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Field Evaluation of Rice Hybrids (*Oryza sativa*) under Agro Climatic Conditions of Allahabad (UP)

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A B S T R A C T

The present study was elucidated to the "Field Evaluation of Rice Hybrids under Agro Climatic Conditions of Allahabad (UP) in *kharif* 2017".The research was conducted during *Kharif* season of 2017 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (U.P.). The experiment was conducted to find out the best performance of 15 Rice hybrids in RBD design with three replications. In an experiment it was revealed that variety KR-25 performed better than other varieties i.e. plant height (146.56 cm), tillers per plant (17), panicle length (28.86 cm), yield per plant (56.48 g), grain yield (8.87 t ha^{-1}) was found to be significantly higher than other varieties respectively.

Introduction

Rice is the most crucial cereal food crop of India, which occupies about 24% of gross cropped area of the country. It contributes 42% of total food grain production and 45% of total cereal production of the country. India (2010) yield of rice was 120.62mtn 44mha followed by China (197.21mt). During the last five decades the rice production trend has kept in pace with population growth trend. Global demand for rice is rising with the population growth, increasing affluence and changing dietary habits. The UN/FAO forecasts that global food production will need to increase by over 40% by 2030 and 70% by 2050 (FAO, 2009). Exploitation of heterosis is one of the alternatives for rising the production and productivity of rice. Heterotic hybrids hold great potential for improving economic yield in order to meet the global food needs (Hossain, 2014). Among the available genetic options to increase the productivity, adoption of hybrid rice breeding technology is one of the practically feasible and sustainable approaches. Moreover, hybrid rice normally has a yield advantage of 20 - 30% over non hybrid rice cultivars (Lokanadhan, 2010). A male sterile line is used as a female parent and grown side by side with a pollen parent in an isolated plot to produce a bulk quantity of hybrid seed ensuing from cross pollination with the adjoining fertile pollen parent (Li *et al.*, 2010).

Chinese rice scientists started breeding hybrid rice only after discovery of a "wild abortive" (WA) source of cytoplasmic male sterility (CMS) in a wild rice in 1970. Over the past three decades, the technology has helped China to achieve food security (Kobayashi, 2007).

Materials and Methods

The experiment was carried out during *Kharif* season of 2017 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (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. Different crops grown in successive years and seasons in the experimental field were recorded for the last 5 years to get an idea about the different species grown. The experimental field was ploughed with the help of tractor drawn plough followed by two harrowing and planking. After this flooding and puddling operation was carried out with help of rotavator after that the 15 Rice hybrid seeds were first tested for germination in the laboratory of Agronomy Department, SHUATS, Allahabad. Ten seeds for each variety were taken for germination test. Germination test was done using filter paper and petridish under laboratory condition and Twenty-one to twenty four days old seedlings were taken out from the nursery and transplanting was done manually maintaining of spacing of 20 x 10 cm.

Dose of fertilizer application basal dose of fertilizer was applied just before last puddling on 08 July, 2017, Half dose of nitrogen and full dose of phosphorus and potassium followed by two topdressings of $1/4^{th}$ dose of nitrogen on 31/07/2017 (23 DAT) &23/08/2017 (50 DAT) The experiment was conducted in Randomized block design consisting of 15 treatments combinations with 3 replications and was allocated randomly in each replication The data recorded during the course of investigation was subjected to statistical analysis by "Analysis of variance technique". The significant and non-significant treatment effects were judged with the help of 'F' (variance ratio) table. The significant differences between the means were tested against the critical difference at 5% probability level. For testing the hypothesis,

Results and Discussion

The results obtained from the experiment are discussed here under field Evaluation of Rice Hybrids under Agro Climatic Conditions of Allahabad (UP) In *Kharif* season the Plant heightwas recorded at 20, 40, 60 and 80 DAT. It was found to be significant from 60 and 80 DAT while, 60 and 80 DAT it was found to be non-significant. At 20 DAT, highest plant height (16.90 cm) was recorded with the rice hybrid KR-19(T_9) though non-significant. At 40 DAT, highest plant height (33.31cm) was recorded with the rice hybrid KR-13(T_3) though non-significant At 60 DAT, highest plant height (91.25 cm) was recorded with the rice hybridKR-21 (T_{11}) which was found to be statistically at per with KR-12 (T_2), KR-13 (T_3), KR-15 (T_5), KR-16 (T_6), KR-17 (T_7), KR-19 (T_9), KR-20 (T_{10}) and KR-25 (T_{15}). At 80 DAT, highest plant height (114.09 cm) was recorded with the rice hybrid KR-23 (T_{13}) which was found to be statistically at per with KR-11 (T_1), KR-20 (T_{10}), KR-21 (T_{11}), KR-22 (T_{12}). The increase in plant height might be due to the genetic makeup of the variety.

Similar results have also been reported by Haque *et al.*, (2015). The Number of tillers was recorded at 40, 60 and 80 DAT. It was found to be significant from 20 to 80 DAT. At 20 DAT, highest Number of tillers (14.33) was recorded with the rice hybrid KR-24(T_{14}) though non-significant. At 60 DAT, highest Number of tillers (10.70) and (10.43) was recorded with the rice hybrid KR-24 (T_{14}) and KR-16 (T_6) which was found to be statistically at per with KR-26 (T_6), KR-28 (T_8), KR-31 (T_{11}), KR-32 (T_{12}), KR-33 (T_{13}), and KR-34 (T_{14}). At 80 DAT highest Number of tillers (8.87) was recorded with the rice hybrid KR-22(T_{12}) though non-significant. The significant differences could be attributed to their varietal differences and to environmental adaptability. The significant differences could be

attributed to the fact that high yielding varieties (variety KR-39) have relatively high tillering capacity. Similar results have also been reported by Yadav *et al.,* (2004)

The Plant dry weight was recorded at 20, 40, 60 and 80 DAT. 20, 40, 60 and 80 DAT it was found to be non-significant. At 20 DAT highest plant dry weight (2.95) was recorded with the rice hybrid KR-25 (T_{15}) though non-significant. At 40 DAT, highest plant dry weight (12.46) was recorded with the rice hybrid KR-19 (T_9) though non-significant. At 60 DAT, highest plant dry weight (29.57) was recorded with the rice hybrid KR-23 (T_{13}) though non-significant. At 80 DAT, highest plant dry weight (40.75) was recorded with the rice hybrid KR-12 (T_2) though non-significant. The dry matter accumulation depends upon the photosynthesis and respiration rate, which finally increases the plant growth with respect to increased plant height, leaf area and tillers hill^{-1} etc. Thus, the treatment which attained maximum growth, also accumulated higher dry matter similar result have also been reported by Senthil Kumar (2016) The Crop growth ratewas recorded at 0-20, 20-40, 40-60 and 60-80 DAT though non- significant.

The percentage increase in CGR for21July transplanting over 22 July transplanting is due to prevalence of low temperature coupled with less humidity at the reproductive stage or at flag leaf stage which might have reduced the yield as compared to earlier planting. The availability of ample supply of nutrients especially nitrogen through foliar feeding may be the reason for the better performance with regard to CGR. Similar results have also been reported by Yadav *et al.,* (2004). The Relative growth rate was recorded at 0-20, 20-40, 40-60 and 60-80 DAT though non-significant. The percentage increase in RGR due to low temperature coupled with less humidity at the reproductive stage or at flag leaf stage might have reduced the yield. These results confirm the findings of (Yadav *et al.,* 2004). The data pertaining to days to 50% flowering clearly shows that significantly minimum days to 50% flowering was recorded under variety KR-14 (T_4) while the maximum days to 50% flowering was recorded under variety KR-18 (T_8). Day to 50% flowering was due to faster growing nature of the variety (KR-14), which attains the shortest days to reach the 50% flowering stage. Crop matures after 30 days to 50% flowering. However, the other reason might be due to the inherent character of variety (KR-14) to take minimum days to 50% flowering Heritability is a measure of extent of phenotypic variation caused by the action of genes. In the present study high heritability was observed for traits *viz*., plant height, number of spikelets panicle^{-1}, days to 50% flowering, similar results have also been reported by Haque *et al.,* (2015). The data pertaining to days to maturity clearly shows that significantly minimum days to maturity was recorded under variety KR-23 (T_{13}) while the maximum days to maturity was recorded under variety KR-18 (T_8). Day to maturity was due to faster growing nature of the variety (KR-23), which attains the shortest days to reach the maturity stage. Crop mature after 30 days to 50% flowering. However, the other reason might be due to the inherent character of variety (KR-23) to take minimum days to maturity. Heritability is a measure of extent of phenotypic variation caused by the action of genes. In the present study high heritability was observed for traits *viz*., plant height, number of spikelet panicle^{-1}, days to maturity, similar results have also been reported by Haque *et al.,* (2015) The data showed that the significant and highest tillers meter^{-2}was found in treatment (T_1) KR-11. However, treatment (T_{15}) KR-25 was found to be statistically at par with (T_1) KR-11.There was significant difference in number of tillers meter^{-2} among varieties. However, maximum number of tillers meter^2 (378.67) was recorded in variety KR-11 (T_1). Similar results have also been reported by Yadav *et al.,* (2004)

The significant differences could be attributed to the fact that high yielding varieties have relatively high tillering capacity Yadav *et al.,* (2004) The maximum panicle length hill^{-1} (30.17 cm) was recorded under variety KR-13 (T_3). The nitrogen level exerted non-significant effect of on panicle length in hybrid rice.

Table.1

Treatments	Rice Hybrid	Plant height (cm)				Number of tillers hill^{-1}			Days to 50% Flowering	Day to maturity	Tillers m^{-2}	Panicle length (cm)
		20 DAT	40 DAT	60 DAT	80 DAT	40 DAT	60 DAT	80 DAT				
T_1	KR-11	16.01	27.78	71.65	103.86	10.40	7.13	6.87	57.17	98.67	378.67	27.00
T_2	KR-12	15.01	31.80	85.83	101.40	10.87	7.87	7.06	59.32	98.33	334.33	27.53
T_3	KR-13	14.10	33.31	86.75	95.51	9.13	7.33	6.67	59.10	103.00	366.40	30.17
T_4	KR-14	15.07	28.81	74.70	97.90	11.00	8.23	7.95	56.16	98.67	353.33	28.37
T_5	KR-15	16.60	33.27	86.53	98.40	9.87	8.53	7.70	62.12	98.85	337.33	28.40
T_6	KR-16	16.10	30.19	87.12	102.33	13.47	10.43	8.13	67.84	108.67	258.93	27.67
T_7	KR-17	16.13	30.33	85.43	96.47	10.07	8.30	8.00	86.43	102.67	367.33	26.13
T_8	KR-18	15.52	31.90	72.40	97.01	10.40	7.87	6.13	88.19	116.33	325.33	29.03
T_9	KR-19	16.90	28.80	86.24	92.07	10.53	9.10	8.64	66.89	108.33	320.67	27.03
T_{10}	KR-20	15.18	32.67	85.93	107.05	8.33	7.50	7.97	65.49	98.94	289.67	28.33
T_{11}	KR-21	15.50	31.80	91.25	110.08	10.67	9.23	8.07	59.46	99.67	340.67	26.93
T_{12}	KR-22	15.40	29.23	89.27	104.38	12.67	9.23	8.87	67.01	107.00	338.67	27.40
T_{13}	KR-23	15.00	30.70	75.45	114.09	9.20	8.03	7.79	68.43	98.00	371.73	26.13
T_{14}	KR-24	13.73	26.35	75.74	102.35	14.33	10.70	7.53	68.89	99.67	334.47	24.73
T_{15}	KR-25	14.60	31.30	89.07	94.49	9.80	8.20	7.33	66.53	102.00	376.20	27.00
F test		**NS**	**NS**	**S**	**S**	**NS**	**S**	**NS**	**S**	**S**	**S**	**NS**
SEd (±)		**0.94**	**2.28**	**5.0**	**5.16**	**1.72**	**0.94**	**0.74**	**0.44**	**1.75**	**29.53**	**1.49**
CD (P=0.05)		**-**	**-**	**10.24**	**10.56**	**-**	**1.92**	**1.51**	**0.90**	**3.59**	**60.49**	**-**

Table.2

Treatments	Rice Hybrid	Plant dry weight (g)				Crop growth rate (g m^{-2} day^{-1})				Relative growth rate (mg g^{-1} day^{-1})			
		20 DAT	40 DAT	60 DAT	80 DAT	0-20Days	20-40Days	40-60Days	60-80 Days	0-20 Days	20-40 Days	40-60 Days	60-80 Days
T_1	KR-11	2.23	11.02	28.77	38.92	5.58	21.97	44.28	25.47	0.0399	0.1199	0.1677	0.1830
T_2	KR-12	2.19	11.42	29.46	40.75	5.48	23.07	45.11	27.63	0.0391	0.1217	0.1691	0.1851
T_3	KR-13	2.37	9.40	27.75	39.35	5.92	17.58	45.88	28.93	0.0419	0.1119	0.1661	0.1835
T_4	KR-14	2.47	11.53	28.32	39.94	6.17	22.66	41.97	29.05	0.0447	0.1214	0.1671	0.1843
T_5	KR-15	2.01	9.61	29.25	39.23	5.03	19.00	49.10	24.95	0.0345	0.1131	0.1687	0.1834
T_6	KR-16	2.36	9.81	28.27	39.55	5.89	18.64	46.14	28.21	0.0428	0.1141	0.1670	0.1838
T_7	KR-17	2.37	9.46	26.98	38.72	5.92	17.73	54.97	29.33	0.0430	0.0667	0.1647	0.1828
T_8	KR-18	2.41	11.13	29.50	39.50	6.03	21.81	45.91	25.01	0.0435	0.1199	0.1691	0.1838
T_9	KR-19	2.04	12.46	29.25	39.60	5.11	26.03	41.99	25.87	0.0357	0.1260	0.1688	0.1838
T_{10}	KR-20	2.65	12.11	27.09	38.35	6.63	23.64	37.44	28.15	0.0478	0.1247	0.1649	0.1822
T_{11}	KR-21	2.83	10.78	28.47	38.58	7.08	19.87	44.22	25.28	0.0518	0.0927	0.1298	0.1401
T_{12}	KR-22	2.37	10.48	27.95	37.60	5.92	20.29	43.68	24.12	0.0430	0.0915	0.1224	0.1338
T_{13}	KR-23	2.63	10.41	29.57	39.55	6.58	19.43	47.90	24.96	0.0483	0.0966	0.1315	0.1384
T_{14}	KR-24	2.37	9.54	28.99	39.64	5.93	17.93	48.62	26.63	0.0427	0.0907	0.1245	0.1368
T_{15}	KR-25	2.95	10.94	28.78	39.45	7.37	19.98	44.60	26.68	0.0539	0.1189	0.1679	0.1837
F test		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SEd (±)		0.30	1.22	1.50	1.82	-	0.01	0.06	0.11	-	-	-	-
CD (P=0.05)		-	-	-	-	-	-	-	-	-	-	-	-

The shortest panicle was registered by variety KR-24 (T_{15}) which is significantly different from the other varieties. The significant differences in panicle length among the hybrid rice varieties could be attributed to their genetic make-up. The results confirms the findings of Rahman *et al.,* (2013)

The highest significant number of filled grains panicle^{-1} (283.95) was recorded under the treatment T_{15} (variety KR-25). However T_1, T_3 and T_{11}(KR-11, KR-13 and KR-21), were found to be significantly at par to treatment with T_{15}. The favourable reason might be that hybrid rice produces long roots and broad leaves that enable them to take up more nutrients and produce more grains. T_{15} (variety KR-25), is suited to existing climatic condition of the place especially during the grain-filling stage of the panicle development. Similar results have also been reported by Bhuiyan *et al.,* (2014).

The lowest unfilled grains (no.) panicle (24.33) recorded under the treatment T_2 (KR-12), although the differences among the treatments was found to be significant. The reason might be that hybrid rice produces long roots and broad leaves that enable them to take up more nutrients and not produce more grains. Treatment T_{14}, KR-24(138.33), is unsuited to existing climatic condition of the place especially during the grain-filling stage of the panicle development. Similar results have also been reported by Bhuiyan *et al.,* (2014).

The significant and highest grain yield hill^{-1} (50.70 g) was found in treatment T_{15} (KR-25) was recorded under the treatment T_{15} (variety KR-25). However T_2, T_1 and T_9 (KR-12, KR-11 and KR-19), was found to be significantly at par to treatment with T_{15}. However, lowest grain yield hill^{-1} (38.51 g) was found in treatment T_4 (KR-14).

The higher grain yield under variety (KR-25) might be due to the optimum utilization of nutrient. The hybrids of short duration high yielding have the potential to give the maximum grain yield then rest of the varieties. The another reason of the high yield of variety (KR-25) is due to the better growth attribute resulting to produce higher grain yield. Similar findings were reported by Ranjitha *et al.,* (2013). The data showed that the significant and highest grain yield (8.16 t ha^{-1}) was found in treatment T_{15} (KR-25) and lowest grain yield (6.96t ha^{-1}) was found in treatment T_1 (KR-11). In general biological yield per plant had highly significant positive correlation with plant height, days to maturity, filled grain per panicle and total number of grains per panicle. Grain yield per plant had highly significant positive correlation with plant height, panicle length, 1000-grain weight, harvest index, grain yield per plot, grain yield meter^{-2} and with grain yield hectare^{-1}.

These results confirm the findings of (Rahman *et al.,* (2013). The data showed that the significant and highest Harvest index (41.93%) was found in treatment T_{15}. However treatment (KR-25) T_{15} was found to be statistically at par with $T_{14}T_8T_5T_1$. The harvest index significantly increased in (KR-25) due to lower mortality percent of tillers in grain ratio and total biological yield. The variety KR-25 due to high mortality percent of tillers resulted reduced grain ratio and total biological yield. Similar results have been also reported by Yadav *et al.,* (2010).

Maximum benefit cost ratio (2.96) was recorded in the treatment T_{15} (variety KR-25) because of higher net return (₹ 80711.58 ha^{-1}) as also obtained by Fayez *et al.,* (2015) The net return (₹ ha^{-1}) of hybrid rice has been presented in table 4.12 the treatment T_{15} (varietyKR-25) recorded the highest net return (80711.58). The cost of cultivation (₹ ha^{-1}) of hybrid rice is presented in the table 4.12 Cost of cultivation (₹ 41111.75ha^{-1}) was recorded in all treatments T_1 to $T_{15,}$ The cost. Of cultivation was higher due to cost of transplanting. The results confirm the findings of Haque *et al.,* (2015).

The gross return (₹ ha^{-1}) of hybrid rice has been presented in table 4.12 Maximum gross return (₹ 126628.33 ha^{-1}) was obtained from treatment T_{15}(variety KR-25) due to highest grain and straw yield.

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