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RESEARCH ARTICLE

BENEFICIAL UTILIZATION OF ELEPHANT DUNG THROUGH VERMICOMPOSTING

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ABSTRACT

An attempt was made for vermicomposting of wild elephant's dung in presence of sugarcane press-mud (the residue of filtration of sugarcane juice) using *Perionyx excavatus* earthworms and also to find out the possible utilisation of these dung in vermicomposting of young and soft uloo grass (*Imperata cylindrica*) which is grown profusely in uncultivable lands and bunds. The experiment showed that vermicomposting of elephant dung alone was possible in 5.5 months time. Addition of equal quantity of press-mud helped in faster vermicomposting by reducing 1.5 months time. Elephant dung also helped in vermicomposting of Uloo grass within 5 months. Press-mud showed positive impact in vermicomposting of these tough grasses in less time. Vermicomposts of elephant dung and uloo grass were slightly acidic in pH (5.3 to 5.9). Addition of press-mud made those neutral in nature (6.7 -7.6). Elephant dung vermicompost contained 1.16% total nitrogen, 0.47% total phosphorus, 1.39% total potassium, 1.29% total sodium, 0.87% total calcium and 0.58% total sulphur. Vermicomposts made from equal quantity of Uloo grass and elephant dung, on the other hand, recorded 1.25% N, 0.39% P, 1.33% K, 1.26% Na, 0.82% Ca and 0.85% S. Addition of Press-mud having a good quantity of nutrients, however, improved all nutrients' status further. The experiment, therefore, confirmed that vermicomposting is the right solution for beneficial utilisation of elephant dung as an economical asset. This can be easily adopted by villagers for their earning measure which will be helpful in mitigation of Human-Elephant Conflict. Mixing of Press-mud with elephant dung during vermicomposting produced nutrient rich vermicompost in lesser time.

INTRODUCTION

Two species of Elephants, which can be traced back 26 million years ago, are existed at present as African elephant available across Africa with little bigger size ears and Asian elephant found in India, China, Myanmar, Thailand, Cambodia, Malaysia, Sri Lanka, Sumatra and Borneo with little smaller size ears. It is estimated that about 40,000 Asian elephants (*Elephas maximus*) remain in the wild which tend to grow to around 2-4 metres in height and 3-5 tons in weight. The incidents of wild elephants entering into nearby villages surrounding the forest area in group, destroying standing paddy crops as well as village houses and even killing people are quite common in recent decades in Assam, Bengal, Bihar, Jharkhand, Odisha and Karnataka. The disappearance of natural habitats due to human activity, and poaching of elephants for their ivory, tusks, hides, etc are the major causes of Human – Elephant conflicts. Reduction in elephant habitats due to deforestation, food scarcity and drying of water-bodies in summer as well as encroachment of forest land for urbanization, mining, monoculture plantation, rail / road construction, irrigation project development, etc are important and responsible factors of frequent elephant menaces (Kar and Lahiri, 2002; Swain and Patnaik, 2002). According to Forest Survey of India, the North-eastern states of India lost 1,802 sq. Km of elephant range habitat between 1991 and 1999. In northern Karnataka, Orissa and Jharkhand also, elephants have lost large chunks of habitat to mining and encroachments (Lenin and Sukumar, 2011). Khuntia and Mohanty (2013) mentioned that the cause of declination of elephant population in Keonjhar district of Odisha from 153 to 73 during 1999 to 2012 was due to loss of elephant corridors and deforestation which forced the elephant to raid standing crops and human habitation. Human – Elephant Conflict caused loss to both human beings and elephants. According to Lenin and Sukumar (2011), elephant population killed an average of 350 people annually during 2005 to 2010, and damaged an average of 330 sq. km of crops every year during 2007 to 2010. The Central and State Governments together spent Rs 10 to 15 crores every year on controlling elephant depredation and paying ex-gratia to affected people. Elephants also paid the price of conflict. Around forty to fifty elephants were killed every year while crop raiding and forests are destroyed in the belief that it would prevent them from using the area. Being continuous voracious feeders of wide variety of plants and mineral rich soils, elephants eat about 200 to 270 kg of food per day and release about 100 to 130 kg dung per day in the form of balls of size 100 to 150 mm in diameter, 70 to 180 mm in length and 1 to 2 kg in weight. Fifty to sixty percent of foods come out as dung being undigested. Elephants are poor digester of food and their semi digested dung is very fibrous as it contains a great deal of

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twigs, fibres and seeds that remain virtually untouched and helps in seed dispersal process (Kitamura *et al.,* 2007). Its decomposition rate is so slow that it assumed to be in a "steady state" for three months (Nehanji and Plumptre, 2001). Masunga *et al.* (2006) mentioned that Carbon mineralisation from the dung was extremely rapid during the first 48 hours after deposition, but the micro-organism activity became progressively more limited due to quick drying of dung with time. Good numbers of domestic elephants are also available in different zoos of India and in many temples of South India. The disposal of elephant dung either released by the hard of wild elephants in the village area or by the domesticated elephants in Zoos and temples is, therefore, a matter of great concern as the heaps attract lots of mosquitoes and create unhealthy atmosphere. Burning dry elephant dung emits lots of carbon dioxide into the atmosphere causing environmental problem. Various attempts were made time to time to use this dung for giving villagers tangible benefits from the wild elephants which will ultimately help to mitigate the Human – Elephant Conflict. Instead of nuisance, the elephant dung can be considered as economic asset by the villagers, Zoo authority and Temple owners.

The handmade papers for preparing cards, notebooks, photo albums, etc are produced by the Great Elephant Poo Poo Paper Company Limited in UK since2002 (Black, 2008) and by Paper Shekhawat and Mehra in India since 2004 (Unnikrishnan, 2012). Every 1000 kg of dung yields around 150 kg pulp. About 115 sheets of paper can be produced from 100 kg dung released by one elephant per day. As shown by Mandal and Brahmachary (2002) elephant dung is a good source of Caffeic acid type phenolics which have both stimulatory effect in lower concentrations and inhibitory effects in higher concentrations on paddy seedling growth. London (2012) reported that the costly but popular elephant dung coffee was made from beans eaten and digested by elephants living on a reserve forest in Thailand. When animals passed the beans in their excrement, they were harvested, cleaned up and processed into coffee grinds for making testy and medicinal coffee. The 50 kg of dry elephant dung can be produced from 100 kg fresh dung. The 500 kg of dry elephant dung would produce 500 litres of biogas daily for at least 14 days. A prototype biogas plant using elephant dung was set up in Puttalam, Sri Lanka in 2003 for harvesting biogas (Wijeyamohan, 2003). Low cost activated carbon prepared from sulphuric acid treated elephant dung was found very effective adsorbent for the removal of Rhodamine B, toxic cationic dye used in textile, printing and paint industries, from an aqueous solution (Theivarasu and Chandra, 2011). According to Adeola (1992), elephant dung was used as enema or smeared on body of sick child for recovering from childhood diseases associated with close birth. Sometimes it was mixed with some medicinal herbs and smeared on affected body parts for recovering from bone fractures, oedema and elephantiasis. However, all above mentioned techniques did not become popular and disposal of elephant dung is still remaining as unsolved. Being organic in nature and semi digested, elephant dung can be converted to compost following simple and safe vermicomposting technique for mitigating the less availability of fertilizer in villages nearer to forest. Keeping all these above in view an attempt was taken for vermicomposting of wild elephant's dung in presence of sugarcane press-mud using *Perionyx excavatus* earthworms. It was also tried to find out possible utilization of elephant dung in vermicomposting of young and soft uloo grass (*Imperata cylindrica*).

MATERIALS AND METHODS

About 200 kg Elephant dung (ED) was collected from the field where a group of wild elephants stayed for a week in search of food at Tezpur. Twenty kg cow dung (CD), 50 kg sugarcane Press-mud (PM, the residue of filtration of sugarcane juice available at Sugar mill as by-product) and about 100 kg finely chopped uloo grass (UG) profusely grown in uncultivated fields and bunds were also collected for this experiment. Beds in triplicate were made using above raw materials as per following treatments.

T_1 = Mixture of 5kg ED + 5 kg CD + 10 kg chopped UG
T_2 = Mixture of 5 kg ED + 5 kg PM + 10 kg chopped UG
T_3 = Mixture of 10 kg ED + 10 kg chopped UG
T_4 = Mixture of 10 kg ED + 10 kg PM
T_5 = 20 kg ED only.

Raw materials were first mixed with required quantity of water for just making the materials moist and then kept for 7 days by making a heap and covering with black polythene sheet. All beds were arranged in completely randomized design inside a room. Materials of each bed was mixed twice after 7 and 14 days and covered with polythene sheets to facilitate initial decomposition and maintenance of optimum moisture at about 80 to 90 %. After 21 days all beds were rebuilt after mixing bed materials and 200 adult *Perionyx excavatus* earthworms were released on top of each bed which was covered then with moist Hessian cloths. Water was spread over beds time to time for maintaining moisture. Earthworms deposited vermicompost on the top of bed as excreta. When the bed materials became black coloured and loosely granular structured materials up to lower layer as observed during time to time physical verifications, then vermicomposts of each bed were spread in the shade for bringing down the moisture to about 40 to 50 %. Earthworms were separated following heap method and by hand screening. Vermicomposts of each bed was sieved separately through 2 mm sieve and samples were collected in triplicate for chemical analysis in the laboratory following standard procedures as mentioned by Tandon (1993).

Total nitrogen was estimated following Kjeldahl Digestion and Distillation method. The pHs of vermicompost samples were determined from 1:2 compost : water mixture using pH meter. Di-acid digestion of samples was carried out using concentrated HNO_3 and $HClO_4$ mixed in 9:4 ratio. Extracts of digested samples were used to determine total potassium, sodium and calcium using flame photometer while phosphorus and sulphur using spectrophotometer. Results were calculated on oven dry basis and analyzed statistically.

RESULTS AND DISCUSSION

Data presented in Table 1 showed that about 11.5 to 13 kg vermicomposts were prepared from 20 kg composted materials. Vermicomposting of only elephant dung took about 5.5 months

time. Mixing with cow dung and uloo grass hastened the composting. However, addition of press-mud reduced the vermicomposting time of elephant dung by one month or more indicating its positive impact and better edible environment to earthworms. According to United Nations Development Program (UNDP) in Nepal Annual Report 2012, vermicomposting of elephant dung was really a slow process by which 60 kg vermicomposts could be harvested from 100 kg elephant dung. Semi-digested elephant dung was very good feed for earthworms whose population increased seven fold within 8 months. In vermicomposting of 196 kg elephant dung after mixing with 9.8 kg cow dung and 500 ml of extended Effective Microorganisms (EM) and using Eudrilus eugeniae earthworms alone or in combination with Eisenia foetida and Perionyx excavates earthworms Ganguly *et al.* (2010) also observed vermicompost formation and cocoons production after 4 months only indicating the slow process. The pHs of elephant dung vermicompost was found varied from 5.3 to 7.6. Addition of Uloo grass with elephant dung slightly reduced the pH while addition of press-mud made the elephant dung vermicompost to be neutral in reaction and good for plant growth.

Table 1 Vermicomposting time, vermicompost production and pH of Elephant dung vermicomposts

Treatments	Time (months)	Production (kg)	pH (1:2)
T_1 = ED 5 kg + CD 5 kg + UG 10 kg	5.0	12.0	5.7
T_2 = ED 5 kg + PM 5 kg + UG 10 kg	4.5	12.8	6.7
T_3 = ED 10 kg + UG 10 kg	5.0	11.5	5.3
T_4 = ED 10 kg + PM 10 kg	4.0	13.0	7.6
T_5 = ED 20 kg	5.5	12.5	5.9
Range	4.0 – 5.0	11.5 – 13.0	5.3 – 7.6

The nutrient analytical data presented in Table 2 showed that elephant dung vermicomposts contained 1.16 to 1.40 % total nitrogen, 0.39 to 0.62 % total phosphorus, 1.28 to 1.62 % total potassium, 0.76 to 1.20 % total calcium, 0.58 to 0.94 % total sulphur and 1.21 to 1.73 % total sodium indicating their richness in nutrient content. Elephant dung vermicompost was in no way inferior to other vermicomposts prepared from cow dung and crop wastes. Mixing with uloo grass increased the nitrogen and sulphur content of elephant dung vermicomposts, but addition of press mud, on the other hand, increased considerably all nutrients of elephant dung vermicomposts.

Table 2 Nutrient analysis of elephant dung vermicomposts

Treatments	N (%)	P (%)	K (%)	Ca (%)	S (%)	Na (%)
T_1	1.25 + 0.08	0.45 + 0.02	1.28 + 0.07	0.76 + 0.05	0.94 + 0.10	1.21 + 0.12
T_2	1.28 + 0.09	0.54 + 0.01	1.45 + 0.05	1.04 + 0.03	0.82 + 0.06	1.57 + 0.09
T_3	1.25 + 0.10	0.39 + 0.02	1.33 + 0.07	0.82 + 0.05	0.85 + 0.10	1.26 + 0.10
T_4	1.40 + 0.07	0.62 + 0.01	1.62 + 0.03	1.20 + 0.04	0.70 + 0.07	1.73 + 0.08
T_5	1.16 + 0.09	0.47 + 0.01	1.39 + 0.02	0.87 + 0.03	0.58 + 0.04	1.29 + 0.05
Range	1.16 – 1.40	0.39 – 0.62	1.28 – 1.62	0.76 – 1.20	0.58 – 0.94	1.21 – 1.73

CONCLUSION

The experiment, therefore, showed that vermicomposting of elephant dung is a simple procedure which can easily be adopted by the villagers for improving their income. Since vermicomposts are in great demand by farmers practising organic farming or even in tea gardens, this may be best option for beneficial utilisation of elephant dung. Tough uloo grass can also be vermicomposted using elephant dung instead of cow dung. Press mud enhances vermicomposting of both elephant dung and uloo grass. Press mud not only helps in nutrient enrichment of elephant dung vermicomposts but also reduces vermicomposting time.

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