ECOLOGICAL FARMERS ASSOCIATION OF ONTARIO

SOIL HEALTH 2020

RESEARCH REPORT

Direct seeding into compost mulch

Farmer-Researcher

Jason Hayes
Burdock Grove Farm
Grey County

IN A NUTSHELL

To reduce tillage for crops that are direct seeded, Jason tested different composts in a no-till deep bed system in one trial each of lettuce and carrots.

- The substrates for deep compost mulch differed with respect to growing lettuce and carrots, but bare ground control produced the highest seedling count for lettuce and the greatest yield for carrots.
- Optimizing the use of deep bed compost requires a systems approach since seeding depth and irrigation rate, etc. differ by substrate. It was not practical, however, for Jason to test each substrate in a systems-context which limits the applicability of these results.

MOTIVATION

Growing vegetables in deep beds using compost as mulch is one way organic growers implement no-till methods. Because of the particle size of woody compost/mulch, however, this method is generally incompatible with direct seeding (vs transplanting, which works well). To minimize tillage for direct seeded lettuce and carrots, Jason compared different compost/mulches.

DESIGN

For lettuce, Jason divided a bed into blocks of 4x1-meter increments and randomly assigned each 1-meter increment to one of four treatments: **Bokashi compost - batch 1** (made via anaerobic fermentation; 6), **compost from another farm (Farm P)** (6), **Sittler compost** (5), and **bare ground control** (5). He repeated this until he reached the end of the bed. The total number of sections per treatment is denoted in brackets above.

On May 13, 2020, he direct seeded Lettuce Mix OG from Fedco at a rate of 34-40 seeds/ft across 6 rows, as shown in **Photo 1**. Two weeks later, he weeded and then recorded seedling count in each section separately, followed by combined weeding time for all sections of each treatment.

For carrots, Jason used a similar method of randomly assigning blocks of 3x1meter to one of three treatments: **Bokashi compost - batch 2** (6), **peat** (3) and **bare ground control** (4). On July 14, 2020, he direct seeded Yaya carrots from William Dam at a rate of 60 seeds/ft across 4 rows. Jason chose a high seeding rate after a carrot trial in May with a lower rate failed. In the fall, he harvested the carrots by section and weighed yield.

Jason sent samples of his two Bokashi compost batches and the Sittler compost to A&L Canada Laboratories Inc. for compost analysis. Full reports are attached to the end of this report.

Photo 1. (top to bottom) **(a)** The form Jason built to establish replicate plots of the different compost treatments in a single row; **(b)** Jason's lettuce trial, with replicate blocks of the deep mulch treatments and bare soil controls.

Photo 2. Jason and Heidi weeding the lettuce trial. Note the pigweed pressure in the second treatment from the bottom of the photo.

FINDINGS

Lettuce seedling count

To evaluate the effect of the compost type on seedling count of lettuce after first weeding, we used a statistical model called analysis of variance (ANOVA) with a 95% confidence level to calculate the least significant difference (LSD) needed to see among treatments in order to call them "statistically different". Using this approach, the LSD Jason needed to see was 48 seedlings, and he concluded that the control had higher seedling count than the three compost treatments and that the Bokashi (batch 1) produced the lowest yields, as shown in **Figure 1**. See **More on Statistics** at the end of the report.

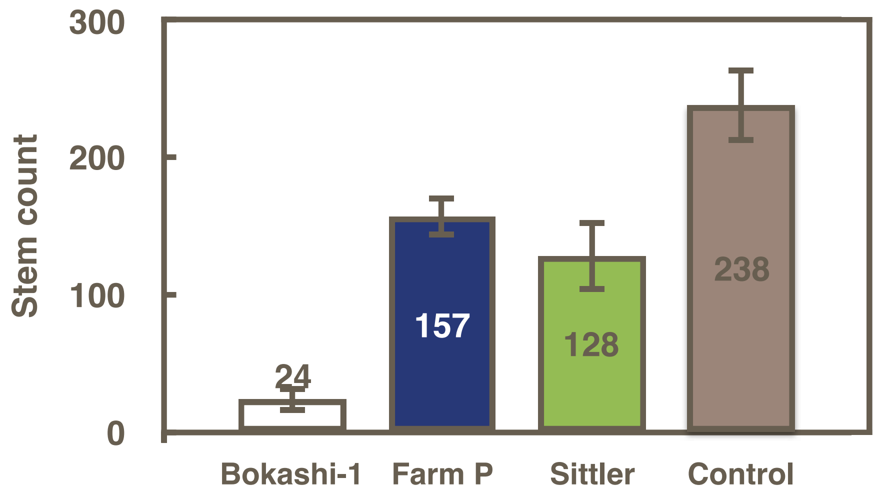

Figure 1. Lettuce seedling count in three composts and bare ground control. Bars represent means and lines represent standard errors. Jason needed to see a difference of 48 seedlings in order to call treatments different. Accordingly, the control germinated the most lettuce and Bokashi the least with Sittler and Farm P compost intermediate.

Table 2. Total weeding time for each treatment in minutes.

Treatment	Total weeding time (min)
Bokashi - 1	9
Farm P	78
Sittler	10.5
Bare ground control	21

In addition to seedling count, Jason recorded total weeding time for the different treatments (not individual replicate sections). Without replicate data, we could not perform statistical analysis on weeding times, but were able to report total weeding times for each treatment in Table 2. From the treatment totals, it is clear that Farm P compost took the longest to weed. This was because of the pigweed seed bank in this treatment. Weed pressure may have also affected seedling count in the Farm P compost. Jason observed good lettuce germination in Farm P treatment sections, but some of the lettuce may have been pulled while weeding the pigweed. This is in contrast to Bokashi1 and Sittler composts that had very few weeds germinate and suppressed weed germination from below.

Carrot yield

Similarly, we used an ANOVA with a 95% confidence level to calculate the LSD that Jason needed to see in order to call carrot yield from different treatments different. As shown in **Figure 2**, carrot yield was more consistent among the three treatments. The LSD he needed to see was 859 grams, such that the control yielded significantly more than the peat, and the yield from Bokashi (batch 2) was indistinguishable from control and peat.

General notes

In addition to the trial documented above, Jason seeded a lettuce trial in July and a carrot trial in May but terminated them early due to weed pressure. From the first carrot trial, he decided to use a higher seeding rate for the second trial

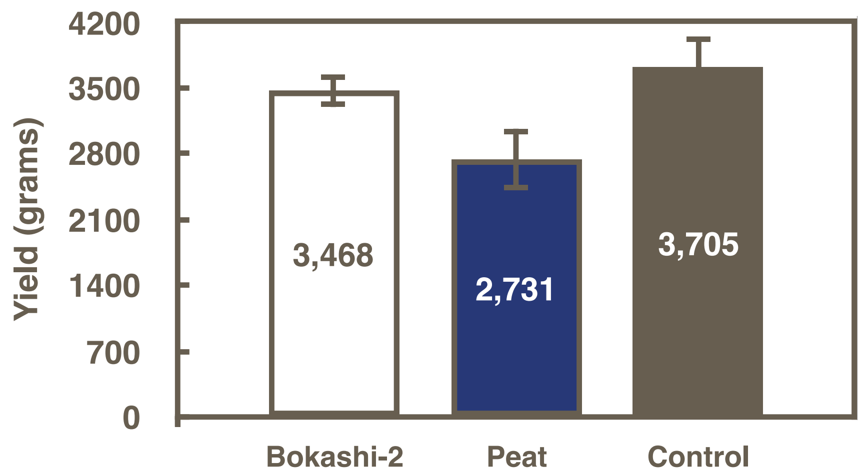

Figure 2. Carrot yield comparing two composts and bare ground. Bars represent means and lines represent standard errors. Jason needed to see a difference of 859 grams in order to call treatments different. Accordingly, the control yielded the most carrots and peat the least with Bokashi indistinguishable from the two.

Photo 3. Weighing carrot yield in each replicate plot.

(with success!); and from the second lettuce trial, he learned that it is hard to find ideal space in the garden for research trials (the location of the trial was shaded by other crops).

In general, the compost treatments were at a disadvantage. Given that the only practical set-up for Jason this year was a single bed with multiple treatment sections in the bed, he was unable to adjust seed depth and irrigation for each treatment. As such, he seeded all treatments at the depth of the control and irrigated at a time that was a bit late for the compost treatments (the black surface of the composts gets hot and dries out fast) and a bit early for the bare ground (meaning control sections were well watered).

TAKE HOME MESSAGE

Results from one trial each, showed direct seeding lettuce and carrots into deep compost is possible, but efficacy depends on the specific compost. When considering a compost for direct seeding, Jason recommends a very fine particle size, and either a high clay content or a very mature compost, or both. Moisture holding ability is key where irrigation water, and the energy to pump it, are limited.

NEXT STEPS

Jason has by no means given up on direct seeding in a deep compost mulch no-till system. The trial illuminated a number of nuances that all need to be weighed and balanced to arrive at a technique that will work consistently on his farm. For instance, these trials were all executed on beds that were only beginning the transition to no-till this year. How will the soil respond after a year under mulch? Or two? Perhaps raking the mulch lightly to incorporate a bit more soil is needed where weed pressure is under control; perhaps lightly nudging the mulch aside to run the drill, and covering up at some point during germination or just after would be effective. Absolutely every situation is different.

Jason also realized the need for dedicated research farms to answer questions that require a full systems approach (i.e. comparing different deep bed composts with unique seeding depth and irrigation rate, etc.). Farmers have relevant and practical research questions; but sometimes they are forced to compromise design in order to squeeze a trial into a working market garden.

Compost analysis continues on pages 4-9.

MORE ON STATISTICS

Using a 95% confidence level means:

- When we measure a seedling count or yield difference between any two treatments that is greater than the calculated least significant difference (LSD), we expect this difference would occur 95 times out of 100 and, therefore, consider it a reliable difference.
- When we measure a seedling count or yield difference between any two treatments that is less than the calculated LSD, we consider these treatments unreliably different and not statistically different.

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REPORT NO. C20105-80002
ACCOUNT NO. 95000

A&L CANADA LABORATORIES INC.

2136 Jetstream Rd, London, ON, N5V 3P5 Tel (519) 457-2575 Fax: (519) 457-2664

TO:

COPY: BURDOCK.GROVE.FARM@(

COMPOST ANALYSIS

LAB NUMBER: 1058004
SAMPLE ID: BAKASHI - BATCH 1

DATE RECEIVED: 2020-04-14
DATE REPORTED:
DATE PRINTED: 2020-04-21

PARAMETER	ANALYSIS RESULT	POUNDS PER TON
Dry Matter	55.3 %	
Nitrogen (Total)	1.106 %	22.1
NH4-N	21 ppm	
Phosphorus (Total)	0.3514 %	
Phosphate (P as P205) **	0.8082 %	16.2
Potassium (Total)	0.7196 %	
Potash (K as K2O) **	0.8635 %	17.3
Organic Matter *	40.1 %	
pH	7.43	
Carbon:Nitrogen Ratio (C:N)	20 : 1	
Sulfur	1370.2 ppm	
Bulk Density (as Recieved)	283 kg/m3	
Conductivity (@ 25 deg C)	2.59 ms/cm	
Sodium	0.13 %	2.6
Aluminum	266.3 ppm	
Boron	9.0 ppm	
Calcium	1.3209 %	26.4

* Organic Matter is reported on an as is basis.
**Available nutrients are reported as total available. Only a portion of these nutrients will be available the year of application.
For information on nitrogen availability, see reverse side of page.

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COMPOST ANALYSIS

LAB NUMBER: 1058004
SAMPLE ID: BAKASHI - BATCH 1

DATE RECEIVED: 2020-04-14
DATE REPORTED:
DATE PRINTED: 2020-04-21

PARAMETER	ANALYSIS RESULT	POUNDS PER TON
Copper	22.8 ppm	
Iron	549.9 ppm	
Magnesium	0.2795 %	5.6
Manganese	51.0 ppm	
Zinc	64.8 ppm	

* Organic Matter is reported on an as is basis.
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REPORT NO. C20203-80001
ACCOUNT NO. 95000

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COMPOST ANALYSIS

LAB NUMBER: 2038002
SAMPLE ID: SITTLERS

DATE RECEIVED: 2020-07-21
DATE REPORTED: 2020-07-27
DATE PRINTED: 2020-07-28

PARAMETER	ANALYSIS RESULT	POUNDS PER TON
Dry Matter	65 %	
Nitrogen (Total)	0.801 %	16.0
NH4-N	30 ppm	
Phosphorus (Total)	0.1902 %	
Phosphate (P as P205) **	0.4375 %	8.7
Potassium (Total)	0.9647 %	
Potash (K as K2O) **	1.1576 %	23.2
Organic Matter *	25.1 %	
pH	8.18	
Carbon:Nitrogen Ratio (C:N)	17 : 1	
Sulfur	1313.0 ppm	
Bulk Density (as Recieved)	598 kg/m3	
Conductivity (@ 25 deg C)	4.78 ms/cm	
Sodium	0.06 %	1.2
Aluminum	4519.5 ppm	
Boron	10.1 ppm	
Calcium	5.4682 %	109.4

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C20203-80001

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ACCOUNT NO. 95000

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COMPOST ANALYSIS

LAB NUMBER: 2038002
SAMPLE ID: SITTLERS

DATE RECEIVED: 2020-07-21
DATE REPORTED: 2020-07-27
DATE PRINTED: 2020-07-28

PARAMETER	ANALYSIS RESULT	POUNDS PER TON
Copper	17.1 ppm	
Iron	7895.3 ppm	
Magnesium	1.1291 %	22.6
Manganese	287.2 ppm	
Zinc	53.2 ppm	

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COMPOST ANALYSIS

LAB NUMBER: 2038003
SAMPLE ID: BOKASHI - BATCH 2

DATE RECEIVED: 2020-07-21
DATE REPORTED: 2020-07-27
DATE PRINTED: 2020-07-28

PARAMETER	ANALYSIS RESULT	POUNDS PER TON
Dry Matter	86.9 %	
Nitrogen (Total)	0.797 %	15.9
NH4-N	66 ppm	
Phosphorus (Total)	0.2419 %	
Phosphate (P as P205) **	0.5564 %	11.1
Potassium (Total)	0.4457 %	
Potash (K as K2O) **	0.5348 %	10.7
Organic Matter *	30.7 %	
pH	6.70	
Carbon:Nitrogen Ratio (C:N)	21 : 1	
Sulfur	3212.2 ppm	
Bulk Density (as Recieved)	374 kg/m3	
Conductivity (@ 25 deg C)	4.13 ms/cm	
Sodium	0.08 %	1.6
Aluminum	5308.7 ppm	
Boron	11.6 ppm	
Calcium	4.5528 %	91.1

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COMPOST ANALYSIS

LAB NUMBER: 2038003
SAMPLE ID: BOKASHI - BATCH 2

DATE RECEIVED: 2020-07-21
DATE REPORTED: 2020-07-27
DATE PRINTED: 2020-07-28

PARAMETER	ANALYSIS RESULT	POUNDS PER TON
Copper	21.5 ppm	
Iron	8871.0 ppm	
Magnesium	1.7408 %	34.8
Manganese	321.3 ppm	
Zinc	64.6 ppm	

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