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RESIDUAL EFFECTS OF COMPOST APPLIED TO SWEET CORN OVER TWO CROP SEASONS

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ABSTRACT

This study evaluated two composts, leaf and yard waste (LYW) and biosolids (BS), as soil amendments at three application rates for sweet corn production in Maine during 2010 and 2011. Pre-plant compost application rates of 0, 10, 20 and 40 tons/per acre were applied in 2010. Half of each plot received additional compost in 2011 at the 2010 application rate. Marketable yield, ear length, and plant height data were collected. Compost application increased plant height, ear length and marketable yield compared to no compost application. BS compost produced greater yields in 2010 compared to LYW compost. There was no significant difference between the 10 and 20 or 40 tons/acre in plant height in 2010, indicating no advantages with the 10 tons/acre versus the 20 or 40 tons/acre. However, in 2011, there was a significant difference between 10 and 20 tons/acre in plant height. Yield in both years was greater with increased compost applications but not significantly. These trends suggest that compost has a residual effect on the soil and crop productivity.

INTRODUCTION

Organic matter is critical to the long-term health and productivity of soils (Magdoff and VanEs, 2000). Additions of compost to soil have been shown to improve its physical and biological qualities. Becker et al. (2010) showed that the bulk density and electro-conductivity of soil improved after compost amendments. Ros et al. (2006) found that long-term compost treatments have positive effects on the soil biota. They also found that microbial biomass carbon (C) and basal respiration was significantly increased for compost treatments. In first year experiments, Reider (et al. 1991) found no significant differences in corn yield between compost application (207-273 lbs/acre) and conventional nitrogen (N) fertilizer (130 lbs/acre). Greenwood (et al 1999), also reported no significant difference in sweet corn yield with the application of yard and waste compost compared to conventional fertilizer applications. Westermann, et al. (2000), found that residual crop yield benefits were only apparent when 10-20 tons of compost were applied the previous year. No third year effect was found.

This experiment evaluated the use of compost as the exclusive source of N on a crop with high N requirements. If farmers can replace some or all of their conventional N fertilizers with compost, there may be a financial cost savings as well as additional benefits to soil health.

METHODS

Site Description:

A two-year experiment was carried out from May 2010 to August 2011 on a one-acre field at Highmoor Farm, a University of Maine Experimental Station in Monmouth, Kennebec County, Maine. The predominate soil is an Agawam fine sandy loam. The USDA climate zone is 4. Prior to planting in 2010, 80 lbs. of $P_2O_5$was broadcast in all plots as recommended by soil tests. No additional conventional or organic fertilizer was added in either year.

Treatment Description and Experimental Design:

The experiment compared two types of compost at three application rates and an untreated control. The experiment was conducted in a randomized complete block design with three replications. The control plots did not receive compost in either year. Compost application rates of 10, 20 and 40 tons/acre were chosen as 'typical farm rates' based on conversations with growers. The characteristics of the two composts, biosolids (BS) and leaf and yard waste (LYW) used were different and are described in Table 1.

Compost Type	Total Nitrogen %	Bulk Density (lbs/cu yard)	pH	C:N

Leaf and Yard Waste (LYW)	0.45	893	7.2	15.3
Biosolids (BS)	0.61	657	7.9	31.9

Table 1: Characteristics of composts used as soil amendment to sweet corn plots in 2010 and 2011.

The biosolids compost (BS) was produced by an in-vessel system at the Lewiston Auburn Pollution Control Authority in Lewiston, Maine. The recipe for the BS compost was one part by volume municipal biosolids from the waste water treatment facility and three parts wood shavings. The leaf and yard waste (LYW) compost was made at the University of Maine Compost Research and Education Facility at Highmoor Farm in turned windrows. The recipe for the LYW compost was 3 parts by volume leaf and yard waste, one part chicken manure and one part horse bedding. Compost windrows were turned weekly using a wildcat compost turner for 4 weeks, and then cured for 7 months. Compost was hand-applied (Fig. 1) at the rates of 0, 10, 20 and 40 tons/acre onto 12x100 foot plots and incorporated to a uniform depth of 8 inches using a Perfecta harrow.

Each plot was planted with four rows of sweet corn (*Zea mays)*, ‘BC 0805’, spaced on 34” centers, producing a plant population of approximately 28,000 plants per acre (Fig. 2 and Fig. 3). A cover crop of oats (*Avena sativa* L. cv. Rodeo) was planted after harvest in August of 2010. The oats winter-killed in early November, 2010.

Figure 1. Compost was hand-applied to each plot.

Figure 2. Sweet corn field in early June, 2010.

Figure 3. Sweet corn field in early July, 2010.

The plots established in 2010 were permanently marked by stakes at plot corners; making it possible to identify and use the same plots in 2011. The plots were split into two 50' sub-plots at the start of the 2011 growing season. One treatment sub-plot received compost application identical to the 2010 application. The corresponding paired sub-plot received no compost application in 2011. Weeds were managed by a single application of Lumax (mesotrione, S-metolachlor, triazine) at 3 qt/acre each year. No insecticides were applied in either year.

Data was collected from the center two rows of each plot in both 2010 and 2011. The following data were collected: number of marketable ears (Fig. 3), ear length, and plant height at harvest. The data were analyzed using Stastix9 ™(Analytical Software, Tallahassee, FL). Data collected in 2010 were analyzed as a randomized complete block with three replications. In 2011, the experiement was designed as a split-split plot. The data collected in 2011 were analyzed using ANOVA, which allows the greatest precision to compare the compost application rates. Analysis of the data using regression would make it possible to make some inferences of the effect of application rates not tested (i.e. a calibration scheme), however that was not the intent or design of the experiment. We were interested in making comparisons of low, medium and high rates of compost application.

Figure 3. Sweet corn (*Zea mays)*, var. 'BC 0805' at harvest in August, 2010.

RESULTS AND DISCUSSION

The application of BS or LYW compost in 2010 produced significant increases in plant height, ear length, and number of marketable ears compared to plots receiving no compost application (Table 2). The BS compost produced the tallest plants and highest yields, followed by the LYW compost and the control. The effects are likely the result of the higher N content of the BS compost.

Crop year	Compost application	Compost type	Plant height (in.)z		Ear length (in.)		Marketable ears per acre (dozen)	
2010								
	2010	BS	84.68	a	8.97	a	1085	a
	2010	LYW	80.82	b	8.83	b	756	b
	2010	control	79.03	c	8.75	b	543	b
2011								
	2010	BS	70.78	a (b)x	7.00	a (b)	999	a (a)
	2010	LYW	71.28	a (b)	7.09	a (b)	1148	a (a)
	2010	control	64.72	b	6.32	b	583	a
	2010, 2011	BS	85.18	a (a)	7.40	a (a)	1499	a (a)
	2010, 2011	LYW	84.40	a (a)	7.55	a (a)	1370	a (a)
	2010, 2011	None	75.58	b	6.91	b	500	b

Table 2. Sweet corn plant height from plots receiving biosolids(BS) or leaf and yard waste (LYW) compost applications in 2010 or in both 2010 and 2011. (zMeans within a crop year/compost application followed by the same letter are not significantly different at p=0.05. x Means of identical compost type followed by the same letter within parenthesis are not significantly different at p=0.05)

The application of compost in 2010 continued to have effects in the 2011 growing season. Plots receiving either compost in 2010 continued to produce larger plants and longer ears in 2011 compared to untreated plots with no further compost added (Fig. 4). The number of marketable ears from each of the treatments was not significantly different, even though the compost amended plots produced roughly twice as many marketable ears. It is interesting to note that the LYW treatment produced a greater yield than the BS compost the second year after application. The LYW compost had more nitrogen tied up in organic matter, which required more time to become available to the crop.

Figure 4. Data collection in late August 2010.

Compost applications in 2010 and 2011 resulted in significantly taller plants with longer ears and greater yields compared to no compost application at all. The application of either compost in 2011 produced significantly taller plants with longer ears compared to plots receiving compost only in 2010. Compost application in 2011 however, did not result in significantly greater yields when compared to plots receiving compost only in 2010. This indicates there is a carry-over effect of compost and that compost may not need to be applied yearly to have significant benefits to crop yield.

BS Compost

Application of BS compost of 10 tons/acre or greater resulted in increased plant height, ear length and yield during the 2010 growing season (Table 3). However, only application rates of 20 or 40 ton/acre produced statistically significant differences compared to untreated controls. No significant difference was determined between application rates of 10, 20 or 40 tons/acre.

In 2011, plant height was significantly less in untreated plots compared to plots receiving BS compost applied in both 2010 and 2011 at rates of 20 or 40 tons/acre (Table 3). No significant differences in ear length or yield were detected in among BS treated plots in 2011. However, plots receiving compost in 2010 trended to produce taller plants with longer ears and greater yields compared to untreated control plots. The 2011 yield in plots only receiving compost in 2010 still maintained increases over the control plots similar to those observed in 2010. Perhaps more importantly, plots receiving compost in both 2010 and 2011 produced yields more than two times greater than the control plots.

Crop year	Compost application	Compost application rate (ton/acre)	Plant height (in.)		Ear length (in.)		Marketable ears per acre (dozen)		Increase above control
2010									
	control	0	79.03	b	8.75	b	543	b	0
	2010	10	84.26	ab	8.93	ab	926	ab	1.71
	2010	20	84.24	a	9.02	a	1069	a	1.97
	2010	40	85.53	a	8.97	a	1262	a	2.32
2011									
	control	0	70.15	c	6.63	a	541	a	0
	2010	10	68.00	c	6.43	a	667	a	1.23
	2010	20	71.21	bc	7.31	a	861	a	1.59
	2010	40	73.13	abc	7.08	a	1472	a	2.72
	2010, 2011	10	79.64	abc	7.11	a	1416	a	2.62
	2010, 2011	20	88.73	a	7.62	a	1777	a	3.28
	2010, 2011	40	87.16	ab	7.41	a	1305	a	2.41

Table 3. Sweet corn plant height from plots receiving BS compost applications in 2010 or in both 2010 and 2011. (Means within a crop year followed by the same letter are not significantly different at p=0.05)

LYW Compost

Application of LYW compost had measurable effects on plant height, ear length and yield (Table 4) though statistically significant differences were few. The absence of significant differences is thought to be the result of high variation within treatments. The application of LYW at the 20 tons/acre rate did not increase plant height compared to the control, however, the 10 and 40 tons/acre treatments significantly increased plant height over the control. The 2010 marketable yield was greater in plots amended with compost though the increase was not significant.

There was a carry-over effect apparent in the 2011 data. Plants grown in plots receiving compost in 2010 tended to be taller, have longer ears, and produce greater yields (Fig. 5). The plants growing in plots receiving LYW compost in both 2010 and 2011 were taller than those grown in plots not receiving any compost or compost only in 2010. Yield tended to increase as compost application rates increased. Sweet corn grown in 2011 on plots amended with LYW compost in 2010 had greater yields in relation to untreated plots compared to 2010. This could be an indication that the nutrient value of the compost applied in 2010 was not fully available until the 2011 growing season. It is also apparent with LYW that the additional compost applied in 2011, with the exception of the 40 tons/acre treatment, did not substantially increase plant growth or yield when compared to plots receiving compost in 2010.

Crop year	Compost application	Compost application rate (tons/acre)	Plant height (in.)		Ear length(in.)		Marketable ears per acre (dozen)		Increase above control
2010									
	control	0	79.03	b	8.75	b	543	a	0
	2010	10	82.16	a	8.81	a	783	a	1.44
	2010	20	78.28	b	8.83	b	745	a	1.37
	2010	40	82.03	a	8.85	a	740	a	1.36
2011									

control	0	70.15	c	6.62	a	541	b	0
2010	10	68.99	b	6.99	a	944	b	1.75
2010	20	73.36	bc	7.29	a	1361	b	2.52
2010	40	71.28	bc	6.95	a	1139	b	2.10
2010, 2011	10	83.01	ab	7.64	a	1389	b	2.57
2010, 2011	20	82.19	abc	7.20	a	1194	b	2.21
2010, 2011	40	88.00	a	7.81	a	1528	a	2.82

Table 4. Sweet corn plant height from plots receiving LYW compost applications in 2010 or in both 2010 and 2011. (Means within a crop year followed by the same letter are not significantly different at p=0.05)

Figure 5. Plant measurements were taken at harvest in each year.

CONCLUSION

The application of compost for one or two seasons significantly increased sweet corn ear length and plant height over untreated controls. While further research is necessary to determine differences in overall yield, a trend towards increased yield is discernible. Marketable yields showed strong tendencies in response to the application rates. These trends support the idea that compost has a residual effect on the soil and crop productivity. If growers are able to replace some fertilizer with compost, they may be able to save money by making their own compost or purchasing it locally. The benefits to the soil of adding organic matter as well as N with compost can increase longer-term soil productivity, as well as satisfy some of the short-term fertility requirements of corn. Composts with high levels of available N tend to show more immediate plant response in terms of growth and yield, while compost with more N tied up in the organic fraction show more carry over growth response in subsequent seasons.

LITERATURE CITED

Becker, S.J., Ebrahimzadeh, A., Plaza Herrada, B.M., & Lao, M.T. (2010). Characterization of Compost Based on Crop Residues: Changes in Some Chemical and Physical Properties of the Soil after Applying the Compost as Organic Amendment. *Communications in Soil Science and Plant Analysis*, 41, 6 (2010) 696-708.

Greenwood, J.D., Gallaher, R.N., & McSorely, R. (1999). Impact of Compost and Tillage on Sweet Corn Yield, Soil Properties and Nematodes. Proceedings of the 22nd Annual Southern Conservation Tillage Conference for Sustainable Agriculture Athens, GA 6-8 1999. *Georgia Agricultural Experiment Station Special Publication 95*. Athens, GA.

Magdoff, F. and VanEs, H. (2000). *Building Soils for Better Crops*. Sustainable Agriculture Network. Second Edition.

Reider, C., Janke R., and Moyer, J. (1991). Compost Utilization for Field Crop Production. Technical Report submitted to the Pennsylvania Energy Office, Rodale Institute, Kutztown, PA.

Ros, M., Klammer, S., Knapp, B., Archberger, K., Insam, H. (2006). Long-term effects of Compost Amendments of Soil on Functional and Structural Diversity and Microbial Activity. *Soil Use and Management*, 22 (2006) 209-218.

Sikora, L.J. and Yakovchenko, V. (1995). Soil Organic Matter Mineralization after Compost Amendment. *Soil Science Society of America Journal,* 60 (1996) 1401-1404.

Weber, J., Karczewska, A., Drozd, A., Licznar, M., Licznar, S., Jamroz, E., Kocowitz., A. (2006). Agricultural and ecological aspects of a sandy soil as affected by the application of municipal solid waste composts. *Soil Biology & Biochemistry*, 39 (2007) 1294-1302.

Westermann, D. J. Stark, C. Falen, Tindall, T. (2000). Long Term Effects of Dairy Compost on Crop Production and Soil Quality. Presented at the University of Idaho Sugarbeet School, Twin Falls, ID.