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Physiological parameters and productivity of scented rice influenced by different organic and chemical nutrient packages

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Abstract: *Physiological parameters and productivity of scented rice influenced by different organic and chemical nutrient packages were carried out at the Research Cum Instructional Farm IGKV, Raipur (C.G.) during* kharif *season of 2010 and 2011. The soil of experimental field was inceptisols (*Matasi*), which was low in nitrogen and medium in available phosphorus and potassium. The experiment was laid out in randomized block design and repeated three times. The experiment includes evaluation of response of treatments of organic, chemical and integrated nutrient management practices on scented rice variety Kasturi. The combination of treatments were 1- T_1 (50% RDF + 50% N (CDM), 2-T_2 (100% N(1/3 each CDM +NC+CCR), 3-T_3 (100% N (1/3 each CDM + NC + CCR) + green manure in rice), 4- T_4 100% N (1/3 each CDM + NC + CCR) + Deep summer ploughing), 5- T_5 (50% N(CDM)+RP+PSB+*Azos.*), 6-T_6 (100% N(1/3 each CDM+NC+CCR) +* Azos.+ *PSB) and 7-T_7 (100% RDF). The results revealed that among different combination of treatments (T_1 to T_7) the T_7 exhibited highest dry matter accumulation, CGR, RGR and LAI (100% RDF) followed by T_1 (50% RDF + 50% N (CDM) and T_3 (100% N (1/3 rd each CDM + NC + CCR). The highest grain yield, straw yield and net return was recorded, respectively, in treatment T_7 (100% RDF), T_1 and T_3 (100% N (1/3 each CDM + NC + CCR) + GM in rice). Similarly, the various physiological growth and productivity parameters investigated in our study revealed optimum promotion by application of 100% RDF i.e. 80:50:30 employed in T_7 treatment.*

Key words: *Phosphorous solubilising Bacteria, cow dung manure, green manure, neem cake, deep summer ploughing, Azospirillum.*

INTRODUCTION

India is the traditional producer and exporter of basmati rice. Basmati rice are most preferred and therefore fetch a very high premium in both international and domestic markets. Food crops grown using organic inputs having less or no chemicals are being preferred over conventionally produced food by the consumers. Organic food as is self explanatory needs large quantity of organic manures to supply nutrients in soil but on the contrary, there is a serious decline in organic matter in Indian soils particularly in arid, semi-arid and sub-humid climate. Application of organic manure not only improves the soil organic carbon for sustaining the soil physical quality but also increases the soil P (Singh *et al.,*2007) the replacement of external inputs viz., chemical fertilizers by farm-derived organic inputs normally leads to a reduction in variable input costs under organic management. This approach restores soil health and productivity in long term (Mitra *et al.*, 1992), and also results in gradual increment in the grain yield with use of organics over a period of time Surekha (2007). In Chhattisgarh, by virtue of using less quantity of chemical fertilizers and pesticides and dependency upon naturally available sources of nutrients, producing organic food could have better opportunity towards high remuneration with premium price in market with inherent lesser cost advantage. Therefore, an experiment has been conducted to evaluate different organic inputs, nutrients sources as well as to compare the chemical and integrated nutrient management in rice.

MATERIALS AND METHODS

Field experiment conducted during Kharif 2010 and 2011 at the Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (CG), which had adequate facilities for irrigation and drainage. During the last

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few years Rice - Potato - Fallow and rice - onion - fallow cropping system was adopted with recommended package for organic and integrated nutrient management practices. Some parameters practiced during research are enlisted below.

1. Dry matter accumulation (g hill^{-1}) : Five hills from each plot were selected randomly and uprooted carefully at 30, 60 and 90 DAT and at harvest. After removing roots, the samples were sun dried followed by drying in an oven at 65°C. The samples were dried for 24-48 hours till the constant weight were obtained. The samples were weighed on an electrical balance and then averaged to get dry matter accumulation hill^{-1}.

2. Crop growth rate (CGR) : Crop growth rate was calculated by the following formula

$$\text{CGR (g day}^{-1}) = \frac{W_2 - W_1}{t_2 - t_1}$$

Where, W_1 and W_2 are dry matter at times t_1 and t_2, respectively.

3. Relative growth rate (RGR) : Relative growth rate was calculated as per formula -

$$\text{RGR (g g}^{-1}\text{day}^{-1}) = \frac{\ln W_2 - \ln W_1}{t_2 - t_1}$$

Where, W_1 = Total dry wt of plant at time t_1

W_2 = Total dry wt of plant at time t_2

$t_2 - t_1$ = time interval in days.

4. Leaf area index (LAI) : Leaf area was recorded manually. Leaves of plants from three hills were collected and grouped in 3-7 groups according to length and width of the leaves. The length and width of a representative leaf of each group was measured with the help of scale. The leaf area was worked out by the formula:

Leaf area = Length x Width x Correction factor (K)

Correction factor 0.75 was used.

The leaf area index was calculated by the following formula:

$$\text{LAI} = \frac{\text{Total leaf area (cm}^2)}{\text{Total ground area (cm}^2)}$$

The weight of clean grains recorded from each net plot was converted into q ha^{-1} by multiplying with the conversion factor of 123.4 for 20 x 10 cm spacing. Grain weight of sample plants was also added with plot yield before converting into yield ha^{-1}. The straw yield of each net plot including the straw weight of sample plants was also converted into q ha^{-1} by multiplying with the factor used in case of grain yield. The harvest index was calculated by dividing the grain yield with biological yield (grain + straw yield) and multiplied by 100.

RESULTS AND DISCUSSION

Growth and Physiological Parameters

The first prerequisite for yield is higher dry matter production per unit area. Dry matter accumulation hill^{-1} was recorded at 30, 60, 90 DAT and at harvest stage of the crop growth. T_7 (100% RDF) recorded higher dry matter accumulation, while lowest dry matter accumulation was recorded under T_5 . The higher value of dry matter accumulation in 100% inorganic nutrients treatments might be due to higher direct availability and translocation of nutrient during development phase of growth stage which facilitate more photosynthesis process and resulted in higher dry matter accumulation. Murali and Setty (2001) and Netam *et al.* (2008). The crop growth rate progressively increased with increasing crop age upto 90 DAT and thereafter decreased. Except during germination-30 DAT and 60-90 DAT the other two observation i.e. 30-60 and 90- at harvest registered significant variation in crop growth rate d. During 30-60 DAT period highest crop growth rate was noted with T_7 (100% RDF), however the least value of crop growth rate was noted under treatment T_5 (50% N CDM + *Azos* + RP + PSB). On an average 100% inorganic fertilizer was considered superior i.e. more crop growth rate followed by integrated and organic nutrient management treatment. Results was in fashion with the findings of Singh *et al* 2001. In general ,relative crop growth rate increased with the crop age upto 30-60 DAT and there after decreased upto maturity because it was the cumulative increment of dry matter accumulation. The relative crop growth rate was also calculated from dry matter accumulation observations. Except during 30-60 and 60-90 DAT, where no significant variation was observed, relative crop growth rate showed significant variation at germination-30 DAT and 90- harvest stage. At germination-30 DAT significantly higher relative growth rate was observed under T_7 (100% RDF) over T_5 (50% N CDM + *Azos* + RP + PSB) which gives the least value for relative crop growth. Leaf area index is the ultimate expression of the photosynthetic activity of the plant, which may have a direct effect on growth and yield parameters during the phasic developmental stages of crop. On an average 100% inorganic fertilizer resulted higher leaf area index in all the stages of growth followed by INM and organic manure treatment. This results may be due to better uptake and utilization of nutrients under T_7 and T_1 might have resulted in greator canopy coverage per unit ground area. Maske *et al.* (1997).

Grain, Straw Yield and Harvest index

The ultimate yield (produce) is the final assessment of different treatments under any agronomical investigation. higher grain yield was recorded under T_7 (Fig. 1), followed by INM and 100% Organic treatments. Whereas, the lowest grain yield was recorded under treatment T_5. On comparison, 100% inorganic fertilizer recorded maximum grain yield followed by INM and 100% organic manures while INM recorded maximum straw yield. powar and Mehta (1997). HI under different treatments might be due to fact that relative lower values of straw yield increases the harvest index in respective treatments.

Table 1
Dry matter accumulation (g hill^{-1}) of rice as influenced by different organic, inorganic and integrated nutrient management (pooled 2years)

Treatment		*Dry matter accumulation, (g hill^{-1})*			
		Germination - 30 DAT	*30 - 60 DAT*	*60 - 90 DAT*	*90 - At harvest*
T_1	50% RDF +50% N (CDM)	3.09	14.63	27.48	28.78
T_2	100% N (1/3rd each CDM+NC + CCR)	3.00	14.45	25.93	26.91
T_3	T_2+GM in rice	3.04	14.13	24.27	25.39
T_4	T_2 +DSP	2.97	13.76	24.82	26.36
T_5	50% N (CDM) + *Azospirillum*+ RP+PSB	2.93	13.70	23.66	24.66
T_6	T_2+ *Azospirillum*+PSB	3.02	14.07	25.73	26.77
T_7	100% RDF	3.21	14.82	30.02	31.13
	SEm±	0.07	0.65	2.20	2.07
	C.D. (P=0.05)	0.23	NS	NS	6.28
Comparison					
100% inorganic fertilizers (T_7)		3.21	14.82	30.02	31.13
Integrated nutrient management (T_1)		3.09	14.63	27.48	28.78
100% organic fertilizer- mean of (T_2+T_3+T_4+T_6)		3.00	14.10	25.18	26.35
50% organic fertilizer ($T_{5)}$ + Azos. + RP + PSB		2.93	13.70	23.66	24.66
	Overall mean	3.05	14.31	26.58	27.73

Table 2
CGR (g day^{-1} Plant^{-1}) of rice as influenced by different organic inorganic and integrated nutrient management (Pooled 2 years)

Treatment		*CGR (g day^{-1} Plant^{-1})*			
		Germination - 30 DAT	*30 - 60 DAT*	*60 - 90 DAT*	*90 - At harvest*
T_1	50% RDF +50% N (CDM)	0.060	0.384	0.428	0.118
T_2	100% N (1/3rd each CDM+NC+CCR)	0.058	0.381	0.380	0.089
T_3	T_2+GM in rice	0.059	0.369	0.352	0.101
T_4	T_2 +DSP	0.058	0.360	0.369	0.100
T_5	50% N (CDM) + *Azospirillum*+ RP +PSB	0.057	0.359	0.317	0.090
T_6	T_2+ *Azospirillum*+PSB	0.059	0.368	0.389	0.094
T_7	100% RDF	0.062	0.387	0.506	0.139
	SEm±	0.001	0.022	0.07	0.027
	C.D. (P=0.05)	NS	0.068	NS	0.083
Comparison					
100% inorganic fertilizers (T_7)		0.062	0.387	0.506	0.139
Integrated nutrient management (T_1)		0.060	0.384	0.428	0.118
100% organic fertilizer- mean of (T_2+T_3+T_4+T_6)		0.058	0.368	0.372	0.096
50% organic fertilizer ($T_{5)}$ + Azos. + RP + PSB		0.057	0.359	0.317	0.090
	Overall mean	0.059	0.376	0.405	0.108

Table 3
RGR (g g^{-1} day^{-1} $plant^{-1}$) of rice as influenced by different organic, inorganic and integrated nutrient management (Pooled 2 years)

Treatment		*RGR (g g^{-1} day^{-1} $plant^{-1}$)*			
		Germination - 30 DAT	*30 - 60 DAT*	*60 - 90 DAT*	*90 - At harvest*
T_1	50% RDF +50% N (CDM)	0.021	0.052	0.021	0.005
T_2	100% N (1/3rd each CDM+NC+CCR)	0.021	0.052	0.019	0.003
T_3	T_2+GM in rice	0.021	0.051	0.018	0.004
T_4	T_2 +DSP	0.021	0.051	0.019	0.006
T_5	50% N (CDM) + *Azospirillum*+ RP +PSB	0.020	0.051	0.016	0.003
T_6	T_2+ *Azospirillum*+PSB	0.021	0.051	0.019	0.006
T_7	100% RDF	0.022	0.050	0.023	0.006
	SEm±	0.005	0.001	0.003	0.001
	C.D. (P=0.05)	0.001	NS	NS	0.003
Comparision					
100% inorganic fertilizers (T_7)		0.022	0.050	0.023	0.006
Integrated nutrient management (T_1)		0.021	0.052	0.021	0.005
100% organic fertilizer- mean of (T_2+T_3+T_4+T_6)		0.021	0.050	0.018	0.004
50% organic fertilizer (T_5) + Azos. + RP + PSB		0.020	0.051	0.016	0.003
	Overall mean	0.021	0.050	0.019	0.004

Table 4
Leaf area index (LAI) of rice as influenced by different organic, inorganic and integrated nutrient management (Pooled 2years)

	Treatment	*Leaf area index (LAI)*		
		30 DAT	*60 DAT*	*90 DAT*
T_1	50% RDF +50% N (CDM)	3.27	4.97	5.34
T_2	100% N (1/3rd each CDM+NC+CCR)	2.95	4.79	5.18
T_3	T_2+GM in rice	3.21	4.94	5.27
T_4	T_2 +DSP	3.06	4.86	5.20
T_5	50% N (CDM) + *Azospirillum*+ RP +PSB	2.80	4.72	5.16
T_6	T_2+ *Azospirillum*+PSB	3.16	4.89	5.23
T_7	100% RDF	3.31	5.03	5.39
	SEm±	0.20	0.13	0.04
	C.D. (P=0.05)	NS	0.40	0.13
Comparison				
100% inorganic fertilizers (T_7)		3.31	5.03	5.39
Integrated nutrient management (T_1)		3.27	4.97	5.34
100% organic fertilizer- mean of (T_2+T_3+T_4+T_6)		3.09	4.87	5.22
50% organic fertilizer (T_5) + Azos. + RP + PSB		2.80	4.72	5.16
	Overall mean	3.11	4.89	5.27

Table 5
Grain yield (q ha^{-1}) , straw yield (q ha^{-1}), harvest index (%) of rice as influenced by different organic, inorganic and integrated nutrient management (Pooled 2 years)

	Treatment	*Grain yield (q ha^{-1})*	*Straw yield(q ha^{-1})*	*Harvest index(%)*
T_1	50% RDF +50% N (CDM)	39.17	58.63	40.02
T_2	100% N (1/3rd each CDM+NC+CCR)	36.25	54.51	39.87
T_3	T_2+GM in rice	38.02	57.27	39.91
T_4	T_2 +DSP	36.56	55.18	39.84
T_5	50% N (CDM) + *Azospirillum*+ RP +PSB	30.85	50.88	37.72
T_6	T_2+ *Azospirillum*+PSB	36.58	56.19	39.44
T_7	100% RDF	39.67	57.75	40.71
	SEm±	1.19	1.00	0.81
	C.D. (P=0.05)	3.62	3.06	NS
Comparison				
100% inorganic fertilizers (T_7)		39.67	57.75	40.71
Integrated nutrient management (T_1)		39.17	58.63	40.02
100% organic fertilizer- mean of (T_2+T_3+T_4+T_6)		36.85	55.79	39.77
50% organic fertilizer (T_5) + *Azos*. + RP + PSB		30.85	50.88	37.72
	Overall mean	36.73	55.77	39.65

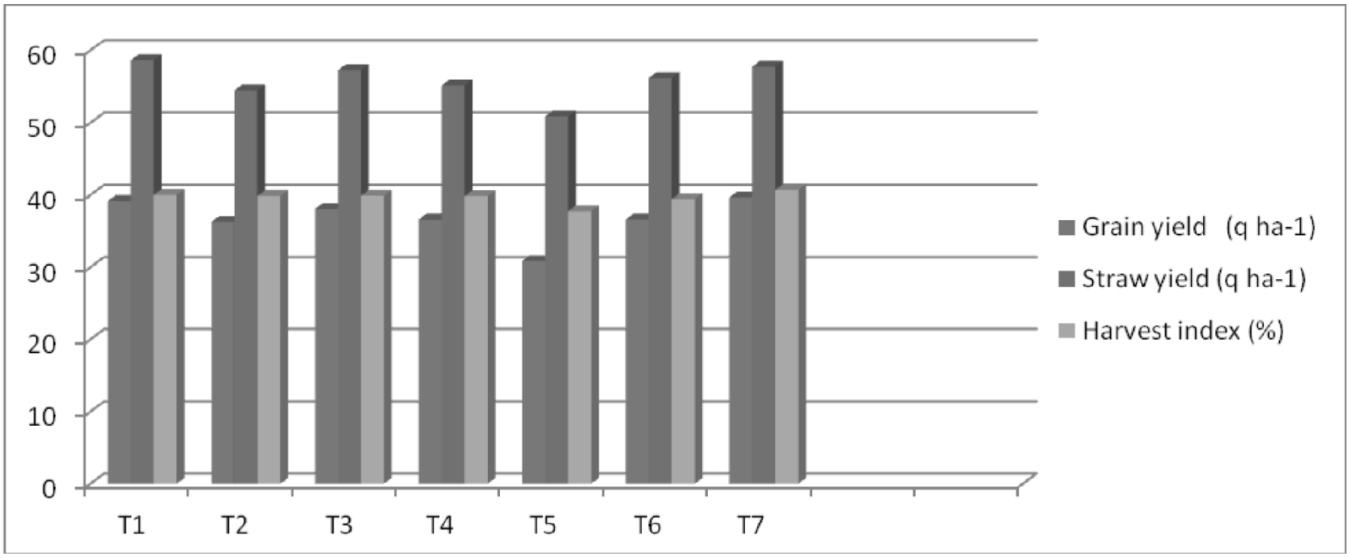

Figure 1 : Grain yield (q ha^{-1}) , straw yield (q ha^{-1}), harvest index (%) of rice as influenced by different organic, inorganic and integrated nutrient management (Pooled 2 years)

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