

THE EVALUATION OF OLIVE PRUNING WASTE AS A VERMICOMPOST FEEDSTOCK

Abstract

In this project, vermicompost was prepared under laboratory conditions from local olive pruning (B) and cow manures (G) with the addition of earthworms (S) and without Red Wiggler earthworms (*Eisenia fetida*). The feed stocks were composted individually (B, BS, G, GS) and mixed (BG, BGS). There were three replicates per treatment. All treatments were incubated for 6 months in the laboratory. Available N, P, K, and C/N analyses were carried out on samples taken from each treatment 30, 60, 90 and 180 days after composting began. Results were analyzed with repeated measures ANOVA. Means were subsequently compared with LSD.

Final C/N ratios of the treatments with earthworms (BS, GS) were lower than without earthworms (B, G) after 180 days. The average total N values were sufficient for a fertility treatment except for earthworm treatment GS on day 30. Also available P was poor in the GS, BS, and BGS treatments but, K was adequate. When the application*period interaction was taken into consideration, the common effect of different period and applications on N, C/N and K amounts (except P) ($p < 0.01$) were significant statistically.

Introduction

Olive has an important role in the culinary culture of the Mediterranean region. It is a tree fruit which has maintained its central role in providing cooking oils, fruit for human consumption, animal feed, and other products since pre-historic times and it is the oldest known tree yielding harvest in Turkey and Asia Minor. Wastes from olive production and processing include pruning wastes and pumice from oil production. In particular pruning waste finds little productive uses and is usually burned for energy or as a waste management strategy. Pruning waste may thus be a feed stock for composting that would facilitate the return of some of the nutrients from olive wastes to the land.

In this project, the nutrient element content vermicompost made from olive pruning waste as compared with that made from manure and a blend of manure and pruning waste.

Materials & Methods

In this project, vermicompost was prepared under laboratory conditions from local olive pruning (B) and cow manures (G) with the addition of earthworms (S) and without earthworms. The feed stocks were tested individually and mixed with and without earthworms (B, BS, G, GS, BG, BGS). In addition to earthworm (20 earthworm was put to each bin), washed sand and pure water was put the each experiment bin (Figure 1). There were three replicates per treatment. Water extracts are analyzed for P and K by ICP-OES. Calibration standards are prepared according to instrument manufacturer's suggested guidelines. Extracts are diluted with deionized water to bring them within the calibration range of the instrument. Organic matter (for C/N) has been analyzed according to TS 9103 and it has been determined gravimetrically by burning 5 g compost samples in the crematorium with 650 C° at 4 hours, total nitrogen also has been determined by macro Kjeldahl method. Repeated measures treated with analysis of variance (ANOVA) and Tukey's test were made using Statistical software.



Figure 1: Experimental Design (left) and experimental units (right)

Discussion

Many Turkish farmers and agriculturists are not familiar with the value of vermicompost and how to use it in Turkey. Turkey only composts 1% of its organic wastes compared to around 17% in the EU and 8% in the US. Food wastes, agricultural wastes and food technology wastes are likely feedstocks for composting and vermicomposting. Vermicompost is rich in nutrients and may replace chemical fertilizer in some of agricultural and horticultural settings. There is a definite and critical need to increase the fertility of soils with the wastes our food system produces. In Turkey soil organic matter is very low (between 0.5 and 1% in the Ap horizon) even in good agricultural soils. Utilizing more agricultural wastes as soil amendments may help sequester more carbon and improving soils.



Experimental units: Plastic bins that hold the compost and the control treatment (left). Top: Olive pruning waste. Middle: Before composting. Bottom and right hand image: Final product.

Vermicomposting is an expanding waste utilization sector in Turkey. For this reason earthworms are becoming expensive commodities. Some vermicomposters in Turkey sell Red Wigglers by the piece for as much as \$0.20. This price may discourage vermicomposting in the short run.

Results

During our experiment, C:N ratios were reduced to between 12:1 and 17:1 after 180 days. These values were generally lower for the earthworm treatments compared to the respective control treatment. This is to be expected as earthworm compost has typically lower endpoints than other forms of decomposition. The exception was the blend of manure and olive prunings where the C:N ratio end point of decomposition was lower for the material without earthworms. C:N ratio decreased faster with earthworms than without earthworms in the single feedstock treatments but not in the blend of manure and olive treatments. Similarly N concentrations increased faster in the earthworm treatments except when comparing the blend with and without earthworms.

Experiment-Symbols ^a	Days ^b	C ^c (%) ^d	N ^e (%) ^d	C/N ^f	P ^g (%) ^d	K ^h (%) ^d
B ^a	30 ^b	31.60 ^d	1.37 ^e	23.03 ^a	0.24 ^g	1.48 ^h
	60 ^b	30.99 ^d	1.45 ^e	21.28 ^a	0.22 ^g	1.41 ^h
	90 ^b	32.21 ^d	1.52 ^e	21.11 ^a	0.22 ^g	1.50 ^h
	180 ^b	30.23 ^d	1.85 ^e	16.37 ^a	0.32 ^g	2.10 ^h
BS ^a	30 ^b	33.34 ^d	0.92 ^e	35.99 ^a	0.25 ^g	1.45 ^h
	60 ^b	29.95 ^d	1.46 ^e	20.48 ^a	0.26 ^g	1.81 ^h
	90 ^b	28.48 ^d	1.35 ^e	21.06 ^a	0.29 ^g	1.81 ^h
	180 ^b	27.76 ^d	1.86 ^e	14.90 ^a	0.23 ^g	1.74 ^h
G ^a	30 ^b	32.63 ^d	1.96 ^e	16.59 ^a	0.85 ^g	1.48 ^h
	60 ^b	33.81 ^d	2.52 ^e	13.38 ^a	0.80 ^g	1.49 ^h
	90 ^b	32.53 ^d	2.45 ^e	13.24 ^a	1.05 ^g	1.62 ^h
	180 ^b	30.72 ^d	2.05 ^e	14.97 ^a	0.82 ^g	1.68 ^h
GS ^a	30 ^b	30.35 ^d	1.41 ^e	21.43 ^a	0.77 ^g	1.23 ^h
	60 ^b	28.22 ^d	2.08 ^e	13.53 ^a	0.77 ^g	1.38 ^h
	90 ^b	26.94 ^d	2.13 ^e	12.63 ^a	0.83 ^g	1.43 ^h
	180 ^b	27.55 ^d	2.13 ^e	12.93 ^a	0.63 ^g	1.48 ^h
BG ^a	30 ^b	34.64 ^d	1.64 ^e	21.04 ^a	0.43 ^g	1.57 ^h
	60 ^b	32.94 ^d	2.27 ^e	14.52 ^a	0.56 ^g	1.69 ^h
	90 ^b	30.99 ^d	2.24 ^e	13.81 ^a	0.53 ^g	1.70 ^h
	180 ^b	30.66 ^d	2.16 ^e	14.17 ^a	0.63 ^g	1.76 ^h
BGS ^a	30 ^b	31.48 ^d	1.36 ^e	23.15 ^a	0.43 ^g	1.34 ^h
	60 ^b	30.82 ^d	1.24 ^e	24.88 ^a	0.43 ^g	1.41 ^h
	90 ^b	27.64 ^d	1.45 ^e	18.99 ^a	0.46 ^g	1.45 ^h
	180 ^b	28.06 ^d	1.62 ^e	17.33 ^a	0.44 ^g	1.77 ^h

Table 1. Average results of macro element analysis which is belongs to four different periods.

Available P increased or stayed the same in the control treatments but not in the vermicompost, suggesting that it was adsorbed to organic matter as it was mineralized. Increases in K was approximately the same as for N in all treatments.

GS ₁	32
GS ₂	30
GS ₃	33
BGS ₁	108
BGS ₂	151
BGS ₃	90
BS ₁	305
BS ₂	334
BS ₃	295

Table 2: Number of earthworms in each bin after 180 days. Initially 20 earthworms were added to each bin.



Surprisingly, earthworm growth (Table 2) was very limited in the manure treatment. The worm population was 10 times greater in the olive treatment than the pruning waste. The behavior of the C/N ratio and N in the manure and olive pruning waste blend is also mirrored in the growth of earthworms in the bins over the 180 day period. The poor growth of Red Wigglers in the dairy manure solids suggests that the poor performance of the vermicomposted blends may have been caused by the cow manure. However, the aged olive prunings (3 month old) were not limiting the growth of the earthworms.

The low available P values in all treatments were surprising especially for the dairy manure treatments. The standard criteria of N, P and K is given 1.9, 4.7 and 1.4 %, respectively (Arancon and Edwards, 2011). The optimum N value was observed in the G, GS and BG applications according to criteria value which is 1.9 %. Phosphorus contents of the all applications were measured lower than 4.7% but potassium contents were much more than 1.4 % which is standard value, generally.

Conclusion

Composting of specialized agricultural wastes such as olive pruning wastes by earthworms is possible and gives C:N endpoints of 12 – 15:1 within 180 days. Interestingly, available P does not increase with composting. This is of importance in areas where P may be a pollutant of freshwater or where it has built up in the soil. Being tied to organic matter such as vermicompost may make P available again for plant nutrition.



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