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Characterization of Parthenium (*Parthenium hysterophorus* L.) Compost for Major Plant Nutrient Contents at Ginner District of Bale Zone, Oromia Region, Southeastern Ethiopia

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Abstract

This Experiment was conducted at Ginnir District of Bale Zone, Oromia Region, Southeastern, Ethiopia. Therefore this research were conducted with the objective to characterize the quality and nutrient contents of compost prepared from parthenium combination with wheat residue and farmyard manure in terms of major plant nutrient. In order to achieve the specified objective The Parthenium plants were collected before flowering stage and chopped into smaller pieces it can be concluded that compost preparation, sources of material used has significant role particularly different material and methods were adopted during this studied. Consequently, compost of parthenium were prepared independently in three categories or treatments viz,, Parthenium biomass pluss farm yard manure, Parthenium biomass plus crop residue and Parthenium biomass combination with both farm yard manure and crop residue were used. The major chemical properties such as pH, EC, OC, TN, available P, CEC, exchangeable bases (Ca, Mg, K and Na) and micronutrients (Fe, Mn, Cu and Zn) were conducted using standard laboratory procedures. Results for nutrient content characterizations indicated that 7.1 to7.27; 0.000058 to 0.000062 ds/m ; 35.2 to37.8%;1.83% to1.98% and 34.8 to 53.2 cmol+/kg for pH; Ec; OM; TN; and CEC; respectively were obtained. Exchangeable bases also follows similar trend for major essential plant nutrients. The final laboratory analysis of the prepared and harvested Parthenium compost show that the compost had high in plant nutrients and also significantly varied among the three Parthenium compost preparation procedures. Accordingly, Parthenium compost have mulit purpose advantage high nutrient contents, means of weed control and generally uses of organic fertilizers are environmental sound full.

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Nutrients, Parthenium, *Parthenium hysterophorus* L., Parthenium compost.

Introduction

Parthenium (*Parthenium hysterophorus* L., Asteraceae) is an aggressive invasive alien weed species native to the America (Kohli *et al.*, 2006) but now widely spread in Asia, Africa and Australia (Evans, 1997). Parthenium weed was first introduced accidentally into Ethiopia in the 1970s. Parthinium was first found in Ethiopia in 1988 at Dire-Dawa in the Eastern Ethiopia and subsequently found near Desse, North-eastern Ethiopia (Seifu, 1990). They are major food-aid distribution centers and it was believed that parthenium weed seeds were imported from subtropical North America as a contaminant of grain food aid during the 1980s famine (Tamado and Milberg,

2000). Afterwards it spreads rapidly in all regions of the country, along roads and railways in grazing areas and arable land strongly affecting crop production, animal and biodiversity (Tefera, 2002). Parthinium is now widely spread in the central rift valley and neighboring localities of Afar Region, East Shoa, Arsi and Bale in southern Ethiopia.

Composting might be a useful alternative to convert biomass from this species to a useful material that could be used as soil conditioner (Anbalagan and Manivannan, 2012; Jelin and Dhanarajan, 2013). Organic farming involves the use of ecofriendly manures in agriculture. The increased use of chemical fertilizers improved the production but at same time the soil fertility is getting reduced due to inadequate organic matter. To combat this, the use of organic materials is recommended. The compost technology is a promising technique for recycling the weeds and wastes and the resultant product improves the soil fertility and crop production without harming the nature. It is easy to practice, ecologically safe and used to reduce the pollution problems (Yadav, 2015). The practice of compost is at least a century old and now it is receiving worldwide attention as a waste management technique in terms of weeds utilization and reduction in quantity of accumulated wastes (Yadav, 2015). Parthenium weed not only competes with crops and pasture species but it has also been reported as a health hazard to human beings and livestock (Devi *et al.*, 2014).

In the presence of Parthenium the growth and development of crops can be suppressed, and if not controlled. Due to its Aggressive coverage, Bale zone farmers call it 'Anamalee,' in Afaan Oromo- meaning 'Only me' (Personal Communications). Different authors reported that Parthenium the spread of this species which great influence the agricultural, natural ecosystem production and biodiversity as well as also heath of life (Wabuyele *et al.,* 2014; Ayele *et al.,* 2014 and Kumari *et al.,* 2014).

Several studied revealed that Parthenium compost used both as the means of eradicating weed and sources of organic fertilizer i.e. contains two times more N, P and K than Farm Yard uses the nutrient (Ameta *et al.,* 2016; Fitsum *et al.,* 2017).

In spite of enough quantity of various essential macro and micro plant nutrients and huge amount of locally available Parthenium weed, composting of Parthenium is not practiced by farmers in the study area. Additionally, very limited or no scientific studies have been conducted on uses of parthenium as suitable for compost and tried for a better way of eradicating it by utilizing for better crop production.

Therefore this studied conducted with the specific objective to characterize the quality and nutrient contents of compost prepared from parthenium combination with wheat residue and farmyard manure in terms of major plant nutrient.

Materials and Methods

The study was conducted in Ginnir District which is one of the Bale highlands Oromia Regional State, Southeastern Ethiopia. Ginnir is 519 km away from Addis Ababa; Ginir is located at 07^{o} 15′ N latitude and 40° 66′ E longitude at 1972 m above sea level (figure1).

The seasonal rainfall is 531 mm and its mean annual minimum and maximum temperatures are 13.4 and 25.5°C, respectively (Boja & Girma, 2022). The soil type is *Vertisol.* Ginir experience a mono cropping season (main season) that extends from September to January. The Ginir district is very suitable for the production of cereals but pulse, oil crop and horticultural crops are also produced by farmers.

As cite (Boja *et al.,* 2022) the Central Statistical Agency's population projection, the total population of the district by the year 2021 was estimated to be 203,751 (103,592 males and 100,159 females). The topography of the district falls within the altitudinal range of 1200–2406 m above sea level.

According to data from the district agricultural office, the land configuration of the district is categorized as plain, which accounts for approximately 85%, mountain 3%, and rugged and gorge areas account for approximately 12% (i.e., approximately 15% of the area of this district is covered with a valley, gorges, and hills). Similarly, the land use in the district indicates that 30.5% is arable or cultivable, 31.2% is pasture, 35.6% is forest, and the remaining 2.7% is considered swampy, mountainous, or otherwise unusable (GDAB, 2022).

Material used for compost preparation

Compost was prepared from different substrate materials that were locally available crop residues: Maize, sorghum, haricot bean, wheat straw, teff straw, grasses and the whole mixture of straws and grass as a bedding

material. Farmyard manure was added to all substrates in equal amount. The collected substrates were chopped and added to the pit for compost preparation. The materials used in this experiment were Parthenium weed biomass, crop residue and farmyard manure that are obtained from experimental site. Parthenium weed were collected during rainy season at early stage before flowering and cut into small pieces having a maximum size less than 2.5 cm. Wheat straw were used as a good source of carbon for maintaining the required C/N ratio in the process. Likewise, other organic wastes such as ash were used so that the waste was utilized and more balanced compost was prepared. Total quantity and combination ratio of materials were used in the formation of compost, Parthenium to wheat straw ratio = 1:2.78 while Parthenium: cow dung ratio = 1:27.78 were used. The green biomass from the *Parthenium* weed were freshly picked during compost preparation, to facilitate the composting process all the biomass used were cut into pieces.

Compost preparation

The pit of 1 m × 1 m × 1 m size was prepared at Farmers' home garden. Water was sprinkled in the stacking process to maintain 60 per cent moisture. They were kept under semi aerobic condition and plastered with paste of wheat straw, dung and soil with combined ratio at the top. After one month, a turning was given and the moisture content maintained. In about 45 to 60 days, good quality compost was obtained on optimum temperatures and decomposition rates the pit was constructed under shade. The compost unit is constructed with permanent materials for continuous process.

The Parthenium plants were collected before flowering stage and chopped into smaller pieces of 1–2 in mechanically and decomposed with farm wastes and animal wastes for about 20 days. The climatic conditions were favorable and temperature and moisture were maintained by sprinkling water regularly. After 20 days the materials were mixed and temperature was checked. The composting process was carried out for duration of 60 days the pit composting methods were used for compost preparation.

Parthenium Compost Laboratory analysis

Parthenium Compost samples were collected from each compost pits. The samples were sieved and then analyzed for it's the compost quality was analyses at Sinana agricultural research center soil laboratory and at baatuu soil research laboratory. The pH and EC of compost was measured in the supernatant suspension of a 1:2.5 soil to water ratio using a pH meter and electrical conductivity; respectively (Rhoades, 1982). Walkley and Black (1934) used for the determination of organic carbon. Total nitrogen was determined using the Kjeldahl method as described by Bremner and Mulvaney (1982). Total exchangeable bases (Ca2+, Mg2+, K+ and Na+) were conducted for Ca2+ and Mg2+ were determined by atomic absorption spectrometry (*AAS*) while K+ and Na+ were determined by flame photometer (Okalebo *et al.*, 2002*)*. Cation exchange capacity (CEC) was determined using (Chapman, 1965). A germination test of 100 seeds which were picked from the compost were planted in beds to find out if any of them was viable (Araya *et al.*, 2015).

Results and Discussion

Selected chemical properties of Parthenium compost

The pH and Electrical Conductivity

As the laboratory analysis result revealed that the highest (7.27) and the lowest (7.17) pH value was recorded for obtained *Parthenium* biomass combination farm yard manure and *Parthenium biomass plus animal manure and Parthenium biomass plus* wheat straw; respectively (Table 1). This finding agreement with finding of Jouquet *et al.,* (2013) who stated that the values of pH was ranged from 6.8-8.41 for compost. The study carried by (Spiers and Fietje, 2000; Araya *et al.*, 2015) also revealed that the higher pH goes with a higher K level, which was responsible for the high Electrical Conductivity (EC). Electrical conductivity (Ec) values were not significant variation in which totally it ranges from 0.000056 to 0.000062 (dS/m) ds/m (Table 1). According to Santamaria *et al.*, (2001) and Mulugeta *et al.*, (2022) EC values of *Parthenium* compost were free from salinity. This increase in EC might be due to the slight increase in Potassium ions (K+) and other ions as decomposition proceeds. The increase in EC could be due to the release of mineral salts such as phosphates and ammonium ions through the decomposition of organic substances (Huang *et al.*, 2004).

Organic matter, C: N Ratio and Cation Exchange Capacity (CEC)

The analyzed result showed that, relatively the highest mean value of organic matter (37.8%) was recorded under Parthenium compost combine farm yard manure

pluss crop residue and the lowest (35.2%) mean values of organic carbon was registered from the compost prepared from Parthenium compost pluss farm yard manure (Table 1). In general, the status of organic in all type compost is high when compared with its availability in garden soil. This finding is in conformity with the study of Mulugeta *et al.*, 2022; Tadele *et al.*, 2020). Low C: N ratio was registered from all types of Parthenium compost. Low C: N ratio indicates higher rate of mineralization.

Result indicates that the lowest (11%) was registered under Parthenium compost prepared from Parthenium biomass plus crop residua whiles the highest (11.4) from Parthenium compost combine farm yard manure pluss crop residue from (Table 1). This result confirmed with different authors Derib *et al.*, (2016) and Mulugeta *et al.*, (2022) who stated that vermicompost had lowest C: N ratio as compared to conventional compost. CEC of Parthenium compost made from all treatment was very high status which was ranged from 34.8 to 53.2cmol+ kg-1.

This result confirmed the study conducted by Mulugeta *et al.*, (2022) who found that 33.23 to 65.43cmol+ kg-1 of CEC in conventional compost. The compost prepared from Parthenium plus farm yard manure and crop residue had higher content of EC, OC, NT and CEC. The report by Veena and Shivani (2012) also showed *Parthenium* was good for soil and animal feed because it is protein rich weed.

Total Nitrogen

The composition of *Parthenium* weed with respect to major nutrients in the present investigation was estimated as lowest from Parthenium compost pluss farm yard manure1.83 and(1.98%) highest was obtend from Parthenium compost combine farm yard manure pluss crop residue and the of nitrogen was registered from the compost prepared. The result obtain from similarly work done by Biradar *et al*., (2005); Araya *et al.*, (2015) and Ameta *et al.*, (2016).

Exchangeable bases (Ca, Mg, K and Na) of Parthenium compost

The analyzed result showed that the values for exchangeable bases (Ca, Mg, K and Na) were varied from 4.56 to 5.40(cmol (+)/kg), 1.30 to 3.25 (cmol (+)/kg), 1.51to 1.86(cmol (+)/kg) and 0.24 to 0.33(cmol (+)/kg) for Ca, Mg, K and Na; respectively (Table 2). In all case relatively highest value obtained *Parthenium* biomass combination both wheat straw and farm yard manure higher than compost made from *Parthenium biomass plus animal manure and Parthenium biomass plus* wheat straw).

Agreement with this finding of Channappagoudar *et al.*, (2007) In general, the *Parthenium* compost obtained using mixed farm yard manure and other crop residue were rich in exchangeable cations than Parthenium compost pluss farm yard manure compost. The result agreement with the findings of Amir and Fouzia (2011) reported that the exchangeable bases (Ca, Ma and K) were significantly increased compost made from Parthenium biomass pluss farmyard manure to *Parthenium* compost obtained using mixed farm yard manure.

Recommendations

Parthinium (*Parthenium hysterophorus*) is now days widely spread almost in all over agro ecology and It became major threat in affecting agricultural production and reducing land productivity. The government and different NGOs have been tried a lot of alternatives so far to avoid or reduce its expansion though no significance change is observed yet. Using parthinium weed for composting is a new strategy to maximize the benefit from this weed consequently to reduce its expansion.

Compost has good macro and micronutrients when compared to Farm Yard Manure. They help to increase soil fertility and increase the crop yield considerably. Parthenium can be utilized effectively as organic manure by composting thereby preventing alarming spread of it. Use of environmentally friendly technologies for sustainable soil productivity and crop production and also means of controlling weeds were identified from the current studied. Parthenium compost prepared from parthenium biomass combination with both farm yard manure and crop residue was better nutrient contents as compared to only compost made from parthenium biomass only. Generally, from the studied point of view creating public awareness especially in farmers' area about the effect of *Parthenium hysterophorus* on agricultural productivity, ecosystem as well as on strategies control methods should be recommended. In generally, there is a need for further studies on the rate of application of Parthenium compost and their effect on crop yields and soil physic chemical properties under field condition.

Table.1 Organic matter and some macronutrient

Trt	pH-H_2O (1:2.5)	EC (dS/m)	OM (%)	TN (%)	CEC (cmo(+)/kg	C:N
T1	7.17	0.000062	35.2	1.83	34.8	11.2
T2	7.26	0.000056	36.1	1.91	46.2	11
T3	7.27	0.000058	37.8	1.98	53.2	11.4

T1 = Parthenium compost + farm yard manure; **T2** = Parthenium compost + crop residue, **T3** = Parthenium compost + farm yard manure + crop residue

Table.2 Exchangeable Basic cations

Trt	Exchangeable Basic cations (cmol (+)/kg)				PBS(%)
	Ca	Mg	K	Na	
T1	**4.56**	**1.30**	1.51	**0.24**	21.87
T2	**4.80**	**2.00**	1.68	**0.31**	19.1
T3	**5.40**	**3.25**	1.86	**0.33**	20.38

Where T1 = Parthenium compost + farm yard manure; **T2** = Parthenium compost + crop residue, **T3** = Parthenium compost + farm yard manure + crop residue

Fig.1 Map of study area

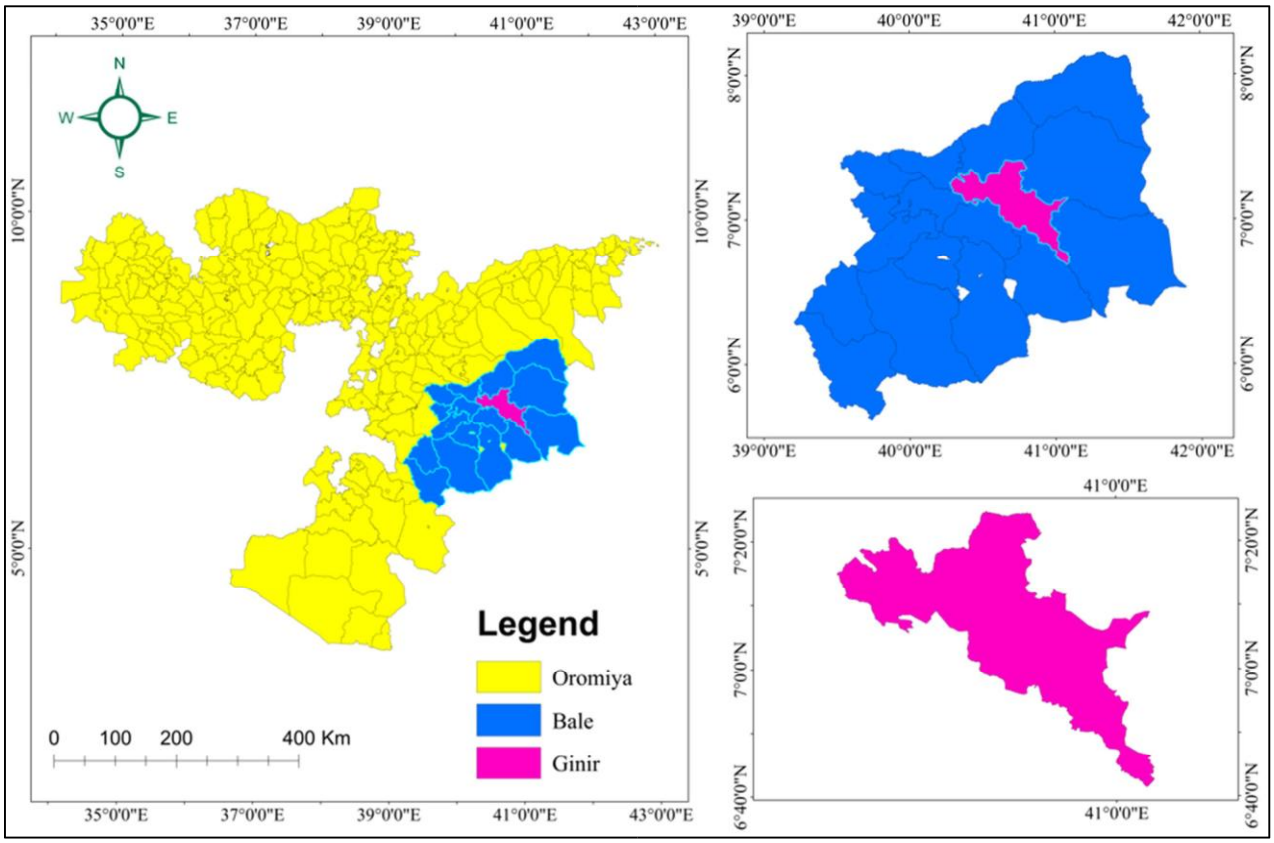

Fig.2 Pit prepared for compost and while Parthenium is added

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Conflicts of Interest

Author declared no conflict of interest.

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