The Nutrient Content of Organically and Conventionally Grown Horticultural Crops

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Fertilizer and MSW Compost Applications to Lowbush Blueberries

- Field experiments were initiated in May 1999
- Established field sites: Debert, N.S. (Truro sandy loam) and 2 sites near Musquodoboit, N.S (both Rawdon gravely loamy sands).
- Treatments were in a RCB with 6 treatments and 4 blocks -
    - Control [no fertilizer]; NK fertilizer; NPK fertilizer; and 3 rates of MSW compost: the equivalent of 100, 200 and 400 kg total N ha^{-1}

Fruit Yield (kg ha ^{S1}), macronutrients (g kg^{-1}), and micronutrients (mg kg^{-1}) analysis of berries sampled in 2001 and 2002*

Location	Treatment	Yield	N	P	K	Ca	Mg	Mn	Fe
Debert[x]									
	Control	3486	6.0	0.89	3.6	0.85	0.35	175b	34ab
	NK	2928	5.9	0.90	3.8	0.90	0.34	202b	20a
	NPK	2592	6.1	0.90	3.8	0.93	0.35	177b	30ab
	MSW1	3110	6.4	0.96	4.1	0.90	0.38	118ab	24ab
	MSW2	3335	6.3	0.93	3.9	0.92	0.34	81a	31ab
	MSW3	4292	6.9	0.90	3.9	0.87	0.34	68a	68b
White Field									
	Control	3593	6.5	0.79ab	3.9	1.07	0.38	214b	45
	NK	3701	5.9	0.64a	3.6	0.63	0.33	191b	52
	NPK	4892	5.8	0.77ab	3.9	0.89	0.34	187b	63
	MSW1	7082	6.1	0.84b	3.8	0.90	0.35	162ab	38
	MSW2	4206	5.8	0.76ab	3.8	0.89	0.34	120a	45
	MSW3	4688	6.1	0.79ab	4.1	0.80	0.31	109a	53
South Branch									
	Control	4180	4.9	0.53	3.6ab	0.65	0.35	40ab	40
	NK	3780	4.6	0.48	3.3a	0.62	0.36	30a	21
	NPK	5700	4.7	0.52	3.5ab	0.61	0.34	40ab	69
	MSW1	5710	4.6	0.49	3.6ab	0.61	0.35	32ab	48
	MSW2	6510	5.1	0.54	3.8ab	0.67	0.34	46b	78
	MSW3	5230	5.6	0.57	3.9b	0.66	0.32	47b	84

*Treatment means in a column (each site) followed by the same letter are not significantly different at p² 0.05

[x] Debert and White Field produced fruit in 2002, South Branch produced fruit in 2001.

Strawberry Expt. at BP 2002-2004

5 treatments & 3 cultivars; extractable soil and total leaf macro-, minor- & trace elements

Treatments had significant effects on

- Soil extractable K - Ruminant compost
- Soil extractable Ca - MSW compost
- Leaf K - Ruminant compost
- Leaf Ca - MSW compost

Although NS, the compost treatments (FMYC, Rum and MSW) produced higher soil P, Ca, Mg and some micronutrients than the NPK treatment

Trace elements – No significant treatment effects; leaf values were below toxic limits

Jen's Experiments

Strawberries (Sable) - comparison of fertilizers, ruminant compost, MSW compost, ruminant non-aerated compost tea, and MSW non-aerated compost tea (4 reps, RCB)

Raspberries (Willamette) - comparison of ruminant & MSW compost, and non-aerated ruminant and non-aerated MSW compost tea (4 reps, Chi sq)

Experimental Parameters :

- Plant growth: fruit yield; macro- and micronutrient content of leaves
- Fruit quality indices: nutrient content of fruit, FRAP assay, sugar content
- Soil properties: macro- and micronutrient content, % C, %N

Results – Strawberries

- Ruminant C in 2005 (2.3kg/m^2) and MSWC & MSWC tea in 2006 (1.6kg/m^2) produced the most berries
- No differences in plant tissue nutrient content among treatments in 2005; MSWC increased tissue Ca and Ruminant C increased tissue Mg in 2006
- **No differences in berry nutrient or antioxidant content among treatments (2005)**

Fruit Results at Lower Onslow, N.S.

Fruit yields (kg m^{2}), macronutrients (g kg^{-1}), and micronutrient (mg kg^{-1}) analysis of raspberries sampled in 2001*

Trtmt	Yield	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn	B
Fert	2.0b	9.9	1.6	8	1.0a	0.8	38b	24b	4	16	11
MSW1	1.1a	9.1	1.6	7	1.0a	0.8	26a	14a	4	15	8
MSW2	2.0b	8.6	1.8	8	1.2b	0.9	16a	12a	5	15	9
mean		9.2	1.7	8		0.8			4	15	9

Fruit yields (kg m^{2}), macronutrients (g kg^{-1}), and micronutrient (mg kg^{-1}) analysis of raspberries sampled in 2002*

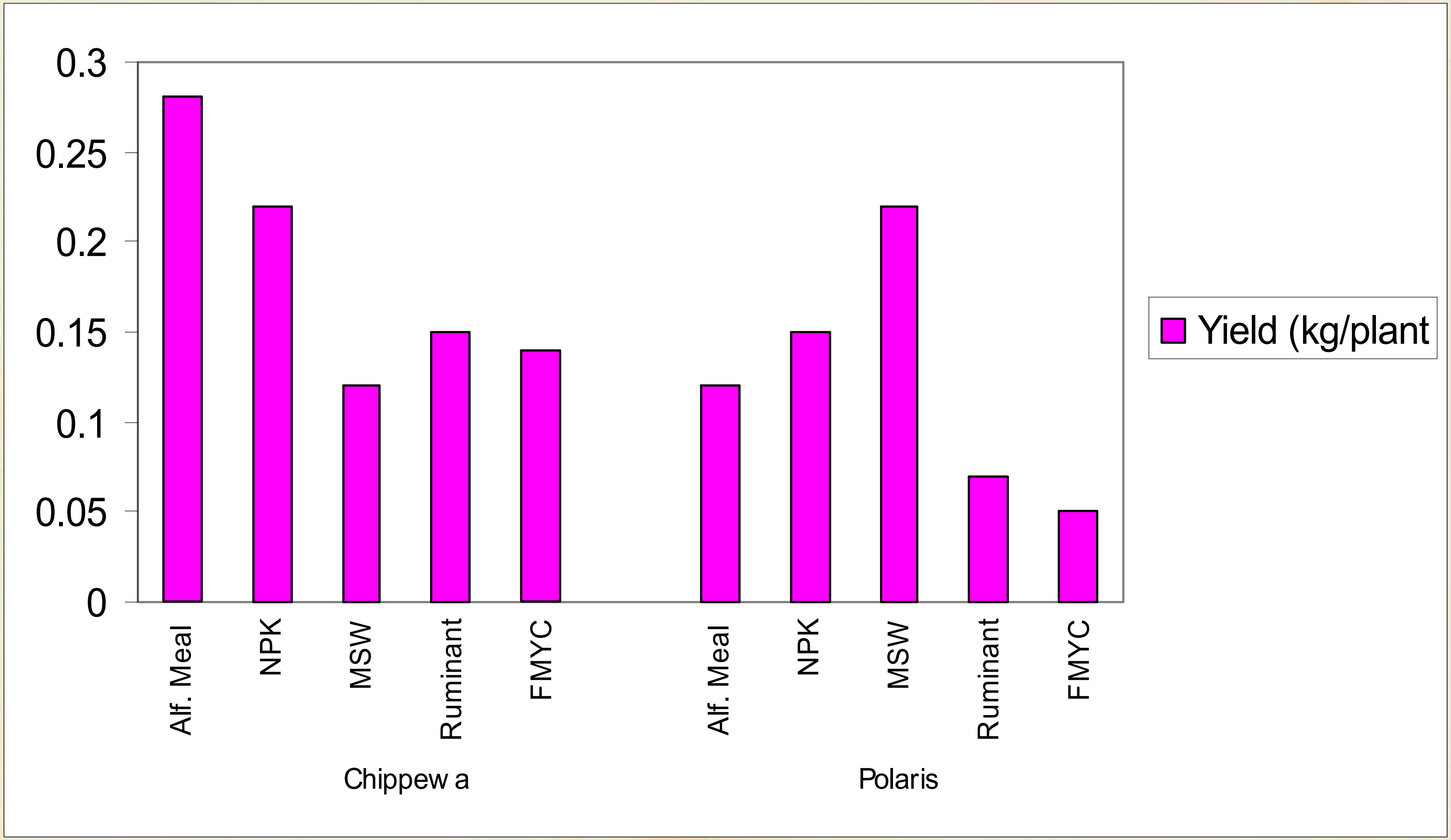
Trtmt	Yield	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn	B
Fert	2.0	7a	1.5a	8	1.0a	0.8	44	21b	4	15	9
MSW1	1.9	7a	1.9b	7	1.0a	0.9	46	12a	5	16	7
MSW2	2.2	9b	1.8b	8	1.2b	0.9	70	11a	9	15	8
mean	2.3			8		0.9	53		6	15	8

BP Half-high blueberry experiment (2002-2004)

- Two cultivars (Polaris, Chippewa)
- Five treatments (fertilizer [50/150N, 175/130 P_2O_5, 30/110 K_2O], MSW Compost, RUM Compost, FMY Compost, alfalfa meal+rock P)
- Five blocks (RCB)
- No herbicides or pesticides

- Evaluation: Fruit yield, soil and plant nutrients + trace elements

Half-high Blueberry Yields - 2004



BP Half-high blueberries (2005 - 2008)

- Two cultivars (Polaris, Chippewa)
- Five treatments (Control, MSWC, RUMC, MSWC tea , alfalfa meal+rock P)
- Five blocks (RCB)
- No herbicides or pesticides

- Fruit yield, soil and plant nutrients + trace elements

Mean Half-high Blueberry Yields - 2005 (g/plant)

Cultivar	Trt 1	Trt 2	Trt 3	Trt 4	Trt5	mean
Chippewa	104	134	110	106	76	106
Polaris	136	92	88	132	46	99

Mean Half-high Blueberry Yields – 2006 (g/plant)

Cultivar	Trt 1	Trt 2	Trt 3	Trt 4	Trt5	mean
Chippewa	135	301	210	183	299	226
Polaris	148	218	190	144	145	169

Trt 1 = alfalfa meal + rock P
Trt 2 = control (formerly fert.)
Trt 3 = MSW compost
Trt 4 = Ruminant compost
Trt 5 = MSW compost tea (formerly FYMC)

published in J. Vegetable Crop Production, vol. 2(1): 13-25,1996

Yield, Vitamin and Mineral Content of Four Vegetables Grown With Either Composted Manure or Conventional Fertilizer

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ABSTRACT. Although there is a considerable amount of interest in organically produced crops, there is a lack of scientific research evaluating vegetable production from paired organic and conventional experimental plots. A comparative study was conducted for three years in a Pugwash sandy loam near Truro, N.S. Five replicates of two treatments (organic and conventional) were established annually for carrots, cabbages, potatoes and sweet corn. The addition of pesticides, lime and NPK fertilizer to the conventional plots followed the Nova Scotia Soil Test Recommendations; while lime, rotenone or Bt and composted manure were applied to the organic plots according to the guidelines established by the Organic Crop Improvement Association, Inc. (OCIA). The compost was made using chicken or beef manure and straw. Compost was analysed for total N and applied at rates appropriate to each crop assuming 50% N availability during the cropping season. Marketable yields were recorded and representative leaf samples and edible portions of the vegetables were digested and analysed for 12 macro- and micronutrients. At harvest, α and β carotene and vitamins C and E were evaluated by HPLC.

Given the number of factors evaluated each year for each of the four crops there were relatively few differences in the yield, vitamin and mineral content of the vegetables grown using the two different production systems. We believe this was related to the proper use of fertility amendments and pest control practices. When quality compost is analyzed prior to use, vegetables can be provided with approximately the same amount of essential nutrients from compost as from inorganic fertilizers.

TABLE 3. Significant effects of treatments on edible or leaf nutrients where P is less than 0.12*

crop	component	Element	Conc.	Org	Conv	Pr>F
Cabbage	edible/leaf	N	g/kg	19.0	19.1	0.107
		Mn	mg/kg	19.4	21.6	0.115
		Zn	mg/kg	16.3	13.3	0.105
Carrot	edible	N	g/kg	13.4	14.1	0.095
		S	g/kg	1.82	1.66	0.050
		B	mg/kg	20.5	18.1	0.022
		Mn	mg/kg	18.8	21.2	0.027
		Cu	mg/kg	6.4	7.8	0.068
	leaf	Na	g/kg	5.4	4.6	0.033
		S	g/kg	4.23	3.59	0.109
Corn	leaf	Cu	mg/kg	12.0	13.8	0.070
Potato	edible	P	g/kg	1.73	1.38	0.067
		Mg	g/kg	0.81	0.75	0.004
		Na	mg/kg	40	30	0.074
		Mn	mg/kg	4.3	5.3	0.083
	leaf	B	mg/kg	21.9	17.2	0.110

* Analyzed by ANOVA using SAS

published in Agriculture, Ecosystems & Environment 61:155-162, 199

Yield, Vitamin and Mineral Contents of Organically and Conventionally Grown Carrots and Cabbage

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Table 6
Vitamin content of carrots (mg/kg fresh weight)[a]

	1990			1991			1992		
Vitamin	Con[c]		Org[d]	Con		Org	Con		Org
Vitamin C	16.9	*	21.5	29.4		26.9	34.3	*	28.7
	±2.9		±2.5	±7.0		±6.5	±4.1		±3.9
Vitamin E	15.5		13.8	13.6	*	14.0	7.5		8.3
as *a*--tocopherol	±1.7		±2.8	±1.4		±1.4	±0.8		±2.5
a-carotene	38.5		37.5	35.6		35.5	32.9	*	28.5
	±5.5		±11.8	±1.9		±2.0	±3.4		±4.2
§-carotene	124.5		118.6	89.1		84.0	92.8	*	81.4
	±24.2		±21.6	±14.2		±6.9	±10.7		±6.0
§-carotene	143.8		140.0	103.3		101.8	109.2	*	95.7
equivalents[b]	±22.4		±23.2	±10.0		±7.6	±12.3		±6.9

* denotes significant difference at p ² 0.05

[a] values are mean ± S.D.

[b] §-carotene equivalents = §-carotene + (*a*--carotene) 0.5

[c] Con = conventional

[d] Org = organic

Table 8
Marketable yield (t/ha) and vitamin content of cabbage[a]

	1990		1991		1992	
	Con[b]	Org[c]	Con	Org	Con	Org
Yield	52.33	* 56.00	56.36	53.04	30.63	27.68
	±3.06	±3.06	±4.87	±10.93	±3.79	±5.98
Vitamin C	534.20	539.22	498.72	487.11	583.56	* 412.45
(m*g/g* fresh wt.)	±37.21	±29.88	±61.98	±26.64	±63.94	±32.40
Vitamin E	0.44	0.43	0.34	0.31	0.32	0.34
as a-tocopherol	±0.08	±0.09	±0.09	±0.10	±0.01	±0.02
(m*g/g* fresh wt.)						

* denotes significant difference at p ² 0.05

[a] values are mean ± S.D.

[b] Con = conventional

[c] Org = organic

published in Agriculture, Ecosystems and Environment 68:207-216, 1998

Yield, Vitamin and Mineral Contents of Organically and Conventionally Grown Potatoes and Sweet Corn

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TABLE 5.
VITAMIN C CONTENT OF POTATOES AS A FUNCTION OF STORAGE TIME (µG/G FRESH WT)

	1990			1991	
TIME	CONV	ORG	TIME	CONV	ORG
1 WEEK	380.1	360.4	1 WEEK	171.6	164.6
S.D.	±32.3	±43.7	S.D.	±25.2	±17.6
CV %	8.5	12.1	CV %	9.2	10.2
8 WEEKS	ND	ND	8 WEEKS	84.4	80.7
			S.D.	±4.4	±5.7
			CV %	5.2	7.1
12 WEEKS	178.9	173.5	12 WEEKS	60.1	58.0
S.D.	±14.7	±17.2	S.D.	±10.0	±6.9
CV %	8.2	9.9	CV %	16.6	11.9
24 WEEKS	67.6	70.5	24 WEEKS	19.3	18.6
S.D.	±6.5	±11.7	S.D.	±2.3	±2.5
CV %	9.6	16.6	CV %	11.7	13.5

TIME = TIME OF ANALYSIS IN WEEKS AFTER HARVEST
ND = NOT DETERMINED

Table 6.
Marketable yield (t/ha) and vitamin content of sweet corn kernels [a]

	1990		1991		1992	
	Con [b]	Org [c]	Con	Org	Con	Org
Corn [d]	4.73 ±0.87	4.80 ±0.14	12.95 * ±0.54	11.16 ±0.87	8.92 * ±1.20	5.97 ±0.82
Corn cob mass (g)	119 ±6	115 ±9	197 ±9	185 ±14	125 * ±5	107 ±3
Vitamin C (µg/g fresh wt.)	77.84 ±12.90	72.97 ±18.62	108.74 ±10.21	104.76 ±12.25	12.81 ±1.06	15.50 ±4.11
Vitamin E as a-tocopherol (µg/g dry wt.)	1.33 ±0.52	0.92 ±0.77	1.32 ±0.25	1.28 ±0.29	0.20 ±0.16	0.48 ±0.27
as g-tocopherol (µg/g dry wt.)	22.95 ±3.15	22.67 ±1.32	9.71 ±1.39	9.15 ±2.36	5.40 ±1.11	6.57 ±1.39
Total Vitamin E [e] (µg/g dry wt.)	4.32 ±0.76	3.68 ±0.87	2.58 ±0.37	2.47 ±0.58	0.90 ±0.23	1.39 ±0.42

* denotes significant difference between treatments at p ² 0.05 for that year

[a] values are mean ± S.D.

[b] Con = conventional

[c] Org = organic

[d] corn yield is based only on the total cob weight

[e] total Vitamin E = a-tocopherol + (g-tocopherol) 0.13

Biological, Agriculture and Horticulture 23:85-96, 2005

Soil fertility, yield, and nutrient contents of vegetable crops after twelve years of compost or fertilizer amendments.

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Fresh Crop Yields (kg) From the 6 Paired Rotation Plots in 2001 (the 12th year)

Plot #		NPK	YMFC
1	Cauliflower*	10.2	4.0
2	Tomatoes	34	43
3	Onions	21	23
4	Peppers	5.3	6.2
5	Carrots	21	23
	%GradeA	72.9%	73.2%
6	Green Beans**	3.9	6.2
	Yellow Beans**	5.0	7.7

* Yields significantly higher with the NPK treatment

** Yields significantly higher with the YMFC treatment

Mean nutrient content of the edible portion of the 6 vegetables in 2001

	YMFC	NPK	
C	440	436	g/kg
N	13	12	g/kg
P *	2.7	3.3	g/kg
K	12	16	g/kg
Ca	1.7	1.8	g/kg
Mg	1.1	1.2	g/kg
S	2.9	4.5	g/kg
Fe	47	60	mg/kg
Mn	11	13	mg/kg
Cu	8	8	mg/kg
Zn	16	17	mg/kg
B	11	11	mg/kg

* significant differences between treatments at $p < 0.05$

Summary of Significant Results for Leaf and Soil

SOIL			LEAF		
1999	2000	2001	1999	2000	2001
CEC	CEC	pH	Fe		P
C	C	EC*	B		K
N	Ca	CEC			
P	Mn	C			
K	Cu	N			
Ca	Zn	P			
Mn	B	Ca			
		Mg			
		Mn			
		Cu			
		Zn			
		B			

* EC analyzed in 2001 only

Discussion

Mineralization of recently added & previously applied organic matter (compost) strongly influence plant response in a particular crop year, especially for high nutrient-demanding crops. Seasonal variation in soil moisture and temperature seem to have a greater influence on plant production, through mineralization, than the source and amount of mature compost applied.

Conclusion

I conclude that long-term applications of agronomically-appropriate levels of quality compost provide equivalent levels of nutrients for most vegetable crops. After about 5 years, quality compost produces similar crop yields and nutrient contents as fertilizer.

Future Research at BP

- New strawberry expt. -planted 2006, 3 MSWC and 2 MSWC tea rates
- Continue raspberry expt.
- Continue half-high blueberry expt.
- Continue blackberry expt. (since 2003)
- Continue asparagus expt. (since 2002)
- ‘07 - turfgrass, tomatoes, beans (compare composts, amended composts, combo.)

A VIEW OF THE ATLANTIC FROM FROM MY FRONT PORCH