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Development of Spad Values for Rice Variety Co (R) 48 while using Various Sources of Organic Manures in Comparison with Rdf and Inm at different Growth Stages of Rice for Attaining Optimum Yield

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ABSTRACT

Field experiments were carried out at Tamil Nadu Agricultural University, Coimbatore, India during samba (August-December) season of 2012 and 2013 to study the effect of different sources of organic manures in comparison with INM and RDF on growth and yield of rice (Oryza sativa L.) to determine the crop growth stage specific optimum SPAD value for higher grain yield. The experiment consisted of fourteen treatments which were laid out in Randomized Block Design, replicated thrice and SRI method of planting was adopted during both the years. Among fourteen treatments, four treatments with different organic manures at 100 per cent RDN on equi nutrient basis (farm yard manure, vermi-compost, poultry manure and (Dhaincha) green manure) another six treatments consisted of 50 per cent combination of each manure, one treatment with 1/4th combination of all the manures and one absolute control (without organic or inorganic). These treatments were compared with the recommended dose of fertilizer (RDF) and integrated nutrient management practice (RDF + Dhaincha). The treatments imposed had significant influence on leaf nitrogen content (SPAD values) during both the years. Data on SPAD values increased from active tillering to flowering in rice at all treatments during both the years. The INM practice recorded higher SPAD values and which was on par with recommended NPK fertilizers at different growth stages of rice. Among the organic treatments 100 per cent RDN through green manure recorded higher SPAD values followed by 100 per cent RDN through each organic manures applied. Higher rice grain yield was recorded with INM practice followed by recommended NPK fertilizers, among the organic treatments 100 per cent RDN through green manure followed by 100 per cent RDN through each organic manures.

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INTRODUCTION

Rice (*Oryza sativa* L.) yield trend analysis in many long-term experiments suggests that rice yields in Asia are either stagnant or declining (Duxbury, 2001; Ladha *et al*., 2003; Yadvinder-Singh and Bijay-Singh, 2003; Pathak *et al*., 2003). This has been mainly due to decrease in soil organic carbon and reserve of nutrients, non-uniform distribution of rainfall, improper nutrient management approaches (FAO, 1994; Cassman *et al*., 1997; Cakmak, 2002), especially nitrogen (Ladha *et al*., 2003) that resulted in poor nutrient supply capacity of soil and use efficiency of the applied fertilizer. Nitrogen is one of the key nutrients that limits rice growth in many production systems (Tirol-Padre *et al*., 1996) and nitrogen deficiency is one of the most serious nutritional disorders in rice. Nitrogen contributes to carbohydrate accumulation in culms and leaf sheaths during the pre-heading stage and in the grain during the ripening stage of rice. A major reason why farmers would apparently waste more money by applying more fertilizer than a crop can use is a perception that the general recommendations are not appropriate for their individual situations. Also flooded soils have several pathways for nitrogen loss resulting in low N fertilizer recovery efficiency, which remains a problem in rice production in Asia. There is close relationship between amount of applied N to soil and N content of grain, which ultimately determines the yield of crops (Wilson *et al*., 2001). So change for farmers is to convert the applied N in soil to grain yield with maximum efficiency because N is one of the most costly inputs to rice based cropping system either by organic or inorganic means of supplements. Successful nitrogen management requires better synchronization between crop N demand and N supply from all

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sources throughout crop growing season (Cui *et al*., 2008). The objective of the investigation was to determine the crop growth stages SPAD values for rice variety CO (R) 48 for optimum rice grain yield production, while using various sources of organic manures in comparison with RDF and INM.

MATERIALS AND METHODS

Field experiments were carried out at Wetland Farms of "O" block at Tamil Nadu Agricultural University, Coimbatore, India during *samba* (August-December) season of 2012 and 2013. Coimbatore is situated in the Western agro-climatic zone of Tamil Nadu at 11^{o}N latitude and 77^{o}E longitude and at an altitude of 426.7 m above mean sea level. The soil of the experimental field was clay loam in texture belonging to *Typic Haplustalf* with the initial analysis of the soil of the experimental site revealed that the soil was slightly alkaline (pH= 8.0 and 8.1) with low soluble salts (EC= 0.43 and 0.42dSm^{-1}), medium in organic carbon content (0.42 and 0.41%), low in available N (254.0 and 260.0 kg ha^{-1}), low in available P (16.7 and 17.8 kg ha^{-1}) and high in available K (402.0 and 418.0 kg ha^{-1}) during the first and second years respectively.

III. Field experiment:

The field experiment consisted of fourteen treatments which were laid out in Randomized Block Design, replicated thrice and square planting (25 x 25 cm) was adopted during both the years. Among fourteen treatments, four treatments with different organic manures at 100 per cent RDN on equi nutrient basis (farm yard manure, vermi-compost, poultry manure and (Dhaincha) green manure) another six treatments consisted of 50 per cent combination of each manure, one treatment with 1/4th combination of all the manures and one absolute control (without organic or inorganic). These treatments were compared with the recommended dose of fertilizer (RDF) and integrated nutrient management practice (RDF + Dhaincha). The rice variety CO (R) 48 with field duration of 135 days was used in the trial. Separate nurseries were raised for conventional (INM and RDF) treatments and organic nursery for organic treatments. For organic and inorganic treatments separate experimental plots were maintained in both the years of study. Method of planting adopted was square planting and transplanted with 14 days old seedlings. All other package of practices were carried out as per recommendation of CPG (2012) for INM and RDF treatments. For organic treatments no herbicide was used, neem seed kernel extract, *Pnchagavyaa* and *Pseudomonos* were used as prophylactic plant protection measures. Irrigation and plant protection measures were followed uniformly in all the plots as per the requirements.

IV. Plant sampling and growth observations:

Plant samples were collected at different growth stages from all treatments till harvesting. For this purpose, non destructive observations on tiller number 10 hills in each side (total 20 hills) of a plot, leaving two border rows, were recorded and the average number of tillers of a respective hill was established (Thyagarajan *et al*., 1995). From these 20 hills, five representative hills were considered as sample hills. After collection, the plant samples were cleaned and washed in water to remove surface contamination and separate into stems (leafsheath+stem), leaves. Thereafter the plant parts were kept for oven drying till constant biomass. Dry biomass of leaves and stems are noted down. The dried plant parts were powdered in a porcelain basin to homogenate for N analysis(Yoshida and Parao, 1976).

V. Grain yield:

The crop was harvested at grain moisture content of 18-20%. In each plot, a one m^2 area, where plant sampling was not done earlier was selected for grain yield determination. These samples were first air dried in shade and then oven dried at 70^{0}C to constant weight and dry weight was recorded and expressed in kg ha^{-1}. Grains from each net plot were cleaned, sun dried, weighed and adjusted to 12% moisture content and the grain yield was expressed in kg ha^{-1}.

VI. SPAD value measurement:

The chlorophyll meter developed by the Soil-Plant Analysis Development (SPAD) unit of Minolta Camera Company, Osara, Japan. The instrument (SPAD 502) was used for SPAD value measurement. The SPAD values used to obtain from the intact leaves as described by Peng *et al*. (1993). The experiment field plot observations were recorded at active tillering, panicle initiation and flowering stages by taking five observations per leaf around the mid point of each leaf blade, 30 cm apart on upper (dorsal) side of the midrib. Readings from five plants i.e. 24 readings, were averaged to represent the mean SPAD values.

VII. Statistical analysis:

The SPAD values at critical stages of rice plants (active tillering, panicle initiation and flowering) and the grain yield at harvest during the both the years of experimentation were tested at 5% level of significance .Data on various characters were subjected to statistical analysis (Gomez and Gomez, 2010).

RESULTS AND DISCUSSION

8.1. Rice leaf N content (SPAD value):

The treatments imposed had significant influence on leaf nitrogen content(SPAD values) during both the years (Table 1). Data on SPAD values increased from active tillering to flowering in rice at all treatments, during both the years of investigation. The INM practice (T14) recorded higher SPAD values (34.8, 35.6 and 36.4; 35.0, 35.9 and 36.8 in 2012 and 2013, respectively) at active

tillering, panicle initiation and flowering and it was on par with recommended NPK fertilizers (T13). Among the organic treatments, 100% RDN through green manure (T5), recorded higher SPAD values (31.4, 32.6 and 34.0 during 2012) at active tillering, panicle initiation and flowering, respectively and it was followed by 100% RDN through each organic manure (T12). During the conformity trial also similar nature of results were noticed. The absolute control (T1) registered lower SPAD values (25.1, 25.8 and 27.8; 25.6, 26.0 and 27.5 in 2012 and 2013, respectively) at active tillering, panicle initiation and flowering.

Table 1: Effect of organic manures, RDF and INM on leaf N content (SPAD values) of rice at different growth stages and grain yield (kg ha^{-1}) .

Treatments	*samba* 2012				*samba* 2013			
	AT	PI	F	Grain yield (kg ha^{-1})	AT	PI	F	Grain yield (kg ha^{-1})
T_1 : Absolute control	25.1	25.8	27.8	3602	25.6	26.0	27.5	3646
T_2 : 100% RDN through FYM	27.0	28.8	29.8	4164	26.8	28.2	31.4	4190
T_3 : 100% RDN through VC	27.8	28.4	30.6	4296	27.6	30.0	33.2	4380
T_4 : 100% RDN through PM	28.4	30.4	32.2	4377	28.6	30.6	33.4	4550
T_5 : 100% RDN through GM	31.4	32.6	34.0	5084	32.4	34.2	34.4	5140
T_6 : 50% RDN each of through FYM + VC	26.2	27.2	28.6	3910	26.4	26.6	29.0	3980
T_7 : 50% RDN each of through FYM + PM	29.8	31.2	32.4	4721	30.0	32.1	33.6	4833
T_8 : 50% RDN each of through FYM + GM	27.2	28.0	30.0	4236	27.0	29.6	32.7	4316
T_9 : 50% RDN each of through VC + PM	30.5	31.6	33.2	4923	30.6	32.2	34.0	4986
T_{10} : 50% RDN each of through VC + GM	26.6	27.4	29.2	4079	26.9	27.4	30.0	4140
T_{11} : 50% RDN each of through PM + GM	28.0	29.4	31.8	4322	27.5	29.2	32.2	4430
T_{12} : 25% RDN each of through FYM + VC + PM + GM	31.0	31.8	33.5	5004	31.2	33.4	34.1	5120
T_{13} : RDF (150 : 50 : 50) NPK kg ha^{-1}	31.6	32.8	34.6	5603	32.8	34.6	34.8	5680
T_{14} : INM Practice (RDF + GM @ 6.25 t ha^{-1})	34.8	35.6	36.4	6235	35.0	35.9	36.8	6270
SEd	2.7	2.8	2.9	425	2.7	2.9	3.1	432
CD (p=0.05)	5.5	5.7	6.1	874	5.5	5.9	6.2	889

FYM: Farm Yard Manure, VC: Vermi-compost, PM: Poultry manure, GM: Green manure (Dhaincha) *Sesbania aculeata*
RDN: Recommended Dose of Nitrogen, RDF: Recommended Dose of Fertilizers, INM: Integrated Nutrient Management
AT: Active tillering, PI: Panicle initiation, F: Flowering.

8.2. Grain yield:

The three important critical growth stages of rice are active tillering, panicle initiation and flowering stages where the crop should not suffer from any stress for achieving the target yield. The optimum SPAD values must be observed during these critical growth stages for yield maximization. The treatments imposed had influenced the rice grain yield in both the years of experimentation (Table 1). The grain yield of rice extended from 3602 to 6235 kg ha^{-1} during 2012 and from 3646 to 6270 kg ha^{-1} during 2013. The INM practice (T_{14}) recorded higher grain yield (6235 and 6270 kg ha^{-1} in 2012 and 2013, respectively). The grain yield under INM practices was comparable with recommended RDF (5603 and 5680 in 2012 and 2013, respectively). Among the organic treatments, 100% RDN though green manure (T_5) recorded higher grain yield (5084 and 5140 in 2012 and 2013, respectively). Next to 100 per cent RDN through green manure, higher grain yield was recorded with 25% RDN through each organic manure (T_{12}) (5004 and 5120 in 2012 and 2013, respectively). The lower grain yield (3602 in 2012 and 3646 in 2013) was obtained with absolute control (T_1), which did not receive organic manures and recommended NPK fertilizers.The INM practice recorded higher SPAD values (rice leaf N concentration) and grain yield it was comparable with recommended NPK fertilizers treatment. Among the organic treatments, 100% RDN through green manure at active tillering, panicle initiation and flowering stages of rice. This might be due higher nutrients supplied through the INM treatment and 100 % RDN through green manure application, to the growing tissues which led to the synthesis of more chlorophyll. This is in accordance with the results obtained by Shanthi and Vijayakumari (2005). In addition, prolific root also might have sustained the leaf N concentration at a higher level throughout the crop growth period. The beneficial influence of INM practice organic manures (T_2 to T_{12}) and recommended NPK fertilizers on growth and physiological characters was observed when compared to absolute control. In the present study, the non supply of nutrients through any sources resulted in poor performance of rice could be noticed by lower SPAD values of all the growth stages in absolute control. When nutrients are not supplied, rice has to obviously depend upon initial soil nutrients, which is not sufficient to produce even reasonable yields. This is agreement with the findings of Natarajan (2003).

IX. Conclusion:

The average SPAD values obtained for achieving the optimum rice grain yield for RDF (31.6, 32.8 and 34.6; 32.8, 34.6 and 34.8), for INM practice (34.8, 35.6 and 36.4; 35.0, 35.9 and 36.8), for 100% RDN through green manure (31.4, 32.6 and 34.0; 32.4, 34.2 and 34.4) and for 100% RDN through each organic manure recorded with 31.0,31.8 and 33.5; 31.2, 33.4 and 34.1 at active tillering, panicle initiation and flowering stages of rice during both the years of experimentation. The average SPAD value for medium and long duration rice varieties were found to be 35.4 and 40.1, respectively for attaining optimum grain yield and for indica varieties the SPAD value was reported as 35.0 for attaining optimum yield (*Peng et al*., 1996 and Huang *et al*., 2008). There had been different studies where the critical or optimal SPAD value was used as the desired SPAD value for target yield (Balasubramanian *et al*., 2000; Wang *et al*., 2001).

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