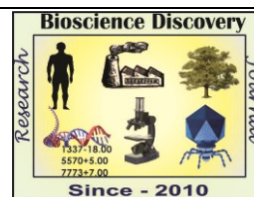


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**Research Article**



## Conversion of *Parthenium hysterophorus* L. Weed to compost and vermicompost

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### Abstract

*Parthenium hysterophorus* L. belongs to family Asteraceae is an aggressive invasive alien weed species native to the Americas but now widely spread in Asia, Africa and Australia. 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 being and livestock. Compost production and utilization has been shown to be a great asset towards cleaner environment. An experiment was carried out in the Research farm located in the Shibala, Dist. Yavatmal, Maharashtra to decompose *Parthenium* by different methods of composting and vermicomposting. Composting was done by NADEP compost (AC) and Bangalore pit compost (BC) method. Vermicomposting was done by pit method (PVC) and worm bin method (BVC). The composts and vermicomposts were analyzed for N, P, K, Ca and C:N ratio at every 20 days up to 100 days. The results show a high increase in nitrogen, potassium, phosphorus, Ca, but decrease in C/N ratio in both compost and vermicompost. The vermicompost prepared in worm bin (BVC) gives high nutrients as compared to pit vermicompost (PVC) and AC, BC Composts. The toxic weed *Parthenium* used in this experiment is thus converted into valuable resources compost and vermicompost with higher concentration of nutrients and can be used as amendment for growth of crops.

### INTRODUCTION

*Parthenium hysterophorus* L. known as congress grass is a dangerous imported weeds and is poisonous, pernicious, allergic and aggressive and causes a serious threat to human being and livestock (Kohli *et al.*, 2006). At present it is one of the most troublesome and obnoxious weed of wasteland, forest, pasture, agricultural land and cause nuisance to mankind (Tefera, 2002; Bakthavathsalam and Geetha, 2004). It is dangerous problematic weed not only in India but other parts of world as Asia, Africa, America and Australia (Evans, 1997). *Parthenium* is aggressive dominating weed in many parts of the world due to its allelopathic properties, which enables 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). Study by Wiesner *et al.* (2007) indicated that *Parthenium* causes general illness, asthmatic problems, irritations of skin and pustules on hand balls, stretching and cracking of skin and stomach pains on humans.

It was also reported to cause severe crop losses. Sorghum grain yield losses between 40 and 97% were reported if *Parthenium* is left uncontrolled throughout the season (Tamado, Ohlander and Milberg, 2002).

*Parthenium* weed seed is also a contaminant of grain, pasture and forage seeds. (Chippendale and Panetta, 1994). *Parthenium* is also known by 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, road sides, railway sides, water courses, cultivated fields and overgrazed pastures (Wiesner *et al.*, 2007). The allelochemicals released from *Parthenium* affecting many 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). Poor farmers of cannot afford the purchase of herbicides and the use of herbicides is unsafe in terms of health and environmental considerations. Therefore, other options must be sought for sustainable *Parthenium* management.

Composting is a natural way of recycling of solid waste management process. Compost contains macro and micro nutrients, 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 improve soil health, reduce soil loss, increased 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 are 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, micronutrients and also contain 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 a highly nutritive organic manure and scientifically proving as a 'miracle for even degenerated soils' with significantly high agronomic impacts (5-7 times) on crops over the conventional composts (Subler *et al.*, 1998).

Earlier research was carried out on use of different manures prepared from different weeds for increasing 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 application of compost, which may also encourage end users about its composting. Ghadge *et al.* (2013) proved that problematic weeds can be used for 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 nutrient source for crop plants.

## MATERIAL AND METHODS:

### Experimental site:

An experiment was conducted in the research farm located at Shibala, Dist. Yavatmal, Maharashtra, India.

### Raw material and making of compost and vermicompost:

The fresh vegetation of *Parthenium* was collected from nearby localities of Shibla. Composting was done by NADEP compost (AC) and Bangalore pit compost (BC) method. Vermicomposting was done by pit method (PVC) and worm bin method (BVC). Earthworm species *Eudrilus eugeniae* Kinberg as 100 individuals each were released. The process of composting was followed as described by Stoffella and Kahn (2001). The uniformly mixed samples (100gm) of each treatment were collected, oven dried at every 20 days up to 100 days and used for nutrient analysis.

### Chemical analyses:

The decomposing *Parthenium* composts and vermicompost samples were chemically analyzed at every 20 days up to 100 days. Calcium (Ca) Content was analyzed by titrating the acid soluble ash solution against 0.01 N KMnO<sub>4</sub> solution using methyl red as indicator (AOAC, 1995). Nitrogen (N) was estimated by micro-Kjeldahl method after digesting the sample with Conc. H<sub>2</sub>SO<sub>4</sub> (Bailey, 1967). The amount of phosphorus was measured following Fiske and Subba Rau (1972) as described by Oser (1979). Potassium(K) Content was determined on a flame photometer as suggested by Jackson (1973). The C:N, ratio was also calculated.

## RESULTS AND DISCUSSION

Nutrient content of samples of *Parthenium* vermicompost by worm bin method (BVC) and pit method (PVC) is given in Table 1 and 2 respectively. *Parthenium* compost prepared from NADEP (AC) method and Bangalore pit method (BC) is given in Table 3 to 4. Changes in the nitrogen percentage from 20 days to 100 days of all manure types are represented in Fig. 1. The high level of nitrogen during the process of vermicomposting is probably contributed by earthworms through excretion of ammonia along with reduction of organic waste to nitrogen component.

Changes in phosphorus, potassium and calcium are given by fig. 2 to 4 respectively. It shows increase in nutrients. Similar trends were reported by Ansari and Rajpersaud (2012). The general rise in phosphate level from initial materials during the process of vermicomposting is probably due to mobilization and mineralization and mobilization of phosphorus due to bacterial and fecal phosphatase activity of earthworms (Ansari and Ismail 2008). Potassium forms part of the micronutrient that is boosted by the presence of earthworm activity on organic matter (Ansari and Ismail 2001). Organic fertilizers contain the second largest amount of potassium, but these are released at a slow rate in the soil, thus preventing wastage by being washed away (Jaikumar et al., 2011).

Changes in C:N ratio are represented in fig.5 which shows decline from 20 to 100 days. Ansari and Rajpersaud (2012) also showed a decline in C:N ratio during the process of litter breakdown and decomposition. C:N ratio is progressively brought down, especially through feeding by earthworms to levels when nitrogen can be directly taken up by plants (Ismail 1997). The nitrogen gets mineralized and is shifted to nucleic acids (Ismail 2005), ammonia, urea and nitrates and carbon is used for respiration by the microbes. The net result is the lowering of the C:N ratio during the decomposition process while composting and vermicomposting.

At the end of 100 days maximum N, P, K, Ca percentage was observed in *Parthenium* vermicompost prepared from worm bin method followed by pit method, NADEP compost while less values are obtained in Bangalore pit compost. Earlier *Parthenium* composting experiments also showed high N, P and K content (Son, 1995; Biradar et al., 2006; Channappagoudar et al. 2007). The values of nutrients in *Parthenium* vermicompost are

in accordance with Yadav (2015). Vermicomposting was found to be more effective than composting (Naikwade et al., 2012, Naikwade 2014).

Both compost and vermicompost type of manure show increase in N, P, K, Ca percentage and decrease in C:N ratio in all types from 20 days up to 100 days. Respiratory activity of earthworms and microorganisms increases with time (Curry, Byrne, Boyle, 1995; Edwards and Bohlen, 1996). These results are accordance with Bansal & Kapoor (2000) who showed that vermicomposting with *Eisenia foetida* of crop residues and cattle dung resulted in significant reduction in C: N ratio and increase in N. *Eisenia foetida* helps to increase the microbial activity and release the nitrogen, potassium and calcium as suggested by (Edwards, 1995).

According to Goyal et al., (2005) there was statistically significant correlation between C:N ratio and CO<sub>2</sub> evolution, water soluble carbon and humic substances. C:N ratio and CO<sub>2</sub> evolved from finished compost can be taken as the most reliable indices of compost maturity. Talashilkar, Bhargarath, Mehta, (1999) studied changes in chemical properties during composting of organic residues as influenced by earthworm activity. According to them there was a decrease in C: N ratio. The organic carbon is lost as CO<sub>2</sub> and N contents of compost is decomposed on the initial N present in the waste and extent of decomposition (Crawford, 1983; Gaur & Singh, 1995). Some workers have reported higher content of NPK and micronutrients in vermicompost (Jambhelkar, 1992; Delgado et al., 1995). The improved nitrogen, phosphorus, potassium and calcium and decrease in pH and organic carbon was observed by (Yadav and Garg 2011) in *Parthenium* vermicomposted with *Eisenia fetida*. The studies clearly indicate that use of worms is highly useful in composting of toxic plant material like *Parthenium*.

Vermicomposting is a better option over composting as earthworms enhance the process of waste conversion and produce a better product. By this process there is a safe disposal of waste biomass in to highly rich manure and is a step towards sustainable development by utilizing weed waste in to black gold (Sharma et al 2016). The results of (Sivakumar et al., 2009) indicated that the *Parthenium* compost at low amendments with cowdung help its eradication with better utilization. Controlling *Parthenium* weed by composting and

**Table 1 Nutrient analysis of *Parthenium* vermicompost prepared in worm bin (BVC)**

Time Duration	N	P	K	Ca	C:N
20 Days	0.54	0.12	0.08	2.03	34.18
40 Days	0.82	0.15	0.10	2.14	32.26
60 days	0.94	0.19	0.13	2.42	30.53
80 Days	1.01	0.24	0.15	2.64	28.14
100 Days	1.07	0.26	0.17	2.73	27.85

**Table 2 Nutrient analysis of *Parthenium* vermicompost prepared by pit method (PVC)**

Time Duration	N	P	K	Ca	C:N
20 Days	0.52	0.11	0.07	2.01	33.68
40 Days	0.75	0.13	0.09	2.20	31.72
60 days	0.90	0.18	0.11	2.35	29.08
80 Days	0.97	0.24	0.14	2.61	27.96
100 Days	1.02	0.25	0.16	2.66	27.68

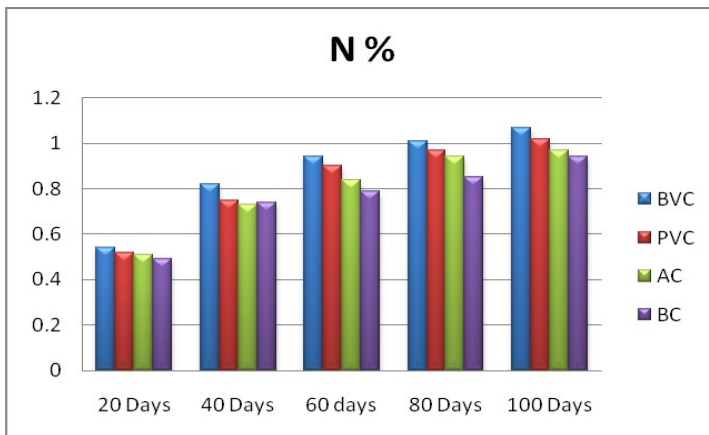
**Table 3 Nutrient analysis of *Parthenium* compost prepared by NADEP method (AC)**

Time Duration	N	P	K	Ca	C:N
20 Days	0.51	0.11	0.06	1.94	34.29
40 Days	0.73	0.14	0.08	2.12	32.47
60 days	0.84	0.18	0.11	2.21	30.60
80 Days	0.94	0.21	0.12	2.39	28.55
100 Days	0.97	0.23	0.15	2.45	27.83

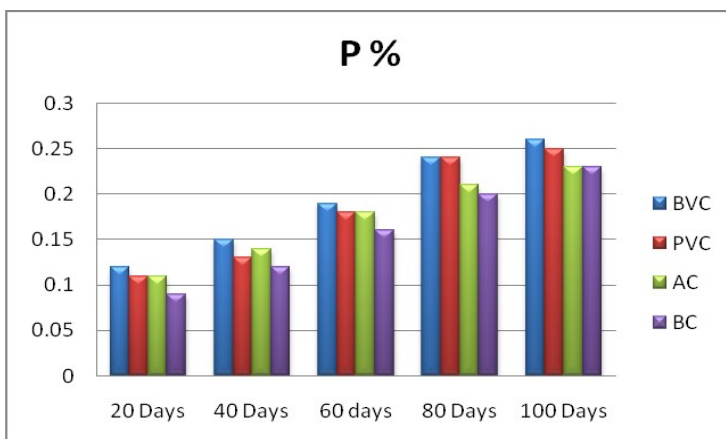
**Table 4 Nutrient analysis of *Parthenium* compost prepared by Bangalore pit method (BC)**

Time Duration	N	P	K	Ca	C:N
20 Days	0.49	0.09	0.07	1.98	33.51
40 Days	0.68	0.12	0.08	2.11	31.67
60 days	0.79	0.16	0.1	2.28	28.93
80 Days	0.91	0.2	0.13	2.41	27.75
100 Days	0.94	0.23	0.16	2.47	27.52

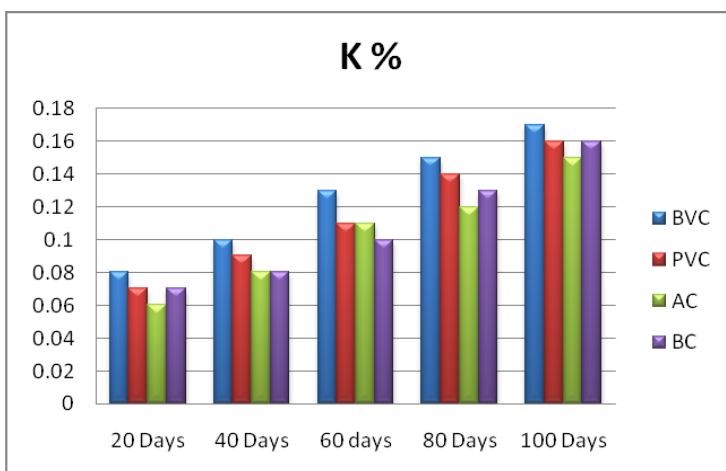
**Fig.1** Changes in nitrogen percentage of *Parthenium* manure by different methods from 20 days to 100 days



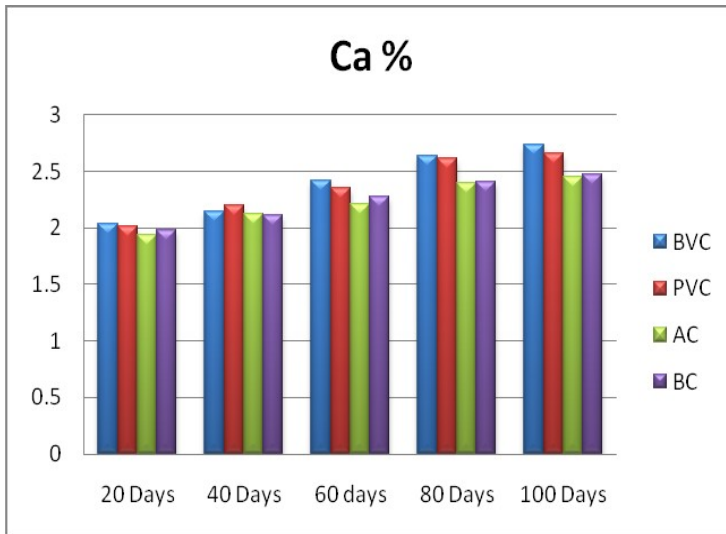
**Fig.2** Changes in phosphorus percentage of *Parthenium* manure by different methods from 20 days to 100 days



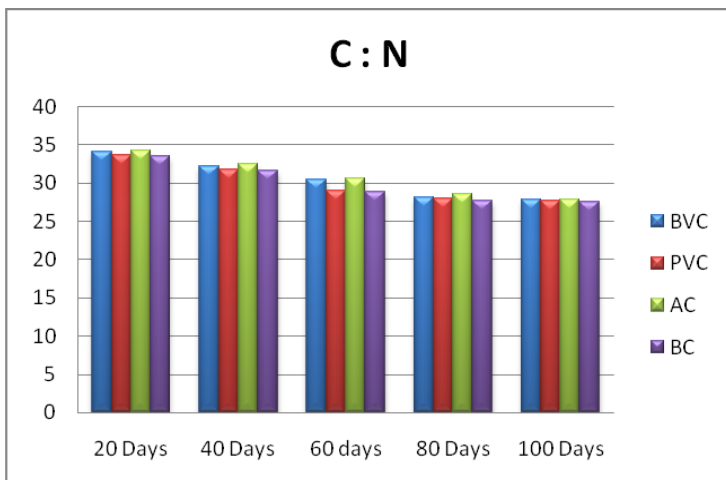
**Fig.3** Changes in potassium percentage of *Parthenium* manure by different methods from 20 days to 100 days



**Fig.4 Changes in calcium percentage of *Parthenium* manure by different methods from 20 days to 100 days**



**Fig.5 Changes in C: N ratio of *Parthenium* manure by different methods from 20 days to 100 days**



providing nutrients to the desired crops will be an ecofriendly step (Ameta 2016 b). By using farming techniques such as composting, vermicomposting, sustainable farmers produce food without having a negative effect on the environment. Instead of harming soil, air and water, sustainable farms actually enhance and preserve the land so that future generations can continue to use it for food production. By using problematic weed *Parthenium* for preparation of manures we can avoid environmental hazards of use of chemical herbicides as well as chemical fertilizers. This is environment friendly method to increase soil productivity leading to sustainable agriculture.

Toxic weed like *Parthenium* can be used as source of nutrients for the crops by converting it into compost and vermicompost. Most efficient method is vermicomposting by worm bin method with use of *Eisenia foetida*. While preparation all types of composts and vermicomposts showed increase in N, P, K, Ca percentage and decrease in C:N ratio in from 20 days up to 100 days. Compost and vermicompost prepared from *Parthenium* are rich in nutrients. Vermiculture and vermicomposting technology is easy to practice, ecologically safe, economically sound. Utilization of *Parthenium* for the preparation of compost and vermicompost will provide new perspective in nutrient management of soil.

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