No-Tillage Field Corn and Vegetables Using Yard Waste Compost

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Abstract

Disposal of yard waste on farmland could help reduce the need for additional landfill disposal sites and should help improve soil quality and productivity. The objective of this study was to determine the effect of disposal of yard waste compost (YWC) on production of field corn (Zea *mays)* and vegetables. Several on-farm and experiment station studies were conducted from **1993** to **1994.** Corn forage yield improved **from** the cumulative application of **YWC.** By the third year, **YWC** mulch-treated corn forage yields were **11.2** Mg/ha greater than control treatments, a highly significant economic difference. Much of the yield advantage from YWC application was attributed to improved soil water storage at corn planting time. Squash ***(Cucurbita pepo)*** and okra ***(Hibiscus esculentus)*** yields between locations were heavily dependent upon our ability to provide timely irrigation and the degree of nematode infestation. Transplanted seedlings and incorporated **YWC** treatments appeared to result in best yields, based upon our limited data.

Introduction

Interest in composting today is driven by the high cost of establishing and operating landfills as well as by new restrictions to reduce the amount of materials going into landfills, concerns over groundwater pollution by landfills, and generally a greater commitmenton the part of the public to recycling. Yard waste compost (YWC) is produced from plant-derived organic matter mostly from urban homeowners. New Jersey research (Kluchiniski, et al., 1993) confirmed our work in Florida (Gallaher and McSorley, 1994a; 1994b) because they reported that soil water and crop yields were increased and nematodes were generally decreased from use of leaf mulching as a soil amendment. In a no-tillage study, the senior author (Gallaher, 1977) found that no-tillage mulch planting management (killed rye *(Secale cereale* L.) cover crop) for corn *(Zea mays* L.) and soybean *(Glycine max* L. Merr.) resulted in more water conservation and drought tolerance for the crops. The no-tillage rye mulch treatments resulted in 46% and 30% greater corn and soybean seed yield, respectively, compared to control no-tillage plots where rye tops were removed for forage.

The Florida laws that have restricted disposal of organic yard trash in landfills (Kidder, 1993) have resulted in large reserves of YWC due to the building of composting facilities near urban areas. Experiment station and on-farm soil and crop management research will be required to overcome the fears of potential users (home gardeners and farmers), and to create markets for this YWC.

The objective of this study was to determine the effect of disposal of YWC on field corn and vegetable production.

Materials and Methods

Field corn forage experiments were in randomized complete block designs with five replications imposed on a farmer's field near Gainesville, FL from 1992 to 1994. Treatments for experiment one imposedon a Bonneaufine sand soil were: (Treatment 1) 0 Mg YWC/ha in 1992 + 269 Mg YWC/ha mulch (M) in 1993 + 269 Mg YWC/ha mulch in 1994; (Treatment 2) 0 Mg YWC/ha in 1992 + 269 Mg YWC/ha incorporated in 1993 + 269 Mg YWC/ha incorporated in 1994; (Treatment 3) 0 Mg YWC/ha all 3 years, the control treatment. Field corn experiments two and three differed from experiment one in that all treatments either received 134 Mg incorporated YWClha (experiment 2) or 269 Mg incorporated YWClha (experiment 3), respectively in 1992 only, followed by the same YWC applications used in experiment one for both 1993 and 1994.

Vegetable experiments were imposed on the same soil and treatment conditions at the farmer's location [squash *(Cucurbita pepo* L.); okra, *(Hibiscus esculentus* L.)] in 1993 and in 1993 and 1994 at the University of Florida Agronomy Farm. The soil on the Agronomy Farm was an Arredondo fine sand. The YWC used was identical to that used in the field corn experiments and the following similar treatments were imposed on each vegetable crop: 269 Mg/ha incorpo-

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rated, 269 Mg/ha M, and 0 Mgka (control). Less than 5 cm YWC was used in all cases except for < 2.5 cm YWC on vegetable plots in 1994. The YWC was analyzed for dry matter, organic matter, C, N, pH, and minerals using standard procedures. Yield data were taken from the middle two rows of the four- to six-row plots. Wood Resource Recovery of Gainesville, FL, donated, hauled, and assisted farmers and research assistants in spreading the YWC each year. The analyses of variance (ANOVA) of data were carried out using standard statistical procedures for randomized complete block and split-plot experimental designs.

Results and Discussion

The YWC was about 50% dry matter and had a very high C:N ratio (Table 1). Cumulative applications of YWC have totaled 806,672, and 269 Mg/ha for some treatments depending upon the experiment during the past 3 years (Table 2). The cumulative effects from large applications of YWC in our studies have resulted in significant increases in soil pH, extractable plant nutrients, CEC, and water holding capacity (data not shown). The YWC applications also resulted in significant, but sporadic decreases in populations of plant parasitic nematodes (particularly *Paratrichodorus minor* (Colbran) Siddiqi), depending on the experiment and year (Gallaher and McSorley, 1994a; other data not shown).

Increased forage yields of field corn from use of YWC ranged from 5.8 Mglha to 11.2 Mglha (based on 30% dry matter silage) depending upon the experiment (Table 2). Increased yield was positively correlated with the increased soil organic matter, improved soil fertility conditions, and greatly increased soil water storage capacity. At planting time for the third year of corn (1994), the top 0.64 m of soil, treated with YWC for a mulch, contained as much as 5.8 cm more water than the control without YWC. To replace this much water through irrigation would cost between $50 and $l00/ha depending upon the irrigation system used. Mulched YWC treatments consistently had greater amounts of stored soil water compared to the incorporated YWC treatments (Gallaher and McSorley, 1994b).

Squash yield was greater at the Green Acres Agronomy Farm than at the Haufler farm (Table 3). This was likely

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

Analysis	Company yard l992A	Hauf. l992A	Hauf. & Agron. l993B	Hauf. l994C	Agron. l994D
DM g/kg	451.0	572.0	507.0	515.0	498.0
OM glkg	780.0	772.0	665.0	635.0	592.0
C g/kg	392.0	398.0	335.0	320.0	313.0
N g/kg	9.4	8.6	9.2	9.0	9.1
C:N ratio	41.7	46.3	36.4	35.6	34.4
pH chopped	6.2	5.7	—	6.5	7.5
pH ground	6.3	5.8	7.0	6.2	7.1
Ca g/kg	17.5	14.3	23.0	24.4	34.1
Mg g/kg	1.8	1.3	2.0	1.8	1.9
K g / k	2.6	1.9	3.2	2.8	2.9
p g/kg	1.2	0.8	1.9	1.5	1.8
Cu mg/kg	11.8	11.7	16.3	16.0	18.0
Fe mg/kg	1,448.0	1,580.0	1,473.0	1,793.0	1,825.0
Mn mg/kg	176.0	146.0	142.0	173.0	188.0
Zn mg/kg	151.0	91.0	112.0	96.0	118.0

DM = dry matter; OM = organic matter in DM; chopped = compost samples were chopped into coarse particles using a grinder; ground = subsamples of the chopped samples were ground with a Wiley mill to pass a 2 mm stainless steel screen. Values are the average of four replications.
A = < 5 cm size applied to the Haufler (Hauf.) farm field corn.
B = < 5 cm size applied to the Haufler field corn and vegetable experiments and the Agronomy (Agron.) farm vegetable experiment.
C = < 5 cvm size applied to the Haufman field corn.
D = < 2.5 cm size applied to the Agronomy farm vegetables.

Table 2. Compost treatment and field corn forage yield from use of yard waste compost (YWC) on Haufler farm research plots for 1992, 1993, and 1994.

Application Rates and Amount Applied				Forage Yield		
1992	1993	1994	3-yr Total	1992	1993	1994
Experiment number one						
Mg/ha				-- Mg/ha @ 30% DM --		
0	269 M-IH	269 M-IH	538	28.0	23.1a	33.6a
0	269 I	269 I	538	28.0	21.3a	30.2ab
0	0	0	0	28.0	9.9 b	23.1 b
Experiment number two						
134 I	269 M-IH	269 M-IH	672	22.4	10.5a	27.1a
134 I	269 I	269 I	672	22.4	9.9a	23.3a
134I	0	0	134	22.4	9.4a	21.3a
Experiment number three						
269I	269 M-IH	269 M-IH	806	26.2	28.5a	41.0a
269 I	269 I	269 I	806	26.2	26.0a	38.5a
269 I	0	0	269	26.2	20.4b	29.8 b

M-IH = 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.
For yield data, values in columns not followed by the same letter are significantly different at the 0.05 level of probability.

Table 3. Cumulative total squash yield from application of 269 Mg/ha yard waste compost treatments.

Yard Waste Compost Treatment	Amount	Experiment Location, 1993 Green Acres	Haufler Farm	Average
	Mg/ha	kg/ha		
Conv. till incorporated	269	29,100	16,000	22,500a
No-till mulch	269	19,400	10,200	14,800b
Conv. till control	0	24,900	17,400	21,100a
Average		24,500	14,500*	

* Average values between experiment locations are. significantly different at the 0.10 level of probability. Average values among yard waste compost treatments not followed by the same letter are significantly different at the 0.05 level of probability.

because of better irrigation management on the Agronomy farm. No-tillage mulch compost gave a lower squash yield compared to conventional tillage incorporated squash (Table 3). Transplanted squash yield was 38% greater than yield of direct-seeded squash (Table 4). Insect damage to seedlings was a major problem.

Lower infestation of nematodes on the Haufler farm than on the Agronomy farm may be part of the reason for lower okra yield on the Agronomy farm (Table 5). Conventional tillage incorporated YWC resulted in the highest okra yield on the Haufler farm. Transplanted okra tended to give greater yield compared to directseeded particularly in the incorporated YWC (Table 6). Okra establishment was very difficult because of seedling death and insect damage. The heavy infestation of nematodes resulted in seedling death and stunted, low-producing plants. In general, vegetable yields were affected more by plant establishment methods than by YWC treatments, whereas YWC treatments were extremely beneficial for field corn.

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Table 4. Cumulative total squash yield from application of 269 Mg/ha yard waste compost treatments, Green Acres, 1994.

Yard Waste Compost Treatment	Crop Establishment Method			
	Amount	Transplanted	Seeded	Average
	Mg/ha	kg/ha		
Conv. till incorporated	269	18,900	15,300	17,100
No-till mulch	269	14,800	9,800	12,300ab
Conventional till control	0	8,100	5,200	6,700 b
Averaee		13.900	10.100*	

*Average values between crop establishment methods are significantly different at the 0.05 level of probability. Average values among yard waste compost treatments not followed by the same letter are significantly different at the 0.05 level of probability.

Table 5. Cumulative total okra yield from application of 269 Mg/ha yard waste compost treatments.

Yard Waste Compost Treatment	Experiment Location, 1993			
	Amount	Green Acres	Haufler Farm	Average
	Mg/ba	kg/ha		
Conv. till incorporated	269	290 a*	1,778 a	1,030
No-till mulch	269	240 a	410 b NS	320
Conv. till control	0	359 a	600 a NS	480
Average		290	930	

NS = Average values between experiment locations are not significantly different at the 0.10 level of probability.

* Average values between experiment locations are significantly different at the 0.10 level of probability. Average values among yard waste compost treatments within a location not followed by the same letter are significantly different at the 0.10 level of probability.

Table 6. Cumulative total okra yield from application of 269 Mg/ha yard waste compost treatments, Green Acres, 1994.

Yard Waste Compost Treatment	Crop Establishment Method			
	Amount	Transplanted	Seeded	Average
	Mg/ha	kg/ha		
Conv. till incorporated	269	2,270 a	340 a*	1,310
No-till mulch	269	450 b	30 a NS	240
Conv. till control	0	610 b	40 a NS	330
Average		1,110	140	

NS = Average values between experiment locations are not significantly different at the 0.10 level of probability.

* Average values between crop establishment methods are significantly different at the 0.05 level of probability. Average values among yard waste compost treatments within a crop establishment method not followed by the same letter are significantly different at the 0.10 level of probability.