

# SOIL MICROBIAL BIOMASS CARBON ( $\mu\text{gCg}^{-1}$ DRY SOIL) AT DIFFERENT GROWTH STAGES OF PADDY AS INFLUENCED BY LONG TERM APPLICATION OF FERTILIZERS AND MANURE UNDER CHHATTISGARH CONDITION

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**Abstract:** A field study was carried out during *Kharif* season of 2010-11 at the Research and Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur (C.G.). Experiment was conducted to examine the “soil microbial biomass carbon ( $\mu\text{GCG}^{-1}$  dry soil) at different growth stages of paddy as influenced by long term application of fertilizers and manure under Chhattisgarh condition”. Soil microbial biomass carbon at different growth stages of paddy were determined from surface (0-15 cm) soil samples. The soil microbial biomass carbon at different growth stages was determined in paddy crop and fertilizer application significantly influenced soil microbial biomass carbon where the highest soil microbial biomass carbon was recorded under T<sub>4</sub> (100% NPK +FYM) followed by T<sub>5</sub> (50% NPK +GM), T<sub>2</sub> (100% NPK) treatment. T<sub>1</sub> (Control) recorded the lowest soil microbial biomass carbon. The grain yield of rice was observed to be significantly influenced due to different treatments. The highest was recorded with T<sub>4</sub> (100%NPK +FYM), and was found significantly superior over rest of the treatments. The lowest grain yield was noticed under control plot.

**Keywords:** microbial biomass, paddy, grain yield, FYM

## INTRODUCTION

Microbial biomass serves the nutrient supply of rice crops in two ways: as a mixture of microbial catalysts governing nutrient availability and as a passive source of nutrients. The productivity of irrigated rice crops is declining over years of continuous, intensive cultivation and appears to be associated with a decreasing N supply capacity of the soil. Soil microbial biomass is a living pool containing 1- 5% of the soil organic matter, excluding root, meso- and macro-fauna (Sparling, 1992). Its activity and often fast turnover impact soil characteristics affecting its quality by conduction of biochemical transformation of organic matter being a source (Haubensak *et al.*, 2002;). The soil microbial biomass acts as the transformation agent of the organic matter in soil. As such, the biomass is both a source and sink of the nutrients C, N, P and S contained in the organic matter. It is the centre of the majority of biological activity in soil. To properly understand biological activity in soil one must, therefore, have knowledge of the microbial biomass. Investigating the flow of carbon and nitrogen in the soil, from newly deposited plant or other materials to the mineral forms of carbon dioxide and ammonium or nitrate ions clearly shows the central role of the microbial biomass. Microbial biomass determinations may indicate changes in the soil organic matter before they can be detected by measuring total soil carbon (Powlson *et al.*, 1987) making possible its use as an indicator of early changes in soil organic matter content.

The soil microorganisms play integral role in nutrient cycling, soil stabilization and organic matter decomposition. Greater soil disturbance decreases

average microbial biomass (Follett and Schimel, 1989). Soil is an ecosystem with complex biochemical reaction, going on continuously by producing of several enzymes in soil, which catalyse these biochemical reactions and are responsible for nutrient cycling in soil system

Among the carbon pools in soil, soil microbial biomass carbon is the only living entity. It quickly interacts and manifests status of soil health well in advance as microbes are closely associated with soil matrix as well as and soil plant system. Thus, the effect of puddling intensity in rhizosphere of rice grown can be accessed through this tool. Keeping all in view, the present study “Soil microbial biomass carbon ( $\mu\text{gCg}^{-1}$  dry soil) at different growth stages of paddy as influenced by long term application of fertilizers and manure under Chhattisgarh”.

## MATERIAL AND METHOD

A field study was carried out during *Kharif* season of 2010-11 at the Research and Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur. The experiment was carried out in randomized block design with 4 replications having treatments: T<sub>1</sub> (Control without fertilizer), T<sub>2</sub> (100% NPK), T<sub>3</sub> (100% N alone), T<sub>4</sub> (100%NPK+FYM), and T<sub>5</sub> (50%NPK+Green manure). A medium duration high yielding paddy variety “Mahamaya” was taken as crop.

Soil microbial biomass carbon was determined by the fumigation extraction method as per the procedure of Jenkinson and Poulson (1976). A quantity of moist soil (40gm) was weighted into a 500 ml. schott bottle and kept for fumigation. Ethanol-free chloroform was prepared immediately before fumigation. The

chloroform was poured in a separate funnel and washed with concentrated H<sub>2</sub>SO<sub>4</sub> (each with 1/2 of volume of chloroform) and another 3 times with same volume of distilled water similarly and one bottom whitish phase was collected all the washing were given to make the chloroform free of ethanol. The required volume of ethanol free chloroform 5 ml was kept in 500 ml. schott bottle put neoprinseptum and put for 24 hrs in dark place after 24 hrs neoprinseptum was opened and chloroform vapour release sound, keep it for left 30 min. to 1 hour. Both fumigated and non-fumigated soils suspensions were transferred in 250 ml conical flasks and 160 ml of 0.5M K<sub>2</sub>SO<sub>4</sub> was added and shaking was done for 45 min. After shaking thoroughly, filtered and 10 ml of the filtrate was transferred in 500 ml conical flask then 10 ml. of 0.03N K<sub>2</sub>CrO<sub>7</sub>, 20 ml. of concentration H<sub>2</sub>SO<sub>4</sub> were added and put for digestion and send broth at 50<sup>0</sup> C for 30 min and immediately add 20 ml. distilled water, 5 ml. of orthophosphoric acid were added to conical flask. The blank was also run with 20 ml. distilled water each along with by adopting same procedure mentioned above and then 4 to 5 drops of diphenylamine indicator were added. The content as titrated against 0.04N ferrous ammonium sulphate to get a brick red to light green as the end point.

$$\text{SMBC } (\mu\text{g C g}^{-1} \text{ soil}) = \frac{E_{\text{CF}} - E_{\text{CNF}}}{E_{\text{EC}}}$$

where

E<sub>CF</sub> = extractable carbon in the fumigated soil sample

E<sub>CNF</sub> = extractable carbon in the Non fumigated soil sample

E<sub>EC</sub> = 0.25 + 0.05 it represent the efficiency of extraction of SMBC

Microbial biomass carbon ( $\mu\text{g} / \text{g soil}$ ) = (ECF - ECNF) / 0.25

## RESULT AND DISCUSSION

Data presented in Table 1 indicated changes in soil microbial biomass carbon (SMBC) at different crop growth stages of paddy as influenced by fertilizer application. The highest significant SMBC was (312.52  $\mu\text{g C g}^{-1}$  dry soil) found in the treatment T<sub>4</sub> (100% NPK+FYM), while the lowest significant SMBC was recorded in T<sub>1</sub> (control) plot (130.40  $\mu\text{g}$

C g<sup>-1</sup> dry soil) for all growth stages of the crop. The table reveals that at transplanting stage there is no significant difference in SMBC due to treatments T<sub>1</sub> (control) and T<sub>3</sub> (100% N) i.e. they are at par. However T<sub>1</sub> and T<sub>3</sub> are significantly different from T<sub>2</sub>, T<sub>4</sub> and T<sub>5</sub>. Similarly at PI stage, the treatments T<sub>2</sub> and T<sub>3</sub> were at par but they were significantly different from T<sub>1</sub>, T<sub>4</sub>, and T<sub>5</sub>. Similar findings were reported by Zhang *et al.* (2009) and Kaur *et al.* (2008). The result of this study indicated that the soil amended with PC (plant compost) and IPC (integrated plant compost) increased MBC significantly which was more than that observed in control and inorganic fertilizers. Increasing MBC after application of organic amendments at a higher rate of application suggested that this soil is C-limited and that the labile carbon provided by PC and IPC may have been used as a source of energy by the microorganisms indicated that soils treated with FYM and composts showed a significant increase in total organic C and biomass C in response to the increasing amounts of organic C added.

Data presented in Table 2 indicated that the grain yield of rice crop increased significantly due to application of T<sub>4</sub> (100%NPK+FYM), T<sub>5</sub> (50%NPK+GM), T<sub>2</sub> (100%NPK) and T<sub>3</sub> (100%N) respectively over control. Among all the treatments the highest significant grain yield (4955.0 kg/ha.) recorded under T<sub>4</sub> (100%NPK+FYM), while the lowest significant grain yield was in T<sub>1</sub> (control) (2585.0 kg/ha) for all growth stages of the crop. Among all the treatments, T<sub>4</sub> (100%NPK+FYM) showed higher grain yield than T<sub>5</sub> (50%NPK+GM) followed by T<sub>2</sub> (100%NPK). The T<sub>3</sub> (100% N) treatment recorded significantly lower grain value than all other T<sub>2</sub> (100%NPK), T<sub>5</sub> (50% NPK+GM) and T<sub>4</sub> (100% NPK+FYM) treatments but it was significantly higher than control treatment. The rice grain yield (4517kg/ha) obtained under combined application of T<sub>5</sub> (50% NPK+GM) was at par with the yield recorded under recommended dose of T<sub>2</sub> (100%NPK) fertilizer (4542kg/ha). The findings are in accordance with those of Singh *et al.* (2007) who also reported that increase in grain yield due to combined application of organic with inorganic fertilizer over application of chemical fertilizer.

**Table 1:** Soil microbial biomass carbon ( $\mu\text{g C g}^{-1}$  dry soil) in different growth stages of paddy as influenced by continuous application of manure and fertilizers

Treatments	Stages			
	Transplanting	Tillering	PI	Harvesting
T <sub>1</sub> = Control	130.84 <sup>a</sup>	152.82 <sup>a</sup>	135.77 <sup>a</sup>	130.40 <sup>a</sup>
T <sub>2</sub> = 100% (RDF)	155.63 <sup>b</sup>	195.10 <sup>c</sup>	170.05 <sup>b</sup>	160.92 <sup>c</sup>
T <sub>3</sub> = 100% N	142.86 <sup>a</sup>	181.02 <sup>b</sup>	158.35 <sup>b</sup>	138.21 <sup>b</sup>
T <sub>4</sub> =100% (RDF)+FYM	249.57 <sup>d</sup>	312.52 <sup>e</sup>	264.65 <sup>d</sup>	260.07 <sup>e</sup>
T <sub>5</sub> =50% (RDF) + GM	204.54 <sup>c</sup>	244.52 <sup>d</sup>	228.17 <sup>c</sup>	216.68 <sup>d</sup>

<b>SEm±</b>	<b>4.08</b>	<b>2.25</b>	<b>6.19</b>	<b>2.38</b>
<b>CD (P=0.05)</b>	<b>12.56</b>	<b>7.76</b>	<b>19.09</b>	<b>7.35</b>

**Note.1** The subscripts a, b, c, d and e are showing significance of difference among different means at different growth stages of paddy as influenced by continuous application of manure and fertilizers.

**Table 2:** Grain yield (kg/ha) as affected by different treatments as influenced by continuous application of manure and fertilizers

<b>Treatments</b>	<b>Rice</b>
	<b>Grain yield (kg/ha)</b>
T <sub>1</sub> = Control	2585.00 <sup>a</sup>
T <sub>2</sub> = 100% (RDF)	4542.50 <sup>c</sup>
T <sub>3</sub> = 100% N	3740.00 <sup>b</sup>
T <sub>4</sub> =100% (RDF)+FYM	4955.00 <sup>d</sup>
T <sub>5</sub> =50% (RDF) + GM	4517.50 <sup>c</sup>
<b>SEm±</b>	<b>74.87</b>
<b>CD (P=0.05)</b>	<b>230.70</b>

**Note.1** The subscripts a, b, c, d and e are showing significance of difference among different means at different growth stages of paddy as influenced by continuous application of manure and fertilizers

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