Winter 2020

THE UNIVERSITY OF BRITISH COLUMBIA

Organic Vegetable Nutrient Management Project: Regional Field Trials

Our project was designed to help identify organic nutrient management strategies that are most likely to balance goals of crop production and environmental stewardship on organic vegetable farms. We collected over 40 compost samples, 600 soil samples, and setup *on-farm trials* at 20 farms for two growing seasons (2018, 2019) in three regions: Fraser Valley, Pemberton, and Vancouver Island. We also managed two *experimental sites* with randomized, replicated treatments at two locations: UBC Farm in Vancouver and Green Fire Farm in Duncan.

Attached to this report you will find:

1. A summary of data measured across all farms
2. A summary of composts sampled in 2019

On-Farm Trial Design

In this part of the study, we assessed nutrient management strategies for applying nitrogen (N) and phosphorous (P) under actual operational farm conditions, in each of the three farming regions studied. Because the goal of our research was to investigate how best to balance economic and soil management objectives with minimal expectations of laboratory analysis and nutrient management planning, across a diversity of working farms, we relied on crop (N/P) removal estimates to determine amendment application rates. Crop removal calculations are based on target yields and the nutrient content of the crop, and do not depend on soil tests and interpretation. In contrast, amendment application rates using an agronomic balance approach are calculated using the predicted crop uptake minus the predicted available nutrients determined from all sources including soil and cover crops analysis. For further information on organic nutrient management, and to explore nutrient calculators, see the Nutrient Management Ref. Guide.

Three treatments were established at each on-farm trial site:

1. **'High Compost' (HC):** Compost targeting N removal
2. **'Low Compost + N' (LC+N):** Compost targeting P removal + feather meal to target N removal
3. **'Typical' (TYP):** Your typical approach for supplying nutrients for the crop in the trial

Results – *general summary*

The three nutrient management strategies were evaluated in terms of: 1. Crop yield, 2. Input costs, 3. Post-harvest available N, 4. Post-harvest available P, and 5. Mid-season labile soil carbon.

- We found wide variation in costs and availability of organic nutrient sources, with high N and P composts being relatively inexpensive in the Fraser Valley, whereas they were either lower nutrient or more expensive on Vancouver Island; Pemberton composts were between these
- Our findings suggest that relatively inexpensive and available nutrient sources can result in higher levels of post-harvest available N and P. Environmentally, this indicates a need for additional monitoring that is consistent with changing provincial regulations (see Nutrient Management Ref. Guide).
- Overall, we only found consistent outcomes in terms of post-harvest soil P, where HC > LC+N.

Results – *data summary*

1. Project results: The results from analyzing data collected across all farms are summarized in Table 1; a brief description of the utility of these criteria as indicators and how they are measured are also described in this table. These data are plotted in figures in **Appendix A.** Results – *Project results*.
2. Data by farm: The data from outcomes measured across all farms, as well as amendment and calculated nutrient application rates, are provided in **Appendix B.** Results – *Data by farm*, and compost data is provided in **Appendix C.** *Compost test results*.

Next Steps

We are still processing samples and analyzing data from the experimental sites (UBC and Green Fire farms), and these results will be shared in the future.

Table 1. Summary of results from analyzing data collected across all farms and regions.

Indicator [Measurement in brackets]	**Importance**	**Primary findings**
Crop yield [Harvestable crop biomass]	An indicator of farm productivity.	• Averaged over regions and years, no differences in yield were found. • However, in 2019, in the Fraser Valley only, yields were greater in the HC plots than the TYP plots. Relative yield data are plotted in **Figure 2**
Input costs [Cost of inputs + associated shipping; only inputs containing N and P]	An indicator of the economic feasibility of the nutrient management strategy.	• Averaged over regions and years, no differences in input costs were found. • Only in the Fraser Valley, both the HC and LC+N plots had greater input costs than the TYP plots. • Input cost data are plotted in **Figure 3**
Post-harvest available N [Ammonium (NH_4^+) + nitrate (NO_3^-)]	An indicator of: 1. Nitrogen-use efficiency, 2. Environmental impact (potential for N loss to environment)	• Averaged over regions and years, no differences in post-harvest available N were found. • However, some plots had post-harvest NO_3^- concentrations higher than the regulations being phased in in BC [learn more by visiting Ministry of Agriculture website] • Post-harvest NO_3^- data is plotted in **Figure 4**, relative to the values in these forthcoming regulations
Post-harvest available P [Kelowna-extractable P]	An indicator of: 1. Phosphorus-use efficiency, 2. Environmental impact (potential for P loss to environment)	• Averaged over regions and years, post-harvest available P was 21% higher in the HC plots than in the LC+N plots • Post-harvest available P data is plotted in **Figure 5**, relative to agronomic soil test values published by BC Ministry of Agriculture
Soil carbon [Permanganate-oxidizable carbon (POx-C)]	An indicator of the impacts to soil carbon balance, i.e., soil health	• Averaged over regions and years, no differences in POx-C were found.

Questions? Want to know more? Visit http://sal-lab.landfood.ubc.ca/, or contact us directly:

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Agriculture and Agri-Food Canada

organic SCIENCE CLUSTER 3

Appendix A. Results – *Project results*

Reading a boxplot:

In the figures below, data are plotted using boxplots. A boxplot is a standard method to illustrate the distribution of data, and useful in conveying the symmetry, grouping, and skewness of a dataset. Boxplot features (outliers, whiskers, interquartile range, median, and mean, are illustrated on Figure 1).

Relative Yield:

Yield measurements were collected in kilograms per bed metre (kg bed m^{-1}), but due to the wide variety of crops used in this study, to better visualize differences, we have converted the yield data to normalized relative yield data, by year and farm. This is performed by dividing the measured yield value of one plot by the average of the three plots within that farm (i.e., dividing Plot 1 by the average of Plots 1, 2, and 3). This produces a percentage yield value, relative to the farm average (hence the name, "relative yield"). Yield data are illustrated in this report as relative yield, but all statistical analyses were performed on data in the original units (kg bed m^{-1}), using a model that can account for the variability in these data.

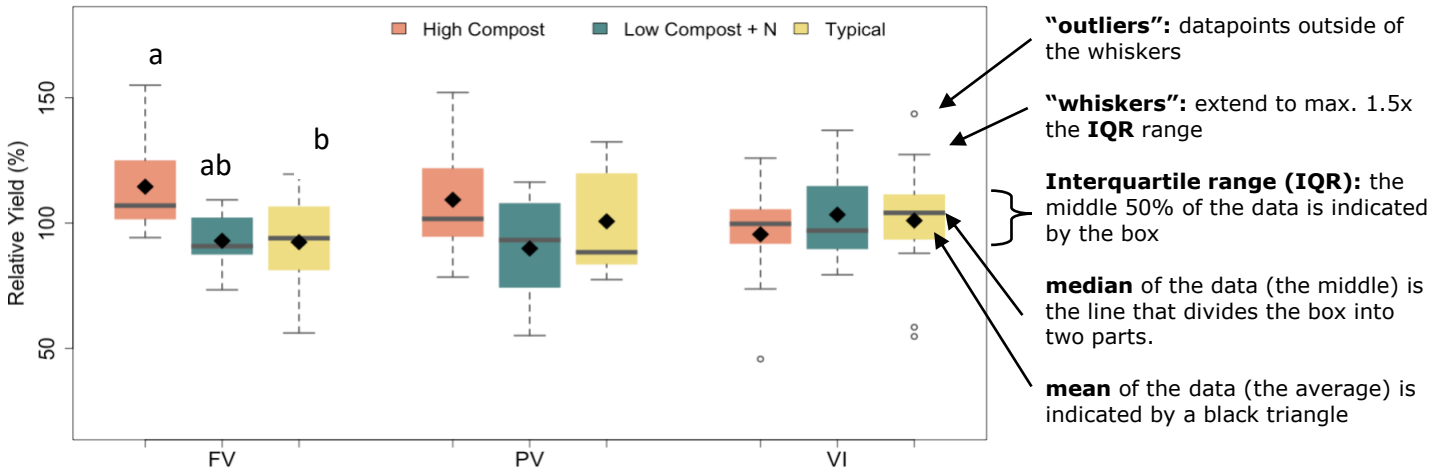

Figure 1. Boxplot of relative yield by nutrient management strategy, averaged over years within regions (lower Fraser Valley (FV), Pemberton Valley (PV), and Vancouver Island (VI)). There were no significant differences found across all regions. Within regions, yields of nutrient management strategies with different letters are significantly different in 2019 only.

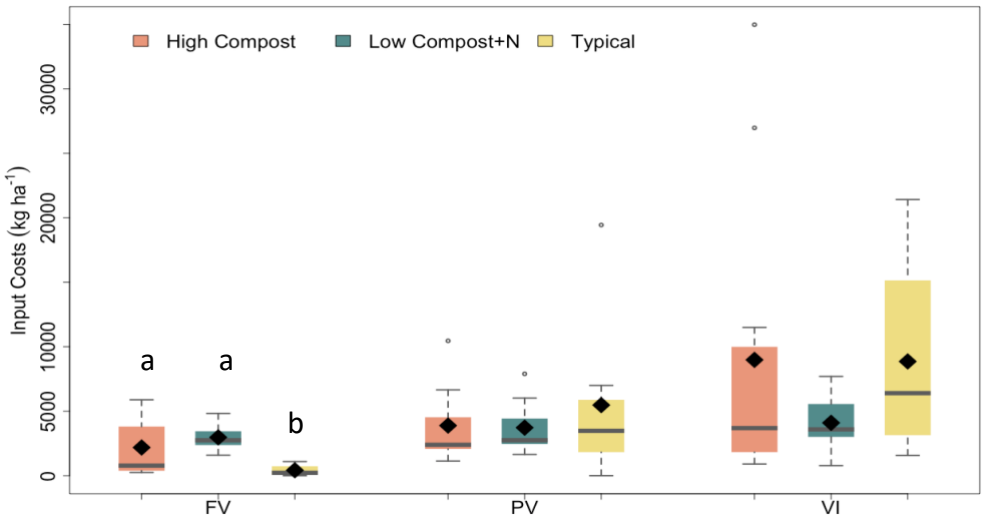

Figure 2. Boxplot of input costs ($) by nutrient management strategy, averaged over years within regions (lower Fraser Valley (FV), Pemberton Valley (PV), and Vancouver Island (VI)). There were no significant differences found across all regions. Input costs of nutrient management strategies with different letters are significantly different.

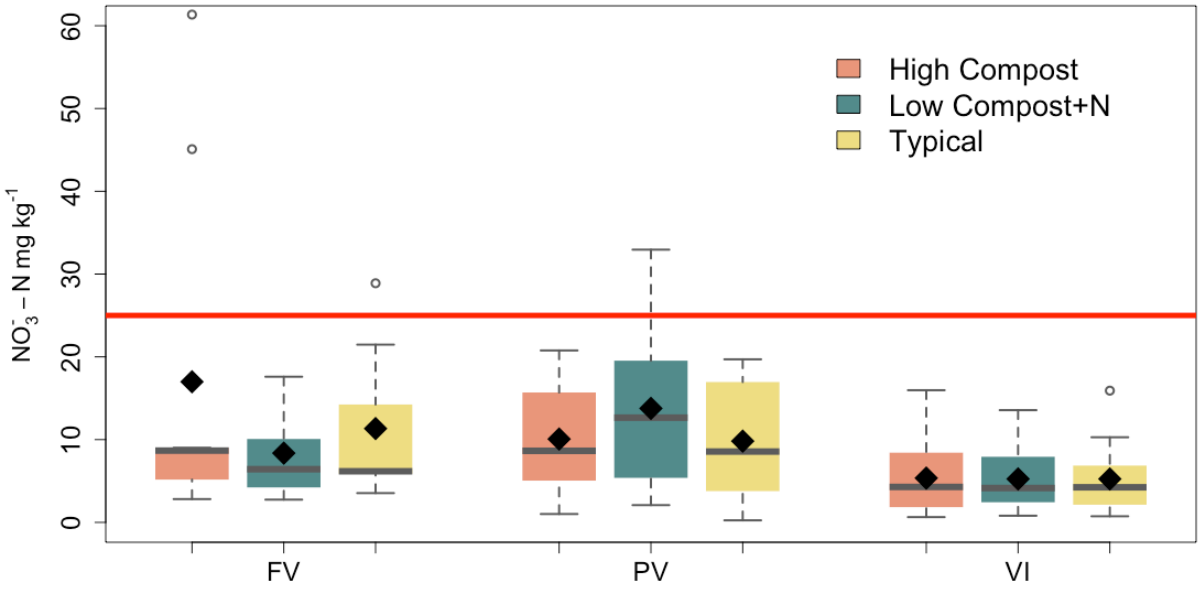

Figure 3. Boxplot of post-harvest NO_3^- (mg kg^{-1}) in the 0-30cm depth by nutrient management strategy, averaged over years within regions (lower Fraser Valley (FV), Pemberton Valley (PV), and Vancouver Island (VI)). The red line indicates the threshold of 25 mg NO_3^- kg for the 0-30 cm depth, which will require farms in certain regions of the province to carry out further actions, as indicated in the new Code of Practice for Agricultural Management. See additional resources handout for further information. There were no significant differences found in yields between nutrient management strategies across all regions.

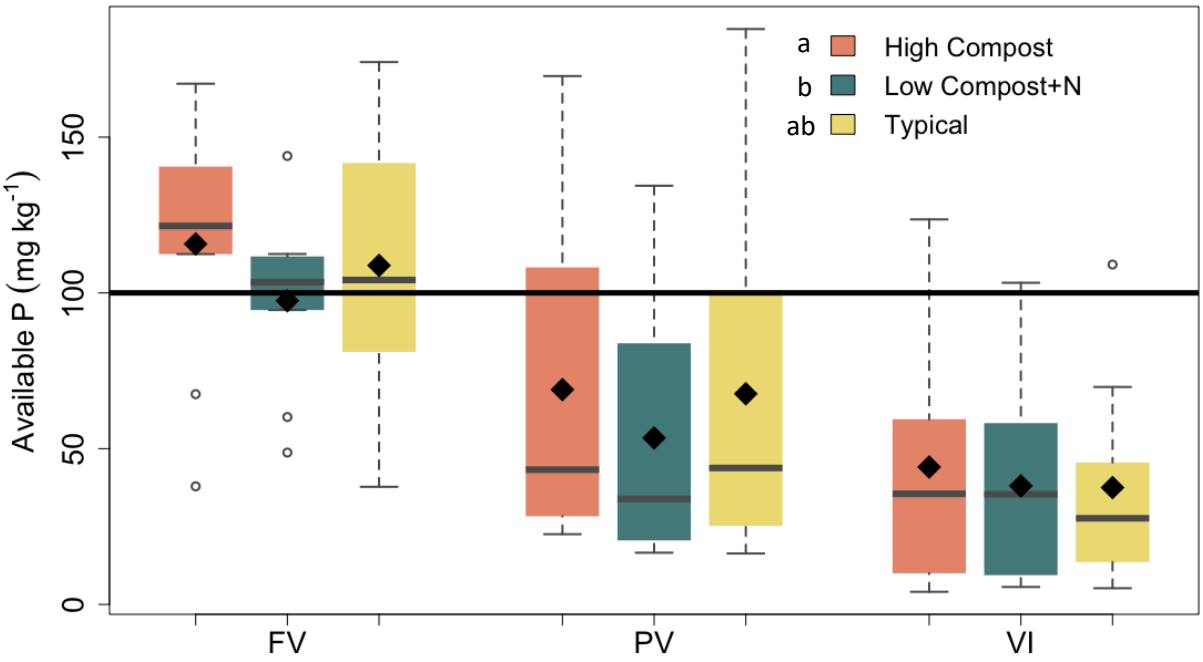

Figure 4. Boxplot of post-harvest available P (mg kg^{-1}) in the 0-15cm depth by nutrient management strategy, averaged over years within regions (lower Fraser Valley (FV), Pemberton Valley (PV), and Vancouver Island (VI)). Nutrient management strategies with different letters (top right) are significantly different when averaged across all regions. The black line indicates the soil test P agronomic threshold of 100 mg kg^{-1}; beyond this, additional P inputs are not expected to provide agronomic benefits. See additional resources handout for more information.

Appendix B. Results – *Data by farm*

Table B - 1. Summary of measured outcomes by farm, year, and nutrient management strategy (POx-C = permanganate oxidizable carbon; an active pool of soil carbon; HC = high compost strategy, LC+N = low compost +N strategy, and TYP = typical nutrient strategy for each farm).

NEW Farm ID	Year	Crop	Strategy	Yield	POx-C	Post-harvest P (0-15cm)	Post-harvest NO_3^- (0-30cm)	Input Costs
				kg bed m^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}	$ ha^{-1}
1	2018	carrot	HC	12.4	1111	35	5	3,609
			LC+N	11.8	1196	20	5	3,164
			TYP	12.3	1178	19	7	6,399
2	2018	beet	HC	4.2	1295	37	2	3,688
			LC+N	5.3	1251	85	3	4,701
			TYP	2.1	1226	47	1	1,570
	2019	-	HC	4.7	1252	50	1	1,942
			LC+N	3.2	1300	85	1	2,851
			TYP	3.3	1321	44	1	4,586
3	2018	beet	HC	1.2	1210	5	10	0
			LC+N	1.9	1203	8	4	5,718
			TYP	1.7	1175	5	3	4,559
	2019	onion	HC	0.7	1091	4	10	4,059
			LC+N	1.6	1059	6	8	6,266
			TYP	2.1	979	5	5	15,765
4	2018	potato	HC	2.4	1129	36	16	904
			LC+N	3.0	1111	35	14	779
			TYP	1.3	1038	28	16	1,695
	2019	beet	HC	4.4	940	47	2	944
			LC+N	4.8	923	39	2	3,590
			TYP	4.5	947	43	7	1,603
5	2018	carrot	HC	10.9	1262	59	1	1,710
			LC+N	11.6	1209	64	1	1,588
			TYP	13.6	1203	70	2	7,564
	2019	beet	HC	10.8	1393	124	7	8,486
			LC+N	9.2	1340	103	10	5,102
			TYP	14.8	1358	109	10	21,417
6	2018	-	HC	9.2	1108	-	2	34,977
			LC+N	8.7	875	-	5	7,698
			TYP	10.3	952	-	5	15,961
	2019	onion	HC	4.5	1091	10	5	26,973
			LC+N	3.8	897	9	8	6,014
			TYP	4.8	944	14	3	14,528
7	2019	potato	HC	2.7	1085	-	-	11,498
			LC+N	2.5	1048	-	-	3,313
			TYP	2.6	1199	-	-	6,371
8	2018	-	HC	-	1209	77	4	-
			LC+N	-	1325	58	3	-

NEW Farm ID	Year	Crop	Strategy	Yield	POx-C	Post-harvest P (0-15cm)	Post-harvest NO_3^- (0-30cm)	Input Costs
				kg bed m^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}	\$ ha^{-1}
			TYP	-	1167	46	3	-
9	2018	potato	HC	3.9	422	118	21	780
			LC+N	3.7	386	95	16	2,746
			TYP	4.0	399	89	45	1091
10	2018	-	HC	-	569	38	3	5,158
			LC+N	-	565	49	4	4,829
			TYP	-	575	38	6	1,083
11	2018	beet	HC	7.8	2710	141	5	-
			LC+N	4.8	2759	106	3	-
			TYP	7.0	2750	131	6	-
	2019	carrot	HC	9.2	2626	112	9	-
			LC+N	5.3	2629	113	9	-
			TYP	3.3	3042	159	12	-
12	2018	carrot	HC	5.7	1237	144	5	5,887
			LC+N	5.2	1279	112	4	2,131
			TYP	7.2	1226	104	4	0
	2019	potato	HC	3.0	1275	133	7	2,460
			LC+N	2.1	1294	103	5	1,590
			TYP	1.8	1200	81	4	0
13	2018	potato	HC	3.4	568	122	61	418
			LC+N	3.1	404	97	18	3,448
			TYP	3.6	665	142	29	373
	2019	potato	HC	6.8	758	167	9	248
			LC+N	6.8	735	144	10	3,443
			TYP	5.2	907	174	14	222
14	2019	potato	HC	4.7	1115	68	9	347
			LC+N	4.9	1094	60	6	2,617
			TYP	3.8	1107	61	6	169
15	2019	potato	HC	2.9	924	49	10	2,120
			LC+N	3.3	914	32	13	2,750
			TYP	2.4	885	52	9	4,766
16	2018	potato	HC	3.7	1035	38	5	2,395
			LC+N	3.1	1188	36	6	2,167
			TYP	2.4	1002	34	2	1,918
	2019	beet	HC	2.8	611	23	5	2,405
			LC+N	1.2	633	18	21	2,744
			TYP	2.7	627	16	8	1,730
17	2018	-	HC	-	1178	139	21	10,456
			LC+N	-	1129	131	33	6,022
			TYP	-	1229	149	20	19,441
	2019	beet	HC	5.4	861	170	12	1,135
			LC+N	6.1	922	134	13	1,647
			TYP	9.0	1086	185	17	6,997
18	2018	beet	HC	7.4	961	32	7	6,657

NEW Farm ID	Year	Crop	Strategy	Yield	POx-C	Post-harvest P (0-15cm)	Post-harvest NO_3^- (0-30cm)	Input Costs
				kg bed m^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}	\$ ha^{-1}
	2019	carrot	LC+N	7.7	733	24	5	7,897
			TYP	9.8	916	36	6	3,478
			HC	3.9	804	77	20	2,027
			LC+N	1.5	689	36	18	2,839
			TYP	2.3	839	53	17	0
19	2018	-	HC	1.4	552	25	1	-
			LC+N	1.6	315	17	2	-
			TYP	1.1	248	17	0	-

Table B - 2 Summary of actual amendment and estimated nutrient application rates. (HC = high compost strategy, LC+N = low compost +N strategy, and TYP = typical nutrient strategy for each farm; C = carbon, N = total N, PAN = Plant-available N, P = phosphorus)

				Application rates: by amendment					**Total application rates:** by nutrient strategy		
ID	**year**	**strategy**	**amendment**	**amendment rate**	**C**	**N**	**PAN**	**P_2O_5**	**N**	**PAN**	**P_2O_5**
				----- Mg ha^{-1} -----		----- kg ha^{-1} -----			----- kg ha^{-1} -----		
9	2018	HC	compost	8.0	3.5	362	108	332	362	108	332
		LC+N	compost	2.4	1.0	106	32	98	183	108	98
			feathermeal (11-0-0)	0.7	0.0	76	76	0			
		TYP	compost	11.2	4.9	507	151	465	507	151	465
10	2018	HC	compost	23.5	7.4	662	140	332	662	140	332
		LC+N	compost	12.0	3.8	336	71	169	403	138	169
			feathermeal (11-0-0)	0.6	0.0	67	67	0			
		TYP	compost	2.6	0.8	73	15	37	97	39	37
			bloodmeal (12-0-0)	0.2	0.0	24	24	0			
11	2018	HC	compost	38.6	13.8	1268	201	648	1268	201	648
		LC+N	compost	4.0	1.4	132	21	66	306	195	66
			feathermeal (11-0-0)	1.6	0.0	175	175	0			
		TYP	compost	44.5	15.9	1460	232	745	1608	379	845
			Enterra (3-2-5)	4.9	0.0	148	148	98			
	2019	HC	compost	18.0	4.1	396	97	211	396	97	211
		LC+N	compost	3.5	0.8	77	19	41	155	97	41
			feathermeal (11-0-0)	0.7	0.0	78	78	0			
		TYP	compost	58.4	13.4	1285	316	682	1499	530	824
			Enterra (3-2-5)	7.1	0.0	214	214	142			
12	2018	HC	compost	23.9	7.0	291	59	389	291	59	389

				Application rates: by amendment					**Total application rates:** by nutrient strategy		
ID	**year**	**strategy**	**amendment**	**amendment rate**	**C**	**N**	**PAN**	**P_2O_5**	**N**	**PAN**	**P_2O_5**
				----- Mg ha^{-1} -----		----- kg ha^{-1} -----			----- kg ha^{-1} -----		
		LC+N	compost	1.5	0.5	19	4	25	72	57	25
			feathermeal (11-0-0)	0.5	0.0	53	53	0			
		TYP	-	0.0	0.0	0	0	0	0	0	0
	2019	HC	compost	8.7	3.8	149	46	261	149	46	261
		LC+N	compost	0.6	0.3	10	3	18	53	46	18
			feathermeal (11-0-0)	0.4	0.0	43	43	0			
		TYP	-	0.0	0.0	0	0	0	0	0	0
13	2018	HC	compost	11.1	5.1	432	263	392	432	263	392
		LC+N	compost	1.1	0.5	42	25	39	145	129	39
			feathermeal (11-0-0)	0.9	0.0	103	103	0			
		TYP	compost	9.9	4.6	386	235	350	386	235	350
	2019	HC	compost	9.2	3.4	267	115	465	267	115	465
		LC+N	compost	0.9	0.3	26	11	46	130	115	46
			feathermeal (11-0-0)	0.9	0.0	104	104	0			
14	2018	HC	compost	17.0	6.7	359	148	421	359	148	421
		LC+N	compost	1.8	0.7	38	16	44	184	162	44
			feathermeal (11-0-0)	1.3	0.0	146	146	0			
		TYP	compost	4.1	1.6	86	36	101	86	36	101
	2019	HC	compost	12.1	2.9	266	87	332	266	87	332
		LC+N	compost	1.2	0.3	27	9	34	105	87	34
			feathermeal (11-0-0)	0.7	0.0	78	78	0			
		TYP	compost	5.9	1.4	130	42	163	130	42	163
15	2019	HC	compost	13.4	3.7	321	64	140	321	64	140
		LC+N	compost	2.3	0.7	56	11	25	108	64	25

				Application rates: by amendment					**Total application rates:** by nutrient strategy		
ID	**year**	**strategy**	**amendment**	**amendment rate**	**C**	**N**	**PAN**	**P_2O_5**	**N**	**PAN**	**P_2O_5**
				----- Mg ha^{-1} -----		----- kg ha^{-1} -----			----- kg ha^{-1} -----		
			feathermeal (11-0-0)	0.5	0.0	52	52	0			
		TYP	Hi-N (10-3-0)	1.4	0.0	139	139	41	139	139	41
16	2018	HC	compost	21.8	5.3	379	91	236	379	91	236
		LC+N	compost	2.6	0.6	45	11	27	101	66	27
			feathermeal (11-0-0)	0.5	0.0	55	55	0			
		TYP	compost	8.2	2.0	143	34	89	143	34	151
			Hi-P (0-12-0)	0.5	0.0	0	0	62			
	2019	HC	compost	20.4	5.5	448	82	202	448	82	202
		LC+N	compost	2.9	0.8	64	12	27	134	82	27
			feathermeal (11-0-0)	0.6	0.0	71	71	0			
		TYP	compost	14.6	4.0	322	59	144	322	59	144
17	2018	HC	compost	51.1	10.5	916	171	529	916	171	529
		LC+N	compost	6.4	1.3	115	21	66	258	164	66
			feathermeal (11-0-0)	1.3	0.0	143	143	0			
		TYP	compost	71.3	14.6	1279	238	737	1358	317	815
			Gaia Green mix (4-4-4)	2.0	0.0	79	79	78			
	2019	HC	compost	15.3	3.8	307	53	183	307	53	183
		LC+N	compost	1.5	0.4	30	5	18	77	52	18
			feathermeal (11-0-0)	0.4	0.0	47	47	0			
		TYP	compost	58.2	14.5	1163	199	692	1163	199	742
			rock phosphate (0-3-0)	1.6	0.0	0	0	50			
18	2018	HC	compost	10.9	4.5	483	215	573	483	215	573
		LC+N	compost	1.3	0.5	56	25	66	246	215	66

				Application rates: by amendment					**Total application rates:** by nutrient strategy		
ID	**year**	**strategy**	**amendment**	**amendment rate**	**C**	**N**	**PAN**	**P_2O_5**	**N**	**PAN**	**P_2O_5**
				----- Mg ha^{-1} -----		----- kg ha^{-1} -----			----- kg ha^{-1} -----		
			feathermeal (11-0-0)	1.7	0.0	190	190	0			
		TYP	compost	5.7	2.4	252	112	298	252	112	298
	2019	HC	compost	11.6	2.7	301	78	318	301	78	318
		LC+N	compost	1.2	0.3	31	8	34	102	78	34
			feathermeal (11-0-0)	0.6	0.0	70	70	0			
		TYP	compost	0.0	0.0	0	0	0	0	0	0
19	2018	HC	compost	175.6	14.6	1102	181	687	1102	181	687
		LC+N	compost	16.1	1.3	101	17	62	291	207	62
			feathermeal (13-0-0)	1.5	0.0	190	190	0			
		TYP	mixed fert (10-3-0)	0.2	0.0	23	23	7	23	23	7
	2019	HC	compost	167.2	7.2	619	120	614	619	120	614
		LC+N	compost	13.9	0.6	51	10	50	171	130	50
			feathermeal (12-0-0)	1.0	0.0	120	120	0			
		TYP	fert blend (6-2-7)	0.5	0.0	27	27	9	27	27	9
1	2018	HC	compost	47.2	10.7	528	87	444	528	87	444
		LC+N	compost	3.9	0.9	44	7	37	120	83	37
			feathermeal (13-0-0)	0.6	0.0	76	76	0			
		TYP	blend (4-7.5-5)	1.4	0.0	54	54	101	103	103	133
			enterra (3-2-5)	1.6	0.0	49	49	32			
	2019	HC	compost	10.3	4.0	381	103	330	381	103	330
		LC+N	compost	1.1	0.4	41	11	34	135	106	34
			feathermeal (13-0-0)	0.7	0.0	95	95	0			
		TYP	'Hi-P' (0-12-0)	0.6	0.0	0	0	69	80	80	69
			bloodmeal (10-0-0)	0.8	0.0	80	80	0			

				Application rates: by amendment					**Total application rates:** by nutrient strategy		
ID	**year**	**strategy**	**amendment**	**amendment rate**	**C**	**N**	**PAN**	**P_2O_5**	**N**	**PAN**	**P_2O_5**
				----- Mg ha^{-1} -----		----- kg ha^{-1} -----			----- kg ha^{-1} -----		
2	2018	HC	compost	24.4	8.4	543	84	348	543	84	348
		LC+N	compost	2.1	0.7	47	7	30	137	97	30
			feathermeal (13-0-0)	0.7	0.0	90	90	0			
		TYP	compost	10.4	3.6	231	36	149	231	36	149
	2019	HC	compost	26.0	6.7	363	59	380	363	59	380
		LC+N	compost	1.7	0.4	24	4	25	80	60	25
			feathermeal (13-0-0)	0.4	0.0	56	56	0			
		TYP	compost	7.5	2.0	106	17	110	226	138	110
			feathermeal (12-0-0)	1.0	0.0	121	121	0			
3	2018	HC	compost	201.2	12.3	1005	151	568	1005	151	568
		LC+N	compost	16.3	1.0	81	12	46	220	151	46
			feathermeal (13-0-0)	1.1	0.0	139	139	0			
		TYP	fish bonemeal (4-13-0)	0.8	0.0	34	34	110	92	92	121
			alfalfa pellets (3-0.6-2.9)	2.0	0.0	59	59	11			
	2019	HC	compost (sea soil)	11.9	3.3	131	27	69	131	27	69
		LC+N	compost (sea soil)	1.8	0.5	19	4	9	157	141	9
			feathermeal (13-0-0)	1.1	0.0	137	137	0			
		TYP	compost (sea soil)	7.4	2.1	82	17	44	288	170	144
			compost (on-farm)	14.0	0.7	63	10	39			
			pro-mix (7-3-3)	2.0	0.0	143	143	62			
4	2018	HC	compost	4.4	1.3	87	25	110	87	25	110
		LC+N	compost	0.3	0.1	5	2	7	26	22	7

ID	year	strategy	amendment	Application rates: by amendment					Total application rates: by nutrient strategy		
				amendment rate	C	N	PAN	P_2O_5	N	PAN	P_2O_5
				----- Mg ha^{-1} -----		----- kg ha^{-1} -----			----- kg ha^{-1} -----		
			feathermeal (13-0-0)	0.2	0.0	20	20	0			
		TYP	fish bonemeal (4-13-0)	0.6	0.0	25	25	80	25	25	80
	2019	HC	compost	8.6	2.3	225	63	298	225	63	298
		LC+N	compost	0.6	0.2	17	5	23	114	102	23
			feathermeal (13-0-0)	0.8	0.0	98	98	0			
		TYP	compost	14.7	4.0	381	107	504	381	107	504
5	2018	HC	compost	16.0	6.2	159	43	94	159	43	94
		LC+N	compost	3.1	1.2	31	8	18	65	42	18
			feathermeal (13-0-0)	0.3	0.0	34	34	0			
		TYP	Bloodmeal (12-0-0)	1.3	0.0	157	157	0	289	289	39
			Hi-N (10-3-0)	1.3	0.0	131	131	39			
	2019	HC	compost	85.6	36.8	771	131	589	771	131	589
		LC+N	compost	6.6	2.8	59	10	46	180	131	46
			feathermeal (13-0-0)	0.9	0.0	121	121	0			
		TYP	compost	57.2	24.6	515	88	394	1116	689	474
			Hi-N (10-3-0)	2.7	0.0	273	273	82			
			bloodmeal (12-0-0)	2.7	0.0	328	328	0			
6	2018	HC	compost	53.0	18.9	603	94	323	603	94	323
		LC+N	compost	7.3	2.6	83	13	46	165	94	46
			feathermeal (13-0-0)	0.6	0.0	81	81	0			
		TYP	compost	13.4	4.8	153	24	82	259	130	401
			fish bonemeal (4-13-0)	1.1	0.0	43	43	140			

				Application rates: by amendment					**Total application rates:** by nutrient strategy		
ID	**year**	**strategy**	**amendment**	**amendment rate**	**C**	**N**	**PAN**	**P_2O_5**	**N**	**PAN**	**P_2O_5**
				----- Mg ha^{-1} -----		----- kg ha^{-1} -----			----- kg ha^{-1} -----		
			bat guano (0-12-0)	1.2	0.0	0	0	140			
			alfalfa pellets (3-2-2)	2.1	0.0	64	64	44			
	2019	HC	compost	53.7	20.4	478	80	295	478	80	295
		LC+N	compost	7.0	2.7	62	10	39	133	82	39
			feathermeal (13-0-0)	0.5	0.0	71	71	0			
		TYP	compost	18.2	6.9	162	27	101	381	246	188
			fish bonemeal (4-13-0)	0.4	0.0	14	14	46			
			alfalfa pellets (3-2-2)	2.1	0.0	64	64	44			
			guano (0-12-0)	1.2	0.0	141	141	0			
7	2018	HC	compost	23.1	5.7	462	107	298	462	107	298
		LC+N	compost	2.2	0.5	43	10	27	109	76	27
			feathermeal (13-0-0)	0.5	0.0	66	66	0			
		TYP	compost	10.4	2.6	208	48	133	251	92	289
			fish bonemeal (4-13-0)	0.6	0.0	25	25	80			
			rock phosphate (0-12-0)	0.6	0.0	0	0	76			
			alfalfa pellets (3-0-2)	0.6	0.0	19	19	0			
	2019	HC	compost	29.1	10.8	465	76	799	465	76	799
		LC+N	compost	1.1	0.4	17	3	30	90	76	30
			feathermeal (13-0-0)	0.6	0.0	73	73	0			
		TYP	compost	7.7	2.9	123	20	211	201	98	270
			Hi-N (10-3-0)	0.8	0.0	78	78	23			
			Hi-P (0-12-0)	0.3	0.0	0	0	37			

				Application rates: by amendment					**Total application rates:** by nutrient strategy		
ID	**year**	**strategy**	**amendment**	**amendment rate**	**C**	**N**	**PAN**	**P_2O_5**	**N**	**PAN**	**P_2O_5**
				----- Mg ha^{-1} -----		----- kg ha^{-1} -----			----- kg ha^{-1} -----		
8	2018	HC	compost	27.9	4.1	321	67	268	321	67	268
		LC+N	compost	2.5	0.4	29	6	25	86	63	25
			feathermeal (13-0-0)	0.4	0.0	57	57	0			
		TYP	-	0.0	0.0	0	0	0	0	0	0

Appendix C. *Compost test results*

Table C 1. Summary of properties of composts sampled in Spring 2019 (REG = Region, FV = Fraser Valley, PV = Pemberton, VI = Vancouver Island, OM = organic matter, MC = Moisture Content (H_2O/Wet), C:N = carbon to nitrogen ratio, NH_4^+ = ammonium nitrogen, NO_3^- = nitrate nitrogen).

									Total Element Content by Microwave Digestion / ICP												
REG	**ID**	**Source**	**Total N**	**OM**	**MC**	**C:N**	**NH_4^+**	**NO_3^-**	**P**	**K**	**Al**	**B**	**Cu**	**Fe**	**Mn**	**Mo**	**Na**	**Zn**	**Ca**	**Mg**	**S**
			------ % -----				-- mg kg^{-1} --		--- % ---		---------- mg kg^{-1} ----------								-------- % --------		
PV	57	On-Farm	0.4	9	34	12	1	190	0.2	0.5	16000	2	39	23000	600	1.4	1300	90	1.3	0.91	0.07
PV	43	Sea to Sky	2.2	54	43	12	500	370	0.4	0.9	12000	21	63	11000	330	2.3	2200	150	3.7	0.57	0.28
PV	37	Sea to Sky	2.4	56	46	12	670	690	0.5	0.8	11000	19	62	13000	360	1.9	1800	150	3.7	0.6	0.27
PV	45	Sea to Sky	2	50	47	13	35	470	0.5	1.1	12000	22	73	12000	370	2.2	2300	180	3.9	0.64	0.32
PV	46	Sea to Sky	2.6	46	41	9	53	3300	1.2	0.8	9400	19	140	9600	570	2.3	2300	370	9.5	0.75	0.47
FV	36	Sea Soil	1.1	56	56	25	10	740	0.3	0.2	10000	6	42	15000	460	0.5	1300	80	1.7	0.58	0.19
FV	38	Net Zero	2.2	46	53	10	2200	280	0.5	1.2	13000	19	46	14000	340	1.7	2100	130	2.4	0.53	0.30
FV	39	Gelderman Farms Compost	1.7	88	76	26	220	3000	1.3	3.5	420	21	93	1000	370	3.5	8100	610	1.4	0.59	0.59
FV	35	Poultry Litter	1.4	76	57	27	8400	3	0.3	0.2	11000	7	42	15000	500	1.4	1400	97	2.4	0.61	0.21
FV	41	Poultry Litter	2.2	48	59	11	4600	5	1.2	1.4	12000	20	210	12000	480	2.8	2700	280	2.9	0.65	0.52
FV	40	Poultry Litter	2.9	74	66	13	9400	210	2.2	2.5	1900	41	370	2300	760	6.4	4000	650	3.6	0.78	0.83
VI	50	On-Farm	0.5	10	30	11	0	10	0.1	0.3	44000	0	70	44000	1000	0.4	450	120	1.3	0.85	0.07
VI	54	Earthbank	0.9	76	56	43	4	180	0.2	0.4	11000	3	56	14000	560	1.3	1100	110	2.2	0.37	0.24
VI	53	Steer / Horse	0.9	86	70	48	46	170	0.3	1	4500	8	15	3600	210	2.0	1300	64	0.9	0.26	0.18

									Total Element Content by Microwave Digestion / ICP												
REG	**ID**	**Source**	**Total N**	**OM**	**MC**	**C:N**	**NH_4^+**	**NO_3^-**	**P**	**K**	**Al**	**B**	**Cu**	**Fe**	**Mn**	**Mo**	**Na**	**Zn**	**Ca**	**Mg**	**S**
			------ % -----				-- mg kg^{-1} --		--- % ---		---------- mg kg^{-1} ----------								-------- % --------		
VI	49	Steer / Horse	1.4	52	73	19	3	200	0.6	0.8	25000	11	33	19000	900	0.9	2300	130	1.5	0.7	0.35
VI	55	Compost - Livestock Offal	1.6	74	64	23	190	75	1.2	0.4	15000	4	34	14000	540	1.6	1600	110	2.9	0.32	0.32
VI	48	Sea Soil	3.7	78	40	11	5200	2	1.4	2.1	1800	31	230	2400	480	4.2	3400	410	6.3	0.69	1.00
VI	51	Horse	2.6	54	40	10	3400	600	1.5	2.5	18000	28	100	15000	920	3.3	5000	550	5.0	0.86	0.69