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CHARACTERISTICS OF COMPOST PREPARED FROM ALLIGATOR WEED (*ALTERNANTHERA PHILOXEROIDES* MART.) COLLECTED FROM DIFFERENT LOCATIONS

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ABSTRACT

Background Weeds produce huge amount of biomass which can be utilized as a rich source of plant nutrients through green manuring, vermi composting and composting. However, it is advisable to test the weed compost quality as it may act as source of phytotoxicity, heavy metal and nitrate contamination.

Methodology A laboratory trial was conducted to analyze the physiochemical quality of alligator weed compost. The experiment was laid out in a completely randomized design (CRD) with three replications. Alligator weed biomass was harvested from four different places i.e. maize field, biogas plant, fallow land and water channel. Collected biomass was shade dried and chopped into smaller pieces (1-2 inches). Chopped materials were composted under anaerobic conditions to evaluate nutritional value and quality of compost. The collected data were statistically analyzed using Fisher's analysis of variance technique at the probability level of 5%. The LSD test was used to check significance between treatment means.

Results The compost prepared from weed biomass collected from biogas plant had significant value of organic matter (69.98%), organic carbon concentration (40.69%), pH (9.2), C: N ratio (24.67) and C: P ratio (126.34). The compost prepared from weed biomass collected from maize field had significant value of nitrogen (3.69%), phosphorous (0.43%) and C: K ratio (28.34). However, the compost prepared from weed biomass collected from fallow land had significant value of lead (6 ppm), cadmium (1.17) ppm, potassium (1.50%) and water holding capacity (12.38%).

Conclusion The compost made from alligator biomass collected from different places had variable physical and chemical properties. The compost of alligator weed biomass collected from near biogas plant had best quality, indicating better potential to improve soil health and plant nutrition.

INTRODUCTION

Agriculture plays inevitable role in the economy of Pakistan, but low input agriculture, poor soil structure and lack of adequate supply of essential nutrients are the key limitations to agriculture productivity. The application of inorganic fertilizers cannot be enough to overcome these limitations as these are costly, cause groundwater pollution, soil pollution, reduced aeration, and decline in organic matter, all these subsequently resulted in poor plant growth and development (Gordon et al. 1993; Plaza et al. 2004). The issues related to excessive use of inorganic fertilizer have been capturing the attention of agronomist towards the addition of compost, organic manures and organic wastes for improving the physical properties of soils which ultimately leads towards the successful crop production (Ahmad et al. 2008). Karlen et al. (1997) reported that organic manures may improve the physiochemical and biological properties of the soils in term of soil structure, soil aeration, porosity, cation exchange capacity, water and nutrient holding capacities and microbial activities. Pakistani soils are low in organic

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matter and fertility, and can be replenished well with the use of compost (Sarwar 2003). Composting technique is an efficient way for the recycling of the waste. Compost having higher nutrient concentrations can easily be manipulated back into field to promote sustainable production of crops. Compost can be used as preservative to soil because it fulfills the plant nutrient requirements, holds soil moisture, solubilizes minerals, and enhances the soil microbes by providing adequate amount of organic matter (EPA 2018). The concentration of different nutrients such as nitrogen (N), phosphorus (P), potassium (K) and micronutrients in composted products is much higher, and can help to replenish soil fertility (McConnel et al. 1993). Decomposed material has high levels of nutrients, less in C**:** N ratio and free from other undesirable traits (Zia et al. 2003).

Harvesting and use of weed for composting are now a desirable way of handling problematic weeds and recycling natural nutrients. *Alternanthera philoxeroides* (Martius) Griseb (Alligator weed) is unique because it can be grown either as a terrestrial plant, deeply rooted in the damp soil of stream banks and ephemeral swamps as a floating aquatic pest of fresh or brackish water, particularly in the presence of high nutrient levels. The use of compost made from weeds increases the level of nutrients in the soil and promotes the crop growth and development (Das et al. 2002; Adewole and Ilesanmi 2011).

Currently, very little information are available on the use of alligator weeds as compost. There is need to focus on the utilization of weeds in productive ways, so that people may get benefit (Chandrasena 2007). However, it is of prime importance that physio-chemical properties of compost should be analyzed before its incorporation into soil to determine its effect on soil properties and plant growth. The main objective of present research was to study physical and chemical properties of alligator weed compost collected from different locations.

MATERIALS AND METHODS

The physicochemical and quality parameters of alligator Weed (*Alternanthera philoxeroides* Mart.) compost were investigated at Weed Science Laboratory, Department of Agronomy and Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan. The geographic location of Faisalabad indicates that it lies at 31.5° N latitude and 73° E longitude with 184.4 m altitude.

Experimental material and layout

Alligator weed biomass was harvested from four different locations i.e. maize field, near biogas plant slurry, fallow land and water channel. Alligator weed biomass was cut at lush green condition during vegetative stage from Directorate of Farms, University of Agriculture, Faisalabad, Punjab, Pakistan. There were four treatments in the study *viz.* alligator weed biomass collected from maize field (T_1), alligator weed biomass collected from fallow field treated with biogas slurry (T_2), alligator weed biomass collected from fallow field (T_3) and alligator weed biomass collected from water channels (T_4). The experiment was laid out in a completely randomized design (CRD) with three replications. The collected biomass was shade dried and chopped into smaller pieces (1-2 inches). Finally, chopped material (2 kg) was composted under anaerobic conditions (chopped material was put into a tub, molasses (250 g) added and then covered with a plastic sheet for 25 days). An optimum moisture level (50%) was kept during the composting process. Compost was manually stirred on weekly basis to supply oxygen during process of decomposition.

Digestion of compost sample

Homogenized sample of Alligator weed compost was taken and oven dried at 70°C till constant weight. Weighed 0.1 g (for P and K determination) and 1.0 g (for N determination) of well dried compost sample were placed in conical flask of 50 mL. Exactly 2.5 mL of the concentrated H_2S0_4 was added into each flask having weighed compost sample. Then, after adding 1 mL of hydrogen peroxide (H_2O_2) in each flask having H_2SO_4, compost was shifted to hot plate for heating. Hot plate was placed in a fume hood. At early stage of heating, temperature of hot plate was kept 200°C for few minutes and when fumes started coming out of the flasks, the temperature increased from 200 to 250°C for about 30 minutes. Flasks were removed from hot plate when material became completely colorless. Digested material was filtered and diluted by adding distilled water and final volume of 50 mL was made. Filtered and diluted aliquots were used for determining the concentration of N, P, K and other nutrients.

Observations

Standard procedures were adopted to measure the concentration of N, P, K, sodium (Na) lead (Pb), cadmium (Cd), zinc (Zn), pH, organic matter, water holding capacity, moisture content, organic carbon content, C: N, C: P and C: K ratios in the compost of alligator weed.

Statistical analysis

The collected data were statistically analyzed using Fisher’s analysis of variance technique with the probability level of 5%. The LSD test was used to check the significance among treatments means (Steel et al. 1997).

RESULTS AND DISCUSSION

Compost nutrient concentration

N, P and K are key nutrients which are absorbed by plants in larger quantities. Weeds are more efficient in absorbing the resources than crop plants, hence they absorb nutrients at faster rate. The statistical analysis indicated that compost of alligator weed biomass had significant influence on N, P and K concentration (Table 1). Significantly highest concentration of N (3.69%) and P (0.43%) was recorded in compost of alligator weed biomass collected from maize field. Whereas, lowest N and P 1.48 and 0.29, respectively was recorded in alligator weed biomass collected from water channel. Maximum K (1.50%) was recorded in alligator weed biomass collected from fallow land which was statistically at par with alligator weed biomass collected from water channel (1.47%). An increase in N contents of compost of alligator weed biomass collected from maize field was in line with results of Sánchez-Monedero et al. (2001). They found that the overall N content in the treatment increased by the concentration of N in the microbial class. Similarly, highest concentration of P in compost of alligator weed biomass collected from maize field was in line with the result of Lin (2008) who reported that faster degradation of organic matter into methane or carbon dioxide reduced the total mass of composting material and increased the concentration of P in the compost. These results were also supported by Khater (2015) who found highest value of P (1.13%) in compost of sugarcane residues and lowest value of P (0.27%) in cattle manure compost. Significantly higher total K in compost of alligator weed biomass collected from fallow land with microbial activity for composting could be due to effective humification in this treatment (Rashad et al. 2010).

Compost Na and metal concentration

Data presented in Table 2 depicted that Na contents of compost of alligator weed biomass collected from different locations did not differ significantly. However, compost prepared from weed biomass collected from fallow land (T_3) consistently showed significantly higher concentration of Pb (6 ppm), Cd (1.17 ppm) and Zn (50 ppm). While, lowest Pb and Cd 1.5 and 0.0, respectively was found in compost prepared from alligator weed biomass collected from water channel and lowest Zn concentration (25.5%) was observed in alligator weed biomass collected from maize field. Heavy metal levels in compost are extremely important because they have a significant impact on crop growth and crop yield. These results of Pb and Zn concentration were similar to those of Hackett et al. (1999). They reported that highest Pb concentration was in fine pulp and paper mill fly ash compost and its lowest concentration was in raw compost of pulp and paper mill fly ash. Highest Zn concentration (56.5 ppm) found in compost of fine pulp and paper mill fly ash compost and lowest (10.6 ppm) in raw pulp and paper mill fly ash compost.

Compost properties

The analysis of variance indicated that organic matter, pH, water holding capacity and moisture contents of compost of alligator weed biomass collected from different locations were significantly affected (Table 3). Data indicated that the maximum organic matter (68.98%), pH (9.16) and water holding capacity (12.38%) were recorded in the compost of alligator weed biomass collected from fallow field treated with biogas slurry. While, the lowest values of the above parameters were recorded in compost of weed biomass collected from the water channel. The compost of alligator weed biomass collected from water channel had more moisture contents (66.15%) and it was it was at par with other two treatments expect control. These findings were contradictory to the results of Bunt (1988) who found that pH of cattle manure and sugarcane plant residue was 5.2 and 7.3, respectively. These results were also in contrast with those of Khater (2015).They reported highest value of water holding capacity in compost of sugarcane residues and lowest value in compost of cattle manure. The results also matched with Petric et al. (2009) who found highest moisture concentration in poultry manure while lowest in wheat straw compost.

C: N, C: P, C: K ratios in compost

The C: N ratio is considered to be one of the simple indices to evaluate any organics for its suitability for soil application and it is the index traditionally used to establish compost maturity (Charest and Beauchamp 2002). Data presented in Table 4 clearly indicated that compost of alligator weed biomass collected from different locations had significant effect on C: N, C: P, C: K and organic carbon. The compost of alligator weed biomass collected from fallow field treated with biogas slurry showed maximum values of C: N (24.64) and C: P (126.34). The lower C: N ratio (9.67) was obtained from the compost of alligator weed biomass taken from the water channel. The minimum C: P ratio (93.67) was noted in compost of alligator weed biomass collected from maize field and it was at par with fallow land and water channel weed compost. While, statistically higher C: K ratio (28.34) was noted in compost of alligator weed biomass collected from maize field. However, minimum C: K ratio (24.67) was noted in the compost of alligator weed which was collected from fallow land. Maximum organic-C content (36.98%) were found in compost of alligator weed biomass collected from filed of maize while,

Table 1 Nutrients concentration in compost of alligator weed biomass collected from different locations

Treatment	N (%)	P (%)	K (%)
T_1	3.69 a	0.43 a	1.41 b
T_2	2.74 b	0.40 b	1.40 b
T_3	2.55 b	0.38 c	1.50 a
T_4	1.48 c	0.29 d	1.47 a
LSD Value	0.1887	2.01	0.54

Any two means with the same letter did not differ significantly at 0.01 level of probability. T1: Alligator weed biomass collected from maize field, T2: Alligator weed biomass collected from fallow field treated with biogas slurry, T3: Alligator weed biomass collected from fallow land, T4: Alligator weed biomass collected from water channel

Table 2 Sodium and metal concentration in compost of alligator weed biomass collected from different locations

Treatment	Na (%)	Pb (ppm)	Cd (ppm)	Zn (ppm)
T_1	2.67^{NS}	2.0c	0.67 b	25.5 d
T_2	2.77	4.5b	0.67 b	46 b
T_3	2.64	6.0a	1.17 a	50 a
T_4	2.74	1.5c	0.00 c	40.5 c
LSD Value		0.94	0.47	1.48

Any two means with the same letter did not differ significantly at 0.01 level of probability. T1: Alligator weed biomass collected from maize field, T2: Alligator weed biomass collected from fallow field treated with biogas slurry, T3: Alligator weed biomass collected from fallow land, T4: Alligator weed biomass collected from water channel

Table 3 Characteristics of compost of alligator weed biomass collected from different locations

Treatment	Organic matter (%)	pH	Water holding capacity (%)	Moisture content (%)
T_1	63.58b	9.13a	9.46b	48.52b
T_2	69.98a	9.16a	12.38a	63.28a
T_3	65.70b	8.50b	11.78a	61.57a
T_4	63.11b	8.45b	9.42b	66.15a
LSD Value	3.02	0.24	0.89	7.57

Any two means with the same letter did not differ significantly at 0.01 level of probability. T_1: Alligator weed biomass collected from maize field, T_2: Alligator weed biomass collected from fallow field treated with biogas slurry, T_3: Alligator weed biomass collected from fallow land, T_4: Alligator weed biomass collected from water channel

Table 4 C: N, C: P, C: K ratios and organic carbon in compost of alligator weed biomass collected from different locations

Treatment	Nutrient ratios			Organic-C content (%)
	C: N	C: P	C: K	
T_1	14.33b	93.67b	28.34a	36.98a
T_2	24.67a	126.34a	25.34b	40.69b
T_3	14.33b	95.00b	24.67c	38.20b
T_4	9.67c	96.67b	24.34b	36.69b
LSD Value	1.43	4.98	1.96	1.76

Any two means with the same letter did not differ significantly at 0.01 level of probability. T_1: Alligator weed biomass collected from maize field, T_2: Alligator weed biomass collected from fallow field treated with biogas slurry, T_3: Alligator weed biomass collected from fallow land, T_4: Alligator weed biomass collected from water channel

minimum organic carbon (36.69%) was in alligator weed biomass collected from water channel and it was statistically similar to other treatments expect maize filed weed compost. The results were in line with the observations of Rosen et al. (1993). They found that the C: N ratio of sugarcane plant residue compost was 15:1. Herbal plant residue compost 20:1 is ideal for ready-to-use compost. The C: P ratio of different composts reflects the mineralization of organic waste and stabilization during the composting process. These results were similar to the results obtained by Vandecasteel et al. (2014) who found that the C: P ratio of compost of grass clipping used as bedding material was 120:1. The C: K ratio is considered one of the basic measures for the evaluation of organic matter in conjunction with its suitability for soil applications (Charest and Beauchamp 2002). These results were in agreement with Rosen et al. (1993).

They reported that the C: K ratio of sugarcane plant residue compost was 15:1. Significantly, lowest concentration of organic carbon (36.69 %) was noted in compost which was prepared from alligator weed biomass collected from water channel. These results were also in line with those of Khater (2015) who found that the optimum value of total organic carbon is higher than 23.6%.

CONCLUSIONS

The compost of alligator weed biomass can be beneficially used to improve soil health and plant nutrition. However, the application of compost may have environmental risks associated with it as quality of compost prepared from weed biomass collected from different locations had different properties. It is recommended that compost of alligator weed biomass collected from near biogas slurry had better potential to improve soil fertility and health.

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