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YARD TRIMMINGS EFFECT ON CORN PRODUCTION AND NUTRIENT AVAILABILITY

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ABSTRACT

Yard trimmings from western Washington are rich in grass clippings and have potential as a soil amendment for crop production. Our objectives were to estimate N availability from yard trimmings and determine their effects on crop production and soil quality. We conducted two field experiments and one on-farm demonstration, applying yard trimmings in the spring and planting silage corn. Rates varied among experiments and ranged from 10 to 102 dry tons/acre. Yard trimmings applied at 20 dry tons per acre provided adequate available nutrients to replace inorganic fertilizer. At 10 to 30 dry ton rates under ideal conditions for corn growth, apparent nitrogen recovery in the crop averaged 10 to 18%, and soil nitrate residual (0 to 24-inch depth) ranged from 33 to 59 lb/acre. We observed variation in N availability with year and source of material, and plan to investigate this further through mineralization studies. In 1998 yard trimmings were applied to a number of local commercial crops, including corn, bulbs, rhubarb, and cabbage.

INTRODUCTION

Yard trimmings composters in western Washington receive peak flows of feedstocks in the spring. This material is often rich in grass clippings and high in moisture, and can lead to composting and odor problems if the volume exceeds the processing capacity of the facility. Alternatives for handling peak flows can reduce potential composting problems without expanding the capacity of the facility.

Application of yard trimmings to cropland is an alternative that has potential benefits for both composters and farmers. Yard trimmings can provide nutrients and organic matter to benefit crop production and soil quality. Researchers in Pennsylvania reported that application of segregated lawn clippings provided up to 16 lb of available N per ton of clippings (LCSWA, 1991). In California yard trimmings contained mostly eucalyptus leaves. It was an effective mulch, but provided few available nutrients (Faber and Downer, 1997).

Yard trimmings in western Washington are a heterogeneous blend of woody and green material, with substantial amounts of lawn clippings in the green fraction. This material could be suitable for application to farmland after minimal processing. It has the potential to be a valuable soil amendment, but little information is available on its nutrient availability or on appropriate application rates. We conducted this research to estimate N availability from yard trimmings and determine their effects on crop production and soil quality.

METHODS

This paper summarizes two field experiments and one on-farm demonstration of yard trimmings applications to silage corn (*Zea mays* L.). In all experiments, we applied yard trimmings in late spring and incorporated them within one day, followed by planting. Each experiment included three yard trimmings treatments, an inorganic fertilizer treatment, and a zero-N check. All experiments used a randomized complete block design with four replications.

The yard trimmings were received at the facilities from curbside pickup or direct delivery. The curbside material ranged in age from 1 to 14 days when received by the composters. The yard trimmings from facility L were ground, screened and partially composted on an aerated bed for three days before shipment to the field. Yard trimmings from facilities C and S were ground and/or screened with no pre-composting. Nutrient content of the yard trimmings materials is summarized in Table 1.

We measured plant-available N (NH_4-N + NO_3-N) in the soil two weeks after the yard trimmings applications. In September we harvested each experiment by hand cutting two 10-foot sections of row from each plot, weighing the entire sample, and randomly selecting 10-12 plants, which were then shredded, combined, mixed, subsampled, and dried at 150^{o}F for determining dry matter yield and N content. Post-harvest soil samples were collected in one-foot increments to a depth of four feet and analyzed for nitrate-N. Specific methods for each experiment follow.

Table 1. Yard trimmings nutrient content.

Experiment	Source	Year	Total N	NH_4-N	C:N	P	K
			--------- %	---------		--------- %	---------
1	L	95	2.23	0.31	18	-	-
	L	96	1.94	0.39	18	0.21	1.23
2	L	97	2.31	0.07	17	0.32	1.55
	L	98	1.62	0.23	18	0.13	1.06
On-farm	C	98	1.50	0.15	21	0.11	0.92
	L	98	1.72	0.26	18	0.09	1.06
	S	98	1.63	0.19	21	0.11	0.96
	Mean		1.85	0.23	19	0.16	1.13

Experiment 1 (1995-96). Yard trimmings from facility L were applied by hand to 30 x 60 ft plots on a Puyallup fine sandy loam (coarse-loamy over sandy, mixed, mesic Vitrandic Haploxerolls) on 5 June 1995 at rates typical for compost (34, 68, and 104 dry tons/acre). Silage corn (cultivar Northrup King 1404) was planted on 9 June, and harvested at full dent stage on 2 October. All plots received starter fertilizer, and the inorganic treatment received 100 lb of N as sidedress on 14 July. In 1996 the 34-ton plots were split with one half receiving an additional 34 tons of yard trimmings. No other treatments received additional yard trimmings. The same variety of corn was planted on

4 June, and harvested at full dent on 24 September. No starter fertilizer was applied, but the inorganic treatment received 150 lb of sidedress N, based on pre-sidedress nitrate tests. Plots were irrigated both years as needed to maintain peak growth, and triticale (*Tritosecale* spp., cultivar Stan 1) was planted as a winter cover crop.

Experiment 2 (1997-98). Yard trimmings from facility L were applied by hand to 15 x 20 ft plots on a Puyallup fine sandy loam at rates of 10, 20, and 30 dry tons/acre each year. In 1997 we applied yard trimmings on 10 June, planted corn (cultivar DeKalb 365) on 11 June, and harvested at full dent stage on 29 September. In 1998 we applied yard trimmings on 18 May, planted corn on 21 May, and harvested on 21 September. The inorganic N treatment received 100 lb N/acre both years based on pre-sideress nitrate tests, and other management was the same as for Experiment 1.

On-farm demonstration (1998). Yard trimmings from three facilities (C, L, and S) were applied to 15 x 250 ft plots on an Oridia silt loam (coarse-silty mixed, nonacid, mesic Aeric Fluvaquents). Applications were made on 20 May at a single rate (20-25 tons/acre) using a rear-discharge manure spreader. Silage corn was planted on 21 May and harvested on 25 September. The cooperating farmer did all field work, and the crop received no supplemental irrigation.

Calculations. Statistics were computed using established procedures. Least-significant differences were compared following a protected (P = 0.05) F-test. Apparent N recovery (ANR%) was calculated as percent of N applied for each year:

$$\text{ANR\%} = [(A - B)/C]*100, \qquad [1]$$

where
A = annual N uptake for treatment of interest (lb acre^{-1})
B = annual N uptake for zero N treatment (lb acre^{-1})
C = annual N applied for treatment of interest (lb acre^{-1})

RESULTS AND DISCUSSION

Field Experiments. Our discussion of yield response and apparent N recovery will focus on Experiment 2. In Experiment 1 the background pool of mineralizable N was larger than expected and we saw no first-year yield response to yard trimmings or fertilizer application. In Experiment 2 the lower yard trimmings rates (10 and 20 tons/acre) produced equivalent silage yield to the fertilizer treatment in 1997, while the highest rate had a significantly higher yield than the fertilizer treatment (Table 2). In 1998 all yard trimmings treatments had significantly higher yields than the fertilizer treatment (Table 3). Apparent N recovery in the crop averaged nearly 10% in 1997 and 18% in 1998, indicating substantial N availability from the yard trimmings. Post-harvest soil nitrate levels were slightly elevated at the 30-ton rate compared with the fertilizer treatment (Tables 2 and 3).

Table 2. Corn silage yield, apparent N recovery, and residual soil nitrate following yard trimmings application. Experiment 2, 1997.

Yard Trimmings Rate	N Rate	Dry Matter Yield	Apparent N Recovery		Residual Soil Nitrate-N (0-2 ft)
dry ton/ac	lb/ac	t/ac	lb/ac	%	lb/ac
0	0	6.2 c	-	-	26 c
10	402	7.0 b	43 b	10.7 b	34 bc
20	803	7.3 b	67 b	8.4 b	45 ab
30	1205	8.1 a	99 a	8.2 b	59 a
Fertilizer*	100	6.8 bc	49 b	49.0 a	44 b

*34-0-0 applied as sidedress. Rate based on pre-sidedress nitrate test.

Table 3. Corn silage yield, apparent N recovery, and residual soil nitrate following yard trimmings application. Experiment 2, 1998.

Yard Trimmings Rate	N Rate	Dry Matter Yield	Apparent N Recovery		Residual Soil Nitrate-N (0-2 ft)
dry ton/ac	lb/ac	t/ac	lb/ac	%	lb/ac
0	0	5.2 d	-	-	35 b
10	315	8.3 b	62 c	19.5 b	33 b
20	631	9.6 a	114 b	18.1 b	38 b
30	946	10.0 a	149 a	15.7 b	48 a
Fertilizer*	100	7.1 c	65 c	65.3 a	33 b

*34-0-0 applied as sidedress. Rate based on pre-sidedress nitrate test.

These results indicate that Puget Sound yard trimmings are a valuable source of nutrients and can completely replace nitrogen fertilizer. Post-harvest soil nitrate residual was low, and an application rate of about 20 dry tons per acre appears adequate for corn production.

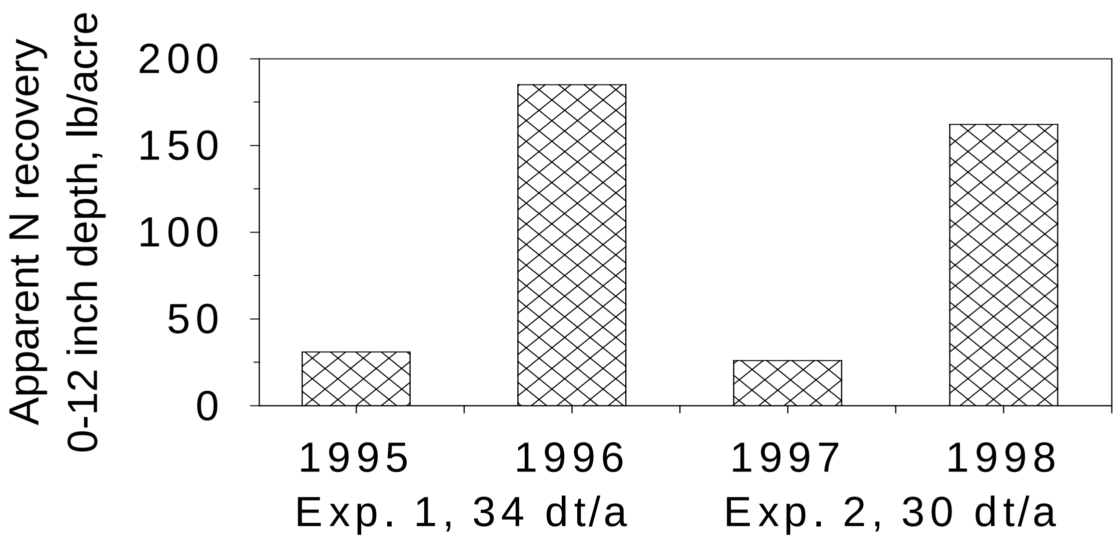
Soil samples collected from Experiment 1 showed that yard trimmings applications increased soil organic matter and potassium levels. Significant organic matter increases were sustained into the second year only when excessive rates of yard trimmings were used (Table 4). Soil pH levels remained unchanged. Soil phosphorus levels increased slightly, but the effect may have been reduced in this soil, because background P levels were high (data not shown).

We measured apparent recovery of available N in the soil two weeks after application, as an indicator of rapidly available N from the yard trimmings (Fig. 1). In both experiments 2-week available N from yard trimmings was much higher after the second-year application compared with the first year. Soil temperature did not account for these differences. One possible cause is year-to-year differences in yard trimmings composition, but no key differences were apparent from our analyses (Table 1). Another possible cause is a priming effect of the first year's application on second-year N availability.

Table 4. Soil organic matter and potassium levels 16 months after high-rate yard trimmings applications. Experiment 1, 1996.

Yard Trimmings Rate	Organic Matter 0-3 in.	3-6 in.	6-12 in.	Potassium 0-12 in.
dry ton/ac	-------------------------------	%	-------------------------------	ppm
0	3.02 a	2.90 c	2.28 b	84 c
34	3.16 a	3.37 bc	2.60 ab	152 b
68	3.36 a	3.61 b	2.50 b	166 b
102	3.93 a	4.22 a	2.88 a	252 a

Figure 1. Apparent nitrogen recovery from soil two weeks after yard trimmings application, experiments 1 and 2.



On-farm demonstration. The on-farm site was not irrigated, and yields and ANR were expected to be lower than for the field experiments. Overall results were similar to Experiment 2, with yard trimmings effectively replacing fertilizer. The three yard trimmings materials produced similar results. Material C had less available N early in the season, with a 2-week soil ANR of 13 lb/acre compared with 69 lb/acre for material L and 48 lb /acre for S. By harvest, silage yield and ANR was similar for all materials, with no significant differences observed (Table 5).

Table 5. Corn silage yield, apparent N recovery, and residual soil nitrate following yard trimmings application at the non-irrigated on-farm demonstration, 1998.

Yard Trimmings Source	N Rate	Dry Matter Yield	Apparent N Recovery		Residual Soil Nitrate-N (0-2 ft)
	lb/ac	t/ac	lb/ac	%	lb/ac
Zero-N	0	5.1 b	-	-	27 c
C	664	6.9 a	41 a	6.2 b	40 bc
L	806	6.6 a	54 a	6.6 b	90 a
S	679	6.7 a	54 a	8.0 b	79 ab
Fertilizer	50	5.5 b	12 b	23.9 a	47 bc

CONCLUSIONS

Western Washington yard trimmings can supply adequate N for corn production. They are also a source of other crop nutrients and organic matter. We observed variation in N availability with year and source of material, and plan to investigate this further through mineralization studies.

Composters see yard trimmings application as a way to increase flexibility in handling peak loads, and farmers value the nutrients and organic matter. Based on the results of this project, farmers in Pierce County have begun using yard trimmings supplied by a local composter. In 1998 yard trimmings were applied to more than 120 acres of farmland producing a diversity of crops, including corn, bulbs, rhubarb, and cabbage. Application rates ranged from 10 to 30 dry tons/acre. Post-harvest soil nitrate tests on the treated fields have shown a low to moderate nitrate residual in most cases. The few exceptions likely had a history of manure applications that increased available N beyond crop needs.

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