



STATUS OF N P K IN VERMICOMPOST PREPARED BY TWO COMMON WEED AND TWO MEDICINAL PLANTS

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ABSTRACT

Vermicomposting is a bio-technique and vermicompost are good superlatives for organic farming. During vermicomposting the nutrients are released and converted into soluble and available forms that's providing nutrients such as available N (nitrogen), soluble K (potassium), exchangeable Ca (calcium), Mg (magnesium), P (phosphorus) and microelements such as Fe (iron), Mo (molybdenum), Zn (zinc), and Cu (copper) which can easily taken up by plants. Vermicompost contains plant growth regulators, soil treated with vermicompost showed better plant growth than treated with inorganic and other organic fertilizers. Adding of vermicompost to soil improves the soil structure, increasing the water holding capacity and porosity. Vermicomposts have also been shown to suppress attacks by soil and foliar transmitted plant diseases. This article reviews various attribute as NPK values of Parthenium hysterophorus, Azadirachta indica, Argemone mexicana, and Vitex negundo vermicompost. pH of each compost are in range of 7.5 – 8.1. Nitrogen (N) content (%) is low in cow dung compost (1.7%) and higher in other plant compost except Azadirachta indica and Vitex negundo, maximum in Parthenium vermicompost (1.8%). Phosphorus (P %) ranges 1.3% to 1.6% and maximum in Azadirachta indica vermicompost. Potassium (K %) ranges 0.8% to 15.8% and all four vermicompost has significantly higher K contents than the cow dung compost. Organic carbon - nitrogen ratios (C/N) were also higher in vermicomposts produced with plant except in Argemone mexicana.

Key words: Argemone mexicana, Azadirachta indica, NPK, organic farming, Parthenium hysterophorus, vermicompost, Vitex negundo.

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1. INTRODUCTION

Organic composting is an ancient agricultural manure producing technique. From last century Vermiculture for producing a better manure or compost called vermicompost developed by agriculturist is now being expanded a new branch in agriculture, termed as Organic Farming. Vermicomposts are stabilized organic soil amendments that are produced by a non-thermophilic process, in which organic matter is broken down through interactions between earthworms and microorganisms, under aerobic conditions. During vermicomposting the nutrients are released and converted into soluble and available forms (Ndegwa and Thompson, 2001) that's providing nutrients such as available N, soluble K, exchangeable Ca, Mg, P and



microelements such as Fe, Mo, Zn, and Cu (Amir and Fouzia, 2011) which can easily taken up by plants (Edwards, 1998; Edwards and Fletcher, 1988a). Sugar factory waste (Lakshmi and Vijayalakshmi, 2000), horticultural residues (Edwards 1988b), pig solids and sludge (Alidadi *et al.*, 2005; Parvaresh *et al.*, 2004), sericulture wastes (Gunathilagraj and Ravignanam 1996), agricultural residues (Bansal and Kapoor 2000), cattle dung (Gunadi *et al.* 2002), domestic kitchen wastes (Sinha *et al.* 2002) and weeds (Gajalakshmi *et al.* 2001) could all be converted into good quality vermicompost with a moderate values of NPK. Vermicomposts have much greater microbial biodiversity and activity than conventional thermophilic composts (Edwards *et al.*, 1998; Edwards 2004). Microbes present in gut wall of earthworm responsible for the biochemical degradation of organic matter and transformed it vermicompost (Aira *et al.*, 2002). Vermicompost contains plant growth regulators and other plant growth influencing materials produced by microorganisms (Grappelli *et al.*, 1987; Tomati *et al.*, 1987) including humates (Atiyeh *et al.*, 2000; Masciandaro *et al.*, 1997; Senesi *et al.*, 1992), cytokinins and auxins (Krishnamoorthy and Vajrabhiah, 1986). In agriculture soil treated with vermicompost showed better plant growth than treated with inorganic fertilizers or cattle manure (Kalembasa 1996; Subler *et al.* 1998). Adding of vermicompost to soil improves the chemical and biological properties (Purakeyastha and Bhatnagar, 1997), improve the soil structure, increasing the water holding capacity and porosity (Lee, 1992; Parthasarathi *et al.*, 2008). Vermicomposts have also been shown to suppress attacks by soil and foliar transmitted plant diseases, such as *Pythium*, *Rhizoctonia*, *Plectosporium* and *Verticillium*. Vermicomposts can also suppress arthropod pests such as caterpillars: including cabbage white caterpillars, tomato hornworms, and cucumber beetles, as well as sucking arthropods: such as scale insects, mealy bugs, aphids and spider mites (Arancon *et al.*, 2005, 2006).

In 1881 Darwin referred Earthworms as farmer's friends and nature's ploughmen. Aristotle called earthworms as the 'intestine of earth' (Martin 1976), as they could digest a wide variety of organic materials. In India 509 species with 67 genera and 10 families have been reported by Kale, 1991. The vermicomposting through different species of earthworm has been studied (Edwards *et al.*, 1998; Kale *et al.*, 1988). Epigeic earthworms as *Eudrilus eugeniae*, *Eisenia foetida* and *Perionyx excavatus* are the almost popularly used species for vermicomposting (Kale *et al.*, 1982). The current article reviews various attribute as NPK values of *Parthenium sp.*, *Azadirachta indica*, *Argemone sp.* and *Vitex negundo* vermicompost.

Parthenium hysterophorus Linn., an exotic weed which introduced in 1956 from seeds present in wheat received from Mexico under the PL-480 scheme of the US Government. This plant, popularly known as congress grass, a dangerous weed and is poisonous, pernicious, allergic and aggressive and have a serious threat to human being and livestock. At present, it is one of the most troublesome weeds in India, spreading rapidly in forests, pastures and agricultural lands. Several attempts have been made for its prevention, eradication and control, but to date without success (Kavita and Nagendra, 2000). Huge amount of locally available *Parthenium* can be utilized as a source of organic matter to prepare its compost. This is why vermicomposting might be a useful alternative to convert biomass from this species to a useful material that could be used as soil conditioner, pest control and eradication of weed.

Argemone mexicana Linn., locally named as Sialkanta in Bengal and North India or Mexican Prickly Poppy (English), belonging to the family Papaveraceae, the trees are branching herb with yellow juice and showy yellow flowers. The plants are toxic to animals and cattle avoid grazing this plant. The plant contains alkaloids as berberine, protopine, sarguinarine, optisine, chelerytherine etc. The seed oil contains myristic, palmitic, oleic, linoleic acids (Khalid, 1985). The seed oil contains myristic, palmitic, oleic, linoleic acid etc. The extract of *A. mexicana* contain three phenolic inhibitors p-hydroxybenzoic, vanillic and salicylic acid, inhibited germination of various crops and reduced root length (Burhan and Shaukat, 1999).

The Neem tree (*Azadirachta indica* A. Juss.) is distributed throughout India. Almost all parts of the tree are used for medicinal purposes (leaf and fruit extract, neem oil, neem oil cake or fruit). Many neem seed products (such as oil, cake extracts and purified fraction) have been intensively tested against a large number of insect



species in view of insecticidal properties of neem leaves extracts (Saxena, 1987), and presenting an important potential for insect control (Fagoonee, 1981). The interest of using neem leaves in this study because for its medicinal and pesticidal properties.

Vitex negundo Linn., local name Nishinda, family Verbenaceae, Commonly known as five-leaved chaste tree is a large, used as medicine and pest controlling agent throughout the India and found mostly warmer region. The plant is aromatic shrub with quadrangular, densely whitish, tomentose branchlets up to 5.5m in height. Upper surface of the leaves are green and the lower surface are silvery in colour. Flower bluish purple, black when ripe. The plant can grow on nutritionally poor soil. The principal constituents the leaf juice are nishindine, flavones, casticin, isoorientin, chrysophenol D, luteolin, p-hydroxybenzoic acid and D-fructose. The main constituents of the oil are sabinene, linalool, terpinen-4-ol, β -caryophyllene, α -guaiene and globulol.

2. Materials and methods

2.1. Composting materials:

Leaves of Neem plant (*Azadirachta indica* A. Juss.), Parthenium (*Parthenium hysterophorus* Linn.), Sialkanta (*Argemone mexicana*) and Nisinda (*Vitex negundo*) plants collected from the Krishnath College, Berhampore, Murshidabad campus were washed, shade dried, and cut into pieces of 3-4 cm length.

2.2. Cow dung:

One week old cow dung was used in experiments because fresh cow dung may be dangerous for earthworms due to decomposition process, when generation of heat take place that may kill earthworms.

2.3. Earth worm:

The earthworm *Eisenia fetida* and *Perionyx excavatus* was purchased from the specimen supplier and cultures were maintained in the laboratory over a period of two years with cow dung as the substrate and food.

2.4. Experimental design:

The present study was carried out during June 2010 to Nov 2010. After collecting plants from the K. N. College campus it was cut into very small pieces and then these small pieces were placed separately in the cemented pits. The pits were covered with polythene. After a period of 30 days all these partially decomposed weeds were mixed with cow dung. By using above plant materials and cow dung, five sets of experiments were set up in cemented pits (100 cm in diameter, depth 45 cm). In all experiment 30 young earthworms were introduced. The moisture content was 50% throughout the study period and maintained by sprinkling of adequate quantities of water. In first set (A) of experiment the bedding was prepared by partially decomposed cow dung. In second set (B) of experiment the bedding was prepared by mixing of partially decomposed cow dung with partially decomposed *Azadirachta indica* A. Juss. Use in 5:1 (wt/wt) ratio. The third set (C) of this bedding was prepared by mixing of partially decomposed cow dung with partially decomposed *Parthenium hysterophorus* used in 5:1 (wt/wt) ratio. In the fourth set (D) the bedding was prepared by taking 5:1 (wt/wt) of partially decomposed cow dung and partially decomposed *Argemone mexicana*. The fifth set (E) of this experiment bedding was prepared by taking 5:1 (wt/wt) of partially decomposed cow dung and partially decomposed *Vitex negundo*. After five days interval turned the compost mixture of bed manually up to 30 days. After 60 to 70 days granular tea like vermicompost appear on the upper surface of compost beds.

2.5 Characteristics of the composts:

After 70 days, worms were removed from the composts. Samples of composts were then shed dried and analysed for pH (1:2.5 soil water suspension), organic carbon (OC) (Walkley and Black, 1934), nitrogen (N) (Humphries, 1956), phosphorous (P) (Jackson, 1973), potassium (K) (Toth and Prince, 1949).

3. Result

The nutrient values of vermicompost obtained in this study are presented in Table 1. and Figure 1. The pH of cow dung compost (control, A) value was 8.1. The pH of other four compost (B, C, D, E) showed significantly similar value. pH of each compost are in range of 7.5 – 8.1. Nitrogen (N) content (%) is low in cow dung (A) compost and higher in other plant compost, except in Neem and Nishinda. There was no significant difference

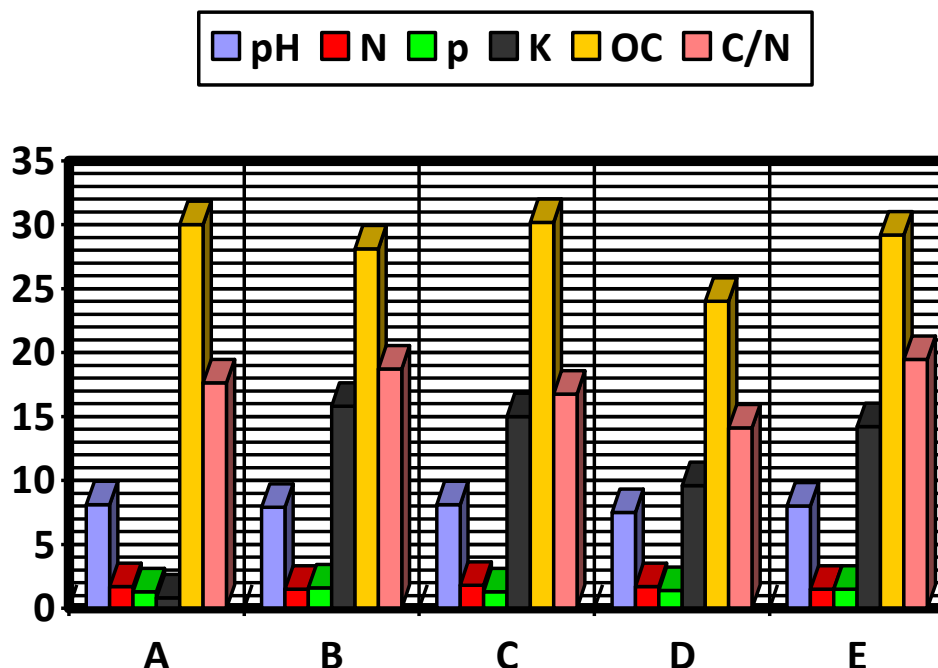


in the N and P content between the Nishinda plant and Neem leaves compost. All compost has significantly higher K contents than the cow dung compost (A). Potassium (K) contents are high in all plant vermicompost. When compared to cow dung compost, significant difference of OC was found in Sialkanta compost. Accordingly the carbon nitrogen ratios were also higher in composts produced with plant except in Sialkanta. Organic carbon (OC) is less in Neem and Sialkanta.

Table 1. Values of different parameter in vermicompost (values are given in percentage).

Vermicompost	pH	N % (Nitrogen)	P % (Phosphorus)	K % (Potassium)	OC % (Organic Carbon)	C/N Ratio
Cow dung (A)	8.1	1.7	1.30	0.8	30.00	17.64
Neem leaves + Cow dung (B)	7.9	1.5	1.60	15.8	28.10	18.73
Parthenium + Cow dung (C)	8.1	1.8	1.30	15.0	30.20	16.77
Sialkanta + Cow dung (D)	7.5	1.7	1.40	09.6	24.00	14.11
Nishinda + Cow dung (E)	8.0	1.5	1.50	14.2	29.20	19.46

Figure 1. Comparisons of parameter in different vermicompost.



4. Discussion

The pH values of soil ranges 7.5 to 8. The pH of five composts showed significantly in same range (A - 8.1, B - 7.9, C - 8.1, D - 7.5, E - 8.0). Decomposition of nitrogenous substrate in to ammonia that may be attributed overall increases of pH (Cohen and Lewis, 1949).



The observed increase in the nitrogen (N) in all composts (except in the case of in Neem and Nishinda leaves compost) showed that the activity of earthworm along with microorganisms promoted mineralization process and brought the nutrients to ready to use form for plant growth. The increased nitrogen may be due to nitrogenous metabolic products of earthworms (Umamahes and Vijayalaksmi, 2003). Atiyeh *et al.* (2000) reported that by enhancing nitrogen mineralization, earthworms have a great impact on nitrogen transformation in manure, so that nitrogen retained in the nitrate form. Hand *et al.* (1988) have been already reported that *Eisenia foetida* in cow dung slurry increased the nitrate-nitrogen content. Lee (1985) reported that vermicompost contain more nitrogen, phosphorous and calcium.

Phosphate (P) values are higher (1.6%, 1.4% and 1.5%) in all vermicompost except cow dung and Parthenium (1.3%). According to Lee (1992) the passage of organic residue through the gut of earthworm releases phosphorus. Available forms of Phosphate is performed partly by earthworm gut wall microbial phosphatase and further released of phosphorus might be attributes to phosphorus solubilising micro organism present in worm cast (Zhang *et al.* 2000; Garg *et al.* 2006).

Total potassium (K) concentration was increased in vermicomposts of all the combination except cow dung. Shutar (2007) suggested that during the vermicomposting process due to enhanced microbial activity cast material contains high concentration of exchangeable K and consequently enhanced the rate of mineralization. Delgado *et al.* (1995) have reported a higher content of K in the new sewage sludge vermicompost. Benitez *et al.*, (1999) studied that the leacheates collected during vermicomposting process had higher K concentrations. Kaviraj and Sharma (2003) observed that level of K was increased 10% by *Eisenia foetida* and 5% by *L. maturitii* during vermicomposting.

Organic carbon (OC) decreases in Neem, Sialkanta and Nishinda in comparison to the cow dung and Parthenim vermicompost. Losses of organic carbon might be responsible for nitrogen addition in the form of mucus nitrogenous excretory substances, growth stimulatory hormones and enzymes from the gut of earthworms (Tripathi and Bhardwaj, 2004; Viel *et al.* 1987). These nitrogen rich substances were not originally present in feed and might have contributed additional nitrogen content.

Observed C:N ratio in all combination are nearly similar and the values ranged in 14.11 to 19.46. According to Senesi (1989) declined in C:N ratio to less than 20 which indicates an advance degree of organic matter stabilization and reflects a satisfactory degree of organic wastes. Suthar, (2008) reported that the C:N ratio of substrate material reflects the organic waste mineralization and stabilization during the process of decomposition. The loss of carbon as CO₂ through microbial respiration and added of nitrogenous excretory material between the C:N ratio of the substrate. C:N ratio is one of the most widely used indicators of vermicompost maturation, decreases sharply during vermicompost process (Kale, 1998; Suther, 2008). A similar reduction in C:N ratio was reported by Senapati *et al.*, (1980), Mba (1983), Talashilkar *et al.*, (1999), Bansal and Kapoor (2000) and Karmegam and Daniel (2000). Muthukumaravel, 1996 and Vasanthi *et al.*, 2005 observed that the mixture of plant waste and cow dung is suitable for the production of higher quality vermicompost when compared with the subjecting the same components individually. Also reported that cow dung influenced the rate of vermicompositing and increased the amount of macronutrients. Ravichandran *et al.*, 2001 observed more NPK in the vermicompost than that in the initial soil. The *Parthenium hysterophorus* vermicompost contains two times more nitrogen, phosphorus and potassium than Farm Yard Manure (FYM) (Angiras, 2008; Channappagoudar *et al.*, 2007).

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