Soil Properties, Nematode Densities, and Corn Yield From Yard Waste Compost Applications

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Abstract: Urban plant debris or urban yard waste can be processed into yard waste compost (YWC) for beneficial application to agricultural land. This reduces the amount of waste deposited into sanitary landfills. The objective of this research was to determine the changes in soil properties. plant-parasitic nematodes and corn yield from application of YWC to farmland in Alachua County, Florida. Two adjacent experiments received large amounts of YWC used as a mulch for no-tillage corn or YWC incorporated into the soil for conventional tillage corn. Both experiments had control treatments with either no YWC applied or applied only the first year (1992) of the 4 year study. Both experiments were in randomized complete block designs with five replications. By the summer of 1995. soil organic matter was 50 to 100% greater from application of YWC. Soil N, CEC, pH and extractable nutrients were all in much greater quantities and nematodes were reduced in soil treated with YWC.

Introduction

Application of urban plant debris to agricultural land can improve soil properties and result in increased crop yield (Gallaher and McSorley, 1994; Gallaher and McSorley, 1995; Kidder, 1993; Kluchinski, et al., 1993). Urban plant debris can be applied in the fresh form (Kluchinski, et al., 1993) or after it has been processed as yard waste compost (YWC) (Gallaher and McSorley, 1994; Gallaher and McSorley, 1995). Reports of plant-parasitic nematode suppression from application of urban plant debris have also been published (Gallaher and McSorley, 1995; McSorley and Gallaher, 1995; Kluchinski, et al., 1993). While many questions remain regarding the application of urban plant debris to agricultural land, most information to date is positive. The objective of this research was to determine the changes in soil properties, plant-parasitic nematodes and corn yield from application of YWC to farmland in Alachua, County, Florida.

Materials and Methods

Two adjacent experiments were conducted for 4 years on the Haufler Brothers farm, Gainesville, Florida from 1992 to 1995. Soil type was a Bonneau fine sand. Three treatments of < 5 cm particle size, 4- to 6-month old YWC were as follows for experiment one: Treatment one had no YWC applied in 1992, had 269 mt/ha YWC applied evenly over the soil surface for a mulch followed by a planting of in-row subsoil no-tillage corn in 1993 and again in 1994. This YWC mulch was incorporated following corn silage harvest each year. No YWC was applied in 1995. Total YWC for treatment one was 538 mt/ha for the 4 years. Treatment two was the same as for treatment one except that the YWC was incorporated prior to planting corn each time in 1993 and 1994. Treatment three received no YWC any year and was the control treatment. Adjacent to experiment one was experiment two which used the same YWC type and source with the same three treatments as used in experiment one with the following exception. All three treatments received 269 mt YWC/ha that was incorporated in 1992. Tables 2 and 4 further illustrate the application and rates of YWC each of the 4 years of the study. Both experiment one and two were randomized complete block designs with five replications.

Yard waste compost was analyzed for dry matter by drying in a forced air oven at 70 C. Dry samples were ground using a Wiley mill to pass a 2.00-mm stainless steel screen and stored in air-tight plastic bags. Samples were then analyzed for organic matter (by combustion), C (estimation from organic matter), pH, N [microKjeldahl digestion (Gallaher, et al., 1995) and colorimetry], P (colorimetry) K (flame emission spectrophotometry), Ca, Mg, Cu, Fe, Mn and Zn (atomic absorption spectrophotometry) (Table 1). Soil samples were taken from the 0.0 to 0.2 m depth prior to application of YWC and corn planting each year and at harvest time each year for testing for Mehlich I (Mehlich, 1953) extractable elements [P (colorimetry), K, Na (flame emission spectrophotometry), Ca, Mg, Cu, Fe, Mn and Zn (atomic absorption spectrophotometry)], N [microKjeldahl digestion (Gallaher, et al., 1975) and colorimetry], CEC (cation summation), pH (electrode and water), and soil organic matter (potassium dichromate). Soil test data is only shown for July sampling in 1995 (Table 2).

Both experiments were fertilized with 202 kg inorganic N, 22 kg P, and 200 kg K per ha each year except 1995 when no P or K was used. Pioneer brand 3154 hybrid corn was planted each year in early march, in six row plots, 0.75 m

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Table 1. Analysis of yard waste compost used on the Haufler farm research/demonstration plots in 1992, 1993, and 1994.

	Haufler farm		
Analysis	1992	1993	1994
DM g/kg	572.0	507.0	515.0
OM g/kg	772.0	665.0	635.0
C g/kg	398.0	335.0	320.0
N g/kg	8.6	9.2	9.0
C:N ratio	46.3	36.4	35.6
pH chopped	5.7	---	6.5
pH ground	5.8	7.0	6.2
Ca g/kg	14.3	23.0	24.4
Mg g/kg	1.3	2.0	1.8
K g/kg	1.9	3.2	2.8
P g/kg	0.8	1.9	1.5
Cu mg/kg	11.7	16.3	16.0
Fe mgikg	1580.0	1473.0	1793.0
Mn mg/kg	146.0	142.0	173.0
Zn mgikg	91.0	112.0	96.0

DM = dry matter; OM = organic matter in DM: chopped =compost samples were chopped into coarse particles using a grinder: ground = sub-samples of the chopped samples were ground with a Wiley mill to pass a 2 m mstainless steel screen. Values are the average of four replications. The source of the, <5 cm size 4 to 6 month old. compost was Wood Resource Recovery. Gainesville, Florida

apart and 30 m long. Whole corn plants were cut from the center two rows of each plot and forage yield measured at 30% dry matter.

All plots were sampled for nematodes at planting time and harvest time each year. Each sample consisted of six soil cores, 2.5 cm diam. and 20 cm deep, collected within the center two rows in each plot. The cores were composited and mixed, and a 100-cm^3 subsample was removed for nematode extraction using a modified sieving and centrifugation procedure (Jenkins, 1964). Yield and nematode data were examined by analysis of variance, followed by mean separation with Duncan's New Multiple Range Test using MSTAT software (Michigan State University, East Lansing, MI).

Results and Discussion

Based upon YWC analyses large quantities oforganic matter and plant nutrients were applied from the amendment treatments (Table 1) However due to the large C:N ratio it would not be expected that immediate benefits from the N in the YWC would be observed for corn growth. Final soil test data at corn harvest time of the 4th-year indicated that the addition of YWC had increased soil organic matter by 90 to 100% over the control for experiment one and was 50 to 80 % greater than the control for experimenttwo (Table 2). However, for experiment two the control had received 269 mt/ha of YWC in 1992 and was still having an impact on organic matter 4- years later. Estimates of the C:N ratio from soil organic matter and N in Table 2 would indicate ratios ranging from 3.6:1 to 4.6:1 which would favor release of N to help meet crop needs. The YWC appeared to have an impact on buffering the soil by observation of the soil pH being higher than for the control. No doubt the addition of large quantities of cations played a major part in moderating change in soil pH and the resulting increase in CEC (Table 2). Generally the addition of YWC had a significant impact on improving soil quality that would favor improved crop growth.

The plant-parasitic nematodes *Criconemella* spp. (mostly *C. ornata* with some *C. sphaerocephala)* and *Pratylenchus* spp. (mostly *P. scribneri* with some *P. brachyurus)* were present in both experiments and tended to be lower in plots amended with compost than in unamended control plots (Table 3). On the other hand, *Meloidogyne incognita* was not consistently affected by compost treatment. *Paratrichodorus minor* numbers were lower in plots receiving YWC for experiment two but not for experiment one. By the end of the fourth year of these experiments (1999, densities of several different nematodes were affected by YWC application. By this time, more of the woody compost material had broken down and soil organic matter had increased substantially in the amended plots. It is not known whether breakdown products may have affected nematodes directly, or whether the increased organic matter and related improvement in soil properties provided a more suitable habitat for

Table 2. Soil properties from use of yard waste compost on the Haufler farm after four years, Gainesville, Florida, 1996.

Compost Treatment				Total													
1992	1993	1994	1995	4 year	pH	OM	CEC	N	P	K	Ca	Mg	Cu	Fe	Mn	Zn	Na
mt/ha						g/kg	meq/100g	mg/kg									
Experiment number one																	
0	269MI	269MI	0	538	6.1	31.2	11.00	1000	113	114	1354	106	0.31	10.2	8.40	7.0	4.5
0	2691	2691	0	538	5.9	33.0	11.40	1220	109	93	1133	110	0.29	11.3	9.54	7.7	4.7
0	0	0	0	0	5.5	16.6	7.47	670	84	77	542	45	0.56	16.5	5.68	4.7	3.6
Experiment number two																	
2691	269MI	269MI	0	806	6.4	42.8	15.90	1530	149	148	2165	133	0.27	19.3	11.24	9.4	5.0
2691	2691	2691	0	806	6.2	36.1	13.20	1190	132	137	2103	139	0.26	21.4	9.65	7.8	6.0
2691	0	0	0	269	5.6	24.0	8.06	800	100	75	812	61	0.44	17.2	6.40	5.7	4.6

MI = compost used as a mulch during the corn crop growing season and incorporated immediately after harvest each year. I = compost incorporated 10 days before planting (DBP) in 1992, 40 DBP in 1993, and 110 DBP in 1994. No compost was applied in 1995. Values are an average of five replications for the top 0.2 m of soil, Estimated C:N ratios Exp l:MI=4.59:1; 1=3.98:1; O=3.64:1 and for Exp 2:MI=4.11:1; I=4.46:1; O=4.41:1.

Table 3. Effect of yard waste compost treatments on initial (March) and final (June/July) nematode population densities on corn during 1995 at a site not previously treated with compost and a site previously treated with 269mt compost/ha in 1992.

Compost Treatment	Site untreated in 1992 with 0 mt/ha			Site treated in 1992 with 269 mtlha		
		10 Mar	21 June		10 Mar	21 June
	mt/ha			mt/ha		
	---------- Criconemella spp. per 100^3 soil ---------					
Mulch	538	6 B	155 b	807	12 ab	40 B
Incorporated	538	22 AB	92 b	807	3 b	69 B
Control	0	62 A	660 a	269	26 a	172 A
	---------- Meloidogyne incognita 100^3 soil ---------					
Mulch	538	6	72	807	15	164
Incorporated	538	11	28	807	9	125
Control	0	6	70	269	15	59
	-------- Paratrichodorus minor per 100^3 soil --------					
Mulch	538	8	28	807	4 b	20 B
Incorporated	538	4	28	807	4 b	27 B
Control	0	9	60	269	12 a	63 A
	---------- Pratvlenchus spp. per 100^3 soil ----------					
Mulch	538	21 b	120	807	30 b	289 a
Incorporated	538	20 b	138	807	23 b	137 b
Control	0	43 a	126	269	56 a	123 b

Data are means of five replications. For each site, means in columns among compost treatments within each nematode not followed by the same letter are significantly different at the 0.05 (small letters) level of probability or at the 0.10 (capital letters) level of probability, according to Duncan's New Multiple Range Test. No letters indicate no differences at the 0.10 level of probability for a given nematode.

naturally-occumng antagonists ofnematodes (Stirling, 1991), since these were not measured in the experiments.

The addition of YWC greatly improved corn forage yield (Table 4). Improvement in forage yield from addition of YWC was greatest in 1993 and 1994 comparedto 1995 (year in which no YWC was added). It is suspected that soil water storage was greater in 1993 and 1994 compared to 1995, due to the YWC mulching or incorporation near the soil surface (Gallaher and McSorley, 1994). The farmers were impressed with the improvement in yield from application of YWC. Since they routinely sell the corn forage as silage and because the YWC had been donated, they realized an immediate economic benefit from its use to improve soil quality for better crop growth and development.

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Table 4. Corn forage yield from use of yard waste compost (YWC) on research/demonstration plots for 1992, 1993, 1994, and 1995, Gainesville. FL

Compost Treatments				Total	Year			
1992	1993	1994	1995	4-yr	1992	1993	1994	1995
Experiment number one								
mt/ha					Forage, Mg/ha @ 30% DM			
0	269MI	269MI	0	538	28.0	23.1a	33.6a	37.6a
0	2691	2691	0	538	28.0	21.3a	30.2ab	37.1a
0	0	0	0	0	28.0	9.9 b	23.1 b	33.6 b
Experiment number two								
2691	269MI	269MI	0	806	26.2	28.5a	41.0a	38.8A
2691	2691	269	0	806	26.2	26.0a	38.5a	39.9A
2691	0	0	0	269	26.2	20.4 b	29.8 b	34.8 B

MI = compost used as a mulch during the corn crop growing season and incorporated immediately after harvest each year. I = compost incorporated 10 days before planting (DBP) in 1992, 40 DBP in 1993, and 110 DBP in 1994. No compost was applied in 1995. For yield data, values in columns among compost treatments not followed by the same letter are significantly different at the 0.05 (small letters) level of probability except for 1995 experiment two which is significant at the 0.10 (capital letters) level of probability.