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**RESEARCH ARTICLE**

# INFLUENCE OF INM PRACTICES ON POST HARVEST SOIL NUTRIENT STATUS AND BIOLOGICAL PROPERTIES IN RICE

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**ABSTRACT**

Field experiments were conducted for evaluating different organic manures on post harvest soil biology in rice during 2007 and 2008. Both the years rice was cultivated during samba season (August to January). The soil of the experimental farm is deep clay, low in available N (198 kg $ha^{-1}$), medium in available P (20.9 kg $ha^{-1}$) and high in available K (271.0 kg $ha^{-1}$). The experiment was conducted in randomized block design and replicated thrice. It comprised of eight treatments which includes absolute control, recommend dose of nitrogen alone and in combination with different organic manures namely green manure pressmud and vermicompost. Rice cultivar CO 43 was used as test cultivar. Significant increase in microbial population of fungai, bacteria and actinomycetes were recorded in 100% RDN along with vermicompost @ 5t $ha^{-1}$ over other treatments and control. Also the same treatment recorded significantly higher soil available N and K and higher organic carbon after the harvest of the crop. But higher soil available P was registered under 100% RDN along with pressmud compost @ 10 t $ha^{-1}$. The least values were recorded in absolute control (no organic and chemical fertilizers).

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## 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.

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In the recent years, vermicompost has been identified as one of the major gears to convert the biodegradable organic materials in to resourceful manure. It is rich in available nitrogen, phosphorus, potassium, calcium, vitamins, natural phytoregulators and micro flora in balanced form that help in reestablishment of the natural fertility of soil (Banik and Ranjita Bejbaruah, 2004). The research works on influencing of vermicompost on rice soils were minimum. Under these circumstances, it is imperative to study the effect of vermicompost on soil biology after the harvest of the rice crop.

## MATERIALS AND METHODS

Field experiments were conducted at Annamalai University, Experimental Farm, Annamalainagar, (11°24' N, 74°44' E and altitude +5.79 m) for two seasons *viz.,* samba 2007 and samba 2008 ( August to January). The experiment comprised of eight treatments includes, $T_1$ - Control (No fertilizer and no organic manure) $T_2$ - 100% RDN (Recommended dose of nitrogen) $T_3$ - $T_2$ + Green manure @ 6.25 t $ha^{-1}$ , $T_4$ - 75% RDN + Green manure @ 6.25 t $ha^{-1}$, $T_5$ - $T_2$ + Vermicompost @ 5 t $ha^{-1}$, $T_6$ - 75% RDN + Vermicompost @ 5 t $ha^{-1}$, $T_7$ - $T_2$ + Pressmud @ 10 t $ha^{-1}$, $T_8$ - 75% RDN + Pressmud @ 10 t $ha^{-1}$. The experiment was laid out in a randomized block design (RBD) and replicated thrice. Rice cultivar CO 43 was used as test cultivar. The average annual rainfall of

Annamalainagar is 1250 mm, distributed over 51 rainy days. The mean maximum and minimum temperature are 30.8°C and 24.7°C respectively. Relative humidity ranges from 76 to 94 per cent. The soil of the experimental field was having a pH of 7.1 and EC of 0.32 $dSm^{-1}$. Taxonomically the soil is classified as Udic chromustert, low in available nitrogen (201 kg $ha^{-1}$), medium in available phosphorus (20.9 kg $ha^{-1}$) and high in available potassium (277 kg $ha^{-1}$). Twenty eight days old seedlings were transplanted with a spacing of 20 cm x 10 cm. The gap filling was done at eight days after transplanting to maintain optimum plant population. The recommended dose of fertilizer 150:50:50 kg $ha^{-1}$ of N, $P_2O_5$ and $K_2O$ was applied. N and $K_2O$ were applied as per the treatment schedule in four equal splits *viz.,* basal, tillering, panicle initiation and heading stages of rice. Entire dose of phosphorus applied as basal. Nitrogen, phosphorus and potassium were supplied through Urea, Super phosphate and Muriate of potash, respectively. All other crop management practices adopted based on CPG (2005). 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 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 permanganate 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 soil. The data were analysed using standard procedures of ANOVA at 5 % level of significance.

## RESULTS

**Available soil nutrients:** Application of organic compost enhanced the available soil N, P and K contents at the end of the experiments when compared to their initial status and over recommended dose of nitrogen alone and control. Among the different treatments, 100% RDN along with vermicomposts @ 5 t $ha^{-1}$($T_5$) recorded higher post harvest soil N and K (Table 1). This might be due to the tendency of vermicompost amended soils to retain more of available N 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 vermicompost 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). Application of 100% RDN + pressmud @ 10 t $ha^{-1}$applied in rice ($T_7$) registered higher available phosphorus at end of the experiment. This might be due to slow release nature of nutrients from organics. It has the capacity to form phospho – humic complex with anions replacement of the phosphate by humate ion and the coating of sesquioxide by humus to form a protective cover and thus reducing the phosphate fixing capacity of soil. These results of the present study corroborate with earlier report of Gaikwad *et al.* (1996).

**Available Organic carbon:** Appreciably higher availability of organic carbon was recorded from plots received vermicomposts @ 5 t $ha^{-1}$ along with 100% RDN than other treatments.

**Table 1. Effect of different INM practices on organic carbon and post harvest available soil nutrients status in 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 |
| $T_1$ | 0.46 | 0.51 | 199.27 | 202.78 | 20.47 | 21.29 | 268.93 | 274.73 |
| $T_2$ | 0.48 | 0.53 | 203.83 | 206.52 | 21.38 | 22.38 | 272.36 | 278.82 |
| $T_3$ | 0.56 | 0.63 | 209.08 | 212.37 | 22.67 | 23.62 | 277.36 | 283.43 |
| $T_4$ | 0.55 | 0.61 | 208.54 | 211.82 | 22.28 | 23.21 | 276.09 | 282.32 |
| $T_5$ | 0.60 | 0.70 | 212.78 | 215.72 | 23.35 | 24.43 | 283.54 | 289.57 |
| $T_6$ | 0.59 | 0.69 | 212.23 | 215.14 | 23.02 | 23.98 | 282.46 | 288.12 |
| $T_7$ | 0.55 | 0.60 | 207.93 | 210.67 | 24.01 | 25.18 | 280.32 | 286.92 |
| $T_8$ | 0.53 | 0.58 | 206.28 | 209.93 | 23.68 | 24.79 | 279.12 | 285.18 |
| SED | 0.13 | 0.12 | 0.30 | 0.44 | 0.33 | 0.18 | 0.54 | 0.47 |
| CD(p=0.05) | NS | NS | 0.59 | 0.91 | 0.62 | 0.36 | 1.08 | 0.92 |

$T_1$ - Control (No fertilizer and no organic manure) $T_2$ - 100% RDN (Recommended dose of nitrogen) $T_3$ - $T_2$ + Green manure @ 6.25 t $ha^{-1}$ , $T_4$ - 75% RDN + Green manure @ 6.25 t $ha^{-1}$, $T_5$ - $T_2$ + Vermicompost @ 5 t $ha^{-1}$, $T_6$ - 75% RDN + Vermicompost @ 5 t $ha^{-1}$, $T_7$ - $T_2$ + Pressmud @ 10 t $ha^{-1}$, $T_8$ - 75% RDN + Pressmud @ 10 t $ha^{-1}$

**Table 2. Effect of INM practices on microbial population in post harvest rice soil**

| | Fungal (CFU × $10^{-4}$ $g^{-1}$) population | | Bacterial (CFU × $10^{-6}$ $g^{-1}$) population | | Actinomycetes (CFU × $10^{-3}$ $g^{-1}$) population | |
|---|---|---|---|---|---|---|
| Treatments | Season-I | Season-II | Season-I | Season-II | Season-I | Season-II |
| $T_1$ | 13.01 | 13.98 | 40.21 | 43.20 | 4.57 | 4.91 |
| $T_2$ | 13.38 | 14.62 | 41.36 | 45.19 | 4.70 | 5.14 |
| $T_3$ | 14.96 | 16.25 | 46.24 | 50.23 | 5.26 | 5.71 |
| $T_4$ | 14.50 | 15.92 | 44.82 | 49.21 | 5.10 | 5.60 |
| $T_5$ | 17.22 | 18.50 | 53.22 | 57.18 | 6.05 | 6.50 |
| $T_6$ | 16.94 | 18.17 | 52.35 | 56.16 | 5.95 | 6.39 |
| $T_7$ | 14.37 | 15.75 | 44.43 | 48.69 | 5.05 | 5.54 |
| $T_8$ | 14.01 | 15.40 | 43.31 | 47.60 | 4.93 | 5.41 |

$T_1$ - Control (No fertilizer and no organic manure) $T_2$ - 100% RDN (Recommended dose of nitrogen) $T_3$ - $T_2$ + Green manure @ 6.25 t $ha^{-1}$ , $T_4$ - 75% RDN + Green manure @ 6.25 t $ha^{-1}$, $T_5$ - $T_2$ + Vermicompost @ 5 t $ha^{-1}$, $T_6$ - 75% RDN + Vermicompost @ 5 t $ha^{-1}$, $T_7$ - $T_2$ + Pressmud @ 10 t $ha^{-1}$, $T_8$ - 75% RDN + Pressmud @ 10 t $ha^{-1}$

population was expressed as colony forming units (CFU) $g^{-1}$ of

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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 Chaudhary *et al.* (2004).

**Microbial Population:** Before transplanting, initially the population of fungi, bacteria and actinomycetes were 7.0 CFU x $10^4$ $g^{-1}$, 22.0 CFU x $10^6$ $g^{-1}$ and 3.0 CFU x $10^3$ $g^{-1}$ respectively . The microbial population in the post harvest soil was affected by application of sources of vermicompost. The values recorded were higher in vermicompost @ 5 t $ha^{-1}$ along with 100% RDN applied plots over recommended dose of nitrogen alone and control plot (Table 2). Among the INM treatments, vermicompost @ 5 t $ha^{-1}$ along with 100% RDN applied plots ($T_5$) registered higher microbial population of bacteria, fungi and actinomycetes during both the season. This might be due to addition of organics, which might have regulated soil temperature and available soil moisture and the humus content of soil. This might have created favourable soil environment for sustenance, rapid multiplication and their activity on nutrient availability (Usha Kumari *et al.,* 2006).

**Conclusion**

Based on two season study, it may be concluded that basal application of vermicompost @ 5.0 t $ha^{-1}$ along with 100% RDN could be recommended to maintain and sustain the soil health in rice. If the availability of vermicompost is limited, green manure can also be recommended for maintaining the soil fertility in Cauvery deltaic region of Tamil Nadu.

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