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EFFECT OF LEAF LITTER COMPOSTS ON CHLOROPHYLL CONTENT AND NUTRIENT UPTAKE OF SPINACH

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ABSTRACT:

The leaf litter acts as a nutrient source and is of great importance in the fertility of the soil. It is a major biodegradable portion of the tree waste and can be used as a raw material for the preparation of composts. The organic manures improve water holding capacity as well as aeration of the soil and increases yield. In this investigation, attempts have been made to see the effect of leaf litter composts on the Chlorophyll content of spinach.

The experiment was conducted in the Department of Botany, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad during July 2005 – Dec. 2005. The dead leaves of trees present in the Botanical garden and Central oval garden were collected for the preparation of different types of composts. The composts were filled into the pots (1.5 kg/pot) with five treatments and four replicates. The treatments were vermicompost, NADEP compost, compost, fertilizer and control. The spinach (*Spinacea oleracea* L. var. “All green”) seeds were sown at the rate of 400 mg in each pot. The chemical fertilizers were applied at the rate of 40 N, 30 P and 30 K kg/ha. The Chlorophyll content of Spinach was analyzed at 50, 84 and 111 days after sowing (DAS).

Key words: leaf litter composts, chlorophyll, spinach.

Introduction-

Compost influences plant growth and health indirectly via the growing conditions (by providing nutrients, especially micro nutrients and by improving soil conditions and water retention capacity). Composts are not inert materials; they are carriers of living organisms. If the fermentation is correctly managed, pathogens are killed during the heat period (Bollen, 1993; Boulter *et al*. 2000). At the same time, antagonists develop during maturation of the compost. Therefore, composts can reduce the incidence of various plant diseases (Fuchs, 1995, 2002; Hoitink, *et al.,*1997). If we also consider the positive effect of quality compost on soil structure, soil erosion and water capacity, it is obvious that an efficient compost management could increase and maintain soil fertility (Fuchs *et al.,* 2004.).

In this investigation, attempts have been made to evaluate the effectiveness of litter composts (LC) as probable alternative sources of nutrients for the yield and nutrient uptake of leafy vegetable spinach.

MATERIALS AND METHODS

Experimental site

The field experiment was conducted in the Research farm at Dr. Babasaheb Ambedkar Marathwada University’s Botanical garden during the period from 29 July 2005 to 2 Dec. 2005.

Organic amendments and experimental plant

The experiment was conducted in truncated porous earthen pots of approximately 10 liter capacity (h= 30.5 cm and d= 29.0 cm). The pots were initially filled up to 2.5 cm height with 12.5 mm nominal size chips of stone (aggregates), which were then covered with 2.0 cm thick layers of 1 to 5 mm size gravel to ensure proper drainage of excess water. A layer of local soil with 2.0 to 2.5 cm thickness was used above the gravel bed and compost layer. The composts (1. 5 kg pot^{-1}) were then top fed (18 to 20 cm thickness) into the pots with five treatment and four replications.

The five treatments were Vermicompost (VCO), Compost (COM), NADEP compost (NADEP), Fertilizer (FER) and Control (CON). Subsequently, the experimental pots were kept in green house without any attempt to control the ambient conditions. The spinach (*Spinacea oleracea* L. var. All green) seeds produced by Sungro Seeds Ltd., 207 Aradhna Bhavan, Azadpur, Delhi, were sown @ 30 Kg ha^{-1} at about 1 to 1.5 cm deep in the soil.

Fertilizer application and plant sampling

The fertilizers were applied at the recommended levels of 40N:30P:30K Kg ha^{-1} as urea: single super phosphate: muriate of potash to fertilizer treatment alone. Entire amount of P_2O_5 and K_2O was applied as basal dose for all the pots at the time of cultivation and N was supplied 58 and 92 days after sowing (DAS) in two equal split doses. The analysis was done at 50 days with successive regrowths at 84 and 111 DAS. The fresh aerial biomass yield obtained per pot was recorded and kept in oven at 70^0C for 48 hrs. the dried samples were weighed, finally milled, sieved and stored in labeled air tight polythene bags for nutrient analysis.

ANALYSIS

Chemical analysis

The chemical analysis was done by adopting standard analytical methods. The chlorophyll contents (a, b and total) were estimated (Arnon, 1949), using 80 % acetone as a solvent for extraction of pigments. Ash values were obtained by heating the moisture-free samples in a muffle furnace at 600°C for 2 hours and calcium (Ca) content was analyzed by titrating the sample against 0.01 N $KMnO_4$ solution using methyl red as an indicator (AOAC, 1995). Nitrogen (N) was estimated by micro-Kjeldahl method after digesting the sample with Conc. H_2SO_4 (Bailey, 1967) and crude protein (CP) was then calculated by multiplying N value with 6.25 as specified by AOAC, (1995). The dry samples were boiled in distilled water, filtered and amount of water soluble reducing sugars was determined in the filtrate by using Folin-wu tubes (Oser, 1979). The amount of phosphorus was measured following Fiske and Subba Rau (1925) as described by Oser (1979). Potassium (K) content was determined on a flame photometer (model Mediflame- 127) as suggested by Jackson (1973).

Statistical analysis

All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant difference (C.D. p = 0.05) which allowed determination of significance between different applications (Mungikar, 1997, 2003).

RESULTS AND DISCUSSION

Nutrient contents of leaf litter compost

The equal amount of garden litter compost was used for the preparation of Compost, Vermicompost and NADEP compost i.e.277 Kg ha^{-1}. The analysis of garden litter compost as fresh weight per pot, Kg ha^{-1}, DM, N, P, K content, Ash percentage Carbon percentage and C : N ratio respectively, showing the input for the experiment (Table 1).

Biomass yield of spinach

Table 2 shows that, the fresh weight of spinach (g^{-1} pot) was found (after 50 DAS) maximum in the treatment of VCOM, followed in order by NADEP, COMP and CONT, while it was minimum in FERT. The dry matter (g^{-1} pot) was found more in the treatment of VCOM, followed in order by the treatment of COMP, NADEP and CONT, while it was found minimum in FERT.

The fresh weight of spinach (g^{-1} pot) was found (after 84 DAS) maximum in the treatment of COMP, followed in order by VCOM, NADEP and CONT, while it was minimum in FERT. The dry matter (g^{-1} pot) was found more in the treatment of COMP, followed in order by the treatment of VCOM, NADEP and FERT, while it was found minimum in CONT (Table 2).

The fresh weight (g^{-1} pot) was found (after 111 DAS) maximum in the treatment of NADEP, followed in order by VCOM, COMP and CONT, while it was lowest in FERT. The dry matter (g^{-1} pot) found maximum in the treatment of NADEP, followed in order by VCOM, COMP and FER, while it was lowest in CON. The values of NADEP and VCOM were statistically significant, while the values of COMP and FERT were statistically non significant (Table 2).

Third harvest (after 111 DAS)

In the third harvest, the maximum per cent of nitrogen and crude protein was observed in the treatment of VCOM followed in order by FER, COMP and NADEP, while it was minimum in CONT. The per cent of phosphorus was more in the treatment of COMP followed by VCOM and NADEP, which shows similar values, followed by FER, while it was lowest in CONT. The per cent of potassium shows the maximum amount in the treatment of VCOM, COMP and CONT, which shows similar values, while it was similarly found minimum in NADEP and FER. The per cent of calcium was found maximum in the treatment of COMP followed in order by FER, VCOM and CONT, while it was minimum in NADEP. The maximum per cent of reducing sugar was observed in the treatment of VCOM, followed in order by NADEP, FER and COMP while it was lowest in CONT (Table 3).

Table 1. Nutrient contents of litter composts produced by different methods

Compost	Input compost pot^{-1}	Input compost Kg ha^{-1}	Dry matter (%)	Dry Matter Kg ha^{-1}	N %	Nitrogen Kg ha^{-1}	P %	K %	Ash (%)	Org. C	C : N ratio
VCOM	1.50	277	68	189	1.00	1.89	0.60	0.10	23.78	41.00	41.00
COMP	1.50	277	69	191	0.79	1.51	0.54	0.10	10.15	17.50	22.15
NADEP	1.50	277	85	236	0.80	1.89	0.60	0.20	20.88	36.00	45.00

All the values are the average of two replicates

Table 2. Biomass yield of spinach as influenced by litter composts

Treatment	50 DAS		84 DAS		111 DAS		Total	
	Fr. wt. g^{-1} pot	Dry wt. g^{-1} pot	Fr. wt. g^{-1} pot	Dry wt. g^{-1} pot	Fr. wt. g^{-1} pot	Dry wt. g^{-1} pot	Fr. wt. g^{-1} pot	Dry wt. g^{-1} pot
VCOM	109.75	6.31	96.41	5.69	65.28	3.92	272.00	15.92
COMP	95.45	6.00	109.67	6.60	51.88	2.85	257.00	15.45
NADEP	101.67	5.48	93.81	4.41	85.92	4.18	281.40	14.07
FERT	62.98	3.25	53.23	3.74	29.18	2.72	145.39	9.71
CONT	89.08	4.77	53.44	3.59	31.23	2.64	173.75	11.00
S.E.±							**27.73**	**1.23**
C.D.(p=0.5%)							**77.09**	**3.42**

All the values are means of four replicates

VCOM = Vermi compost, COMP = Compost, NADEP = NADEP compost, FERT = Fertilizer, CONT = Control.

Table 3 . Proximate analysis of spinach as influenced by litter composts (Third harvest: 111 DAS)

Treatment	Mineral content (%)					
	N	P	K	Ca	CP	TRS
VCOM	3.85	0.39	0.80	0.47	24.06	7.17
COMP	3.48	0.43	0.80	0.93	21.75	5.78
NADEP	2.19	0.34	0.70	0.35	13.69	5.84
FERT	3.62	0.36	0.70	0.51	22.63	5.82
CONT	2.08	0.36	0.80	0.40	13.00	4.47

All the values are means of four replicates

Chemical analysis of Spinach

Third harvest (after 111 DAS)

In the third harvest, the maximum per cent of nitrogen and crude protein was observed in the treatment of VCOM followed in order by FER, COMP and NADEP, while it was minimum in CONT. The per cent of phosphorus was more in the treatment of COMP followed by VCOM and NADEP, which shows similar values, followed by FER, while it was lowest in CONT. The per cent of potassium shows the maximum amount in the treatment of VCOM, COMP and CONT, which shows similar values, while it was similarly found minimum in NADEP and FER. The per cent of calcium was found maximum in the treatment of COMP followed in order by FER, VCOM and CONT, while it was minimum in NADEP. The maximum per cent of reducing sugar was observed in the treatment of VCOM, followed in order by NADEP, FER and COMP while it was lowest in CONT (Table 5).

Chlorophyll contents of spinach

Chlorophyll a, chlorophyll b and total chlorophyll contents varied from 0.23-1.15, 0.14-1.55 and 0.36-2.70 mg g^{-1} leaf fresh weight respectively at first harvest (Fig. 1). At the second harvest, chlorophyll a, chlorophyll b and total chlorophyll contents varied from 0.43-0.73, 0.50-1.05 and 0.93-1.77 mg g^{-1} leaf fresh weight respectively (fig. 2), and during the third harvest varied from 0.41-0.51, 0.61-0.80, and 1.03-1.31 mg g^{-1} leaf fresh weight respectively (fig.3).

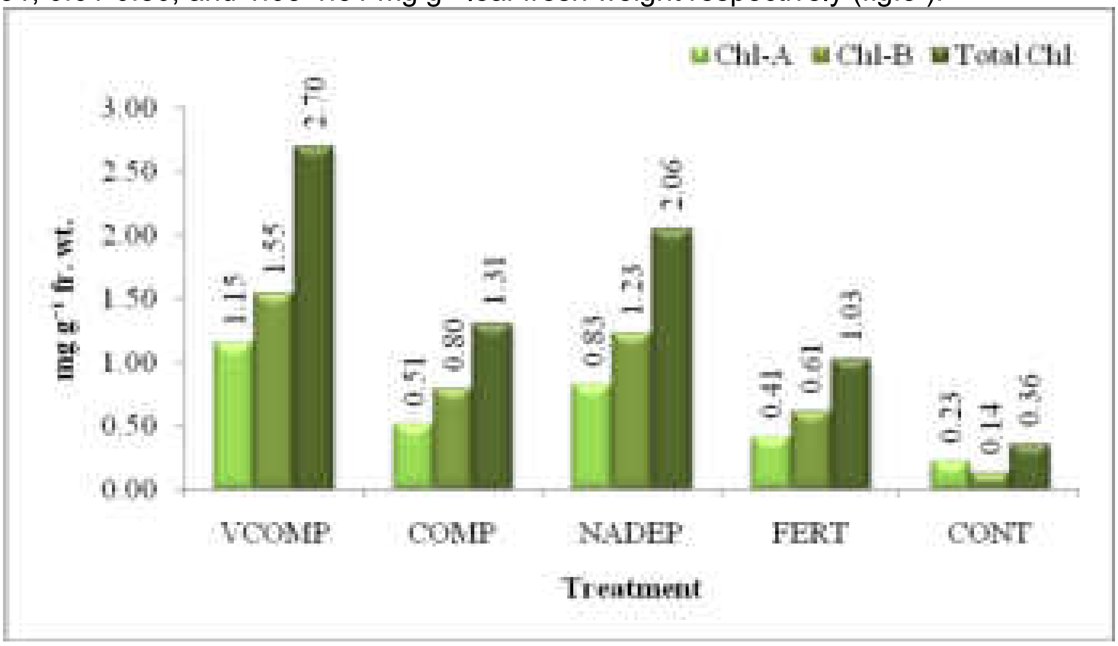

Fig 1. Chlorophyll contents of spinach as influenced by litter composts at 50 DAS .

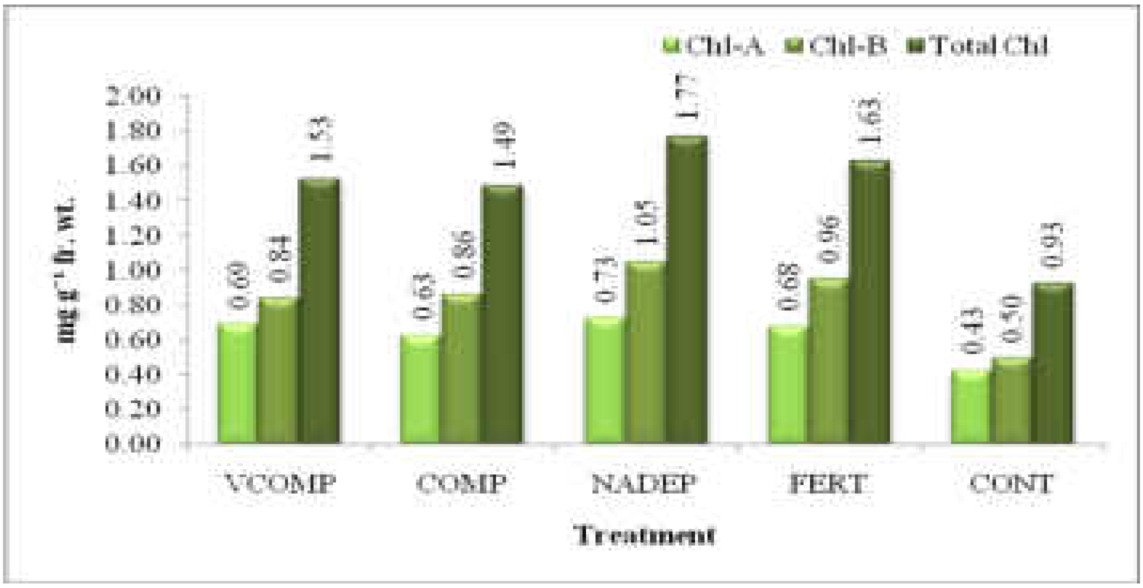

Fig 2. Chlorophyll contents of spinach as influenced by litter composts at 84 DAS .

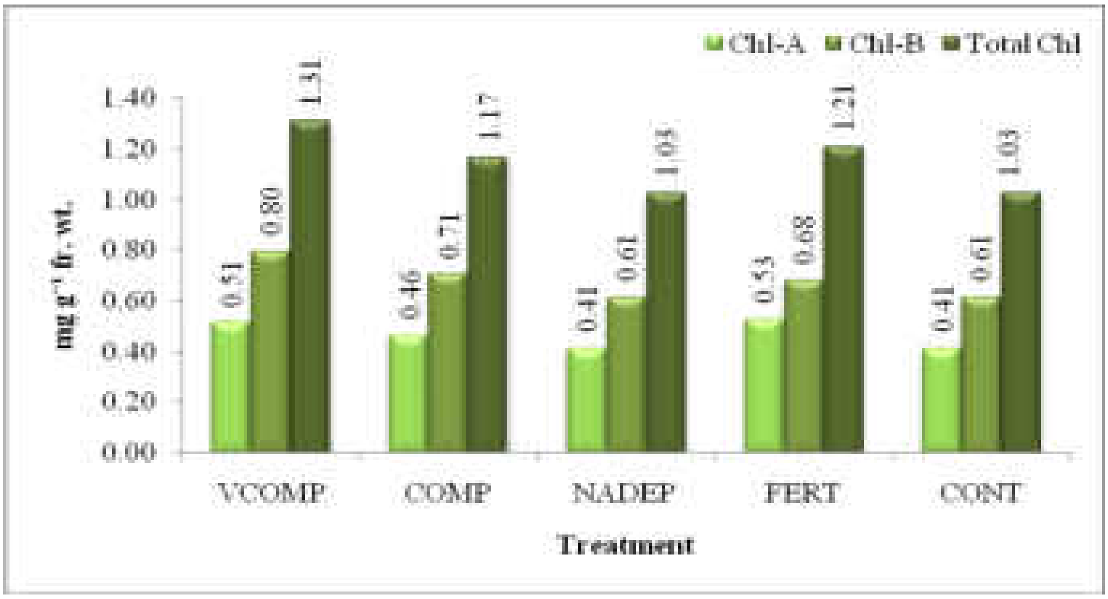

Fig 3. Chlorophyll contents of spinach as influenced by litter composts at 111 DAS

Conclusion

In the present investigation, NADEP compost method and vermicompost performed better than that of the other treatments. The result of this investigation shows that the leaf litter compost can be effectively used as a source of nutrients increasing yield and nutrient uptake. The results are in agreement with the findings reported by Whitbread *et al*. (1999), Soumare *et al*. (2002) and Chamle (2007).

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