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Horticulture Research

Worm Casting Application Methods and Impact on Cabbage Yield

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In a Nutshell

- Worm castings, or vermicompost, are a common addition to potting soil mix and greenhouse bedding, and are recommended for use with nearly any plant
- Castings can be added at seeding or transplant, used to side-dress during the growing season, incorporated to compost piles or vegetable beds, or steeped as a compost tea and added during watering or as a foliar spray
- The objectives of this project were to determine whether casting additions or application method increased yield of fall cabbage.
- While differences are seen with other plants in the literature, no differences were seen here.

Project Timeline:

May 2014 – October 2014

Weighed cabbages await delivery in the walk-in cooler at Middle Way Farm

About the Cooperators

Scattergood Farm is located at Scattergood Friends School, a small Quaker boarding school near Iowa City. The Farm, managed by Mark Quee, has 10 acres of IDALS-certified organic gardens and orchards with 30 acres of pasture used for grass-finish beef and lamb. Scattergood also raises a few heritage breed Guinea hogs, a small flock of turkeys, occasional broiler flocks, and a laying flock of about 100 chickens. Scattergood primarily grows food for their school, but occasionally sells to outside markets.

Middle Way Farm is a commercial market garden located at the Grin City Collective artist residency north of Grinnell and run by Jordan Scheibel. Started in 2013, the farm will include 2 acres of production in 2015 and is in the midst of a 3 year transition to certified organic production, with certification anticipated in 2016. Middle Way Farm produces chemical free vegetables, fruits, flowers, herbs, and plant starts and markets primarily through a Community Supported Agriculture share, the Grinnell Farmers Market, and the Grinnell Local Food Source, an online buying club connecting customers and local producers that Jordan also co-owns and operates.

Background

Worm castings, or vermicompost, are a common addition to potting soil mix and greenhouse bedding, and are recommended for use with nearly any plant as an addition at seeding or transplant, used to side-dress during the growing season, incorporated to compost piles or vegetable beds, or steeped as a compost tea and added during watering or as a foliar spray (UNCO Industries, Inc., 2014). According to the product information, worm castings help improve soil structure, provide beneficial microbes, increase water retention capacity, and provide slow-release nutrients (UNCO Industries, Inc., 2014).

The effects of worm castings on vegetable

yield are examined in the scientific literature pertaining to peppers, tomatoes, strawberries, and marigolds and seedlings in greenhouse and field trials (Arancon, et al., 2004; Arancon, et al., 2006; Arancon, et al., 2005; Arancon, et al. , 2004b; Atiyeh, et al., 2000; Atiyeh, et al., 2002; Cornell University, 2014.; Edwards, et al., 2011). Results are mixed, but several studies show yield increases by using up to 40-50% worm castings in the potting mix in greenhouse settings. These results are speculated to be due to improved physical structure of potting medium, increases in beneficial microorganisms (Arancon et al., 2004), availability of plant growth influencing substances and regulators (Arancon et al., 2004b), humic acid properties related to hormones and hormone adsorption onto humates (Atiyeh et al., 2002), increased nutrient cycling, and resistance to pathogens and nematodes (Arancon et al., 2006).

Figure 1

Plot Layout

	X	1	2	3	4	X
X	Buffer					
A	Buffer	Seeding	Foliar	Control	Transplant	Buffer
	Buffer	Seeding	Foliar	Control	Transplant	Buffer
B	Buffer	Control	Seeding	Transplant	Foliar	Buffer
	Buffer	Control	Seeding	Transplant	Foliar	Buffer
C	Buffer	Foliar	Transplant	Seeding	Control	Buffer
	Buffer	Foliar	Transplant	Seeding	Control	Buffer
X	Buffer					

Figure 1: Each plot is a double row of 10 plants, providing 20 plants per plot. Buffer plots are brassica. Row spacing is 30 in. with 24 in. between plants.

This study used three methods of worm casting application on two farms to determine if cabbage yields would be impacted during a single growing season and if so, which application method would provide the most impact. On-farm field research was conducted by Scattergood Farm (Mark Quee) and Middle Way Farm (Jordan Scheibel) during the 2014 growing season.

The objectives of this project were to determine:

1. *Does the addition of worm castings increase yield of fall cabbage?*

2. *Do yield changes differ based on worm casting application method?*

Method

Cooperators Mark Quee (Scattergood Farm) and Jordan Scheibel (Middle Way Farm) planted three replications of each of the four treatments in a randomized complete block design (**Figure 1**). Each treatment plot was planted in double rows of 10 (20 plants per treatment), with 30 in. spacing between rows and 24 in. spacing between plants within the row. Plants for the trial were started indoors and transplanted to the field. The cabbage variety Saratoga was used for all replications. Worm castings were Midwest Organics Purecast.

End-of-row buffers and adjacent row buffers were supposed to be planted to brassicas, but at Middle Way Farm end-of-row buffers were not planted, and carrots were planted on the south side instead of a brassica. Brussel sprouts were planted to the north. Scattergood Farm planted kale to the east, red cabbage to the south, broccoli to the west and cauliflower to the north.

Three application methods were employed as research treatments: application of worm castings during seeding, during transplant, and as a foliar spray. Control plots received no application of worm castings. For the seeding treatment, worm casting were mixed with the potting soil mix at a ratio of 2:1 (two parts soil mix to one part worm castings). For the transplant treatment, 1/2 cup of worm castings was added to each transplant hole at the time of transplant.

The foliar spray was more problematic. Initially Quee and Scheibel attempted to mix 2/3 cup castings per gallon of water, but found the worm castings to be too insoluble. Fighting clogged nozzles, and feared uneven application, the method was adjusted after the first application to a steeped tea. Castings were mixed with water (2/3 cup worm castings / gal water), shaken, steeped for 24 hours, then strained and decanted, being careful not to disturb sediment on the bottom. The steeped tea was used as the foliar spray. Foliar spray was applied at least twice (Scattergood applied once pre-steeping and once post-steeping).

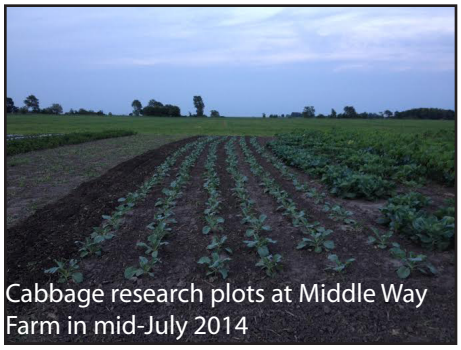
Yield data were collected during harvest. At Scattergood, all cabbages were harvested the same day, October 23, 2014. Middle Way Farm harvested three times during September to accommodate CSA deliveries, harvesting the largest cabbages from each replication plot until all were harvested at the end. Each plot was weighed to find total lb, then divided by the number of harvested heads per plot (18-20 heads) to find mean lb/head by plot.

Data were analyzed using JMP Pro 11 (SAS Institute Inc., Cary, NC) and yield comparisons employ least squares means for accuracy. Statistical significance is determined at $P \leq 0.05$ level and means separations are reported using Tukey's Least Significant Difference (LSD).

Results and Discussion

There was no significant difference in cabbage yield (lb/head) among treatments at either farm (**Figure 2**). For this trial, worm castings, applied at any time with any application type did not improve yields compared to the control. Mean cabbage weight at Scattergood Farm was 3.3 lb/head, mean cabbage weight at Middle Way Farm was 4.0 lb/head.

In the studies cited above, differences in yield of crops (peppers, tomatoes, strawberries and marigolds) were seen during a single growing season under greenhouse and field conditions. Many factors could contribute to the difference in results with this trial. First, Middle Way Farm and Scattergood Farm have both applied worm castings and other soil



Cabbage research plots at Middle Way Farm in mid-July 2014

building amendments in the past; the soil could have enough residual organic matter and fungi/bacteria that additions were not needed. A multi-year trial of treated vs. untreated plots may provide different results.

Conclusions and Next Steps

Though no significant differences in cabbage yields were seen from the worm casting applications in this trial, the two farmers did find some applications easier than others. "Applying castings in potting soil was easiest of three methods, followed by at transplant stage, followed by the foliar spray. I wonder if the foliar spray method could be tweaked. I ended up using women's stockings as tea bags to steep the worm castings in the bucket of water overnight before spraying. This seemed to work but I still have some clogging problems in my sprayer," said Scheibel. He continued, "I hoped for statistically significant differences in yield, at least between control and worm castings, if not between the different methods of worm casting application. I have used worm castings on a garden scale and I have seen great results. The worm castings tea proved more difficult than I expected but I am planning to try it again on a few crops without aboveground edible parts."

Scheibel also noted concern about harvesting cabbages in waves. "I don't know how much the medium size cabbages might have sized up if I left them at the first harvest and waited till the second. Mark [Quee] said cabbages would hold in the field but I wanted to get the larger ones out at first harvest so they didn't rot or crack." Scheibel also noted fungal/mildew problems in the cabbages and nearby brussel sprouts, likely due to the cool, wet summer (See **Figure 3**). These issues did not seem to affect cabbage yield, but did affect the bottom rows of brussel sprouts.

Further testing questions related to worm castings could include a simpler trial to provide a larger sample size of a single variable, or may investigate the impact of worm castings on soil microbes. Said Scheibel, I'd like to focus the experiment, using multiple side-dressings vs. no compost, to determine any significant impact. I suspect producing worm compost could be a good "bang for your buck" compost application on a farm scale, particularly in worm castings tea form. I want to know if it is economical for me to scale up or if I should purchase commercial castings." Scheibel also plans to incorporate castings to all of his germination mixes, which is often done in the scientific literature.

Figure 2

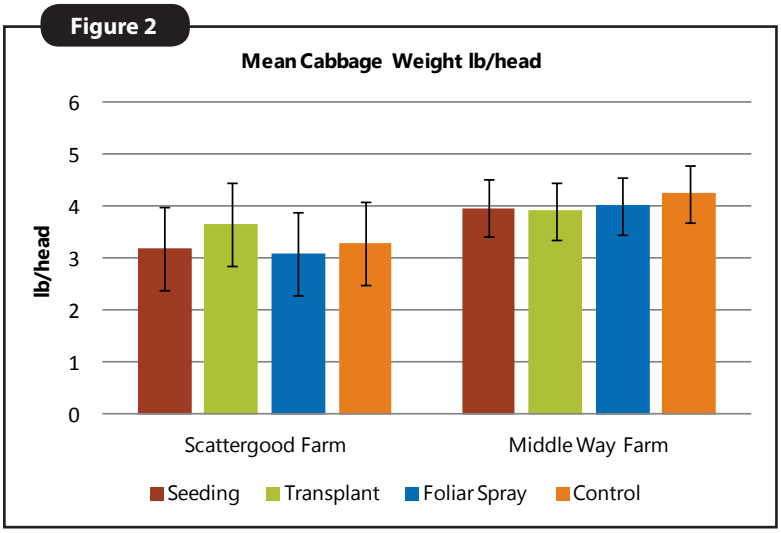


Figure 2. Mean cabbage weight (lb/head) of the three treatments and control plots observed at the farms in 2014. By farm, columns with different letters above them are significantly different. Black bars about the means represent the least significant difference between treatments at each farm (Scattergood LSD = 1.6 lb/head; Middle Way LSD = 1.1 lb/head).

Figure 3

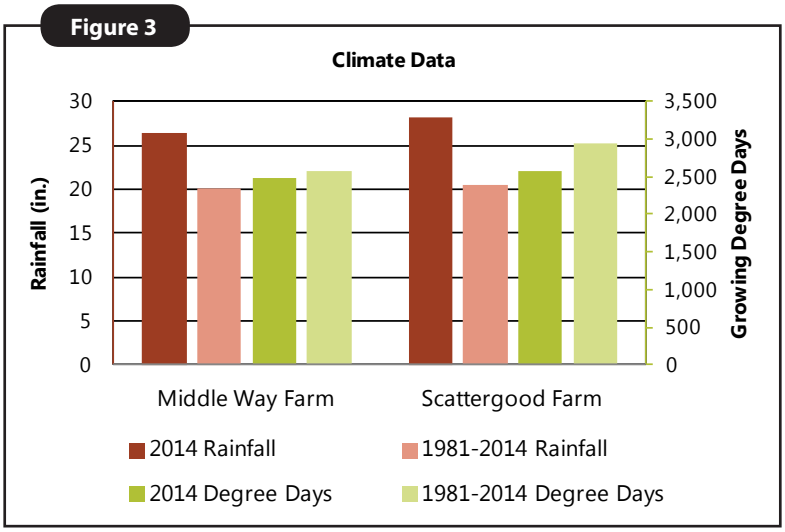


Figure 3. Climate data for precipitation of degree days from Iowa Environmental Mesonet, 2014. Growing Degree Days, base 50 F. 1981-2014 precipitation and degree days represent that average of the time period.

Students weighing cabbages for research at Scattergood Farm.

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Students harvesting cabbage plots at Scattergood Farm in October, 2014.

Cabbage research plots at Scattergood Farm in mid-July 2014

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