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Performance of *Amaranthus hybridus* as Affected by Enrichment of Compost with Urea During Composting

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Abstract: A study was conducted on the influence of nitrogen enrichment on compost during composting at Uyo, Akwa Ibom State, Nigeria. The 2 compost treatments; Poultry Manure/Ash (PMA) and Poultry Manure/Ash enriched with Urea (PMAU) were composted at the ratio of 3:1 dry weight basis, respectively. Regular turnings and wettings were carried out during the period of composting. Completely Randomized Design (CRD) was used in testing the effect of the N-enrichment on Amaranthus hybridus using a pot experiment. Each treatment was replicated four times. The research exponential revealed that plants on soil fertilized with N-enriched compost (PMAU) produced significantly ($p>0.05$) higher plants and dry matter yield than plants fertilized with non-enriched compost.

Key words: Enrichment, compost, *Amaranthus hybridus*, performance

INTRODUCTION

Apart from the use of green manure, farmyard manure, inorganic fertilizers, crop residues and biofertilizers, compost has remained one of the most effective tools in improving on the fertility status, tilth and productivity of the soil. Through composting, organic wastes are decomposed and nutrients are held in their readily available forms for plant uptake (Papendick *et al*., 1986).

Brady and Weil (1999) have reported that composting is the practice of creating humus-like materials outside of the soil by mixing, pilling or otherwise storing organic materials under conditions conducive for aerobic decomposition and nutrients conservation. Practically, any organic substance can be used for composting though some are less suitable (Donalue *et al*., 1990). However, there are variations in the nutrient concentrations of elements in different organic materials used in composting (Asiegbu and Oikeh, 1995) as there are also variations in the nutrient contents of the soil where the compost is to be applied.

Comparatively, composts outscore inorganic fertilizers in terms of having a wide range of essential nutrients and organic matter needed by plants. They are considered less efficient in supplying nutrients slowly to crops with time. This is probably due to the fact that these nutrients are held in organic form. It is therefore necessary to supplement for any nutrient that is known to be low in both compost and the soil, which is most limiting during crop growth and yield. This research therefore evaluates the effect of supplementing for N on the quality of the cured compost and the impact of the composts on the growth and yield of *Amaranthus hydridus*.

MATERIALS AND METHODS

Poultry Manure (PM) used for the research was obtained locally from Ifa Atai in Uyo, Akwa Ibom State, Nigeria, after 2 months of accumulation in a laying pen. Ash (A) was obtained from completely burnt palm kernel shells, used as fire source. Poultry Manure (PM) and Ash (A) were weighed using a mechanical weighing balance and mixed thoroughly in the ratio of 3:1 PM/A dry weight basis. The mixture was made into (2) heaps with one (PMAU) enriched with 30.7 kg N per tonne from urea. The second heap (PMA) had no enrichment. Both heaps of compost were placed under a roofed shade, turned and frequently watered throughout the composting period. Turning and watering continued at every (4) day's interval for the first three weeks and at weekly interval for the rest of the composting period. The cured PMAU and PMA composts were applied at different treatment levels; 2, 4, 8, 12 t ha^{-1} and 10, 20, 40 t ha^{-1}, respectively to *Amaranthus hybidus* on polythene bags and readings were taken weekly for six weeks from planting. Composite samples of the experimental soil and composts were taken at 0, 2, 4 and 8 weeks of composting, respectively and analysed for their content of C, total N, available P, organic carbon and exchangeable bases using standard laboratory procedures.

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RESULTS AND DISCUSSION

Nutrient content of the Poultry Manure/Ash enriched compost (PMAU) showed significant ($p>0.05$) differences with those of non-enriched Poultry Manure/Ash compost (PMA) as presented on Table 1. This results from the supplementation of the compost with urea. Comparatively, the percent increment in the nitrogen content ranged from 1.68 to 2.42% and 1.43 to 2.01% in the PMAU and PMA, respectively during the composting period. There were 25.0 and 21.2 % reductions in the content of nitrogen and carbon in the N-enriched compost after 8 weeks of composting. Also, 25.2 % N and 25.0 % C were lost from the N-enriched compost at the end of composting. However, there were low contents of P, Ca, Mg, K and Na in both composts. The pH of the composts was alkaline, ranging from 8.4 to 8.6 in PMAU and 8.7 to 8.9 in PMA.

Results obtained by De Silva and Breitenbeck (1997) in their experiment suggested that the level of nitrogen enrichment decreased as bagasse decomposed when stored unprotected from the wind and sun. This could also be attributed to the rapid loss of organic carbon in the enriched compost during composting enhanced by faster rate of decomposition due to the enrichment. They also reported greater release of pungent gas (nitrogen) due to volatilization from the compost windrows. This is supported by the fact that during decomposition of organic residues under aerobic condition, nitrogen loss in the form of ammonia (NH_3) could amount to about 60% of its total nitrogen content (Buldelman and Defoer, 2000).

The results revealed that there were significant ($p>0.05$) differences among 3 to 6 weeks of planting as shown on Table 2. Mean plant height recorded in the control experiment was significantly ($p>0.05$) lower than those fertilized with compost alone and N-enriched composts. The highest mean height of *A. hybridus* was recorded in $PMAU_{12}$. Similar results as in the plant height were obtained from the influence of the different compost

Table 1: Some chemical properties of both composts during the composting period

	Composting period (weeks)							
	PMAU				PMA			
Property	0	2	4	8	0	2	4	8
Org. C (%)	22.45	24.97	22.45	17.70	27.56	27.80	26.61	20.61
Total N (%)	2.27	2.42	2.29	1.68	1.93	2.01	10.93	1.43
C/N ratio	9.47	10.32	9.80	10.54	14.28	13.83	13.79	14.41
P(mg L^{-1})	0.06	0.65	0.68	0.80	0.82	0.49	10.00	1.00
Ca (mg L^{-1})	0.03	0.06	0.10	0.14	0.03	0.04	0.06	0.09
Mg (mg L^{-1})	0.03	0.04	0.08	0.08	0.03	0.06	0.05	0.05
K (mg L^{-1})	0.26	0.34	0.13	0.25	0.06	0.01	0.01	0.02
Na (mg L^{-1})	0.03	0.02	0.13	0.25	0.06	0.01	0.01	0.02
pH	8.63	8.42	8.53	8.43	8.68	8.68	8.87	8.82

Table 2: Mean plant height (cm) of *Amaranthus hybridus* as influenced by applied compost treatments

	Week (s) after planting					
Compost treatment (t ha^{-1})	1	2	3	4	5	6
Non-enriched:PMA_{10}	15.25	19.50	27.50	37.25	45.00	56.25
PMA_{20}	15.00	20.00	30.25	39.50	47.75	58.28
PMA_{40}	15.50	21.75	28.50	39.50	47.75	60.50
N-enriched: $PMAU_2$	15.25	22.25	31.00	38.25	50.75	60.25
$PMAU_4$	15.00	22.25	32.50	41.50	51.25	63.25
$PMAU_8$	15.50	21.75	33.50	41.75	52.50	65.00
$PMAU_{12}$	15.50	23.00	34.75	45.75	55.00	67.50
Soil only	14.50	16.25	19.50	24.50	29.00	35.35
LSD ($p>0.05$)	NS	NS	3.63	7.36	3.72	3.73

NS = significant

Table 3: Mean dry matter weight (g) of *Amaranthus hybridus* as influenced by applied composts

	Week (s) after planting					
Compost treatment (t ha^{-1})	1	2	3	4	5	6
Non-enriched: PMA_{10}	0.44	1.85	2.25	2.88	3.95	4.91
PMA_{20}	0.44	1.90	2.06	2.97	3.99	5.00
PMA_{40}	0.43	1.94	2.29	3.12	4.17	5.08
N-enriched: $PMAU_2$	0.42	1.77	2.06	3.02	4.99	5.09
$PMAU_4$	0.44	1.82	2.07	3.07	4.07	5.25
$PMAU_8$	0.44	1.89	2.19	3.15	4.15	5.17
$PMAU_{12}$	0.44	1.86	2.18	3.14	4.17	5.20
Soil only	0.43	1.70	1.96	2.92	3.87	4.52
LSD ($p> 0.05$)	NS	NS	NS	0.13	0.10	0.12

NS = significant

treatments on the dry matter weight of *A. hybridus* except that the significant differences manifested *between* 4 to 6 weeks of planting as shown on Table 3.

The content of N in the cured enriched compost that was higher than that of the non-enriched significantly ($p>0.05$) enhanced the growth and yield of *Amaranthus hydridus*. The application of at least 2 t ha^{-1} of N-enriched compost produced higher plant height and dry matter yield than applying non-enriched compost as high as 40 t ha^{-1}. Fagbayide and Fawusi (1991) also had similar results when analysing for nutrient requirements of *Amaranthus hybridus* and *Corchorus olitorius* in sand culture. He postulated that dry matter weight in crop plant significantly ($p>0.05$) varied with increase in nitrogen and calcium content in soils. John *et al.* (1996) obtained similar results when using the same crop with cured composts.

CONCLUSION

A similar amount of nitrogen was lost from both N-enriched and non-enriched composts during the composting process. Also, more carbon was observed to have been lost in the non-enriched compost than the enriched. This shows that the essence of enriching the compost during the composting process is defeated since much of the supplemented N was lost at the termination of the process. Supplementation with urea may therefore be more efficient after the preparation of the compost. However, the high contents of percent N in the cured N-enriched composts manifested in significantly higher plants and dry matter content of the *Amaranthus hybridus* than the non-enriched compost.

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