E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(6): 155-158
Received: 01-04-2024
Accepted: 10-05-2024

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Evaluation of private sector rice (*Oryza sativa* L.) genotypes under agro-climatic zone of Prayagraj U.P.

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i6c.824

Abstract
A field experiment was conducted at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) during *Kharif,* 2023. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), organic carbon (0.75%), available N (269.96 kg/ha), available P (33.10 kg/ha), and available K (336 kg/ha). The experiment was laid out in a Randomized Block Design with 12 hybrids each replicated thrice. The significantly highest plant height (63.22 cm), No. of tiller/hill (9.99), dry weight (28.96 g/plant), test weight (24.61g), Seed yield (6.95 t/ha) and Harvest Index (33.92%) were significantly higher in UR-350. Rice hybrid UR-350 fetched maximum gross return (INR. 165220 /ha), net return (INR. 111174 /ha) and B: C ratio (2.50).

Keywords: Hybrid rice, Hybrid response, Yield Attributes, Growth Attributes, Economics, Kharif

Introduction
Rice (*Oryza sativa* L.) is one of the most important staple cereal crops in the world and it is one of the main sources of carbohydrate for nearly one half of the world population. India has a long history of rice cultivation and stands first in rice area and second in rice production, after China (Yadav *et al*., 2010) [17]. Rice plants have been traced back to 5000 BC, but the practice of rice growing is believed to have originated in areas of China, and southern & eastern Asia, in about 2000 BC. Rice cultivation is considered to have begun simultaneously in many countries over 6500 years ago. Most believe the roots of rice come from 3000 BC India, where natives discovered the plant growing in the wild began to experiment with it.

India is major rice growing country in world with an area of 43.79 million hectares, having production 112.91 million tonnes and productivity of 2.572 t/ha (Directorate of Economics and Statistics, 2017-2018). In Uttar Pradesh 5.9 million ha and production 13.27 million tonnes with an average productivity of 2447 kg/ha and production of 14.63 million tonnes (Agriculture Statistics, 2016). Rice is the most crucial cereal food crop of India, which occupies about 24% of gross cropped area of the country. 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) and in year 2017-18 the Area, Production, Productivity in Uttar Pradesh and India was 5.81 Million hacter,13.21Million tones, 2283kg/ha and 43.79 Million hectare, 112.91 Million tonnes, 2578kg/ha respectively.

The nutrient contents of rice are 80% carbohydrates, 7-8% protein, the amino acid profile shows that it is rich in Glutamic acid and aspartic acid, highest quality cereal protein being rich in lysine (3.8%), 3% fibre, iron 1.0 mg and Zinc 0.5 mg (Juliano *et al*., 1985). The current global population of 7.55 billion is expected to reach 8.1 billion by 2025 and 9.6 billion by 2050 (Department of Economics and Social Affairs -2018). Globally, rice is cultivated now 159 million hectares with annual production of around 748 million tonnes and average productivity of 4.6 tonnes/ha (FAO, 2016-2017).

The history of hybrid rice progress started since 1908 when Shull coined the term heterosis. Heterotic hybrids hold great potential for improving economic yield in order to meet the global food needs (Mishra *et al*. 2019) [4]. Now, globally, hybrid rice research and development is being carried out in 20 countries. In ten of these countries, the technology has already been commercialized, though the area under hybrid rice is still very limited in all these countries in comparison with China. Hybrid rice technology is very important for the food security of rice-consuming countries where arable land is becoming scarce, population is steadily increasing and labour is cheap. Growing of hybrid rice is a complex process and especially agronomic management of hybrid rice differs considerable from that of conventional varieties. Although the technology is still new, many rice-producing countries have expressed their interest in applying it to improve food security. During the year 2010, hybrid rice was planted in an area of 1.7 mha and 1.5 to 2.5 mt was added to rice production in India through this technology. It occupied 3.86% of rice cultivating area in India. More than 80% of the total hybrid rice area in India is occupied by eastern Indian states like Uttar Pradesh, Jharkhand, Bihar, Chhattisgarh, with some little area in states like Madhya Pradesh, Assam, Punjab and Haryana. As rice is a key source of livelihood in eastern India, a considerable increase in yield through this technology will have a major impact on household food and nutritional security, income generation, besides an economic impact in the region. In view of this, hybrid rice has been identified as one of the components under the National Food Security Mission (NFSM) launched by the Government of India (GOI) with the aim to enhance rice production by 10 mt by 2011-12 (Prasad *et al*., 2016) [11].

2. Materials and Methods

2.1 Study Area Description

The experiment was carried out during Kharif season of 2023 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 25024' 42" N latitude, 810 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 Prayagraj Rewa Road about 5 km away from Prayagraj city. The soil of the experimental field was sandy loam in texture, nearly neutral in soil reaction (ph 7.8), and medium in organic carbon (0.35%) medium available nitrogen (243kg/ha), low in available phosphorus (20.10 kg/ha) and medium in available phosphorous (105.0 kg/ha).

2.2 Treatments and Design: The experiment was laid out in Random Block Design (RBD) and replicated thrice. The experiment comprises twelve hybrids, *viz.*, T_1:UR-225, T_2:UR-235, T_3:UR-245, T_4:UR-255, T_5:UR-300, T_6:UR-310, T_7:UR-320, T_8:UR-330, T_9:UR-340, T_{10}:UR-350, T_{11}:UR-360, T_{12}:UR-370; observation regarding growth, yield attributes and economics was recorded during the field experiment.

2.3 Experimental procedure

The nutrient sources were Urea, DAP, MOP and $ZnSO_4$ to fulfil the requirement of nitrogen, phosphorous and potassium. The recommended dose of 120 kg/ha nitrogen, 60 kg/ha and phosphorus 60 kg/ha potassium were applied according to the treatment details. Basal dose of fertilizer was applied just before last puddling, half dose of nitrogen and full dose of phosphorus and potassium followed by two top dressings of 1/4th dose of nitrogen. Sowing time and Spacing maintained as per the treatment combination. Several plant growth parameters were recorded at harvest and several yield parameters were recorded after harvest.

2.4 Data analysis

All collected data were statistically analyzed using analysis of variance (ANOVA) at 0.05% probability level.

3. Results and Discussion

3.1 Evaluation on growth attributes

The recorded and analysed data pertaining to growth parameters indicated that significantly higher in rice hybrid UR-350 *viz.;* plant height (68.22 cm) statistically at par with UR-300 and UR-235, number of tillers per hill (11.62) statistically at par with UR-320 and UR-300 and plant dry weight (26.93 g) statistically at par with UR-350 and UR-370. The genetic makeup of the variety is a huge contributing factor which have been reported by Haque *et al.* (2015) [8]. An increase in plant height may also be due to the synchronised availability of all the essential plant nutrients especially nitrogen for a longer period during the growth stage. The probable reason for maximum dry matter accumulation depends upon the photosynthesis and respiration rate, which finally increases the plant growth with respect to increase the plant height, leaf area and tiller/hill etc. Thus, a treatment that attained maximum growth also accumulated height and dry matter similar result has also been reported by Kumar (2016) [10].

Table 1: Performance on growth attributes of private sector rice (*Oryza sativa* L.) genotypes under agro-climatic zone of Prayagraj U.P.

Hybrids	Plant height (cm)	Tillers/hill (No.)	Dry Weight (g)	Days to 50% flowering	Days to Maturity
UR-225	66.57	10.34	25.67	51.00	101.00
UR-235	67.75	10.44	26.41	50.66	102.33
UR-245	62.86	10.24	25.52	50.33	101.66
UR-255	65.12	10.92	25.71	52.33	102.66
UR-300	67.81	11.22	26.86	52.33	101.66
UR-310	59.58	11.20	24.83	52.33	102.66
UR-320	61.64	11.34	22.81	52.33	104.33
UR-330	63.01	10.86	24.15	53.66	105.66
UR-340	63.18	10.94	25.48	53.33	102.66
UR-350	68.22	11.62	26.93	52.00	103.33
UR-360	62.53	10.34	25.67	51.66	103.00
UR-370	62.43	10.44	26.51	52.10	107.00
F-test	S	S	S	S	S
S.Em ±	0.41	0.27	0.76	0.53	0.96
CD(P=0.05)	1.23	0.79	2.26	1.58	2.82

3.2 Evaluation on yield and yield attributes
The hybrid UR-350 has recorded significantly higher yield attributes *viz.;* effective tillers (379.89 /m^2) statistically at par with UR-300 and UR-370, panicle length per hill (28.87 cm) statistically at par with UR-225 and UR-300, filled grain per panicle (112.72) statistically at par with UR-300 and UR-320 grain yield (6.95 t/ha) statistically at par with UR-300 and UR-340, straw yield (12.71t/ha) statistically at par with UR-300 and UR-320 and harvest index(33.92%).

Increases in yield attributes such as effective tiller per m^2, panicle length (cm), grain yield (t/ha) straw yield (t/ha) and harvest index (%) have resulted in an increase in grain yield as a result of different genetic makeup. Similar findings were recorded by Meena *et al.* (2016) [11] and Khan *et al.* (2018) [9].

Table 2: Performance on growth attributes of private sector rice (*Oryza sativa* L.) genotypes under agro-climatic zone of Prayagraj U.P.

Hybrids	Effective Tillers/m^2	Panicle length (cm)	Filled Grains /panicle (No.)	Grain Yield (t/ha)	Straw Yield (t/ha)	Harvest Index (%)
UR-225	321.50	28.29	94.68	5.26	12.24	31.84
UR-235	288.33	26.65	100.04	5.16	10.38	30.54
UR-245	268.66	26.61	102.21	4.21	9.29	31.41
UR-255	323.06	27.31	101.53	5.32	10.85	33.03
UR-300	379.66	27.32	111.94	6.43	12.70	33.19
UR-310	362.67	26.72	98.43	5.99	11.69	30.28
UR-320	367.06	25.93	108.41	6.23	12.41	33.90
UR-330	368.06	26.68	104.33	6.40	12.19	31.98
UR-340	357.53	26.80	104.66	6.67	11.91	29.49
UR-350	379.89	28.87	112.72	6.95	12.71	33.92
UR-360	288.33	27.29	96.32	4.46	12.24	31.84
UR-370	368.66	27.02	98.37	5.66	10.38	30.54
F-test	S	S	S	S	S	S
S.Em ±	5.48	1.12	3.34	0.38	0.45	0.76
CD(P=0.05)	17.87	3.31	9.80	1.10	1.35	2.23

3.3 Economics
Tabulated data revealed that Hybrid UR-350 has a maximum gross return (16,5220 INR/ha), net return(11,1175 INR/ha) and benefit-cost ratio (2.05).

Table 3: Performance on economics of private sector rice (*Oryza sativa* L.) genotypes under agro-climatic zone of Prayagraj U.P.

Hybrids	Gross Return (INR/ha)	Net Returns (INR/ha)	B:C Ratio
UR-225	128164.00	74117.99	1.37
UR-235	125363.33	71317.33	1.31
UR-245	105180.00	51134	0.94
UR-255	129310	75264	1.39
UR-300	153523.33	99477.33	1.84
UR-310	143476.66	89430.66	1.65
UR-320	149473.33	95427.33	1.76
UR-330	153070	99023.99	1.83
UR-340	158656.66	104610.66	1.93
UR-350	165220.00	111174.00	2.05
UR-360	110513.33	56467.33	1.04
UR-370	135053.33	81007.33	1.49

*Data was not subject to statistical analysis

4. Conclusion
Based on the findings of this field experiment, it is concluded that among the rice hybrids, UR-350 rice hybrid is recommended as it was found more adaptive, productive and profitable when compared to other rice hybrids under the agro-climatic zone of Prayagraj U.P.

5. Acknowledgement
The authors are thankful to Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India for providing us necessary facilities to undertake the studies.

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