELIMINARY RESULTS

Emergence: Variable emergence was an unpredicted consequence of using a smaller Earthway push-seeder with differently sized seed from carrot cultivars. Germination (tested in the lab for 2007) averaged 85% across all cultivars; Scarlet Nantes and Danvers 126 had lower germination rates (below 80%). The seed size (measured as thousand kernel weight) ranged from 0.83 g to 1.86 g between cultivars, with hybrid cultivars generally having heavier seed (Table 2).

Table 2. Thousand kernel weight (TKW), emergence and plant density of carrot cultivars grown in 2006/2007

	TKW g	**Emergence** plants m row^{-1}		**Harvest density** plants m row^{-1}	
Scarlet Nantes	1.35	29.8	a	31.1	a
Berlicummer 2	0.83	26.9	ab	29.0	ab
Yaya	1.73	24.1	abc	28.2	abc
Nandera	1.40	19.5	cd	25.2	abcd
Chantenay	1.40	22.3	bcd	24.7	abcd
Napoli OG	1.46	21.8	bcd	24.1	bcde
Danvers 126	1.63	23.1	bc	23.2	bcde
Neptune (conv)	1.71	21.4	bcd	21.7	cde
Napoli (conv)	1.50	20.7	cd	21.4	de
Dragon	-	26.1	abc	20.5	de
Berlicummer 1	1.12	24.1	abc	19.2	de
Negrovia	1.86	19.9	cd	18.9	de
Royal Red Core Chantenay	1.47	21.5	bcd	18.9	de
Nectar	1.74	15.9	d	18.6	de
Namur	1.51	18.7	cd	16.4	e
P cultivar		**0.029**		**0.001**	

a-e Values within the same column and followed by the same letter are not statistically different (LS Means, P<0.05).

Recommended seeding rate for carrots depends on row spacing and cultivar: processing carrots may be seeded at 15-20 seeds per 30-cm of row, while fresh carrots can be seeded at twice this density. When the seeding rate of the Earthway seeder was tested, the average rate across cultivars (adjusted for germination) was 37 seeds per 30-cm of row (124 seeds per m row). However, crop density at emergence and harvest was much lower than desired. Stand densities ranged between 16-30 plants m row^{-1} at emergence, and 16-31 at harvest.

Carrot density was significantly different between cultivars at emergence and at harvest (Table 2). Crop stands for the conventionally produced seed were not superior to the organic. The low germination and emergence could be due to the deposition of less seed than expected by the push seeder, poor seed-soil contact, environmental conditions (soil temperature, moisture, crusting, etc.) or a combination of these factors. Attention to proper seedbed conditions at planting can help produce a better crop stand. Growers who have a larger volume of carrots may be better served by investing in a precision seeder that can be calibrated to adjust for variable seed sizes.

Harvested carrots were graded, weighed, measured and assessed for colour and uniformity

Yield: Most organically produced cultivars produced carrots of comparable yield to the conventional standard cultivars Napoli and Neptune, indicating that organic growers do have some worthwhile cultivars available at present from organic seed. There was not a significant difference in total yield or marketable yield (total minus undersized or damaged carrots) of the carrot cultivars examined (Figure 1). For marketable yield, the cultivars Nectar and Nandera (tested in 2007 only) produced highest yield. Carrot yields were lower than expected; the average yield was 26.1 t ha^{-1} and the average marketable yield was 22 t ha^{-1}.

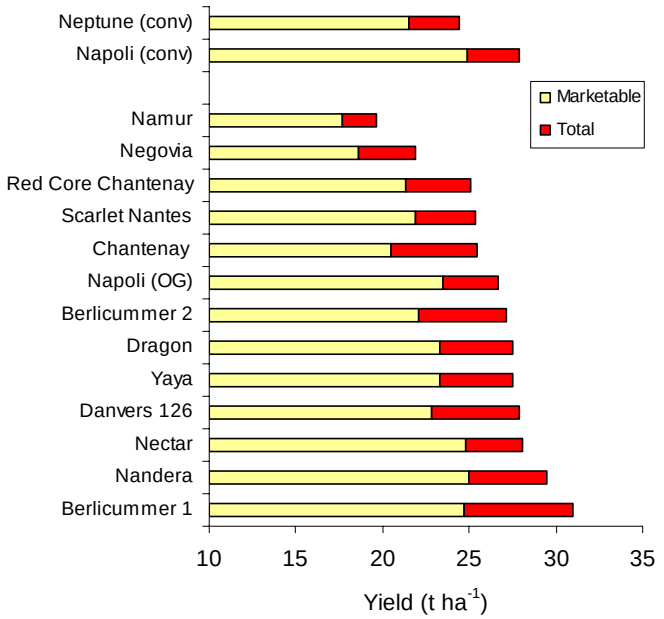


Figure 1. Total and marketable yield for carrots grown from conventional and organic seed

Overall, yield was higher in 2007 (29 t ha^{-1}) than in 2006 (23 t ha^{-1}). After grading, about 85% of carrots were marketable. There was large variation between cultivars and sites, which may be masking differences in yield.

Carrot varieties were also evaluated for root length, size and external colour (pale to deep). Colour is largely a factor of the carrot cultivar and may affect producer and consumer preferences, while root size and length are both influenced by both genetics and management (plant density, soil type, etc.). Dragon, a red-purple cultivar, scored as the darkest carrot but was statistically similar to 5 other cultivars (Table 3). Neptune, which is an imperator-type, was the longest carrot, while the two shortest cultivars were chantenay-type carrots. There were no significant differences in root size, although the smallest carrot (Scarlet Nantes, 41 g) was planted at the highest density. This suggests that the carrot crop can also compensate for low densities at emergence by increasing root size.

Table 3. Average root length, colour rating and uniformity rating for carrot cultivars grown in 2006/2007

	Colour[z] rating		Root length cm		Root size* g root^{-1}
Neptune (conv)	7	bcd	19	a	58
Nandera	7.8	ab	17	ab	62
Napoli (OG)	6.9	bcd	17	bc	59
Berlicummer 1	6.2	d	16	bc	64
Napoli (conv)	7.1	abcd	16	bcd	70
Namur	7.6	abc	16	bcde	65
Negovia	7.8	ab	16	cde	63
Dragon	8.6	a	15	cdef	66
Nectar	6.4	bcd	15	def	77
Danvers 126	6.5	bcd	15	ef	68
Scarlet Nantes	4.8	e	15	ef	41
Yaya	7.1	abcd	14	ef	49
Berlicummer 2	6.2	d	14	f	51
Chantenay	6.4	cd	12	g	50
Royal Red Core Chantenay	7.1	abcd	12	g	67
P cultivar	<0.001		<0.001		0.096

a-g Values within the same column and followed by the same letter are not statistically different (LS Means, P<0.05).
[z] Exterior carrot colour; 1= pale orange 9 = deep red-orange
*Backtransformed means reported

A participant at the 2007 Cultivar Preference test in Charlottetown PE (S. MacKinnon)

Preference Tests: To determine which cultivars produced fresh market carrots that customers would like, consumer preference tests were conducted at Farmers' Markets. The results from all trials are presented below (Table 4). Many of the carrots scored quite closely in the test rankings. Yaya, a new cultivar which was available as organic seed in 2007, consistently ranked as the best tasting carrot. The lower score for some of the storage cultivars (Berlicummer, Danvers 126) may be due to immaturity from early harvesting prior to the cold weather which can sweeten the taste of storage carrots.

Table 4. Carrot Preference Test Results for 2006-07

	Median Rank	
Yaya	8	a
Chantenay	7	b
Napoli OG	7	b
Scarlet Nantes	7	bc
Royal Red Core Chantenay	7	bc
Berlicummer 1	7	bc
Napoli (conv)	7	bc
Neptune (conv)	7	bc
Berlicummer 2	6	c
Danvers 126	6	c

a-c Values within the same column and followed by the same letter are not statistically different (Mann-Whitney, P<0.05)

CREDITS

Roxanne Beavers and Andy Hammermeister (OACC)

THE BOTTOM LINE...

Certified organic carrot cultivars tested on Maritime farms produced yield similar to popular conventional cultivars. The hybrid organic cultivar Yaya was selected as the favourite carrot at consumer preference tests. Carrot establishment and stand density was lower than expected; growers should pay close attention to seedbed conditions at planting.

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