City of Ottawa - Trail Road Landfill Site and Kemptville College - University of Guelph: Compost Field Vegetable Trials.

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Executive Summary.

This research was initiated by the **Regional Municipality of Ottawa-Carleton (RMOC)** in conjunction with **Kemptville College - University of Guelph**. It should be noted that recently, RMOC has been amalgamated into the new **City of Ottawa**. The researcher respectfully acknowledges receipt of funding from **Ontario Waste Diversion Organization (WDO).**

A series of replicated trials using 10 vegetable crops were field-grown under normal production conditions. Each seed type was grown in amended and un-amended field soil in order to determine the suitability of Trail Road landfill site compost for production of vegetable crops. Dry weights were used as the primary determinants of plant performance over a 1 month period with samples being drawn every few days after two weeks of growth until the first killing frost occurred in early November. Dry weights over the entire production cycle were then ranked on the basis of performance comparing each mixture against all other mixtures

Results were mixed. The lateness of the sowing date disallowed germination of some plant species; however, where germination did occur, plant performance was shown to be species specific to some degree. Shorter-term crops tended to respond more favourably in dry weights; however, increased earliness of germination was shown in all crops. The results suggest that compost can be a useful amendment in the production of field vegetable crops utilizing normal cultural practices, but also improved soil tilth.

Introduction.

Increasing costs and environmental questionability of continuing to put recyclable wastes into landfills obligates municipalities to find means for diverting these waste materials from the waste stream into productive end uses. Numerous studies on the apparent benefits of reusable wastes abound in the literature with all areas of organic waste being well represented. This study was undertaken to determine the usefulness of composted organic waste from the Trail Road landfill site for the production of field vegetables. Responsibility for operation of the facility was recently assumed by the new City of Ottawa.

The methodology utilized was as described below (see: Methodology) and relied upon standard experimental procedures and description of results through routine analysis of numeric data and observation of plant materials throughout their production period.

Methodology.

Trials were conducted in the field to determine the suitability of compost as an amendment for the production of a selection of field grown vegetables. In the Horticulture research field site at Kemptville College, ten different vegetables (Table 1) were evaluated on 7 different soil -

compost treatments. (Table 2.) Each treatment (both vegetable and soil+compost) in each replicate was randomly assigned. The evaluation utilized germination rate and dry weight at harvest to determine suitability of the mixed media. It should be noted that the harvest was extremely early and not based on any particular state of plant maturity but rather simply on chronology. The late planting date (early October), obligated by difficulties associated with land application of the compost, resulted in termination of the trials when the first killing frost occurred in early November.

After a series of initially unsuccessful trials utilizing different pieces of equipment in attempting to spread an even layer of compost onto the surface of the native field soil, a small capacity manure spreader towed behind a tractor was found to offer the best control over rate of deposition. Rates of application were determined in part by differential operation of power take-off (pto) revolution speed in combination with selection of different ranges and individual gearing on the tractor being used. A 50 hp tractor was used in conjunction with a small (8 cubic yard) manure spreader. Depositional rates are indicated in Table 2, and are expressed in terms of the depth added per treatment and extrapolated to the amount added per hectare. After each field soil plot was roto-tilled, it was top-dressed with compost. The compost was then incorporated into the top 15 centimetres of soil with a tractor-mounted rototiller.

Each of 10 vegetable treatments were randomly installed into 7 different compost treatments which were replicated 3 times. (Table 3.) Each area was approximately 1.5 metres in length by 1 metre in width. Five rows were inscribed with a stake, then 4 seeds were installed into each row, thus, 20 seeds were included into each treatment in each replicate. Seed depth was 2.5 centimetres and each seed then covered. Soil samples were removed at planting from each treatment for nutrient analysis. Seeds were monitored twice a week (Tuesday and Thursday) to check for germination. A single sampling of plants occurred on the 31st October which were then dry weighted in the same fashion as the greenhouse plant samples generated in a similar trial using RMOC compost.

Simple analysis of variance procedures were used to analyze the data. All rankings are presented in the tables presented below.

Table 1. Treatment key for vegetables.

Treatment.	**Vegetable**.
A	Cranberry Bean.
B	Thomas Laxton Pea.
C	Earlivee Corn.
D	Rutabaga.
E	Cabbage.
F	Sugar Snap Pea.
G	Golden Wax Bean.
H	Radish - Sparkler White Tip.
I	Radish - Crimson Giant.
J	Beet.

Table 2. Treatment key for vegetable media.

Treatment	**Compost rate application (cm topdressed)**	**Amount per hectare (cubic metres/hectare)**
1	None.	0
2	1.25	125
3	2.5	250
4	3.75	375
5	5	500
6	20	2000
7	40	4000

Table 3. Randomization. (Example: replicate 2.)

	5	**4**	**6**	**2**	**1**	**3**	**7**
F	F5	F4	F6	F2	F1	F3	F7
J	J5	J4	J6	J2	J1	J3	J7
C	C5	C4	C6	C2	C1	C3	C7
E	E5	E4	E6	E2	E1	E3	E7
D	D 5	D 4	D 6	D 2	D 1	D 3	D 7
H	H 5	H 4	H 6	H 2	H 1	H 3	H 7
G	G 5	G 4	G 6	G 2	G 1	G 3	G 7
A	A 5	A 4	A 6	A 2	A 1	A 3	A 7
I	I5	I4	I6	I2	I1	I3	I7
B	B5	B4	B6	B2	B1	B3	B7

Results.

No germination was recorded in Cranberry Bean, Earlivee Corn, Cabbage, Golden Wax Bean, or Beet. Partial although insignificant germination was recorded in one replicate for Rutabaga and Cabbage (data not presented).

Thomas Laxton Pea, Sugar Snap Pea, Sparkler White Tip Radish and Crimson Giant Radish all showed germination in all replicates within 14 days of being sown.

A single early harvest was obtained and ranked for the Thomas Laxton Pea on the 26^{th} October. (Table 4.) The material harvested was not mature plant matter but rather seedlings which had emerged after approximately a month of being sown. All replicates and all media soil treatments showed greater than 90% germination by the end of October. Germination rates were rated on three different occasions and presented in Table 5. Within a week, snow to a depth of several centimetres was present on the ground which effectively terminated the test.

Table 4. Rating of dry weights for Thomas Laxton Pea.

Amount of compost per hectare m^3/ha. (trt #)	Rank**	Dry matter yield -grams/3 plants (averaged over 3 reps)
0 (1)	1	0.71
125 (2)	2	0.70
250 (3)	5	0.62
375 (4)	6	0.61
500 (5)	3	0.69
2000 (6)	4	0.65
4000 (7)	7	0.59

** Ranking 1 = highest, 7 = lowest.

Table 5. Germination rates for Thomas Laxton Pea. (* denotes full germination count.)

Amount of compost per hectare m^3/ha. (trt #)	14 days after sowing Rank	16 days after sowing Rank	18 days after sowing Rank
0 (1)	3	4	6
125 (2)	6	5	4
250 (3)	7	7	5
375 (4)	2	**1***	**1***
500 (5)	5	6	7
2000 (6)	4	3	**1***
4000 (7)	1	**1***	**1***

The data for Thomas Laxton Pea is in some respects contradictory. Earlier germination should lead to a greater accumulation of dry weight. This did not occur. The 4000 m^3/ha application of compost showed a clear advantage in terms of promoting earlier germination. This may have been a result of the greater decompositional heat present in the larger amount being applied, or it may be related to a suspected greater microbial activity as a consequence of the amount applied. Nutritional profiles for each treatment indicated within range or slightly higher than maximal concentrations for all nutrients. Either way, increased earliness of germination is considered beneficial since seed losses are decreased as a consequence of the seed not sitting dormant in a soil leaving it more readily susceptible to soil-borne pathogens. Maintenance of seed viability is directly related to storage practices and the rapidity of seedling growth and emergence; thus, the earlier that growth occurs after sowing, (under normally beneficial environmental conditions) the greater the tendency for increased vigour and resiliency. Paradoxically, those soil amendment treatments which showed the earliest germination (4000 and 375 cubic $m^{3/}$ha) showed the lowest rankings for dry matter accumulation (7 and 6 respectively). No information was gathered on plant morphology due to the small size of the seedlings and time limitations, however, this may have yielded some insight into this apparent discrepancy. It is also possible that these very small differences in dry weight this early on in the production cycle may not ultimately have any significant implications for final plant fitness, yield or harvestability. Presumably, this would play a greater role if the vegetable in question was being grown for consumption as a seedling such as is the case for bean sprouts for use in salads for example.

A single early harvest was obtained for the Sugar Snap Pea on the 31st October. (Table 6.) The material harvested was not mature plant but rather seedlings which had emerged after a month of being sown. All replicates showed some germination; however, in all but the 4000 m^3/ha treatment, full germination did not occur by the date of harvest. Germination rates were rated on three different occasions and presented in Table 7. Within a week, snow to a depth of several centimetres was present on the ground which effectively terminated the test. (Table 5.)

Table 6. Rating of dry weights for Sugar Snap Pea.

Amount of compost per hectare m^3/ha. (trt #)	Rank	Dry matter yield -grams/3 plants (averaged over 3 reps)
0 (1)	2	0.68
125 (2)	7	0.40
250 (3)	6	0.42
375 (4)	4	0.54
500 (5)	3	0.67
2000 (6)	5	0.51
4000 (7)	1	0.68

Table 7. Germination rates for Sugar Snap Pea. (* denotes full germination count.)

Amount of compost per hectare m^3/ha. (trt #)	14 days after sowing Rank	16 days after sowing Rank	21 days after sowing Rank
0 (1)	5	5	5
125 (2)	6	6	7
250 (3)	7	7	6
375 (4)	3	2	4
500 (5)	4	3	3
2000 (6)	2	4	2
4000 (7)	1	1	**1***

The data for Sugar Snap Pea suggests a correlation between earliness of germination and accumulation of dry matter. As indicated above, earlier germination should allow the plant to accumulate more dry matter assuming no other inputs are limiting. This is the case for the 4000 m^3/ha treatment but not for the 2nd ranked germination rate for 2000 m^3 /ha treatment. Again, perhaps an evaluation of the individual morphologies of the plants may have yielded additional clarity. There is a clear connection between the amount of compost used to amend the soil and speed of germination as indicated in Table 7. In a short period crop such as radishes which has a maturation date of between 28-35 days, this data suggests a faster crop turnaround and possibly the addition of an extra crop per season for a grower.

A single early harvest was obtained for the Sparkler White Tip Radish on the 31st October. The material harvested was not mature plant but rather seedlings which had emerged after a month of being sown. Dry weight data and germination and emergence data are similar for both radish cultivars. (Tables 8 and 10). Dry weight accumulation was highest in two of the higher compost application rates (500 and 2000 m^3/ha - ranked 1 and 2 respectively) although a clear relation between amount of compost added and dry matter weights was not clearly demonstrated in Sparkler White Tip. Germination was very rapid across all soil treatments with full germination occurring in most treatments by day 11 after sowing. By the final evaluation 16 days after sowing, all treatments showed complete germination for both radish cultivars. (Tables 9 and 11.) Within a week of initial harvest, snow to a depth of several centimetres was present on the ground which effectively terminated the test.

Table 8. Rating of dry weights for Sparkler White Tip Radish.

Amount of compost per hectare m^3/ha. (trt #)	Rank	Dry matter yield -grams/3 plants (averaged over 3 reps)
0 (1)	7	0.09
125 (2)	3	0.13
250 (3)	4	0.12
375 (4)	5	0.12
500 (5)	1	0.15
2000 (6)	2	0.14
4000 (7)	6	0.11

Table 9. Germination rates for Sparkler White Tip Radish. (* denotes full germination count.)

Amount of compost per hectare m^3/ha. (trt #)	11 days after sowing Rank	16 days after sowing Rank
0 (1)	1*	1*
125 (2)	1*	1*
250 (3)	6	1*
375 (4)	1*	1*
500 (5)	1*	1*
2000 (6)	7	1*
4000 (7)	1*	1*

A single early harvest was obtained for the Crimson Giant Radish on the 31st October. The material harvested was not mature plant but rather seedlings which had emerged after a month of being sown. Crimson Giant Radish demonstrated almost identical plant growth, dry weights and germination rates as for Sparkler White Tip Radish. The data shows a slightly clearer relationship between amount of compost added and dry matter accumulation with 375, 500 and 2000 m^3/ha compost added providing the largest dry weights. (Table 10). Within a week, snow to a depth of several centimetres was present on the ground which effectively terminated the test.

Table 10. Rating of dry weights for Crimson Giant Radish.

Amount of compost per hectare m^3/ha. (trt #)	Rank	Dry matter yield -grams/3 plants (averaged over 3 reps)
0 (1)	7	0.12
125 (2)	5	0.17
250 (3)	4	0.17
375 (4)	3	0.17
500 (5)	2	0.19
2000 (6)	1	0.19
4000 (7)	6	0.16

The germination rate data (Table 11) mimics that for the other radish data. Clearly, radish appears uninfluenced by type of media for this variable (soil); however, this data viewed in the context of the dry weight data suggest that some advantage in terms of more rapid crop productivity may be present with certain compost application rates.

Table 11. Germination rates for Crimson Giant Radish. (* denotes full germination count.)

Amount of compost per hectare m^3/ha. (trt #)	11 days after sowing Rank	16 days after sowing Rank
0 (1)	1*	1*
125 (2)	1*	1*
250 (3)	7	1*
375 (4)	1*	1*
500 (5)	1*	1*
2000 (6)	1*	1*
4000 (7)	1*	1*

The lateness of compost application curtailed an experiment that would have yielded a greater amount of more pertinent data if each crop had been allowed to mature. This would have required anywhere from 35 to 115 days from date of sowing depending upon species. Nevertheless, the findings indicate that there is some species specificity in terms of response to compost amendment, and that dry matter accumulation is not always strongly correlated with rate of compost applied or with germination rate. In terms of benefits associated with compost use, it should be noted that no disease symptoms were manifested in any of the added compost trials, nor was weed control any more of an issue versus regular soil treatment. There is abundant research evidence that clearly show the benefits of adding organic matter to poor soils in order to improve soil tilth and nutrition. The fields at Kemptville College are in routine use on a yearly basis and are typically fertilized prior to planting. Perhaps the addition of the compost would be more appropriate on soils that were lacking in either nutrition and/or organic matter. Other benefits to adding compost include increased microfloral and faunal populations through both addition (supplementation) and the creation of a more favourable environment for those that already exist on-site. In short term crops, there is a clear advantage to incorporating greater amounts of City of Ottawa compost with increased or equivalent germination rates, but more importantly higher dry matter accumulation. In longer-term crops, germination rates were enhanced but dry weight accumulation ranked low. Whether this is significant in the long term requires another set of more appropriately timed trials. Since the primary determinant of whether a plant is "successful" is the yield generated from that plant, it makes sense to continue with a new series of trials in which the crops would be allowed to fully mature. It is the intent of this researcher to continue on with a similar set of trials starting in May of 2001. Sufficient residual activity in the plots from the addition of the compost on these trials may have some impact on this new series of trials.

Transferability to other regions/municipalities in Ontario.

As indicated earlier, there is a substantial body of evidence indicating the usefulness of composted organics in various horticultural/agricultural applications. The results contained herein support these assertions to some degree by providing some additional evidence. The composted products from the Trail Road landfill site are not specifically sorted prior to the composting process being applied; however, the end product appears to be of a consistent enough quality and repeatable nutritional quotient which would allow use of the material in a variety of horticultural/agricultural settings. It follows that similar composts generated in a likewise fashion at other facilities throughout Ontario, would be as useful in similar applications. The issue that remains is one of convincing prospective purchasers of the worth (read: purchase price) of the product. This can only be really achieved by inclusion of prospective major industry partners/consumers in a longer term and more appropriately timed research project. To some degree, the marketing survey conducted in conjunction with this and a related research project involving greenhouse crops, helps to answer some of these questions, but what appears to be currently lacking is the endorsement by these industry partners, as a consequence of concrete performance by composted products in a production scenario.

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