MANAGEMENT OF YARD WASTE COMPOST FOR SOIL AMENDMENT AND CORN YIELD

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ABSTRACT

Grass clippings, shrubbery trimmings and tree parts from urban homesites comprise a large quantity of plant derived organic matter waste requiring environmentally safe disposal. The objective of this study was to determine the effect of yard waste compost (YWC) on soil properties, corn (*Zea mays*) nutrition. phytoparasitic nematodes, and yield of corn. Treatments applied on a field near Gainesville, Florida were 120 tons YWC and 60 tons YWC/acre compared to control plots receiving no YWC. Pioneer Brand 3154 hybrid corn (*Zea* mays L.) was planted 3 March 1992 in rows 30 inches apart for a final population of 14,800 plants/acre. Soil and corn leaf tissue samples were taken three times during the corn growing season to assess the soil properties and nutritional status of the corn. Whole plant dry matter and grain yields were estimated at corn maturity. Initial (Pi) and final (Pf) nematode counts were made from the soil samples three weeks after planting and at corn harvest time. Within each YWC plot a split plot analysis was performed on time of sampling and depth of sampling for all soil and plant chemical analyses. Averages and standard deviations were calculated for nematodes. Soil organic matter decreased with soil depth, and increased over the growing season, especially in the 120 ton YWC/acre rate. The immediate plowdown and planting of corn resulted in N deficiency in the young corn. Calcium and Mg were also deficient in corn leaf tissue. Three of four nematodes were suppressed from use of YWC.

INTRODUCTION

Florida law requires lined landfills while federal law will prohibit use of unlined landfills in the U.S. by 1994 (Kidder. 1993). Florida law already restricts the disposal of organic yard waste in landfills. A large industry is developing in Florida whose objective is to make wood chip mulch and compost from yard waste, products which should be environmentally safe to apply to the land and result in potential benefits. For example, yard waste compost (YWC) can be applied in large quantities to farm fields to help improve soil properties and crop yield. Applying large quantities of organic waste to land can potentially result in increased soil organic matter. Soil organic matter is highly correlated with soil cation exchange capacity, water holding capacity, and generally improves yield of crops. It takes only a small increase in soil organic matter to slow pesticide leaching in soil and help restrict its movement into ground water (Arthur, 1989). Therefore, application of YWC to crop land where large inputs of chemicals are used in production could have the potential benefit of stopping or slowing the movement of chemicals through the soil and reduce the potential for ground water pollution. Disposal of municipal leaves on agricultural lands was highly successful and beneficial in New Jersey (Kluchinski, et al., 1993). They reported that soil water and crop yields were increased and nematodes were generally decreased from use of leaf mulching as a soil amendment.

Microorganisms play a major role in decomposition of organic matter such as composts, crop residues, animal manures or green manure. Their success in decomposition and subsequent use of N by higher plants is dependent on the ratio of C:N in the wastes. For organic matter with a C:N ratio greater than 20:1, N will temporarily be immobilized in microbial tissue and will create N-deficient soil for plants being grown following the addition of such organic matter wastes. For wastes or residues with a C:N ratio less than 20:1, N will be mineralized in the form of NH_4^+ or NO_3 for absorption and uptake by plant roots (Jones. 1982).

The objective of this study was to determine the effect of disposal of YWC on soil properties, corn (*Zea mays* L.) nutrition, phytoparasitic nematodes and yield of corn.

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MATERIALS AND METHODS

Wood Resource Recovery of Gainesville, Florida donated YWC under the supervision of Mr. Rodney Douglas, and Mr. Dale Haufler and Mr. Donnie Haufler applied 120 tons and 60 tons/acre on 2 112 acre plots on their farm on 2 February 1992 to compare with control plots receiving no compost. The research/demonstration plots were in a field near Gainesville, Florida. On 10 February 1992 the field was moldboard plowed which buried the compost to a depth of 6 to 10 inches. Pioneer brand 3154 hybrid corn was planted 4 March 1992 in rows 30 inches apart for a final population of 14,800 plants/acre. During the planting operation 70 pounds N/acre from anhydrous ammonia was injected 8 inches under the row behind subsoil shanks. In addition an application of 250 pounds 7-18-14 (N-P_2O_5-K_2O) was applied during the planting operation 2 inches below and 2 inches beside the seed. An additional 300 pounds of muriate of potash (KCl) was broadcast over the corn on 25 March. On 15 April when corn was about 6 to 10 inches tall, 165 pounds N/acre as anhydrous ammonia (NH_3) was knifed into every other row middle.

Soil and plant samples were replicated four times from each treatment. Soil samples were taken from the 0 to 8, 8 to 16 and 16 to 24 inch depths beginning on 2 March 1992. Additional soil samples were taken three times during the corn growing season. Corn leaf samples were also taken three times for measurement of nutritional status. Four samples of YWC were collected from the Haufler's field at the time of plowdown and four additional samples were collected from the Wood Resource Recovery compost yard. Whole plant dry matter and grain yields were estimated at corn maturity.

Soil analyses included OM, extractable nutrients, pH, N and water content. Nitrogen, P, K, Ca, Mg, Cu, Fe, Mn, and Zn concentrations were determined in corn leaf tissue, the whole plant samples at maturity and the YWC. Percent dry matter and organic matter was also determined in the YWC. Nutrient contents were determined in the whole plant samples. Initial (Pi) and final (Pf) nematode counts were made from the soil samples three weeks after planting and at harvest of the corn. Within each YWC researchIdemonstration plot a split plot analysis was performed on time of sampling and depth of sampling for all soil and plant chemical analyses. Averages and standard deviations were calculated for nematodes.

Table 1. Analysis of yard waste compost used in the Haufler farm demonstration plots in 1992.

	Compost sample site	
Analysis	Haufler farm	Company yard
Dry matter (%)	57.2	45.1
Organic matter (OM) (%)	77.2	78.0
C from carbon analyzer (%)	39.8	39.2
N (%)	0.859	0.944
C:N ratio	46.3	41.5
pH chopped	5.7	6.2
pH ground	5.8	6.3
Ca (%)	1.43	1.75
Mg (%)	0.128	0.176
K (%)	0.193	0.255
P (%)	0.080	0.116
Cu (ppm)	11.7	11.8
Fe (ppm)	1580.	1448.
Mn (ppm)	146.	176.
Zn (ppm)	91.2	151.3

Table 2. Corn leaf analysis affected by yard waste compost.

Compost ton/acre	22 April(<12 in)	12 May(YML)	6 May(EL)
	Sample date and type of tissue		
	%		
	Nitrogen		
120	1.90b def	2.66a def	2.63a def
60	2.39a def	2.56a def	2.51a def
0	3.01a def	2.45b def	2.64b def
Sufficiency Range	3.5-5.0	3.0-3.5	2.75-3.2
	Potassium		
120	3.15a	2.80b	2.75b
60	3.08a	3.33a	2.63a
0	3.60a	2.93b	2.50c
Sufficiency Range	2.5-4.0	2.0-2.5	1.75-2.25
	Magnesium		
120	0.11b def	0.10b def	0.13a
60	0.12a def	0.12a def	0.13a
0	0.15a	0.13a	0.13a
Sufficiency Range	0.15-0.45	0.13-0.30	0.13-0.30
	Calcium		
120	0.25b def	0.29b	0.37a
60	0.24c def	0.32b def	0.36a
0	0.32b	0.33b	0.38a
Sufficiency Ranae	0.30-0.70	0.25-0.50	0.25-0.50

< 12 in = whole corn plant less than 12 inches tall; YML = youngest mature leaf; EL = ear leaf; def = deficient concentration; Sufficiency range is according to Jones, et al., 1991.

RESULTS AND DISCUSSION

From the analysis of the YWC applied on the Haufler research/demonstration plots we learned that it had a C:N ratio of 46.3 (Table 1). Because the C:N ratio is larger than 20:l we should have expected the YWC to immobilize soil N, the effect being greatest for the 120 ton/acre treatment. Our observations on 22 March confirmed this prediction. Nitrogen deficiency symptoms were very severe in the 120 ton/acre treatment and moderate in the 60 ton/acre treatment. No observable N deficiency was evident in the control plots.

The YWC applied to the field had a N concentration of 0.859 % (Table 1) and a content of 1179 lb/acre and 590 lb/acre for the 120 ton and 60 ton/acre treatments, respectively. In order to have a 20:1 C:N ratio the YWC would have had to contain 2732 and 1366 lb N for the 120 and 60 ton YWC/acre treatments, respectively in order for soil N to not be immobilized by microorganisms. In this case the YWC was short by 1553 and 777 lb N/acre for the 120 ton and 60 ton/acre treatments, respectively to keep N immobilization from occurring. The Hauflers added 165 lb N/acre as anhydrous ammonia on 15 April using a coulter and knife injector implement in every other middle

Table 3. Effect of yard waste compost and soil depth on nematode densities on two sampling dates.

Soil Depth	Sample Date	Compost, ton/acre 0		60		120	
inch		No/100 cm³ soil					
		no	sd	no	sd	no	sd
		Criconemella spp.					
0-08	27 Apr	73	17	105	21	112	19
8-16	27 Apr	95	18	93	21	108	33
16-24	27 Apr	88	15	86	18	196	94
0-08	30 Jun	379	135	366	76	274	106
8-16	30 Jun	554	164	386	88	537	136
16-24	30 Jun	330	46	228	41	564	284
		Meloidogyne incognita					
0-08	27 Apr	6	5	3	2	1	1
8-16	27 Apr	10	4	3	2	5	2
16-24	27 Apr	3	1	5	3	6	3
0-08	30 Jun	286	163	88	37	68	43
8-16	30 Jun	531	327	225	74	85	58
16-24	30 Jun	130	62	104	53	17	12
		Paratrichodorus minor					
0-08	27 Apr	69	6	38	6	26	3
8-16	27 Apr	98	16	49	13	16	4
16-24	27 Apr	42	8	18	5	6	1
0-08	30 Jun	161	32	80	22	79	14
8-16	30 Jun	120	26	61	18	54	11
16-24	30 Jun	65	3	51	17	28	7
		Pratylenchus spp.					
0-08	27 Apr	6	3	2	1	4	2
8-16	27 Apr	9	4	1	1	7	3
16-24	27 Apr	24	17	5	3	8	4
0-08	30 Jun	264	94	103	35	228	163
8-16	30 Jun	452	58	78	24	195	53
16-24	30 Jun	192	65	59	23	107	73

no = number of nematodes; sd = standard deviation

of the corn rows. This method of application concentrated the N in a small area limiting its contact with the YWC but accessible to corn root. This procedure should have assisted in limiting immobilization by microorganisms. The observed N deficiency symptoms disappeared quickly after this fertilizer application. Estimated silage yields at 30 % dry matter were not different among the treatments; 120 ton YWC = 11.7 ton/acre, standard deviation (sd) = 3.7; 60 ton YWC = 10.0 ton/acre, sd = 2.1; 0 ton YWC = 12.5 ton/acre, sd = 1.3. Incorporation of the YWC 4 to 6 months before planting of corn would likely have allowed time for the YWC to breakdown and equilibrate in the soil. If this had been done the N deficiency would likely have not occurred and yields would have likely been greater in the YWC plots than was observed in our study. Additional research will test this hypothesis as well as look at the longer term benefits to soil properties and yield.

SUMMARY AND CONCLUSIONS

Soil organic matter decreased with soil depth and increased significantly over the growing season, especially in the 120 ton YWC/acre plot. Soil test N, K, and P generally decreased with soil depth. These test values at corn harvest time generally increased over the test values at planting in YWC plots compared to the control plot. Immediate plowdown of YWC resulted in apparent tie-up of N and N deficiency symptoms in corn in proportion to the amount applied. The corn plants were deficient in N in all treatments throughout the season, which was likely due to timing of N application (Table 2). Calcium and Mg deficiency occurred in the compost treated plots during vegetative growth (Table **2)**. This was likely due to heavy application of K and N fertilizer. All nematode numbers were greater at time of corn maturity compared to numbers at the beginning of the study (Table 3). Meloidoqvne incoqnita (Kofoid & Whitel Chitwood, Paratrichodorus minor (Colbran) Siddiqi and Pratvlenchus spp. appeared to be suppressed by use of compost. The greatest suppression by compost was on Meloidogyne incognita. These three nematodes generally were in lower numbers in the 16-24 inch soil depth. Criconemella spp. were more evenly distributed in the soil.

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