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Influence of Various Sources of Vermicompost on Soil Biological Properties in SRI Method of Rice Cultivation

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Abstract: *Field experiments were conducted for evaluating different sources of vermicompost on post harvest soil biology in rice cultivated under SRI method in tail end area of Cauvery delta zone in tamil nadu for two seasons. The soil of the experimental farm is deep clay, low in available N (192 kg ha^{-1}), medium in available P (21.7 kg ha^{-1}) and high in available K (275.0 kg ha^{-1}). The experiment was conducted in randomized block design and replicated thrice. The experiment comprised of eight treatments which includes recommend dose of fertilizer alone and in combination with vermicomposts prepared from various organic wastes namely Paddy straw, Coirpith, sewage sludge, Sugarcane trash, Pressmud and Crop residues @ 5t ha^{-1}. Rice cultivar ADT 36 was used as test cultivar. Significant increase in microbial population of fungai, bacteria and actinomycetes were recorded in pressmud based vermicompost @ 5t ha^{-1} with RDF over other vermicomposts and control. Also the same treatment recorded significantly higher soil available N, P and K and higher organic carbon after the harvest of the crop. The least values were recorded in absolute control with no organic and chemical fertilizers.*

Keywords: *SRI, post harvest available N, P_2O_5 and K_2O, Soil Microbial population, Organic Carbon.*

INTRODUCTION

In India, rice accounts for about 45 per cent of total food grain production and 55 per cent of cereals production. It occupies about 44.6 million hectares with a production of 86.0 million tonnes and it continues to hold the key to sustain food production by contributing 20 to 25 per cent of agriculture GDP and assures food security in India for more than half of the total population. In contrast, recent slow down or plateauing of yields in irrigated rice was noticed as a result of soil health and decline in productivity level (IRCN, 2001). Undoubtedly, the decreasing rate of cereal production is mainly attributed to much more dependence on inorganic fertilizers. As a result, the soil is mined out with more depletion of nutrients.

There is a need to make rice cultivation more efficient in terms of returns on farmer investments and use of natural resources namely soil and water. Addition of any form of organics has been found to improve the soil health in addition to increase in crop yields and also sustains the soil fertility. Vermicompost was important among the organic manures which excels most.

Vermicomposting has been recognized as an eco friendly technology for converting organic wastes into high value organic manure, rich in nitrates, available phosphorus, calcium, vitamins, natural phyto-regulators and micro flora in balanced form which help in restoring the natural fertility of soil (Purakayastha and Bhatnagar, 1997).

The research work on different raw materials used for preparing vermicompost and their influence on rice soils were minimum.Under these circumstances, it is imperative to study the effect of different vermicompost on soil biology after the harvest of the rice crop is necessary.

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MATERIALS AND METHODS

Field experiments were conducted at Annamalai University, Experimental Farm, Annamalainagar, Chidambaram (11°24′ N , 74°44′ E and altitude +5.79 m) India for two seasons *viz*., kuruvai and Navarai 2013-14. The experiment comprised of eight treatments with or without different sources of vermicompost. The different treatments includes, T_1-control (No fertilizers), T_2 - Recommend dose of fertilizer alone, T_3 – T_2 + Paddy straw based vermicompost @ 5t ha^{-1}, T_4 – T_2 + Sewage based vermicompost @ 5t ha^{-1}, T_5 – T_2 + Coirpith based vermicompost @ 5t ha^{-1}, T_6 - T_2 + Sugarcane trash based vermicompost @ 5t ha^{-1}, T_7 – T_2 + Pressmud based vermicompost @ 5t ha^{-1}, and T_8 – T_2 + Crop residues based vermicompost @ 5t ha^{-1}. The experiment was laid out in a randomized block design (RBD) and replicated thrice. Rice cultivar ADT 36 was used as test cultivar.

The different organic waste was collected and cut in to pieces if necessary, turned over manually for 15 days in order to pre-compost it so that it becomes palatable to earthworms. Vermicompost was prepared using heap method. After 3 months, matured vermicompost was applied to experimental plots as per the treatment schedule.

The average annual rainfall of Annamalai nagar is 1300 mm, distributed over 56 rainy days. The mean maximum and minimum temperature are 31.9°C and 23.2°C respectively. Relative humidity ranges from 78 to 96 per cent. The soil of the experimental field was having a pH of 7.2 and EC of 0.33 dSm^{-1}. Taxonomically the soil is classified as Udic chromustert, low in available nitrogen, medium in available phosphorus and high in available potassium.

The seedlings were raised by dapog method and transplanted on 14 day after sowing. One seedling per hill was planted with a spacing of 25 cm × 25 cm. The recommended nutrient dose @ 120 kg N, 38 kg P and 38 kg K for season I and 150 kg N, 50 kg P and 50 kg K for season II was applied in all the treatments except in absolute control. Nitrogen, phosphorus and potassium were supplied through Urea, Super phosphate and Muriate of potash, respectively. The entire dose of phosphorus and half dose of nitrogen and potassium were applied as basal and remaining 50% nitrogen and potassium were applied in two equal spilts during maximum tillering and panicle initiation stage. The gap filling was done at five DAT to maintain optimum plant population. Application of 2.5 cm depth of water after the formation of hairline crack was followed in SRI. The field was irrigated under alternate wetting and drying method for once in two days after disappearance of ponded water. Irrigation was with held 10 days before harvest. Weeding was done thrice using cono weeder at 10 days interval from 10^{th} day after transplanting. Need based plant protection measures were adopted based on the economic threshold level of pest and diseases.

The post harvest composite soil samples were collected after the harvest of rice fallow crop and analysed for post harvest available nutrients.

Analytical methods employed for soil/manure were as under

Particulars	*Author(s)*	*Method*
Organic carbon	Walkley and Black (1934)	Chromic acid wet digestion method
Available N	Subbiah and Asija (1956)	Alkaline permanga-nate method
Available P	Olsen *et al.* (1954)	Colorimeter method
Available K	Stanford and English (1949)	Flame photometric method

The population of bacteria, fungi and actinomycetes were estimated by serial dilution and plate count technique by plating on appropriate media *viz.,* nutrient agar, potato dextrose agar, and kenknights agar media, respectively. Microbial population was expressed as colony forming units (CFU) g^{-1} of soil.

The data were analysed using standard procedures of ANOVA at 5 % level of significance.

RESULTS

Available Soil Nutrients

Vermicompost application irrespective of source of preparation enhanced the available soil N, P and K contents at the end of the experiments when compared to their initial status and over recom-mended dose of fertilizer alone and control.

Table 1
Effect of different vermicomposts on organic carbon and post harvest available nutrients in SRI rice

	Organic carbon		Available Nitrogen (kg ha^{-1})		Available Phosphorus (kg ha^{-1})		Available Potassium (kg ha^{-1})	
Treatments	Season-I	Season-II	Season-I	Season-II	Season-I	Season-II	Season-I	Season-II
T_1 – Control	0.41	0.43	180.12	185.03	17.50	20.30	269.40	276.80
T_2 – RDF alone	0.45	0.47	185.50	189.41	20.80	22.31	272.51	279.32
T_3 – T_2 + PS VC	0.47	0.48	188.11	193.03	22.20	23.10	275.12	282.15
T_4 – T_2 + S VC	0.55	0.56	192.45	198.08	22.90	23.95	279.08	286.12
T_5 – T_2 + CP VC	0.57	0.59	194.70	201.32	23.67	24.71	281.40	288.80
T_6 – T_2 + SC VC	0.51	0.55	191.31	197.40	23.00	23.82	278.10	285.61
T_7 – T_2 + PM VC	0.59	0.60	196.42	204.12	24.20	25.41	283.80	290.13
T_8 – T_2 + CR VC	0.49	0.52	189.16	194.21	21.80	23.09	276.07	283.01
SEd	0.13	0.13	0.70	0.59	0.27	0.30	0.73	0.57
CD (p = 0.05)	NS	NS	1.46	1.23	0.55	0.62	1.51	1.18

*RDF = Recommend Dose of Fertilizer, PS VC = Paddy Straw Based Vermicompost, SVC = Sewage Based Vermicompost, CPVC = Coirpith Based Vermicompost, SCVC = Sugar Cane Trash Based Vermicompost, PMVC = Pressmud Based Vermicompost, CRVC = Crop Residue Based Vermicompost

Among the different vermicomposts, pressmud based vermicompost with RDF (T_7) recorded higher post harvest soil N, P and K. This might be due to the tendency of pressmud based vermicompost amended soils to retain more of available N, P and K at the growth cycle, probably due to the presence of more organic matter (Arancon *et al*., 2006). Further increase in microbial population due to addition of pressmud might have regulated soil temperature and continuous available soil moisture and humus content of soil. This might have created favourable soil environment for microbes favouring their sustenance, rapid multiplication and effect on nutrient availability. Similar observations have been made by Rangaraj *et al.,* (2007).

Available Organic Carbon

Appreciably higher availability of organic carbon was recorded from plots applied with different vermicomposts than over recommended dose of fertilizer alone and absolute control. This increase in organic carbon content of soil in the aforesaid treatments might be due to the buildup of humus by organic manures and large amount of crop residue. This is consistent with the views of Babu Mathew (2001).

Microbial Population

Before sowing, initially the population of fungi, bacteria and actinomycetes were 6.0 CFU × 10^4 g^{-1}, 11.0 CFU × 10^6 g^{-1} and 3.0 CFU × 10^3 g^{-1} respectively.

The microbial population in the post harvest soil was affected by application of different sources of vermicompost. The values recorded were higher in vermicompost applied plots over recommended dose of fertilizer alone and control plot. (Table 2).

Among different vermicomposts, application of pressmud based vermicompost had a salutary effect on population of fungi, bacteria and actinomycetes over others. This was followed by coirpith based vermicompost and sewage sludge based vermicompost. Plausible reason may be the presence of rice microbial population in the pressmud based vermicompost and higher organic carbon present in it (Rangaraj. *et.al.,* 2007).

CONCLUSION

Based on 2 season study, it may be concluded that basal application of pressmud based vermicompost @ 5.0 t ha^{-1} along with RDF could be recommended to maintain and sustain the soil health in rice under SRI method over normal conventional practice of rice cultivation. If the availability of pressmud is

Table 2
Effect of different vermicompost on microbial population in post harvest SRI rice soil

Treatments	*Fungal (CFU × 10^{-4} g^{-1}) population*		*Bacterial (CFU × 10^{-6} g^{-1})population*		*Actinomycetes (CFU × 10^{-3} g^{-1})population*	
	Season-I	*Season-II*	*Season-I*	*Season-II*	*Season-I*	*Season-II*
T_1 – Control	6.7	6.9	11.4	11.6	3.7	3.8
T_2 – RDF alone	7.1	7.6	13.1	13.6	4.1	4.7
T_3 – T_2 + PS VC	18.5	18.3	52.4	53.1	5.1	5.3
T_4 – T_2 + S VC	19.3	19.3	55.4	56.3	5.8	5.8
T_5 – T_2 + CP VC	19.5	19.6	56.3	57.6	5.9	6.1
T_6 – T_2 + SC VC	19.1	19.1	54.6	54.6	5.7	5.7
T_7 – T_2 + PM VC	19.7	20.3	58.7	60.1	6.1	6.2
T_8 – T_2 + CR VC	18.7	18.6	53.1	53.8	5.5	5.6

*Data not statistically analyzed, *RDF = Recommend Dose of Fertilizer, PSVC = Paddy Straw Based Vermicompost, SVC = Sewage Based Vermicompost, CPVC = Coirpith Based Vermicompost, SCVC = Sugar Cane Trash Based Vermicompost, PMVC = Pressmud Based Vermicompost, CRVC = Crop Residue Based Vermicompost

limited, coirpith based vermicompost can also be recommended for maintaining the soil fertility in the coastal regions of India.

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