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Land application of composted poultry litter as a nutrient source for the growth of *Lycopersicum esculentum*.

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ABSTRACT

From the statistics it was seen that India is expected to produce 260 million layers (77,700 million eggs) and 3500 million broilers (5.9 million tonnes) in the year 2010. Poultry development in the recent past has shown very fast development and at present in A.P. the total population of poultry is 193 millions and from these birds the litter is estimated at 17.70 lakh tons per year. This tremendous increase of poultry industry results in substantial amounts of poultry litter, which can efficiently use in solving the present agronomic problems thus leading to sustainable agriculture. The application of poultry litter on land has been a long used disposal method that benefits soil and plant. Composted poultry litter is being applied on agricultural fields as an amendment to provide nutrients and also enhance the organic matter content and improve the physico-chemical properties of the cultivated soils. In the present study, quantitative changes in physical, chemical and microbial properties of composted poultry litter were studied. In order to understand the composting process and evaluate the suitability of composted poultry litter as soil amendments to Lycopersicum esculentum plant, Lycopersicum sps was planted and monitored for growth performance and yield. The effect of land application of composted poultry litter on the soil organic matter content and other properties as the soil quality indices were being evaluated in this case study.

Keywords: Composted poultry litter, soil fertility and solid waste management.

I. INTRODUCTION

Indiscriminate use of chemical fertilizer is harmful for soil and biodiversity. Crave for maximum income is the root cause for this burning problem. There is a need to increase the productivity of marginal soils through appropriate fertilizer application to provide food for an ever increasing population (Faridullah et al., 2009). Animal manure can be a plentiful source of organic soil amendments but proper management is imperative to prevent adverse environmental effects that can result from application of manure to soil (Preusch et al., 2004). Agronomic practices aimed at reducing the dependence on inorganic fertilizers can contribute to the sustainability of agriculture. One of the measures being adopted for relieving environmental problems arising from agricultural production is to recycle animal manure and other organic products as fertilizers and soil amendments (Eneji et al., 2001, 2003; Bolan et al., 2004). Poultry litter has been traditionally applied to agricultural soils for decades as an organic fertilizer, because it is good source of plant nutrients (Moore et al., 1995). The use of manure in agricultural land is beneficial to the soil properties (Olayinka. 1997) on account of their valuable ingredients and characteristics (Eneji et al., 2001).

Poultry litter, a combination of accumulated chicken manure, feathers and bedding materials, is a potential feedstock for bioenergy and other value-added applications (Bernhart et al., 2010). Poultry wastes contain higher concentrations of Nitrogen (N), Calcium (Ca), and Phosphorus (P) than wastes from other farm animals (Stephenson et al. 1990). Organic mulches made with manures that are rich in nutrients may release significant quantities of nutrients if they are not managed properly (Anonymous, 1999). Disposal of poultry litter (PL) is one of the major concerns of poultry farmers in congested cities, who have resorted to burning to reduce the volume available for disposal. By the year 2010, India is expected to produce 260 million layers (77,700 million eggs) and

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3500 million broilers (5.9 million tones) (http://mofpi.nic.in). As per the last 17th livestock census, the state of Andhra Pradesh ranks first in poultry population (21.0% of the country). There is a very sharp increase by around 62% in the fowl population and by 61% in the total poultry in the state during the period from 1997 to 2003 (www.17th Live Stock census India). Poultry development in the recent past has shown very fast development and at present in A.P. the total population of poultry is 193 millions and from these birds the litter is estimated at 17.70 lakh tons per year (www.appcb.ap.nic.in). This tremendous increase of poultry industry results in substantial amounts of poultry litter, which can efficiently use in solving the present agronomic problems thus leading to sustainable agriculture.

Composting may provide a beneficial alternative method for handling poultry litter due to immobilization of nutrients and a reduction in litter volume. Studies have shown that the composting process immobilizes N in the litter and produces humus, a source of organic materials and slow release-nutrients (Paul and Clark, 1996). The slow release of nutrients from composted poultry litter (CPL) may lessen adverse environmental effects from leaching of N in run-off from farmlands (Chang and Janzen, 1996).

Vegetable crops fetch attractive prices at local markets and generate income through out the year. Vegetables provide household nutritional security since they are rich in vitamins, minerals and roughage which constitute the essentials of a balanced diet. The use of Poultry litter as a source of fertilizer would mitigate the problem of poultry litter disposal. Therefore, use of composted poultry litter as manure will result in reduced levels of environmental pollution and brings about sustainable agricultural development.

II. MATERIALS AND METHODS

A. Study area

The pot experiments were carried out at Surya Farms, Thagarapuvalasa in Gudivada Village, Vizianagaram (Dist), Andhra Pradesh, India during July 2008 to July 2009. Poultry litter was collected from progressive poultry farm in Boyapalem, Visakhapatnam. The test soil was collected from Surya Farm. Analysis of physico chemical characteristics of garden soil was carried out as per standard procedures (Jackson, 1973). Litter was obtained from a poultry farm in Boyapalem consisting of $2000m^2$ concrete floored houses with a stocking density of 20 fowls $/m^2$ at the start of each 60-day production cycle; the floor is covered with $5kg/m^2$ of rice hull. It was highly efficient moisture absorbent and constitutes an important source of carbon in poultry litter used as fertilizer (Sweeten, 1988).

B. Sampling Procedure for Fresh Litter

At the end of each production cycle after removal of the birds, the litter was removed with a loading shovel and piled under cover and the floors were washed and disinfected. Specifically ten samples each of 200g were obtained from random points in each pile, at depths of 50-100 cm. These ten samples were then pooled. The final collected composite samples of 2 kg fresh litter was collected. The fresh litter samples were taken in cleaned, sterilized test tubes for physico-chemical and microbial analysis. The analysis was done with in 24- 48 hours collection of Fresh poultry litter (Lopez-Mosquera. et al. 2007).

C. Composting

The poultry litter collected from the poultry farm was composted in a prototype composter (cement vessel). This vessel was constructed with a volume of 250 l. Then it was filled with 120 ± 1 Kg of poultry litter. During composting period, stirring of litter was carried out successively at weekly intervals. Care was taken to retain moisture. After 60 days of composting, the composting material was collected and then transformed in to experimental pots.

D. Drying

The samples of poultry litter (fresh and composted poultry litter) were collected and dried at shaded light. The samples were sieved through the 2mm screen, homogenized for further analysis

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(Anderson and Ingram, 1998). Then all homogenized samples (both fresh and composted) were carried to the laboratory with necessary precautions. Simultaneously both control and test soil samples were analyzed for their nutritive value.

E. Laboratory/ analytical methods

The garden soil, fresh and composted poultry litter samples were analyzed for the following Physico-Chemical and microbial parameters and were analyzed before the plantation of seeds.

F. Plantation

After the characterization of physico-chemical properties of the composted poultry manure, then it was mixed with soil and applied to the pots at different ratios. The composted poultry manure was amended with soil at four rates, 75% (3:1 soil and litter), 25% (1:3 soil and litter), 50% (1:1 soil and litter), 100% litter (control PL), 100% soil (control soil) and soil with of commercial fertilizer (CF). Respective controls were also maintained to compare the results for each treatment. All the pots were labeled with code. The 6 pots of 3sets (triplicates) were allotted for ***Lycopersicum*** species seeds and three sets were sown with 50 seeds of each ***Lycopersicum*** sps seeds in each pot.

For irrigation, an equal amount of water was given to each pot at the same time when the mixtures in the pots dried (everyday). 40 days were elapsed as growing period under the controlled conditions. During this period any additional compost were not applied, but endosulfan and thiram (Dolgen et al. 2004) were given as pesticide. Following the 40 days of the growing period, the plants were harvested. Fig. 1 presents the pictures of the ***Lycopersicum*** plants before harvesting.

The test soil samples were collected from the experimental pots during decomposition on the days of 0^{th} day, 10^{th} day and 40^{th} days and were air dried, sieved to pass through 2mm screen and stored at room temperature (27± ºC) until use. The following physico- chemical parameters were analyzed in order to determine the characteristics of the test soil. All procedures were adopted from Jackson, M.L. (1973) and analysis was carried as described. Then the plants were uprooted with out damaging their roots by using lancet, and the leaves and the roots were washed with de-ionized water and dried at oven at 60 ºC through a week and then weighed in the laboratory. The soil of the study area was initially characterized in order to assess its fertility status before setting of experimental pots with litter application. Following the 10^{th} day 20^{th} day and 40^{th} day, the *Lycopersicum* plants were taken for the biochemical analysis.

III. RESULTS AND DISCUSSION

The results showed slight differences because of decomposition of organic manure. During decomposition the poultry litter undergoes some changes. Differences that affects N mineralization rates of fresh litter include uric acid concentration in broiler litter (which depends on diet), number of flocks grown on the litter, and moisture content of the litter (Gordillo and Cabrera, 1997). Moisture content is particularly important because it supports bacterial activity and thus the production of the enzyme urease, which breaks down uric acid molecules to simpler N forms (Cabrera et al. 1993). Fresh litter probably contained recently formed organic N that was less stable than N previously incorporated in to the organic fraction, which is often found in composted litter (Broadbent, 1986). A significant finding of the current work was that litter source had a large effect on mineralization rates of fresh but not composted poultry litter. Composting yield, a more predictable and reliable source of mineralizable N than fresh litter. Composting did not have as consistent an effect on P as it did on N. Results indicate that application of composted poultry litter (CPL) solely based on N requirements may result in significant P inputs to the environment (Preusch et al. 2002).

Data presented in Table -1 provides the physico-chemical properties of soil and that of Table -2 summarizes the principal characteristics of the fresh and composted poultry litter. The mean, S.D values of C/ N ratio of 6.3 ± 0.2 (fresh poultry litter) and 11.3± 0.3 (composted poultry litter) recorded for poultry manure (Table - 2) was low (less than 20 according to Lloyd *et al.* 2003). This indicates that the composted poultry litter was used in this study was of high quality.

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Lycopersicum sps was cultivated in soil along with the poultry litter as an amendment. In experimental pots during decomposition of the poultry litter while plant grows indicates its utilization by the cultivated plants. Various parameters like pH, Organic Carbon (%), Nitrogen (g/kg), Phosphorus (g/kg), Potassium (g/kg), were analyzed in the soil at regular intervals at 0^{th} day, 10^{th} day and 40^{th} day. Total 6 units of pots were setup with different poultry amendments, soil and litter in 3:1, 1:1, 1:3 ratios were labeled as L_{31}, L_{11}, L_{13} respectively and other two units L_{CL}, L_{CF} posses only poultry litter and soil with CF respectively. All the samples from L_{CS}, L_{31}, L_{11}, L_{13}, L_{CL} and L_{CF} were analyzed for all the above parameters.

pH was observed as 6.87, 7.23, 7.68, 8.20, 8.29 and 7.25 respectively for 0^{th} day, 7.12, 7.18, 7.58, 7.99, 8.20, 7.15 respectively for 10^{th} day and 7.20, 7.16, 7.41, 7.73, 8.16 and 7.13 respectively for 40^{th} day. The Organic Carbon (%) resulted as 10.2, 15.5, 21.2, 26.6, 29.4 and 10.7 % respectively for 0^{th} day, 10.0, 14.9, 20.8, 26.0, 29.0, 10.2 % respectively for 10^{th} day and 9.8, 14.6, 20.4, 25.5, 28.9, 10.0 % respectively for 40^{th} day. Nitrogen measured in (%) gram per kilogram, showed the values as 1.2, 2.1, 2.6, 3.2, 3.6, 1.9 % respectively for 0^{th} day, 1.0, 1.9, 2.5, 3.1, 3.5, 1.7 % respectively for 10^{th} day and 0.9, 1.9, 3.9, 5.7, 6.9, 1.1 % respectively for 40^{th} day. Results of Phosphorus reported in mg/g were 1.1, 2.4, 4.3, 6.4, 7.5, 1.6 mg/g respectively for 0^{th} day, 1.1, 2.2, 4.1, 5.9, 7.2, 1.3 mg/g respectively for 10^{th} day and 0.9, 1.9, 3.9, 5.7, 6.9, 1.1 mg/g respectively for 40^{th} day. Potassium levels were observed in those soils and reported in mg/g which was as follows 2.2, 5.2, 9.4, 12.5, 15.4, 3.4 respectively for 0^{th} day, 2.0, 4.8, 8.9, 12.0, 15.2, 3.1 respectively for 10^{th} day and 1.9, 4.5, 8.6, 11.8, 14.9, 2.9 respectively for 40^{th} day.

From the results, it was evident that all the nutrients were gradually taken up by the plant during the course of cultivation in litter amended pots. There was a remarkable difference between the values of these parameters from control to test samples with ratios of soils and composted poultry litter.

The results showed variations in the different poultry litter amendments because of the addition of stabilized manure to soil can affect soil fertility by modifying the physical, chemical and biological properties of the soil (Dick and McCoy 1993). Application of different ratios of composted poultry litter (25%, 50%, 75% & 100%) and CF (Commercial fertilizer) increased vegetable growth yield relative to the control. All the amendments gave growth yields that were significantly similar and higher than the control except sole poultry litter treatment. Pots under CF treatment showed the less significant growth than the composted poultry amended treatment (3:1). However, in combination with composted poultry litter amended with soil and CF treatments increase in all parameters were noted down. This observation corroborates with the finding of Kapkiyai et al. (1998) that maize grain yields were significantly affected by manure and fertilizer application.

The soil organic Matter (SOM) is the source of nutrients for crops that maintain soil fertility and productivity in farming systems (Powell et al., 1999). A decline in organic matter is considered to create an array of negative effects on crop productivity, and therefore maintaining or improving the organic matter content is a prerequisite for ensuring soil quality, future agricultural productivity and sustainability (Katyal et al., 2001). In this study, out of all parameters, soil litter amended soils, SOC (Soil Organic Carbon) observed in one year of study ranged from 10.1 –29.5 % (0.465 – 4.861% SOM) (Ranamukhaarachchi *et al.,* 2005). According to Metson (1961), a productive soil should have an organic matter content of at least 4 %. The generally low organic carbon recorded during the seasons was due to the low inherent soil fertility, high soil temperature and aeration favouring faster microbial activity. Application of amendments (especially CPL and CF) during the one year of experimentation could not raise the organic carbon content in the respective amended pots to the optimum (2.32 %). This suggests that apart from the inherent soil fertility and the prevailing climatic conditions, appreciable rate of increase in SOC will depend on the length of time that management is imposed. This suggests that SOC content gives a picture of large changes in the soil in the long term.

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The insignificant differences in nitrification following amendments application have been reported in literature. The nitrogen available for vegetables growth following application is often estimated from the ammonical N plus a portion of the soil organic nitrogen (Sluijsmans and Kolenbrander, 1997). This study confirmed an earlier observation by Paul and Beauchamp (1996) that the organic nitrogen fraction in manure was not available compared to the soil organic N. There is often a marked seasonality of organic matter decomposition in the wet and dry tropics due to a flush of decomposition associated with the rewetting of dry soils (Appel, 1997). This can lead to a pronounced flush of nitrate in the soil at the onset of the rains which is susceptible to leaching in cultivated soils. The soil of the study area experienced short dry spells which were followed by resumption of rains. This study has established that sampling periods rather influenced mineralization significantly than amendments and cropping systems.

Soil total Nitrogen levels of 0.05 - 0.13 % under amendments and vegetable growth systems were low. This was particularly due to the low soil organic carbon levels (0.77 - 1.37 % or 1.32 - 2.36 % organic matter) found in this study following amendment and was in conformity with the findings of Ranamukhaarachchi et al. (2005) who reported low nitrogen levels under cropping systems in Bangladesh. According to Howarth (2005), the soil organic matter was composed of 5 - 6 % nitrogen. The observation could also be partially ascribed to N losses which occur mainly through leaching, surface runoff, denitrification, etc. In their study on N losses, Bijay and Sekhon (1977) observed that losses of N in the form of nitrate occurred due to leaching with cropping systems consisting of shallow rooted crops. Crop uptake of N is relatively inefficient and often results in average losses of 50 % because of leaching, volatilization or denitrification (Zublena, 1997). The data (Table -3) showed a general increase in exchangeable Potassium during the experimental period. A similar observation was made by Wicks et al. (1988) when they found a decline in potassium in cultivated soils over time.

Out of all plants, the maximum values of root length and shoot length of ***Lycopersicum*** plants grown in composted poultry litter amended (3:1) treatment, for 10^{th}, 20^{th} & 40^{th} days were observed as 4, 6.1, 7.8 and 10.5, 21.2, 32.5cm respectively. The minimum values were found in sole poultry litter treatment (100%) 2.4, 5.2, 6.5 and 8.7, 14.7, 20.5 cm respectively for 10^{th}, 20^{th} & 40^{th} days and that of control treatment of (soil with out amendment) ***Lycopersicum*** showed 3, 5.9, 7.2 and 9.6, 19.4, 29.5 cm respectively. The results indicated that the maximum fresh weight of root and shoot weights of ***Lycopersicum*** plants grown in composted poultry litter amended (3:1) treatment were found 0.09, 0.29, 0.53 and 0.29, 0.85, 2.38 g for 10^{th}, 20^{th} & 40^{th} days respectively. The minimum fresh weights of root and shoot values recorded were 0.05, 0.21, 0.39 and 0.16, 0.69, 1.99 g respectively in sole poultry litter treatment and the control treatment showed 0.07, 0.24, 0.48 and 0.22, 0.78, 2.27 g respectively. Out of biochemical properties of ***Lycopersicum*** plants, the minimum Biomass yield of ***Lycopersicum*** plants grown in sole poultry litter treatment was observed (viz., 73.2, 76.5 and 79.8 %) for 10^{th}, 20^{th} & 40^{th} days. The maximum biomass (78.4, 80.3 and 83.2 %) was found in composted poultry litter amended (3:1) treatment and that of control treatment showed 74.8, 77.3 and 81.5 % respectively for 10^{th}, 20^{th} & 40^{th} days.

The minimum leaf Carbohydrate content of ***Lycopersicum*** plant was found in sole poultry litter treatment (viz., 38.5, 45.6 and 51.8 %) for 10^{th}, 20^{th} & 40^{th} days respectively. The maximum leaf Carbohydrate content (40.3, 47.2 and 53.4 %) was observed in composted poultry litter amended (3:1) treatment and that of control treatment showed 39.3, 46.4 and 52.5 % respectively for 10^{th}, 20^{th} & 40^{th} days. ***Lycopersicum*** plants showed minimum amount of leaf Chlorophyll content in sole poultry litter treatment (viz., 1.5, 2.8, 4.1 mg/g) for 10^{th}, 20^{th} & 40^{th} days respectively. The maximum amount of leaf chlorophyll content was found in composted poultry litter amended (3:1) treatment (2.5, 4.2, 5.9 mg/g) for 10^{th}, 20^{th} & 40^{th} days respectively and that of control treatment showed 2.1, 3.9 and 5.2 % respectively for 10^{th}, 20^{th} & 40^{th} days. The minimum leaf Nitrogen content of ***Lycopersicum*** plant was found in sole poultry litter treatment (viz., 4.5, 5.3, 6.5 g/kg) for 10^{th}, 20^{th} & 40^{th} days respectively. The maximum leaf Nitrogen content of ***Lycopersicum*** plant was observed in

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composted poultry litter amended (3:1) treatment (5.1, 5.9, 7.2 g/kg) for 10th, 20th & 40th days respectively and that of control treatment was showed 4.7, 5.6 & 6.8 for 10th, 20th & 40th days respectively. These results indicated that the lower Protein content of ***Lycopersicum*** plants for 10th, 20th & 40th days were observed in sole poultry litter treatment (viz., 28.12, 33.12, 40.62 mg/g) for 10th, 20th & 40th days respectively. The higher protein content (31.87, 36.87, 45 mg/g) was found in composted poultry litter amended (3:1) treatment and that of control treatment showed 29.37, 35 & 42.5 mg/g for 10th, 20th & 40th days respectively (Table-4).

IV. CONCLUSION

Poultry litter has shown to improve the growth of all the plants under test, as well as resulted in increase yields. Poultry litter not only increased yields but also increased protein content over control and commercial fertilizer pots. Higher yields and protein content at similar rates of litter and commercial fertilizer may result from the fact that litter provides a slow release nitrogen fertilizer, improves soil quality, and reduces soil acidity. The research provided a systematic monitoring of soil physico-chemical properties as affected by specific nutrient management practices in composted poultry litter amended soils. It has added to knowledge on the mineralization of nitrogen under different amendments. Results have shown that NO_3^- - N could be subject to immobilization under amendments during decomposition of composted poultry litter. The research has demonstrated that composted poultry litter is a good store of phosphorus and that plants' need of phosphorus could be met through its application. Advantages of using composted poultry litter were food safety issues are addressed, less wear and tear on spreading machinery, better control of weed seeds and pests and odors during spreading are greatly reduced

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Table 1. Physico-chemical Characteristics of Garden Soil, Fresh and Composted Poultry litter (mean ± SD) n=6.

S.No	PARAMETER	GARDEN SOIL	FRESH	COMPOSTED
1	P^H	6.87 ± 0.02	8.72 ± 0.3	8.29 ± 0.2
2	Electrical Conductivity (m-mhos)	0.04 ± 0.01	0.36 ± 0.02	0.43 ± 0.03
3	Water holding capacity (%)	28 ± 0.8	16.5 ± 1.3	15.5 ± 1.6
4	Moisture content (%)	19.5 ± 2.6	31.5 ± 1.4	28.8 ± 1.3
5	Bulk Density (g/cm^3)	0.92 ± 0.1	0.81 ± 0.1	0.79 ± 0.1
6	Specific gravity	1.48 ± 0.2	0.82 ± 0.05	0.81 ± 0.04

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7	Porosity	0.21 ± 0.1	0.50 ± 0.1	0.55 ± 0.2
8	Organic Carbon (% d.w.)	10.2 ± 0.2	33.6 ± 1.0	29.4 ± 0.9
9	Organic matter (%)	17.58 ± 1.2	57.9 ± 1.2	50.6 ± 1.3
10	Soil Humus (%)	0.11 ± 0.09	2.73 ± 0.7	2.80 ± 0.8
11	Total Nitrogen (%)	1.2 ± 0.5	4.3 ± 0.7	3.6 ± 0.9
12	Phosphorus (g/kg)	1.16 ± 0.15	6.14 ± 0.15	7.63 ± 0.15
13	Potassium (g/kg)	2.26 ± 0.15	16.2 ± 0.15	15.4 ± 0.15
14	Sodium (mg/g)	8.2 ± 0.8	44.5 ± 0.5	42.8± 0.5
15	Calcium (mg/g)	0.77 ± 0.2	6.78 ± 0.5	6.94 ± 0.5
16	Magnesium (mg/g)	0.25 ± 0.01	0.65 ± 0.1	1.32 ± 0.1
17	Nitrates (mg/g)	0.24 ± 0.02	0.52 ± 0.04	0.43 ± 0.05
18	Sulphates (mg/g)	0.25 ± 0.03	0.86 ± 0.05	0.83 ± 0.05
19	Chlorides (mg/g)	139.95 ± 5.3	967.4 ± 6.2	946.5 ± 6.3
20	C/N ratio	8.5 ± 0.6	6.3 ± 0.2	11.3 ± 0.3
21	Microbial Activity (mg/g)	17.38 ± 1.3	32.2 ± 1.3	38.0 ± 1.4

Table 2. Pattern of arrangement of test pots of Lycopersicum esculentum

S.No	**CODE**	**TREATEMENT**	**MATERIALS USED FOR POT**
1	L_{CS}	Control	10 Kg. of garden soil
2	L_{31}	3:1	7.5 Kg. of garden soil 2.5 Kg. of Composted poultry litter was used as organic manure.
3	L_{11}	1:1	5 Kg. of garden soil 5 Kg. of Composted poultry litter was used as organic manure.
4	L_{13}	1:3	2.5 Kg. of garden soil 7.5 Kg. of Composted poultry litter was used as organic manure.
5	L_{CL}	Poultry litter	10 Kg. of Composted poultry litter was used as organic manure.
6	L_{CF}	Soil with CF*	10 Kg. of garden soil 1g. of commercial fertilizer

*** Commercial Fertilizer**

Table 3. Changes in some Physico-chemical properties of Soil of Lycopersicum sps cultivated in Experimental pots during Decomposition

Sample Code	**Treatment**	**0th Day**					**10th Day**					**40th Day**				
		pH	**Organic Carbon (%)**	**N (%)**	**P (g/kg)**	**K (g/kg)**	**pH**	**Organic Carbon (%)**	**N (%)**	**P (g/kg)**	**K (g/kg)**	**pH**	**Organic Carbon (%)**	**N (%)**	**P (g/kg)**	**K (g/kg)**
L_{CS}	Control	6.87	10.2	1.2	1.1	2.2	7.12	10.0	1.0	1.1	2.0	7.20	9.8	0.9	0.9	1.9
L_{31}	3:1	7.23	15.5	2.1	2.4	5.2	7.18	14.9	1.9	2.2	4.8	7.16	14.6	1.8	1.9	4.5
L_{11}	1:1	7.68	21.2	2.6	4.3	9.4	7.58	20.8	2.5	4.1	8.9	7.41	20.4	2.3	3.9	8.6

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L_{13}	1:3	8.20	26.6	3.2	6.4	12.5	7.99	26.0	3.1	5.9	12.0	7.73	25.5	3.0	5.7	11.8
L_{CL}	Poultry litter	8.2	29.4	3.6	7.5	15.4	8.20	29.0	3.5	7.2	15.2	8.16	28.9	3.3	6.9	14.9
L_{CF}	Soil with CF*	7.2	10.7	1.9	1.6	3.4	7.15	10.2	1.7	1.3	3.1	7.13	10.0	1.6	1.1	2.9

Table 4. Morphometrical and Bio-Chemical Parameters of Germinated Lycopersicum sps seeds in experimental pots

Pot Code	Day	Fresh plant Height(cm)		Fresh plant Weight(g)		Chlorophyll content (mg/g)	Nitrogen (mg/kg)	Biomass (%)	Protein (mg/g)	Carbohydrate (%)
		Root	Shoot	Root	Shoot					
L_{CS}	10th Day	3	9.6	0.07	0.22	2.1	4.7	74.8	29.37	39.3
	20th Day	5.9	19.4	0.24	0.78	3.9	5.6	77.3	35	46.4
	40th Day	7.2	29.5	0.48	2.27	5.2	6.8	81.5	42.5	52.5
L_{31}	10th Day	4	10.5	0.09	0.29	2.5	5.1	78.4	31.87	40.3
	20th Day	6.1	21.2	0.29	0.85	4.2	5.9	80.3	36.87	47.2
	40th Day	7.8	32.5	0.53	2.38	5.9	7.2	83.2	45	53.4
L_{11}	10th Day	3.2	9.4	0.08	0.25	2.2	4.9	76.3	30.62	39.8
	20th Day	5.7	19.9	0.26	0.81	4.0	5.8	79.5	36.25	46.7
	40th Day	7.3	29.7	0.50	2.33	5.5	7.0	82.5	43.75	52.9
L_{13}	10th Day	2.5	9.2	0.07	0.23	1.8	4.6	75.8	28.75	39.2
	20th Day	5.3	15.2	0.25	0.78	3.2	5.4	78.2	33.75	46.2
	40th Day	6.8	21.5	0.48	2.26	4.8	6.7	81.8	41.87	52.1
L_{CL}	10th Day	2.4	8.7	0.05	0.16	1.5	4.5	73.2	28.12	38.5
	20th Day	5.2	14.7	0.21	0.69	2.8	5.3	76.5	33.12	45.6
	40th Day	6.5	20.5	0.39	1.99	4.1	6.5	79.8	40.62	51.8
L_{CF}	10th Day	3.1	9.8	0.07	0.24	2.2	4.8	75.2	30	39.5
	20th Day	5.9	19.7	0.25	0.79	3.9	5.6	78.5	35	46.6
	40th Day	7.1	30.1	0.50	2.30	5.2	6.9	81.9	43.12	52.7

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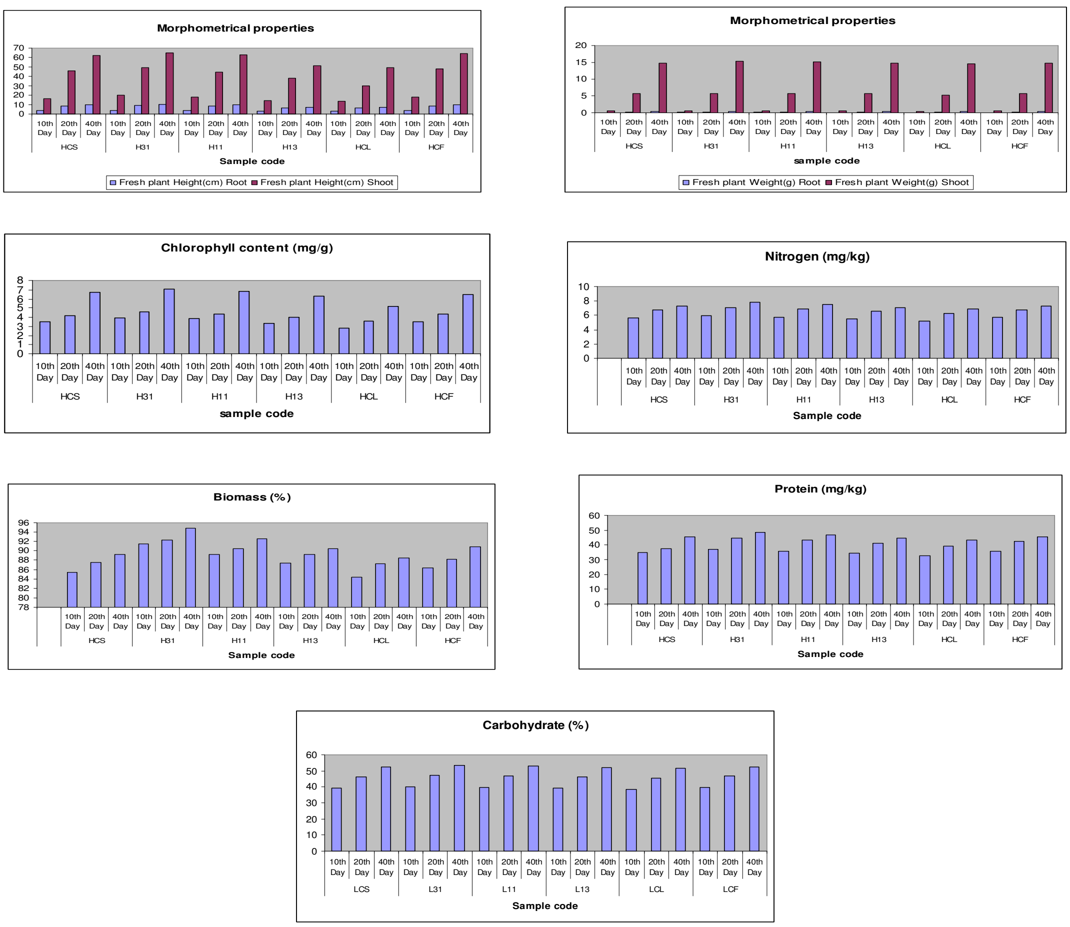
Fig: 1 Lycopersicum sps cultivated in experimental pots on 10th, 20th & 40th day

Fig: 2 Morphometrical and Bio-Chemical Parameters of Germinated Lyccopersicum sps seeds in Experimental pots.



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