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EFFECT OF TENDU LEAF LITTER VERMICOMPOST ON PHYSICO-CHEMICAL PROPERTIES OF SOIL

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Abstract: Increase in human activity in urban areas resulting in generation of huge amount of waste and the disposal and management of this solid waste resulting a serious threat to the environment, thus creating public health problems. The maximum utilization of the waste produced from various sources of urban area including house hold waste, kitchen waste, garden waste, market waste, small scale industrial waste, bio-medical waste, slaughter house waste etc. gives a great opportunity for environmentalist to recover energy from waste in various ways. Public awareness and approach of Municipal Corporation towards waste management is at its low peak. Proper scientific methods can be advantageous for recovering energy from various sources. Solapur city, Maharashtra, India is famous for textile industry. It generates lot of byproducts in the form of waste. Besides textile, beedi industry also still exists from this western Maharashtra region. A number of women workers rely on manufacturing of beedi and considered as main source for their livelihood. Unscientific method of beedi preparation results in generation of vast amount of beedi leaf litter and is being dumped indiscriminately. This solid waste can be a strong contender in production of bio-energy after application to the agriculture when it is being scientifically processed to produce a biofertilizer. Recycling of this organic waste through vermin biotechnology is the best alternative for the production of energy. This is one of the best methods of solid waste recovery to produce energy in the form of agricultural product. The field experiments were carried on the effect of vermicompost on soil is analyzed at post harvest of onion crop. An attempt has been made in the present investigation to recover the bio-energy from the solid waste produced through beedi (Tendu-*Diospyros melanoxylon)* leaf litter. The field experiments revealed higher yield on onion when this tendu leaf litter vermicompost is applied along with the chemical fertilizer.

Keywords: Waste, Tendu, vermicompost, Field experiment, Soil

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INTRODUCTION

Soil is considered as a natural body and is associated with climate, vegetation, characterization and organisms. The main role of the soil is to supply the major nutrients in enhancing the activities related with the growth. Fertile soil will produce abundant crop under natural conditions. The physico- chemical and microbial properties of the soil are influenced by different organic manures. The plant nutrients move from the soil into the roots. Soil pH is essential to determine and provides basics in understanding the soil properties (Gupta, 2004). pH range between 6-7 promote the availability of plant nutrients (Edwards and Bohlen , 1996). Increase in ash content indicates rich organic components in the soil (Singh and Sharma 2002). Electric conductivity (EC) is the main limiting factor which maintains the mobility of anions, water retention and availability of nutrients in the soil (Shrikant *et al*., 2000).Carbon is a backbone of many plant biomolecules. Carbon is fixed through photosynthesis in the plants. Nitrogen (N), Phosphorus (P) and Potassium (K) are the major, micronutrients of the soil. Nitrogen in atmosphere and soil is fixed with the help of nitrogen fixers (Rai *et al*., 2002).Phosphorus is an important component for all cell activities. It is involved in synthesis of energy rich component, ATP. Potassium is another nutrient found in the soil. It plays an important role in translocation of manufactured food.C: N is highly essential for optimum utilization nutrients through roots (Edwards and Lofty, 1977). Several studies reported that the organic wastes have positive effects on soil structure and water holding capacity ((Jedidi *et al*., 2004; Odlare *et al.,* 2008; Shen and Shen 2001; Wells *et al*., 2000). Mahewarappa *et al*., (1999) studied the effect of organic manures on yield of arrowroot, soil physico-chemical and biological properties when grown as an intercrop in coconut garden. They reported increased amounts of organic carbon, improvements in pH, improved soil porosities and water-holding capacities, increased microbial populations and dehydrogenase activity of soil in response to vermicompost treatments.

Lazcano and Dominguez (2011) studied the soil fertility and plant growth after using vermicompost. They stated that application of vermicompost not only enhances the plant growth and also improves the soil biological functions. They have also suggested that the studies have to be diverted to understand the complex interactions between vermicompost-soil-plant in order to satisfy the organic fertilizer application. Joshi *et al*., (2013) studied the vermicompost effect as a soil supplement in enhancing the growth, yield and quality of *Triticum aestivum*. They produced vermicompost from cattle dung and applied to the field study by using randomized block design and observed the growth and yield of Wheat *Triticum aestivum*.

Earthworms are the main resources which are involved in the fertility of soil. They are considered as soil engineers, rejuvenate soil and enrich it with macro and micro nutrients through their roots (Vinceslas *et al*., 1997). Scientific treatment of organic waste results in the

production of the microbial rich biofertiliser. Tendu leaf litter is the waste generated from the beedi industry in and around Solapur city, Maharashtra, India. This waste can be converted into wealth with the help of earthworm species which drives various processes in soil and enhances nutrients and results in increase of microbial diversity. It can be a major source of plant growth regulator. This reflects in plant growth, flowering and yield (Zularism and Zakia, 2010). The sustainable agriculture helps to improve the soil health by interacting all possible measures so that crop productivity is maintained for a longer time.

The overall strategy for increasing crop yield must improve soil by coordinated approach through soil nutrients. Application of vermicompost to the soil enhances all the essential nutrients which in turn supply to the crops for better yield (Singh and Sharma, 2002; Gahukar, 2009). Ramaniuk *et al.,* (2011) studied the soil quality index. They stated that application of vermicompost enhances biochemical and biological properties of the soil. Manyuchi *et al*., (2013) while studying effect of vermicompost, vermiwash and application of them to soil observed that microorganisms present in biofertiliser play a major role in changing soil physico-chemical properties.

In the present investigation the field experiments were carried out by application of vermicompost to the agricultural crop Onion (*Allium cepa*) and thereafter the post harvest soil analysis was carried out to understand the influence of vermicompost on soil fertility which in turn is useful for sustainable agriculture. The present study has been undertaken mainly to recycle tendu leaf garbage produced from beedi industry and using this waste to produce the vermicompost, the biofertiliser with the help of earthworm species *Eudrilus eugeniae*.

Material and Methods: The organic waste for vermicomposting process, consisting of 500kg of tendu leaf litter was collected from local beedi industry, Solapur (Maharashtra). This waste is properly pulverized using mechanical pulveriser and coarse powder of tendu leaf waste is pre-treated with the known quantity of Decomposing Culture (at the rate of 1kg/ton).This enhances the degradation process. For the production of vermicompost conventional heap method is adopted in the agricultural farm at Karamba, Solapur district. The decomposition process requires 30 days after which the partially decomposed organic waste has been given as a feed to the exotic earthworm species *Eudrilus eugeniae.* After the duration of 60 days the decomposed tendu leaf litter is converted into a coarse biofertiliser, the vermicompost.

This final product is applied to the agricultural crop Onion (*Allium cepa)*. Various treatments have been carried out by using Randomised Block Design, The Onion (*Allium cepa*) is harvested and the soil analysis at post-harvest is carried out. During Experimentation a concurrent control and three treatment groups were maintained. The three treatment groups are as follows:

T1-100% N through chemical fertilizer

T2-100% N through tendu leaf litter vermicompost produced by *Eudrilus eugeniae.*

T3-50% N through chemical fertilizer+50% N through tendu leaf litter vermicompost produced by *Eudrilus eugeniae.*

The field experiments were carried out for duration of 120 days. After harvesting the soil was subjected for various physic-chemical properties including Ash, pH, EC, Carbon, C:N, N, P, K, Ca, Mg and microbial count.

Soil samples (1gm) were taken in a 100ml conical flask and are digested using about 30ml of diacid mixture (nitric acid and perchloric acid at 9:4 ratio). The contents were mixed properly and heated for four hours at 90-95 degree centigrade till red fumes ceased out .The samples were cooled ,volume is made up and the nutrients present in the digest were recorded by atomic absorption spectrophometer (AAS) Nutrient estimation were made as per the standard procedures described by Subbaiah and Asija (1956) for nitrogen. Moisture was determined by loss on drying method. The sample is weighed before putting the vermicompost sample in the oven at 105 degree centigrade for 24 hrs and again it is weighed after drying. The difference in the weight gives the moisture content. Ash content was determined by heating moisture free samples in furnace at 550 degree centigrade for 4hrs and percentage ash content was measured on dry basis. pH of the sample was recorded by pH meter and EC by EC bridge .10gms of soil was taken in to clean 100ml beaker to which 50ml of distilled water was added. Suspensions were stirred intermittently for 30min and ph of all the samples were recorded using pH meter. The same suspension after taking pH value were allowed to settle at the bottom for 1hr and electrical conductivity was measured by using EC bridge. For nitrogen content 1gm of vermicompost sample was transferred to Kjeldhal flask. 20ml of concentrated sulphuric acid and 0.4ml of digestion mixture were added .It was digested under low flame for 10-15min until frothing of fumes was stopped. Then it was digested at high flame for one hour till the contents were clear. Kjeldhal flasks were cooled and the contents were transferred to volumetric flask and the volume was made by adding distilled water. 10ml of acid digests were pipette and transferred to microkjeldhal distillation assembly. To this 10 ml of 40% NaOH was added to make the contents alkaline. Distillation was carried out and ammonia was trapped. After distillation, the quantity of ammonia was estimated by titrating it against 0.1 N H_2SO_4 and nitrogen percentage was calculated.

Phosphorus was determined by vandomolybdic acid yellow colour method. Potassium and sodium by flame photometry method. Sulphur by turbid metric method (Chopra 1980). Calcium and Magnesium by the method described by Richards (1984). Iron, Copper, Zinc by AAS (Lindsay and Norwell, 1978).Chloride by argentometric method. Boron described by Berger and Troug (1939).

Microbial analysis

Pour plate method (Dubey and Maheshwari, 1999) has been used for the microbial analysis. One gram of the soil is suspended in ten milliliter of sterile solution and proper dilutions upto 10^3 and 10^4 were made. Total viable count of microorganisms is calculated. To understand the significance of the result various experimental groups in triplicate along with control was subjected for statistical analysis using student 't'test.

Result

The present study is carried out to understand the effect of tendu leaf litter vermicompost produced by *Eudrilus eugeniae* on the physico – chemical properties and microbial count of the soil at post-harvest of Onion crop (Fig.1) (Graph1).

Table No. 3.3: Effect of tendu leaf liter vermicompost and chemical fertilizer on physicochemical properties in soil after harvest.

physicochemical properties	Control	T1	T2	T3
Ash (%)	95.330±9.000	95.410 ±9.500 (0.08%)	97.830±9.700 (2.60%)	97.620±9.200 (2.80%)
Moisture(%)	9.45±0.80	6.23±0.08	12.7±0.02	9.95±0.01
pH	7.367±0.720	7.070±0.800 (0.44%)	7.260±0.700 (1.40%)	7.350±0.680 (0.02%)
EC(mS/cm)	0.700±0.080	0.760±0.110 (0.8%)	0.720±0.090 (2.0%)	0.630±0.600 (9.1%)
C (%)	0.570±0.050	0.970±0.090** (70.00%)	0.730±0.070* (28.00%)	0.703±0.070* (22.00%)
C:N	2.284±0.170	3.340±0.420 (0.46%)	2.613±0.180 (0.14%)	2.923±0.290 (0.63%)
N (%)	0.240±0.020	0.350±0.120* (45%)	0.260±0.030* (80%)	0.270±0.030 (12%)
P (%)	0.140±0.080	0.140±0.020 (0%)	0.170±0.020*** (21.4%)	0.180±0.020*** (28.5%)
K (%)	0.012±0.001	0.029±0.003 (14%)	0.022±0.002** (83%)	0.019±0.002** (58%)

Ca (%)	1.847±0.160	1.870±0.170 (1%)	2.290±0.220* (24%)	2.253±0.290* (21%)
Mg(%)	0.12±0.02	0.30±0.01	0.35±0.03	0.38±0.08
Mn(ppm)	42±0.080	89±0.080	123±0.080	150±0.080
Total microbial count(10 cfu)	5.60 ±0.110	3.1±0.10	11.00±0.10	8.40±0.11

Values are significant at *P<0.05 ** P<0.01 *** P<0.001

Bracket values indicate percentage variation.

Ash content showed marginal increase in all the treatment groups compared to control. The content was in the range between 95.4 to 97.83. In the experimental pH was in the range of 7.07±0.80 to 7.350±0.68. EC content ranged in between 0.630±0.6 to 0.76±0.11 in the experimental groups. Total carbon was increased in the experimental groups and was in the range between 0.70±0.07 to 0.97±0.09. In the experimental groups C:N marginally increased and was in between 2.284±0.170 to 3.340±0.420. Total nitrogen content increased significantly from all the experimental groups and increase was more pronounced in T1 followed by T3 and T2 treatment. Phosphorus content showed increasing trend in both T2 and T3 treatments (0.140±0.020 to 0.180±0.020). Potassium content showed significant increase in T3 treatment followed by T2 and T3 (0.019±0.002 to 0.029±0.003). Calcium content also showed increasing trend more in T2 followed by T3 (1.847±0.160 to 2.290±0.220). Magnesium content showed increasing trend and maximum increase was noticed in T3 followed by T2. The manganese content was found to increase drastically from all experimental groups and increasing trend was more in T3 treatment followed by T2 and T1. Increasing trend was almost all thrice in T3 and more than twice T2 compared to control.

In the present study the total microbial count was increased from post-harvest soil of onion field resulted almost all two times increase in the total microbial count of T2 treatment followed by T3 treatment when compared to control. However it is interesting to note that application of chemical fertilizer decrease the total microbial count when compared with control. From our results it is clear that vermicompost application enhances the total microbial count of soil which is beneficial for the plant to take up maximum nutrients. Microbes play a symbiotic relation between soil and plants.

DISCUSSION

The nutrients are constantly being exported into the plant from fertile soil. Certain extrinsic factors like air, temperature, light; mechanical support, nutrients and water control the plant growth. In the present study the changes in the various physico – chemical parameters from

the soil at post harvest of onion crop before and after application of vermicompost produced from tendu leaf litter resulted in certain significant changes. Earthworms play many different roles in soil. They play an active role in soil organic matter dynamics.

In the present study moisture content was increased more in T2 treatment followed by T3 when compared with control from post harvest soil after treating with the vermicompost produced from Tendu leaf litter engineered by the earthworm species *Eudrilus eugeniae*. Similar results were noticed by Tharmaraj *et al*., (2011) while studying the effect of vermicompost on physical properties of soil after cultivation of Samba Rice. They have observed that the moisture content was more increased after final cultivation of the rice from vermicompost and vermiwash combined treatment. This increasing trend was followed by the vermicompost treatment. In the preset study also 100% vermicompost treatment (T2) resulted in enhancement of moisture content after comparing with control. The water holding capacity of Vermicomposted soil significantly increased which resulted in enhancement of moisture content.

pH of the soil count show much variation from all treatment groups. However pH range towards neutral an alkaline side that generally promotes the availability of nutrients to the plant.T2 treatment showed marginal decrease when compared with control. However, it was towards alkaline side. pH range between 6-7 seems to promote the availability of nutrients to the plants (Brady, 1988). In the present study the post harvest soil after 120 days resulted in increase in ash content marginally in T2 and T3 treatment. This might be due to higher biomass production using vermicompost. There was a slight reduction in EC content especially in T3 group when compared with both experimental groups. Lower EC suggests that the nutrient levels in soil are generally maintained to their optimum level which was readily made available for the plants. . Similarly low EC was observed in the soils treated with vermicompost where enriched compost, FYM and vermicompost applications were made where ragi and cowpea were grown (Srikanth *et a*l., 2000). In the present study post harvest for field experiment using randomized Block Design with treatment groups of T1, T2 and T3 for production of onion crop resulted higher C:N from all experimental groups. This clearly indicates that the vermicompost produced from three different treatments might have adjusted the organic amendments. The earthworms lower C:N and make Nitrogen available to the plants and improves soil fertility (Bhatnagar and Palta, 1996)

In the present study nitrogen content from soil after120 days of harvesting from all experimental groups resulted increase in the content. However, the increasing trend was more in T1 indicating higher chemical fertilizer might have retained some nitrogen after harvesting. Villenave *et al.,* 1999 studied effect of earthworms on soil organic matter and dynamics. They have studied that the earthworms activates increase in nitrogen availability but not total

nitrogen supply. In the present study post-harvest analysis revealed the increase in phosphorus content which is more in T3 suggests that the phosphorus involvement in plant growth is evident. Tomati and Galli.,(1995) studied the role of earthworms in soil fertility and plant production. They have stated that release of K from non-exchangeable K pool passed through earthworm gut and released into the soil. In our studies combination of vermicompost and chemical fertilizer results enhanced phosphorus content this is necessary for improvement of crop production. In the present investigation the soil analysis after harvest resulted increase level of potassium (K) in soil. In the present study Magnesium (Mg)content increased more in T2 indicates that application of vermicompost to soil before harvesting and after harvesting analysis results increased Mg content indicating the role of vermicompost in retaining some quantity in soil after harvesting onion crop. In the present investigation after application of vermicompost, the post-harvest soil of the onion field cop the manganese (Mn) content was found to increase drastically from all the experimental groups. Abdella and Saad (2012) studied the utility and nutrient values of organic and inorganic fertilizer on Teff grass growth and some soil properties. They observed enhancement of Mn from the soil. They have stated that vermicompost has a significant effect when compared to other treatment. They further noted that organic fertilizer application infact has more positive effect noticed in second season. Manivannan *et al*., (2009) while studying the effect off vermicompost on soil fertility and crop productivity of beans *Phaseolus vulgaris* experiments showed increase in manganese 8.2 and 10.6 times from clay loam soil and sandy loam soil respectively. Azarmi *et al*., (2008) while studying influence of vermicompost on soil physical and chemical properties in tomato field observed increase in Mn content after application of vermicompost. They also observed that almost all two to three more times of manganese content was increased after application of vermicompost at the rate of 15 tons/ hectare when compared with control.

In the present total microbial count was increase from post-harvest soil of onion crop resulted almost three times increase in total microbial count of T2 treatment (100% vermicompost) followed by T3 treatment when compared with control. However it was interesting to note that application of chemical fertilizers the microbial count when compared to control. Rom our results it is clear that vermicompost enhances the total microbial count of the soil which is beneficial for the plant to take up the nutrients. Microbes play a symbiotic relation between soil and plant.

Pant *et al*., (2004) while studying vermicompost extracts on growth, mineral nutrients and phyto nutrients observed that microbial count was influenced and the population of active bacteria was significantly higher in all types of vermicompost tea compared to control. Arancon *et al* (2007) while studying vermicompost tea production and plant growth impacts observed

that humic, flavic and other acids n produced by microorganisms have direct role to play in enhancing plant growth.

Sudhakar *et al.,* (2002) studied the effect of vermicompost on soil properties, nutrient availability, uptake and yield of rice. They concluded that the increased availability of nutrients in vermicompost compared to non-ingested soil resulted in significantly better growth and yield of rice. Samaranayake and Wijekoon (2010) investigate effect of selected earthworms on soil fertility, plant growth and three epigenic earthworms *Periyonix excavatus, Eudrilus eugenia* and *Eisenia foetida* on vermicomposting.

CONCLUSION

From our study it is concluded that the waste generated from beedi industry the tendu leaf litter can be reproduced as an organic fertilizer with the help of earthworm species *Eudrilus eugeniae*. After application to onion crop the post harvested field soil showed increase in pH, ash, moisture, EC,N,P,K, Ca, Mg, Mn and microbial count. Vermicompost application is infact economical ecofriendly and easy for application. The organic farming in fact results in sustainable agriculture and one can avoid leaching of field due to over utilization of chemical fertilizers, in India thousands of agricultural land is becoming salty due to excess use of chemical fertilizer. Application of T3 treatment to the fields not only gives good results to crop but also enrich the soil. Our results of the post-harvest soil prove by using different field trials in the second season.

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