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RESPONSE OF SCENTED RICE (*Oryza sativa* L.) CV. PUSA BASMATI-1 TO DIFFERENT FORMS OF ORGANIC MANURES AND SYSTEMS OF PLANTING

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ABSTRACT

A field experiment was conducted during *Kharif* 2011at Crop Research Farm, Department of Agronomy, SHIATS, Allahabad with the split plot design having 18 treatments replicated thrice. The experiment consisted 3 organic sources namely Sunhemp (*Crotalaria juncea*), Dhaincha (*Sesbania aculeata*), both were used as green manuring and FYM (12 t/ha) combined with foliar application of *Panchgavya* and fish amino acid (FAA) with 3 planting systems, *viz*., system of rice intensification (SRI), conventional transplanted rice (CTR) and direct seeded rice (DSR). Out of them SRI found maximum plant height (90.76 cm), number of tillers/hill (16.06), plant dry weight (30.29 g), relative growth rate (0.023 g/g/day), effective tillers/hill (9.33), grain yield (6.29 t/ha), harvest index (49.76%), net return (89,571) and B:C ratio (2.65) when combined with FYM + *Panchgavya*.

Key words : *Green manuring, FYM, foliar spray, SRI, grain yield, harvest index and economics*

Rice (*Oryza sativa* L.) is the world's most important food crops of Asian origin. India has 42.56 m ha area under rice and production 95.33 m tonnes (1). India shares the worlds 21.6% rice production. India holds 2nd and china 1st position in rice production in the world (2). Rice is staple food of more than 60% of Indian population. It accounts for about 43% of total food grain production and 46% of total cereal production in the country. In order to meet the domestic demand of the increasing population the present day production of 95.32 million tonnes (2010) of milled rice has to be increased to130 million tonnes by the year 2025. Uttar Pradesh has an area of 5.63 m ha production 11.94 million tonnes and productivity of 2.120 t/ha of rice (3).

Major constraints to rice production that India faces are land, water, labor and other inputs such as fertilizers, pesticides and insecticides without affecting the agricultural environment. Rapid spread of rice-based cropping system in India has caused an eclipse on sustainability and profitability of soil as well as crop productivity in the long run. With growing concern about the human health, soil quality and environmental safety, need has been felt to rethink over the existing agricultural practices, especially the nutrient management. Further, in order to meet the food grain requirement of the population, sustainability of crop productivity at higher level, especially in developing countries like India is the need of the hour. Results of the long term experiments conducted on rice have shown decline or stagnation in the productivity of this system. The decline in organic matter content and associated changes in nutrient availability and physical properties of soil is also evident. The deficiencies of secondary nutrients are also affecting the performance of rice production (4)..

Organic agriculture faces the challenge and defiance in the present day pollution immersed environs. Soil, which is the source of about 90% of our food, is the key component in any agro-ecosystem. Degradation creeps with the disability of survival of flora and fauna. Any constraint, if approached appropriately, can pave way to the formation and building up of agro-eco-systems, which can restore balance in the various cycle of water, nutrition, *etc*., (5).

During the last decade or so, a new approach, widely known as system of rice intensification (SRI), has attracted attention because of its apparent success in increasing rice yield. The system of rice intensification (SRI) was introduced in India during the year 2000 as a viable alternative of rice cultivation that enhances the productivity while minimizing the inputs. (6) reported that nutrient management must be sound for achieving yield potential of rice under SRI. The use of organic manures such as FYM and GM have been proved to be viable component of INM for SRI. However, the need of the our is to switch to organic farming wherever, there is a possibility of improve productivity potential with organic farming.

MATERIALS AND METHODS

The experiment was carried out during *Kharif* 2011 at Crop Research Farm, Department of Agronomy, Allahabad School of Agriculture, SHIATS, Allahabad (U.P.) which is located at 25^0 24' 42" N latitude, 81^0 50' 56" E longitude and 98 m altitude above the mean sea

level. This area is situated on the right side of the river Yamuna by the side of Allahabad Rewa Road about 5 km away from Allahabad city. The soil was sandy loam (59.60%), available N, P_2O_5, K_2O, organic carbon, pH and EC were 0.028%, 13.05 kg/ha, 156.44 kg/ha, 0.36%, 8.34 and 0.13 dS/m respectively. The experiment was conducted with split plot design having 6 main plot treatments *viz.,* green manuring with *Sesbaniaaculeata* + *Panchgavya* (M_1), green manuring with *Sesbaniaaculeata* + fish amino acid (M_2), green manuring with *Crotalaria juncea* + *Panchgavya* (M_3), green manuring with *Crotalaria juncea* + fish amino acid (M_4), basal application of FYM + *Panchgavya* (M_5), basal application of FYM + fish amino acid (M_6) and 3 sub plot treatments *viz.,* system of rice intensification (S_1), conventional transplanted rice (S_2) and direct seeded rice (S_3) total 18 treatment combinations with three replications. Pusa Basmati 1 variety was taken for experiment.

The nursery for CTR was grown on 5th July 2011 and for SRI nursery was grown on 13th July 2011. The transplanting/sowing was done on 27th July 2011. Half dose of FYM was applied as basal application and remaining dose was applied through *Bokashi* at 43, 51 63 DAS/DAT in all plots. Foliar spray of *Panchgavya* (3%) and fish amino acid (3%) were applied at 15, 30, 45 and 60 DAS/DAT in their respective plots.

RESULTS AND DISCUSSION

Growth parameters

The interaction effect (table-1) between organic manures and systems of planting was non-significant for all growth parameters except plant height, significantly higher plant height (90.76 cm) was observed in treatment T_{13} (Basal application of FYM + *Panchgavya* + SRI). However, treatment T_{16} (Basal application of FYM + FAA + SRI) was statistically at par with T_{13}. Highest number of tillers/hill, plant dry weight, relative growth rate and number of effective tillers/hill was also registered in sametreatment.The younger seedlings in SRI when carefully transplanted by keeping the roots straight (assuring that the roots do not assume 'J' shape) might have encouraged vigorous and deeper root system which in turn resulted into more vigorous and taller plants (7).

Yield attributes

The interaction effect between organic manures and systems of planting (Table-2) was found to be non-significant. However, highest panicle length, number of grains/panicle, test weight, grain yield and harvest index (30.04 cm, 201.46, 23.18 g, 6.29 t/ha and 49.76 % respectively) was observed in treatment T_{13}

Table-1 : Interaction effect of forms of organic manures and systems of planting on growth parameters(at 90 DAS/DAT) of rice.

Treatments		Growth parameters					
		Plant height (cm)	No. of tillers /hill	Dry weight (g/hill)	CGR (g m^{-2}/day) at 75-90 DAS/DAT	RGR (g/g day) at 75-90 DAS/DAT	Effective tillers hill
T_1 :	GM with Sesbania + Panchgavya + SRI	68.64	12.73	20.28	4.77	0.015	6.20
T_2 :	GM with Sesbania + Panchgavya + CTR	63.78	8.20	13.61	2.65	0.005	5.46
T_3 :	GM with Sesbania + Panchgavya + DSR	38.07	3.60	7.87	11.02	0.011	1.33
T_4 :	GM with Sesbania + FAA + SRI	70.59	14.40	19.50	4.68	0.016	7.66
T_5 :	GM with Sesbania + FAA + CTR	64.66	8.20	13.44	4.19	0.009	4.46
T_6 :	GM with Sesbania + FAA + DSR	38.99	3.40	6.77	5.43	0.006	1.13
T_7 :	GM with Crotalaria + Panchgavya + SRI	62.11	12.66	22.05	2.99	0.007	6.73
T_8 :	GM with Crotalaria + Panchgavya + CTR	69.44	10.00	17.41	8.39	0.015	6.73
T_9 :	GM with Crotalaria + Panchgavya + DSR	49.41	4.26	6.75	8.80	0.009	1.86
T_{10} :	GM with Crotalaria + FAA + SRI	70.89	14.66	22.64	3.75	0.009	7.73
T_{11} :	GM with Crotalaria + FAA + CTR	74.91	10.73	17.09	1.62	0.001	7.60
T_{12} :	GM with Crotalaria + FAA + DSR	46.28	4.80	9.72	24.39	0.014	1.60
T_{13} :	Basal application of FYM + Panchgavya + SRI	90.76	16.06	30.29	6.36	0.023	9.33
T_{14} :	Basal application of FYM + Panchgavya + CTR	69.73	8.26	18.44	7.94	0.012	7.33
T_{15} :	Basal application of FYM + Panchgavya + DSR	35.08	3.06	6.73	9.02	0.010	0.93
T_{16} :	Basal application of FYM + FAA + SRI	86.74	12.53	25.17	8.12	0.022	8.93
T_{17} :	Basal application of FYM + FAA + CTR	73.98	8.86	19.14	4.07	0.005	6.93
T_{18} :	Basal application of FYM + FAA + DSR	37.99	3.00	7.09	3.69	0.002	0.93
	SEd (±)	5.44	1.22	2.84	10.77	0.014	1.13
	CD(P= 0.05)	11.22	NS	NS	NS	NS	NS

GM : Green manuring SRI : System of rice intensification FAA : Fish amino acid CTR : Conventional transplanted rice
FYM : Farmyard manure DSR : Direct seeded rice

Table-2: Interaction effect of forms of organic manures and systems of planting on yield parametersof rice.

Treat-ments	Yield parameters						
	Panicle length (cm)	Number of grains/ panicle	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)	
T_1 :	GM with *Sesbania* + *Panchgavya* + SRI	28.99	158.20	22.35	4.47	6.78	42.04
T_2 :	GM with *Sesbania* + *Panchgavya* + CTR	26.20	132.66	20.57	3.28	6.05	43.53
T_3 :	GM with *Sesbania* + *Panchgavya* + DSR	20.03	81.33	19.60	2.40	7.93	25.95
T_4 :	GM with *Sesbania* + FAA + SRI	26.33	150.60	22.16	4.32	5.75	47.80
T_5 :	GM with *Sesbania* + FAA + CTR	25.98	145.00	21.51	3.03	8.38	26.88
T_6 :	GM with *Sesbania* + FAA + DSR	20.63	85.93	19.63	1.63	10.03	18.51
T_7 :	GM with *Crotalaria* + *Panchgavya* + SRI	27.93	144.80	22.05	3.55	6.12	35.20
T_8 :	GM with *Crotalaria* + *Panchgavya* + CTR	25.65	138.00	21.71	3.07	11.25	26.69
T_9 :	GM with *Crotalaria* + *Panchgavya* + DSR	20.47	93.86	21.13	3.14	11.27	25.84
T_{10} :	GM with *Crotalaria* + FAA + SRI	27.s81	158.40	21.79	4.02	4.55	48.36
T_{11} :	GM with *Crotalaria* + FAA + CTR	26.04	139.46	21.47	3.18	7.56	36.17
T_{12} :	GM with *Crotalaria* + FAA + DSR	22.40	102.13	20.27	1.99	10.34	17.23
T_{13} :	Basal application of FYM + *Panchgavya* + SRI	30.04	201.46	23.18	6.29	6.12	49.76
T_{14} :	Basal application of FYM + *Panchgavya* + CTR	27.39	161.60	22.66	4.56	7.94	40.45
T_{15} :	Basal application of FYM + *Panchgavya* + DSR	23.37	120.53	21.06	3.54	5.95	39.89
T_{16} :	Basal application of FYM + FAA + SRI	29.50	187.20	23.16	5.26	9.48	37.90
T_{17} :	Basal application of FYM + FAA + CTR	28.18	177.80	22.20	4.25	12.25	25.72
T_{18} :	Basal application of FYM + FAA + DSR	22.41	114.33	20.91	2.45	9.79	19.71
	SEd (±)	1.49	16.30	0.65	0.92	3.86	13.63
	CD (P = 0.05)	NS	NS	NS	NS	NS	NS

GM : Green manuring SRI : System of rice intensification FAA : Fish amino acid CTR : Conventional transplanted rice
FYM : Farmyard manure DSR : Direct seeded rice

(Basal application of FYM + *Panchgavya* + SRI). Superior value of straw yield (12.25 t/ha) was found with the treatment combination T_{17} (Basal application of FYM + FAA + CTR). Foliar spray of *Panchgavya*showed beneficial effect onyield parameters. The easy transfer of nutrients through foliar spray of *Panchgavya* might be the reason for enhancement of yield attributes (8). Higher grain yield realized with SRI method might be due to large root volume, strong tillers with big panicles as well as higher

Table-3 : Economics of different treatment combinations of organic manuring practices and systems of planting of rice.

	Treatments	Gross return/ha	Cost of cultivation/ha	Net return/ha	B : C ratio
T_1 :	GM with *Sesbania* + *Panchgavya* + SRI	112050.00	47769.00	64281.00	2.35
T_2 :	GM with *Sesbania* + *Panchgavya* + CTR	86520.00	50259.00	36261.00	1.72
T_3 :	GM with *Sesbania* + *Panchgavya* + DSR	77320.00	50484.00	26836.00	1.53
T_4 :	GM with *Sesbania* + *FAA* + SRI	105080.00	48489.00	56591.00	2.17
T_5 :	GM with *Sesbania* + *FAA* + CTR	91090.00	50979.00	40111.00	1.79
T_6 :	GM with *Sesbania* + *FAA* + DSR	71090.00	51204.00	19886.00	1.39
T_7 :	GM with *Crotalaria* + *Panchgavya* + SRI	91930.00	48419.00	43511.00	1.90
T_8 :	GM with *Crotalaria* + *Panchgavya* + CTR	103330.00	50909.00	52421.00	2.03
T_9 :	GM with *Crotalaria* + *Panchgavya* + DSR	104740.00	51134.00	53606.00	2.05
T_{10}:	GM with Crotalaria + FAA + SRI	94580.00	49139.00	45441.00	1.92
T_{11}:	GM with Crotalaria + FAA + CTR	90660.00	51629.00	39031.00	1.76
T_{12}:	GM with Crotalaria + FAA + DSR	79170.00	51854.00	27316.00	1.53
T_{13}:	Basal application of FYM + Panchgavya + SRI	143990.00	54419.00	89571.00	2.65
T_{14}:	Basal application of FYM + Panchgavya + CTR	118400.00	56909.00	61491.00	2.08
T_{15}:	Basal application of FYM + Panchgavya + DSR	91060.00	57134.00	33926.00	1.59
T_{16}:	Basal application of FYM + FAA + SRI	137860.00	55139.00	82721.00	2.50
T_{17}:	Basal application of FYM + FAA + CTR	129750.00	57629.00	72121.00	2.25
T_{18}:	Basal application of FYM + FAA + DSR	85710.00	58679.00	27031.00	1.46

fertility of spikelet. The present findings are similar to those recorded by (9). HI was considerably higher in plants grown at the spacing of 25 x 25 cm than in plants grown in other spacings. This indicates that differences in grain yield at the various spacings were attributable to differences in harvest index (10).

Economics

Observations regarding the economics are given in the Table 3. Highest g ross return (143990.00), net return (89571.00) and benefit-cost ratio (2.65) were registered in treatment T_{13} (Basal application of FYM + *Panchgavya* + SRI) which were 102.55, 350.42 and 90.64% respectively higher compared with lowest value (71090.00, 19886.00 and 1.39 respectively) registered in treatment T_6 (GM with *Sesbania*+ FAA + DSR). The economic analysis shows the potential promise of SRI under organic farming system. The higher returns under organic farming was mainly due to better soil health which resulted in better plant growth, yield components, yield and higher price of organic produce (4).

CONCLUSION

Growth parameters *viz.,* maximum plant height, number of tillers hill^{-1}, plant dry weight and yield attributes, namely, test weight, grain yield and harvest index was recorded in which FYM (12 t/ha) + *Panchgavya*[(3%) 4 foliar spray] was combined with system of rice intensification (SRI). Highest net return and benefit cost ratio was recorded in the treatment in which FYM (12 t/ha) + 4 foliar spray] was combined with system of rice intensification (SRI).

It may be concluded that among the forms of organic manures, FYM (12 t/ha) + *Panchgavya*[(3%) 4 foliar spray]in combination with system of rice intensification (SRI), was found to be the best for obtaining higher grain yield and benefit cost ratio in rice.Since the findings are based on the research done in one season it may be repeated for confirmation.

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