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Full length Article

Effect of litter compost on yield and nutrient content of *Zea Mays* L.

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ABSTRACT

Disposal of different organic wastes is one of the most important intimidations for human which include tree leaves, garden wastes, agricultural wastes etc. Leaves are potential sources of valuable nutrients providing a high quality of organic matter, which should be returned to the soil. *A* field experiment was carried out in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad to evaluate the effects of aerobic (NADEP tank) and anaerobic (Bangalore pit) leaf composts on the yield and nutrient contents of fodder maize. These treatments were compared with fertilizer alone (FER) and absolute control (CON) with four replicates each. The mineral fertilizers N, P_2O_5 and K_2O (120:80:40 kg/ha) were applied through urea, single super phosphate and murate of potash for comparison. The root, stem and leaves of maize plant were analyzed for dry matter, N, P, K, Ca, Reducing sugar etc. The average yield of fresh aerial biomass (Kg/ha), reducing sugar content, nitrogen and crude protein content of maize was highest in the plots received with AC amendment.

Key words: compost, leaves, maize, NADEP, yield.

INTRODUCTION

Environmental hazards associated with modern agriculture technique in modern world have resulted in endangerment of wild species and pollution of ground and surface water (Dick, 1992; Paoletti *et al*., 1992). Environmental groups and governments have demanded reduction of inorganic fertilizer usage in agricultural systems to minimize nutrient leaching into ground water or pollution from surface water runoff. Generally, organic matter content in soils is minimal and is receding to alarming levels. Additions of organic amendments (composts) can reverse losses in soil fertility and replace the lack of traditional cow manure applications in crop production systems (Delas *et al*., 1982).

Generally, agricultural systems depend exclusively on inorganic fertilizers to maintain elevated soil fertility since availability of cow manure is limited. Therefore new sources of organic material that supplement the balanced turnover of organic matter should be investigated. Compost utilization is a method of recovering soil organic matter content (Sequi *et al*., 1996). Compost can provide continuous supply of nutrients and improve efficiency of inorganic fertilizers (Bittenbender *et al*., 1998; Ferreira and Cruz, 1992; Sikora, 1996).

Leaves represent a large percentage of total garden waste. The amount of garden waste is quite higher in almost all Indian cities and therefore its utilization will be useful. Organic waste is a valuable raw material located at wrong place which can be rehabilitated into useful product by making use of appropriate processing technology (Sharma and Verma, 2001).

In terrestrial ecosystems, the litter decomposition is an important functional process, governing the cycling of nutrients (Swift *et al.,* 1979) and thereby regulating the vegetative productivity. Moreover, litter is the main component of detritus food chain, which enters the decomposition subsystem and is broken down by an array of decomposing organisms. Freshly fallen leaves pass through several stages from surface litter to well decomposed humus partly mixed with mineral soil which contains 50 to 80 % of the nutrients, releases back into the soil.

Composting is the controlled decomposition of organic matter to a point where the product can be safely and beneficially used to improve crop productivity (Obeng and Wright, 1987). Recycling and reuse of the waste materials must be carried out in a profitable manner thereby reducing the quantity of waste and helps to diminish the problem of its disposal. In terrestrial ecosystems, the litter decomposition is an important functional process, governing the cycling of nutrients (Swift *et al*., 1979) and thereby regulating the vegetative productivity. Composting can be done by various methods viz. aerobic, anaerobic, windrow, heap etc. Various weeds can be used for composting and vermicomposting effectively as nutrient source for various crops (Naikwade *et al*., 2011a, Naikwade and Jadhav, 2011, Ghadge *et al*.,2013). The effects of compost prepared from leaves by aerobic and anaerobic compost method have not been investigated in detail. In order to utilize the huge amount of leaf litter as valuable resource for composting, a study was conducted to investigate the influence on fodder maize yield and nutrient uptake.

MATERIALS AND METHODS

Raw material and composting process

The freshly fallen dead leaves of trees present in the Botanical garden of Dr. B. A. M. University, Aurangabad were collected from the plantation floor and transported to experimental field for use as raw material to prepare composts during June to October 2009 by NADEP tank (aerobic) and Bangalore pit (anaerobic) methods. Each pit used for composting was 105 x 75 x 90 cm (l x w x h). The leaf litter was spread on the hygienic floor and sprayed with 5 % dung slurry to enhance the composting process. This pretreated material was arranged alternately along with well-composted inoculums and soil on each layer in the aerobic tanks and anaerobic pits. The pits were closed with dung-mud paste to prevent loss of moisture or heat and allowed to decompose. The trenches were watered whenever the dampness was less than 50 percent. After every month interval, turning the whole material upside down was employed for airing and achieving uniform homogenous decomposition of the organic wastes. The pits were again irrigated and closed by dung-mud mixture. Finally, amorphous, dark brown, well-fermented composts were obtained.

Experimental site, design and treatments:

The experiment was carried out in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad during the period from Oct. 2009 to Feb.2010. The Experimental design was a randomized block design (RBD) with four treatments and four replications. The four treatments were (i) NADEP compost (AC); (ii) Bangalore pit compost (BC); (iii) Fertilizer (FER) and (iv) Control (CON). Composts were transferred to the experimental area and incorporated into the top of soil (15 - 20 cm) by disking at the rate of 12 kg/plot (13333 kg/ha). Samples (100 g) of each application were collected for nutrient analyses. These treatments were compared with 100 % fertilizers alone (FER) and control (CON). The fodder maize (*Zea mays* L.) var. 'African Tall' (Mahalaxmi) produced by Mahendra Hybrid Seeds Co. Ltd., Jalna was cultivated at the rate of 100 kg/ha. A plot with the size 9 m^2 and nine rows spaced 30 cm apart was adopted to keep the uniform population density.

Fertilizer applications and plant sampling:

The mineral fertilizers N, P_2O_5 and K_2O (120:80:40 kg/ha) were applied through urea, single super phosphate and murate of potash. Whole quantity of phosphorus (P) and potassium (K) was applied as basal dose for all the treatments except CON at the time of sowing and the two equal doses of nitrogen were applied at 42 and 75 DAS to FER treatment alone in split doses. The crop was harvested during the early hours of the day at 10 - 20 % flowering stage. At the time of harvest, total yield of maize crop per plot was recorded. Samples (100gm) from each plot were randomly collected and kept in oven 80^{o}C till constant weight, Dry matter was determined and the dried samples were grinded and passed through 0.5 mm sieve to get equal size and packed in air tight polythene bags for analyses of nutrient uptake.

Chemical analyses

The chemical analyses were done by adopting standard analytical methods. Nitrogen (N) content was determined by microKjeldahl method (Bailey, 1967). Calcium (Ca) content was determined as per A.O.A.C. (1995) .The amount of phosphorus was estimated following Fiske and Subba Rau (1925) as described by Oser (1979). Water soluble Reducing sugars (WSRS) were determined with the help of Folin-Wu tubes (Oser, 1979). Potassium (K) content was determined using Flame Photometer following Jackson (1973).

Statistical analyses

All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant difference (C.D., p = 0.05) which allowed determination of significance between different applications (Mungikar, 1997) .

RESULTS AND DISCUSSIONS

Chemical analysis of root, stem, leaves per maize plant at 64 DAS

The fresh weight of root, stem and leaves was higher with the AC treatment followed in order by BC, FER and CON (Table 1). The yield of dry matter, nitrogen and crude protein, water soluble reducing sugar in all plant parts showed the similar pattern. The phosphorus, potassium and calcium percentage in all plant parts was higher in both compost treatment and minimum in CON. All the values were statistically significant over control at (C.D., p = 0.05).

Though dry matter percentage was highest in CON in all plant parts the yield of dry matter was minimum in CON. The highest nitrogen and crude protein content was maximum in the leaves followed by stem and minimum in roots. Highest percentage of water soluble reducing sugars was observed in stem (6.09 - 4.30 %), followed by that in leaves (3.35 - 1.68) and roots (3.05 - 1.58). Application of aerobic and anaerobic composts was effective in increasing sugar content in maize plant. On an average the leaves were rich in inorganic nutrients viz Calcium (Ca), Phosphorus (P) and potassium (K). The roots contained minimum quantities of these nutrient elements.

Chemical analysis of root, stem, leaves per maize plant at 110 DAS

At second plant analysis, fresh weight of stem and leaves was maximum in BC treated plots followed in order by AC, FER and CON treatments while in case of root maximum fresh weight was found in AC treatment (Table 2). The yield of dry matter, nitrogen and crude protein, water soluble reducing sugar of all plant parts was higher in both compost treatments and minimum in CON. The highest nitrogen, crude protein and water soluble reducing sugar content was maximum in the leaves followed by stem and minimum in roots. Percentage of phosphorus, potassium, calcium was highest in leaves. With the increase in the age of plant increase in fresh weight, dry weight as well as nutrient content was observed.

Analysis of total aerial biomass of maize crop:

Table 3 gives details of analysis of total aerial biomass of maize plant at final harvesting (110 DAS). The average yield of fresh aerial biomass (Kg/ha) of maize was highest in the plots received with AC amendment (42500 Kg/ha) followed in order by BC, FER and lowest in CON (25000Kg/ ha). Same trend was observed in case of dry matter, nitrogen (Kg/ha) crude protein content (Kg/ha) yield of maize. Yield of total reducing sugar was found more in AC treated plots (465 Kg/ha) followed in order by BC, FER and CON (163 Kg/ha).All the results are calculated on the dry matter basis and the values are the means of four replicates. All the values were statistically significant over control at (C.D., p = 0.05).

These results are with the findings of Whitbread *et al*.,(1999) who showed increase in rice grain yield (23-48%) than control. The leaf litter compost improved the yield and the nutrient uptake of spinach (Chamle and Jadhav, 2007). Based on the results it reveals that the growth and yield of maize increased significantly due to application of leaf litter compost as a result of better uptake of nutrients from the soil. These results are in agreement with Minhas and Sood (1994) who proved that sustainable availability of the nutrients can occur in various crops due to application of organic manure. Plants inoculated with organic manure recorded increase in root, stem, leaf weight (Muthaura, 2010, Naikwade *et al*., 2011b). Same results were obtained in rice by Nandi and Mandal (1977).

The study conclusively indicate that the leaf litter compost can be effectively used as a source of nutrients for fodder maize as reflected by increased yield and nutrient uptake.

Table 1: Analysis of root, stem, leaves per plant of maize (Age of plant: 64 DAS)

Plant Part	Treatment	Freshwt.	Dry matter		Nitrogen		Crude Protein		W.S.R. Sugar		%		
		(g)	%	Yield (g)	%	yield (g)	%	yield (g)	%	yield (g)	P	K	Ca
Root	AC	7.41	31.95	2.39	0.50	0.012	3.12	0.07	3.00	0.07	0.05	0.07	0.33
	BC	7.06	29.72	2.12	0.48	0.01	2.99	0.06	3.05	0.07	0.05	0.06	0.31
	FER	6.45	29.6	2.16	0.46	0.01	2.86	0.06	2.80	0.06	0.04	0.06	0.29
	CON	4.27	32.76	1.39	0.37	0.005	2.34	0.03	1.58	0.02	0.04	0.04	0.27
	SE	**0.70**		**0.22**		**0.002**		**0.01**		**0.012**			
	CD	**1.58**		**0.50**		**0.005**		**0.02**		**0.027**			
Stem	AC	82.27	11.37	9.36	0.98	0.09	6.12	0.57	6.09	0.57	0.14	0.38	0.30
	BC	81.86	10.68	8.73	0.96	0.08	5.99	0.52	5.97	0.52	0.15	0.36	0.30
	FER	66.92	10.61	7.24	0.92	0.07	5.73	0.41	5.52	0.44	0.13	0.37	0.28
	CON	43.26	12.02	5.13	0.65	0.03	4.03	0.21	4.30	0.22	0.12	0.29	0.22
	SE	**9.16**		**0.94**		**0.01**		**0.08**		**0.08**			
	CD	**20.7**		**2.12**		**0.02**		**0.14**		**0.14**			
Leaves	AC	62.21	23.88	14.78	1.98	0.29	12.36	1.83	3.35	0.49	0.08	0.37	0.49
	BC	56.17	24.13	13.53	1.92	0.26	11.97	1.62	3.26	0.44	0.10	0.38	0.48
	FER	44.675	23.79	10.51	1.62	0.19	10.15	1.07	3.18	0.36	0.08	0.37	0.49
	CON	18.00	24.27	4.37	1.23	0.05	7.68	0.34	1.68	0.07	0.06	0.28	0.41
	SE	**9.79**		**2.32**		**0.05**		**0.33**		**0.09**			
	CD	**22.13**		**5.24**		**0.11**		**0.75**		**0.20**			

AC- Aerobic compost (NADEP Method), BC- Anaerobic compost (Bangalore Method),
FER- Chemical Fertilizer, CON- Control, WSR Sugar- Water Soluble Reducing Sugar
SE- Standard error, CD- Critical difference at p=0.05.

Compost whether NADEP compost or Bangalore pit compost prepared from leaf litter, are the best, active and cheapest source of plant nutrients. NADEP compost was found to be more effective than Bangalore pit compost in improving quality of fodder maize. These results are in agreement with the findings of Dad (1992) who carried out experiment on relative performance of NADEP and Bangalore system of composting in relation to time of maturity and quality compost showed that, although the time required to prepare compost by NADEP as well as Bangalore method is almost same, quality of final compost prepared in NADEP pit was found to be better as compared to Bangalore pit.

Although the organic manures contain plant nutrients in small quantities as compared to the fertilizers, the presence of growth promoting principles like enzymes and hormones, besides plant nutrients make them essential for improvement of soil fertility and productivity (Bhuma, 2001). Further the sustainability in agriculture production refers to the capacity to remain productive while maintaining the soil fertility and increasing biodiversity, use of menus and biologically active preparations of animal and plant origin is most commonly used by those farmers who aim for sustainable production. Leaf litter compost generated from the plantation floor assist to compensate the deficiency of organic matter content along with nutrients in the soil and acts as an ideal substitute against inorganic fertilizers. Its regular use in agriculture may results in the long term enhancement on soil productivity.

Plant Part	Treatment	Freshwt.	Dry matter		Nitrogen		Crude Protein		W.S.R. Sugar		%		
		(g)	%	Yield (g)	%	yield (g)	%	yield (g)	%	yield (g)	P	K	Ca
Root	AC	9.46	33.74	3.17	0.60	0.019	3.77	0.12	3.10	0.10	0.055	0.070	0.35
	BC	8.69	31.42	2.72	0.56	0.016	3.51	0.10	3.19	0.09	0.059	0.061	0.33
	FER	8.04	31.31	2.58	0.50	0.013	3.12	0.08	2.99	0.08	0.050	0.066	0.31
	CON	6.93	34.40	2.38	0.42	0.010	2.60	0.06	1.65	0.04	0.037	0.050	0.28
	SE	**0.54**		**0.17**		**0.003**		**0.01**		**0.01**			
	CD	**1.22**		**0.38**		**0.007**		**0.02**		**0.02**			
Stem	AC	185.81	12.72	23.67	1.06	0.25	6.64	1.57	6.54	1.55	0.15	0.41	0.31
	BC	207.60	13.12	27.35	1.00	0.27	6.25	1.71	6.31	1.74	0.15	0.39	0.32
	FER	153.86	11.91	18.36	0.96	0.19	5.99	1.10	5.70	1.17	0.15	0.40	0.30
	CON	55.15	14.62	8.10	0.75	0.06	4.69	0.38	4.67	0.38	0.13	0.31	0.24
	SE	**33.68**		**4.19**		**0.05**		**0.30**		**0.30**			
	CD	**76.12**		**9.47**		**0.11**		**0.68**		**0.68**			
Leaves	AC	48.03	29.53	14.06	2.02	0.29	12.63	1.77	3.56	0.50	0.09	0.39	0.53
	BC	51.45	28.30	14.40	1.94	0.28	12.10	1.74	3.61	0.52	0.10	0.43	0.51
	FER	39.91	26.94	10.75	1.62	0.19	10.15	1.09	3.40	0.38	0.09	0.41	0.52
	CON	21.24	32.34	6.88	1.31	0.09	8.20	0.56	1.97	0.14	0.06	0.30	0.43
	SE	**6.75**		**1.75**		**0.05**		**0.29**		**0.09**			
	CD	**15.26**		**3.96**		**0.11**		**0.66**		**0.20**			

Table 3. Analysis of total aerial biomass of maize plants (Age of crop: 110 DAS)

Treatment	Fresh wt.		Dry matter		Nitrogen		Crude Protein		W.S.R. Sugar	
	(Kg)/plot	Kg/ha	%	Kg/ha	%	Kg/ha	%	Kg/ha	%	Kg/ha
AC	38.25	42500	18.66	7930	1.12	89	7.03	557	5.87	465
BC	35.88	39861	19.35	7713	1.06	82	6.64	512	5.81	448
FER	35.63	39583	18.63	7372	0.98	72	6.12	450	5.01	369
CON	22.5	25000	18.57	4642	0.81	38	5.08	236	3.51	163
SE		**3967**		**766**		**11**		**71**		**69**
CD		**8965**		**1731**		**26**		**161**		**157**

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