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PERFORMANCE OF PHYSIOLOGICAL BASIS OF RICE HYBRIDS UNDER SYSTEM OF RICE CULTIVATION

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Abstract

Among the rice hybrids, PRH-10 recorded significantly highest chlorophyll content, dry matter, LAI, CGR, RGR, NAR, root length, root: shoot ratio and grain yield (9.95 t/ha) over the rest of hybrids followed by NPH-567. The lowest values of these parameters were noted in IR-36. The higher straw yield was recorded (144.8 t/ha) in NPH-567.

Rice currently feeds more than half of the world's population, and demand for rice is expected to rise by almost 40% within 30 years due to population increase (Surridge 2004). The System of Rice Intensification (SRI), which was developed in Madagascar, has brought hope to many rice farmers as it claim to accomplish more rice per drop of water. It is a methodology for comprehensively managing resources, i.e. changing the way that land, seeds, water, nutrients and human labour are utilized. SRI is an amalgamation of multiple beneficial practices, being a low-cost, high-yielding system that could be a sustainable alternative to conventional paddy production. Many reports showed yield enhancement by 25 - 50% or more on the basis of field experiences or on-farm trials (Kabir and Uphoff 2007, Satyanarayana *et al.* 2007, Sinha and Talati 2007, Zhao *et al.* 2009).

The objective of the present study was to investigate whether variation in rice genotype on basis of canopy structure, growth parameters, chlorophyll index, dry matter accumulation, root growth and how different hybrid rice varieties might perform under System of Rice Intensification (SRI) management. These parameters, if properly measured and help to resolve some of the controversy surrounding SRI in the agronomic literature and could also contribute to improvements in rice culture.

The experimental material consisted of 11 hybrid rice (JRH-4, JRH-5, JRH-8, JRH-10, JRH-11, PRH-10, NPH-207, NPH-567, NPH-4113, NPH-369, NPH-999) with IR -36 as a control and was grown in a randomized complete block design with four replications at the Research Farm, College of Agriculture, Rewa (Madhya Pradesh) during the rainy season of 2008-09. Fourteen day old seedlings were transplanted with spacing of 20 cm × 20 cm. The total rainfall received during the crop season was 672.6 mm distributed in 37 rainy days. The soil of the experimental site was clay-loam having favourable pH (7.1) and EC (0.31 ds/m). The soil was medium in organic carbon (0.61 %), available N (270 kg/ha) and high in K_2O (353 kg/ha), but low in P_2O_5 (8.25 kg/ha). Periodical observations were recorded for growth analysis parameters and yield. Chlorophyll content of each randomly selected leaf of sampled plant was measured by the CCM-200 chlorophyll meter. The meter measures the absorbance of wave length and calculates as chlorophyll index and the root-shoot ratio of randomly selected plant of rice were calculated on

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Table 1. Chlorophyll content, growth attributes, yield and straw yield of rice hybrids.

Rice hybrids	Chlorophyll content (booting stage)	Dry matter/ hill (g)	Leaf area index	CGR ($g/cm^2/day \times 10^{-4}$)	RGR ($g/g/day \times 10^{-4}$)	NAR ($g/cm^2/day \times 10^{-4}$)	Roots/ hill	Root length (cm)	Root shoot ratio	Grain yield (t/ha)	Straw yield (t/ha)
		At harvest	90 DAT	At harvest	At harvest	At harvest	90DAT	90DAT	90DAT		
JRH 4	14.95	77.55	5.94	21.0	150	2.80	113.75	25.50	1:6.79	7.950	10.66
JRH 5	14.67	72.35	5.94	22.0	140	2.30	114.25	23.75	1:6.77	7.70	10.3.9
JRH 8	14.82	90.05	6.65	24.0	180	2.82	117.50	28.50	1:7.57	8.32	11.06
JRH 10	15.85	132.0	7.55	31.0	225	3.22	123.75	30.00	1:8.97	8.52	11.33
JRH 11	14.32	82.77	6.09	22.0	160	2.82	116.25	27.25	1:7.62	8,.62	11.58
PRH 10	17.60	155.7	7.60	43.0	390	3.32	168.50	31.50	1:9.02	9.95	12.45
NPH 207	12.75	76.27	5.82	20.0	143	2.45	111.25	23.00	1:7.50	6.94	9.40
NPH 567	16.35	143.2	8.16	33.0	350	3.27	131.50	30.00	1:8.97	8.70	14.48
NPH 4113	15.54	112.5	7.20	28.0	180	2.85	119.25	28.75	1:8.05	8.33	12.17
NPH 369	15.75	118.5	7.42	29.0	190	3.17	121.00	29.00	1:8.75	8.35	12.10
NPH 999	14.32	75.37	5.14	19.0	127	2.20	110.5	21.75	1:6.74	6.25	8.29
IR 36 (Check)	11.60	68.55	5.16	18.0	122	2.00	102.75	20.00	1:7.77	5.15	6.67
SEm±	0.96	0.76	0.44	0.69	0.01	0.32	3.97	0.36	0.03	0.76	3.44
CD (p = 0.05)	2.76	2.2	1.26	2.0	0.03	0.94	11.44	1.04	0.10	2.2	9.92

dry weight basis. Different growth and physiological parameters such as LAI, CGR, RGR and NAR, were calculated by following standard formulae of Radford (1967).

Amongst the rice hybrids, PRH-10 attained the higher chlorophyll content (17.60) at the booting stage and dry matter/hill (155.7g), followed by NPH-567 and JRH-10 (Table 1). This might be due to higher per unit uptake of fertilizer in these hybrids over the others. The leaf area index, crop growth rate, relative growth rate and net assimilation rate were also higher in PRH - 10 in the same order and lowest in IR-36. PRH - 10 showed higher metabolic potential and efficiency to exploit available resources (water and fertilizer) and also harness the solar energy as compared to other hybrids. PRH-10 recorded highest LAI which is correlated with photosynthesis and ultimately produced more dry matter per unit leaf area. At 90 DAT (days after transplanting) stage, PRH-10 recorded significantly longer root length (31.5 cm), root shoot ratio (1 : 9.02) then the remaining hybrids. (Table 1). These findings are in close agreement with those of Shivani and Reddy (2000) and Barisan (2002). The maximum productivity is the ultimate target of any crop producer. Due to maximum increase in all these growth parameters, PRH-10 hybrid produced the maximum grain yield (9.95 t/ha) which was higher by 4.80 t/ha as compared to IR-36 and significantly higher over rest of the rice hybrids. However, NPH-567 and JRH-10 stood the second and third best hybrids, respectively. Grain yield is the end result of all the vegetative and reproductive growth characters and genetic yield potential of PRH-10 which further to produce higher grain. Ajeet *et al.* (2005) also found similar results with respect to variation in the grain yield of hybrid rice and IR 36. Significantly higher straw yield (14.48 t/ha) was recorded by NPH-567. Such an increase in straw yield of these rice hybrids might be due to the conversion of photosynthates into shoot as contrast to economic parts of the plant (Satyanaryan *et al.* 2007).

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