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Evaluation of rice (*Oryza sativa* L.) Hybrids on growth yield and economics under agro-climatic conditions of Prayagraj, U.P.

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Abstract
The field experiment was conducted during *kharif* season of 2021 at Crop Research Farm Department of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (UP). The experiment was carried out to study the evaluation of 10 hybrids, which laid out in Randomized Block Design (RBD) & replicated thrice. The experiment findings revealed that at the harvest the significantly higher Plant height (110.34 cm), plant dry weight (53.28 g/plant), grain yield (6.77 t/ha), straw yield (12.67 t/ha) and harvest index (39.78%) was observed in rice hybrid UR 18. Higher gross returns (1, 77,949.00 ₹/ha), net return (1,16,631.00 ₹/ha) and benefit cost ratio (1.90) also obtained highest in rice hybrid UR-18.

Keywords: Hybrid rice, varietal response, yield, *Oryza sativa* L.

Introduction
Rice is one of the most important food crops and feeds more than 60 percent population of India. Rice has been cultivated in China since ancient times and was introduced to India before the time of the Greeks. Cultivation has been carried into all regions having the necessary warmth and abundant moisture favorable to its growth, mainly subtropical rather than hot or cold. The rice is cultivated on the largest areas in India. Historians believe that while the indica variety of rice was first domesticated in the area covering the foothills of the Eastern Himalayas (i.e. north-eastern India). Rice is inseparable from our day-to-day life since time immemorial as evident from its use in almost all rituals of our culture. The crop is grown in a diverse geographical and climatic conditions ranging from a below sea level in Kuttanad (Kerala) to high altitude in Kashmir valley. Rice is cultivated in a hydrology rang of moisture stress upland condition to waterlogged ecology. Hybrid rice accounts for more than half of the area under the crop and has contributed significantly to yield and output growth even after, relocation of land to other agriculture and non-agriculture uses. With the increasing popularity of hybrid among the Indian farmers it is necessary to develop appropriate cultivation practices if the full genetic potential is to be exploited. Growing of hybrid rice is a complex process and especially agronomic management of hybrid rice differs considerable from that of conventional varieties.

Material and Methods
A field experiment was conducted during *kharif* season of 2021 at the Crop Research farm, Department of Agronomy, Allahabad School of Agricultural, Sam Higginbottom University of Agriculture Technology and Sciences, Allahabad. The experiment site lies between 25-27° N latitude, 8.5°E Longitude and 98 meters altitude. The climate is characterized by the alternate hot rainy season from late June to early September with mean temperature of 38°C. The soil was sandy loam in texture having a pH (7.2), EC (0.14 dS/m), organic carbon (0.38%), available N (225 kg /ha), P (19.5 kg/ ha), K (340 kg/ ha), S (16.8.00 ppm), and Zn (0.51 ppm) during the experimental year. The experiment was laid down in randomized block design (RBD) with hybrids and 3 replications. Twenty five days old seedlings were transplanted to main field conventionally at a spacing of 20 x 10 cm. The crop was fertilized with recommended dose of NPK 120:60:60 kg/ ha was applied. The (100%) full dose phosphorus and potassium whereas (50%) of Nitrogen was applied at the time of planting as basal dose and the remaining.

Nitrogen was applied in two equal split doses as top dressing at active (Tillering & Panicle initiation stage) respectively. Similarly $ZnSo_4$ was applied as basal dose at the rate of 25 kg ha^{-1} for correction of zinc and sulphur deficiency. Irrigation was scheduled at 10-12 days interval as flooding; however other normal cultural practices were followed timely as; weeding at 30 DAT & 45 DAT. One quadrate was harvested in every plot for the determination of results and data was subjected to statistical analysis separately by using analysis of variance technique. The difference among hybrid means was compared by using least significant difference test at 5% probability levels.

Results and Discussion

Growth attributes

Plant height (cm)

Significantly maximum plant height (110.34 cm) was recorded in hybrid (UR 18) at 80 DAT. However hybrid UR16 (109.88 cm) and UR 21 (109.72 cm) were statistically at par with hybrid (UR 18). The increase in plant height might be due to the genetic makeup of the variety. This may be due to first generation hybrid vigor of the plant compared to other cultivars Paramasivan *et al*., 1988. Increase in plant height may also be due to synchronized availability of essential plants nutrients to the crop especially nitrogen for a longer period during its growth stages Deshpande and Devasenpathy 2011. Similar finding was also reported by Parihar *et al*., 2005, Kalyani *et al*., 2012 and Kumar *et al*., 2015.

Plant dry weight (g)

Maximum plant dry weight (53.28 g) was observed in hybrid UR 18 at 90 DAT. However UR 16 (52.88 g), were statistically at par with hybrid (UR 18). The increase in plant dry weight (g) might be due to more assimilatory surface leading to higher dry matter production coupled with effective translocation and distribution of photosynthates from source to sink. Dry matter accumulation depends upon the photosynthesis and respiration rate and during vegetative growth; hybrid rice accumulates more dry matter in the early and middle growth stages which results in more spikelet per panicle. They have bigger panicles and more spikelet per panicle. These factors result in higher yields usually 15% or more than ordinary rice. These results are confirmed by Singh and Khan 2003.

Crop growth rate (g/ m^2 /day) and Relative growth rate (g/ g day)

Crop growth rate (g/ m^2 /day) and Relative growth rate (g/ g /day) of rice recorded at different intervals was found non significant difference among the hybrids. Maximum CGR (56.02) were recorded in hybrid UR 23 and RGR (0.046) were recorded in hybrid UR 20 at 45-60 DAT, while minimum CGR (52.34) were recorded in UR 20 and RGR (0.031) was recorded in UR 25. The percentage increase in CGR is due to prevalence of low temperature coupled with less humidity at the reproductive stage or at flag leaf stage which might be reduced in yield as compare 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 & RGR. Similar results have been reported by Yadav *et al*., 2004.

Yield Attributes

The yield attributes of hybrid rice, *viz*. Highest number of effective tillers /hill (411.33) were recorded in UR 19, grain yield (6.77 t/ha), straw yield (12.67 t/ha) and harvest index (39.78%) were recorded in rice hybrid UR 18. The yield attributes are significantly influenced by genetic potential of the variety and also may be due to synchronized availability of essential plants nutrients to the crop especially NPK for a longer period during its growth & reproductive stages. Increased number of effective tillers/hill may have helped in increasing the photosynthetic area for photosynthesis in plant. In several rice cultivars, the effect on number of effective tillers production at all the growth stages was significant, the number increased till 75 DAT followed by a decline to harvest due to death of some undeveloped tillers, thus tillers development was found to be more in hybrid varieties apart from local variety reported by Akram *et al*., 2007. The higher grains per panicle might be due to optimum utilization of the nutrient. The another reason of the high grains per panicle of variety is due to better growth attribute resulting to produce higher grains $panicle^{-1}$ reported by Ranjitha *et al*., 2013 [11].

Economics

The highest gross return (1, 77,949.00 ₹/ ha), net return (1, 16,631.00 ₹/ ha) and B:C ratio (1.91) was recorded in rice hybrid UR 18.

Table 1: Performance of rice (*Oryza sativa* L.) hybrids on growth attributes.

Hybrid	Plant height (cm)	Tillers/hill (No.)	Dry weight (g/plant)	CGR (g/m^2/day)	RGR (g/g/day)
UR16	109.88	10.28	52.88	52.64	0.035
UR17	94.74	11.13	52.50	52.84	0.034
UR18	110.34	10.43	53.28	52.72	0.045
UR19	105.46	10.86	52.34	52.64	0.036
UR20	102.88	9.21	51.48	52.34	0.046
UR21	109.72	10.61	52.20	52.66	0.037
UR22	91.57	11.03	52.12	52.69	0.044
UR23	92.45	9.34	51.56	56.02	0.045
UR24	100.27	10.34	52.33	52.73	0.033
UR25	90.16	9.45	51.47	52.67	0.031
F test	S	S	S	NS	NS
S.Em(±)	0.26	0.11	0.30	1.80	0.001
CD(0.05)	0.74	0.32	0.87	-	-

Table 2: performance of rice (*Oryza sativa* L.) hybrids on yield attributes at harvest.

Hybrid	Effective tillers/m^2	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)
UR16	353.83	5.61	9.73	36.87
UR17	357.67	4.63	10.1	31.43
UR18	401.83	6.77	12.67	39.78
UR19	411.33	5.51	12.5	30.59
UR20	395.17	4.43	10.67	25.91
UR21	381	5.27	11.9	30.69
UR22	344.33	4.83	10.82	30.86
UR23	313.67	4.68	10.77	30.29
UR24	320	5.48	10.6	34.08
UR25	328.83	4.33	9.4	31.54
F test	S	S	S	S
S.Em(±)	14.56	0.21	0.36	0.86
CD(0.05)	42.11	0.62	0.86	2.94

Table 3: Performance of rice (*Oryza sativa* L.) hybrids on economics at harvest.

Hybrid	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
UR16	61,318.0 0	1,48,393.33	87,075.33	1.42
UR17	61,318.00	1,48,530.00	87,212.00	1.42
UR18	61,318.00	1,77,949.00	1,16,631.00	1.90
UR19	61,318.00	1,72,890.00	1,11,572.00	1.82
UR20	61,318.00	1,58,501.00	97,183.00	1.58
UR21	61,318.00	1,66,950.00	1,05,632.00	1.72
UR22	61,318.00	1,56,146.00	94,828.00	1.55
UR23	61,318.00	1,39,845.33	78,527.33	1.28
UR24	61,318.00	1,36,314.33	74,996.33	1.22
UR25	61,318.00	1,29,054.33	67,736.33	1.1

Summary

The experiment findings revealed that at the harvest the significantly higher Plant height (110.34 cm), plant dry weight (53.28 g/plant), grain yield (6.77 t/ha), straw yield (12.67 t/ha) and harvest index (39.78%) was observed in rice hybrid UR 18. Higher gross returns (1, 77,949.00 ₹/ha), net return (1,16,631.00 ₹/ha) and benefit cost ratio (1.90) also obtained highest in rice hybrid UR-18.

Conclusion

In conclusion, from the data pertaining to the different treatments, it may be indicated that by using hybrid UR 18 higher grain yield and monetary benefits can be realized over local cultivars. Hybrid UR 18 was found to be the best for obtaining highest grain yield, Straw yield, Gross return, Net return and benefit cost ratio. Since the findings are based on the research done in one season it may be repeated for conformation.

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