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A Practical End-Use for Weed Biomass: Plenium for Soil Amendments

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ABSTRACT:

Weeds are unsightly, non-productive plants that compete with crops for scarce natural resources like water, nutrients, and sunlight. For a multitude of factors, including quick growth, strong reproductive potential, adaptability, and most significantly, interference from resource depletion and allelopathy, a weed can become established in any ecosystem. One of the deadliest weeds on the planet, Parthenium hysterophorus L. is listed in the global database of invasive species. Even though India is home to enormous populations of this plant, its economic significance as a food source is constrained by its toxicity. Therefore, composting might be a practical choice for transforming weed biomass into a useful substance that can be used as a soil conditioner.

In the present investigation, an attempt was made to manufacture vermicompost using Parthenium hysterophorus, bagasse, and press mud along with cow dung. The developed product was compared with the normal vermicompost for its nutrient properties. The formulated vermicompost showed pH 6.08, Electrical conductivity 14.20 mhos/cm, Total organic carbon-31.68%, Total organic matter 54.50%, C:N ratio 8.70%, Nitrogen 3.64%, Phosphorus 2.85%, Potassium 1.27%, Sulphur 0.96%, Calcium 6.52%, Magnesium 1.03%, Ferrous 8921.19mg/kg, Manganese 334.47mg/Kg, Copper 83.08mg/Kg and Zinc 99.72 mg/Kg. As compared to control the highest nutrient value N[3.64]%, P[2.85]%, K[1.27]%, Sulphur [0.96%], Calcium [6.52%], Magnesium [1.03%], Ferrous [8921.19mg/kg], Manganese [334.47mg/kg], copper[83.08mg/kg], zinc [99.72mg/kg] was observed in the formulated vermicomposting. From the above results, it

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can be predicted that though Parthenium is an invasive weed, it can be used as a nutrient-rich material for the growth of plants in form of vermicomposting.

Key Words: Parthenium, Vermicompost, Soil conditioner

INTRODUCTION:

Parthenium hysterophorus L. is an invasive weed, commonly known as congress grass carrot grass, bitter weed, or star weed, and belongs to the family Asteraceae. In the rainy season, Parthenium hysterophorus completes its life cycle within 16-18 weeks (Maharjan et al. 2014). It is a dangerous imported weed and is poisonous, pernicious, allergic and aggressive, and causes a serious threat to human beings and livestock (Kohli et al., 2006). Parthenium hysterophorus L. is an aggressive invasive alien weed species native to the Americas but is now widely spread in Asia, Africa, and Australia (Evans, 1997). It spreads rapidly in all regions of the country, along roads and railways, through grazing areas and arable lands, adversely affecting crop production, animal husbandry, and biodiversity. It is poisonous, pernicious, allergic, and aggressive and causes a serious threat to human beings and livestock. At present, it is one of the most troublesome and obnoxious weeds of wasteland, forest, pasture, and agricultural land and causes a nuisance to mankind (Tefera, 2002; Bakthavathsalam and Geetha, 2004). Parthenium is an aggressive dominating weed in many parts of the world due to its allelopathic properties, which enable it to compete successfully with crops and pasture species (Singh et al., 2003; Batish et al., 2005a, b). It's strong competitiveness for soil moisture and nutrients and the hazard it poses to humans and animals (Narasimhan et al., 1977). Wiesner et al. (2007) indicated that Parthenium causes general illness, asthmatic problems, irritations of skin and pustules on handballs, stretching and cracking of the skin, and stomach pains in humans. The seed of Parthenium weed is also a contaminant of grain, pasture, and forage seeds. (Chippendale and Panetta, 1994) Parthenium is also known for its environmental impacts. Because of its invasive capacity and allelopathic properties, it has the potential to disrupt natural ecosystems. It is an aggressive colonizer of wasteland, roadsides, railway sides, water courses, cultivated fields, and overgrazed pastures (Wiesner et al., 2007). The allelochemicals released from Parthenium affecting many

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plant species are sesquiterpene lactones and phenolics (Swaminathan, Vinaya, and Sureshi, 1990). Parthenin is the major sesquiterpene lactone whereas caffeic, vanillic, ferulic, chlorogenic, and anisic acids are the major phenolics (Batish et al., 2002, 2007; Singh et al., 2002). Composting is a natural way of recycling of solid waste management process. Compost contains macro and micronutrients, a diverse microbial population, stable organic compounds (e.g. humic compounds), and also labile organic matter, which is an important source of food and energy for the soil food web (Favoino and Hogg 2008). Composting improves soil health; reduces soil loss, and increases water infiltration and storage (Brown and Subler, 2007). Compost and vermicompost are one of the fastest means of improving soil carbon levels. All composts have several beneficial effects on soil properties (Hoitink, 2008). Vermicompost made by biodegradation of waste organics by earthworms is scientifically proving to be a great soil amender and plant growth promoter superior to all conventionally prepared composts increasing the physical, chemical, and biological properties of soil, restoring and improving its natural fertility (Tolanur, 2009). Vermicompost is rich in nitrogen, phosphorus, potassium, and micronutrients and also contains plant growth hormones and enzymes. There have been several reports that soils amended with vermicompost can induce excellent plant growth. (Agarwal et al, 2010; Sinha et al, 2009). Vermicompost is highly nutritive organic manure and has scientifically proven as a miracle for even degenerated soils‟ with significantly high agronomic impacts (5-7 times) on crops over conventional composts (Subler et al, 1998). Earlier research was carried out on the use of different manures prepared from different weeds for increasing the yield and quality of maize (Naikwade and Jadhav, 2011, Naikwade et al, 2011 a, 2011b). Ameta et al (2016a) proved that no Parthenium plant was germinated after the application of compost, which may also encourage end-users about its composting. Ghadge et al (2013) and (Naikwade, 2017) proved that problematic weeds can be used for the preparation of compost and vermicompost and contains high nutrient content. One option is utilizing Parthenium for the nutrient source purpose. Parthenium composting and vermicomposting is therefore one of these options. Vermicomposting of Parthenium gives end product, which can be utilized as a nutrient source for crop plants.

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MATERIAL AND METHOD:

Experimental site: An experiment was conducted on the farm located at the village Gotumbe Aakhada, (Rahuri Khurd). Tal: Rahuri, Dist: Ahmednagar, Maharashtra, and India. The experimental area was made clean and pest free with using pest repellent.

Raw material and the making of vermicompost and Parthenium vermicompost: The fresh plants of Parthenium before flowering at the vegetative stage were collected from nearby localities of M.P.K.V, Rahuri, and P.V.P. College, Loni, Collected Parthenium plants were cut into small pieces and dried in the sun. Press mud and bagasse are procured from Prasad Sugar Factory, Vambori. Cow dung and Farm yard manure were collected locally.

Vermicompost and Parthenium vermicompost were done by worm bin method (BVC) Naikwade. (2017). The earthworm species Eisenia foetida has been used due to its easy availability, handling, more cocoons formation, and easy maintenance. It procures from the earth-rich vermicomposting unit of Kolhar Bhagwatipur, Tal: Rahata, Dist: Ahmednagar, Maharashtra. Vermicompost is manufactured by using press mud, cow dung, bagasse (at the ratio of 1:2:1) and along with a small quantity of farm yard manure used as an activator, and Parthenium vermicompost manufactured by using Parthenium hysterophorus, press mud, cow dung, bagasse (at the ratio of 3:1:2:1) and along with a small quantity of farm yard manure used as activator. Earthworm species Eisenia foetida as 100 individuals each were released. Maintaining the moisture is about approximately 60- 70%. After 20 days the developed product of Vermicompost and Parthenium vermicompost were compared for their nutrient properties. The uniformly mixed decomposing samples (100 gm) of each Vermicompost and Parthenium vermicompost were collected, Oven-dried, and used for nutrient analysis.

CHEMICAL ANALYSES: The decomposing vermicompost and Parthenium vermicompost samples were chemically analyzed for Nitrogen, phosphorus, iron, potassium, EC, organic carbon, organic matter, carbon: nitrogen ratio, zinc, etc..

Determination of pH - The pH of the sample was determined as per the procedure described by Chandrabode et al., [1998].

Electric conductivity- The electric conductivity of the test sample on the electric conductivity machine.

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Organic matter and organic carbon – The determination of organic carbon and organic matter was carried out as per the procedure of the Muffle Ash Method.

Estimation of total nitrogen – The total nitrogen of the sample was estimated by the Kjeldahl method.

Estimation of phosphorus- The phosphorus of the given sample was estimated by Olsen Method [Gravimetric method].

Estimation of potassium –The given sample was estimated by the Flame photometer method.

Moisture – The moisture of the given was determined on an oven-dry basis.

Iron and zinc – The iron and zinc of the given sample were estimated by the DTPA Extraction / AAS method.

RESULT AND DISCUSSION:

Naikwade, (2017) and Ameta et al [2016a] stated that compost and vermicompost prepared from Parthenium are rich in nutrients. Vermiculture and vermicomposting technology are easy to practice, ecologically safe, and economically sound. Utilization of Parthenium for the preparation of compost and vermicompost will provide a new perspective on nutrient management of soil.

In the present study, the developed product Parthenium vermicompost was compared with the normal vermicompost for its nutrient properties. The formulated Parthenium vermicompost showed pH 6.08, Electrical conductivity 14.20 mhos/cm, Total organic carbon- 31.68%, Total organic matter 54.50%, C:N ratio 8.70%, Nitrogen 3.64%, Phosphorus 2.85%, Potassium 1.27%, Sulphur 0.96%, Calcium 6.52%, Magnesium 1.03%, Ferrous 8921.19mg/kg, Manganese 334.47mg/Kg, Copper 83.08mg/Kg and Zinc 99.72 mg/Kg. As compared to control the highest nutrient value N[3.64]%, P [2.85]%, K[1.27]%, Sulphur [0.96%], Calcium [6.52%], Magnesium [1.03%], Ferrous [8921.19mg/kg], Manganese [334.47mg/kg], copper[83.08mg/kg], zinc [99.72mg/kg]. From the above results, it can be predicted that though Parthenium is an invasive weed, it can be used as a nutrient-rich material for the growth of plants in form of vermicomposting. Vermicompost prepared from Parthenium is richer in nutrients (i.e, N, P, K, Fe, Mn, Cu & Zn) than other Vermicompost. Vermicomposting technology is easy to practice,

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ecologically safe, and economically sound. Utilization of Parthenium for the preparation of compost and vermicompost will provide a new perspective on nutrient management of soil.

Table 1 Nutrient analysis of *Parthenium* vermicompost and Vermicompost

Sr. No.	Parameter	*Parthenium* vermicompost	Vermicompost
1	pH	6.08	7.04
2	Electrical conductivity [EC]	**14.2**	12.3
3	Colour	Brownish black	Brownish black
4	Total organic carbon	31.68	40.11
5	Total organic matter	54.5	69
6	C : N ratio	8.7	19.1
7	N [nitrogen]	**3.64**	2.1
8	P [Phosphorus]	**2.85**	1.89
9	K[pottasium]	**1.27**	1.14
10	S [Sulphur]	0.96	1.65
11	Ca [calcium]	*6.52*	3.31
12	Mg [magnessium]	1.03	1.04
13	Fe [ferrous]	**8921.19**	7546.34
14	Mn[manganese]	**334.47**	248.22
15	Cu[copper]	**83.08**	43.74
16	Zn[zinc]	**99.72**	83.88

SUMMARY AND CONCLUSION:

This study concluded that Parthenium vermicompost formed from a combination of Parthenium hysterophorus weed, press mud, cow dung, bagasse, and farm yard manure has better nutrient value so, it is a rich source of nutrients. It can be prepared at a low cost and it is also easy to prepare. It is a balanced bio-fertilizer, which has more nitrogen, potassium phosphorus, and other micro-macro nutrients than other manures. Parthenium weed compost enhances soil fertility and improves soil texture. It provides us multiple benefits by increasing productivity, reducing the use of chemical fertilizers, improving the soil structure, and last, the most important thing is that it is eco-friendly. It does not have any harmful impact on the environment, humans, and any other crops. Therefore, it is beneficial for achieving the goal of sustainable agriculture

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