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Shivam Kumar
M.Sc. Scholar, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Vikram Singh
Associate Professor, Department of Agronomy, Naini Agricultural institute, SHUATS, Prayagraj, Uttar Pradesh, India

Amit Kumar
Ph.D. Scholar, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Shivam Kumar
M.Sc. Scholar, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

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

Shivam Kumar, Vikram Singh and Amit Kumar

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Abstract
The 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 Randomized Block Design with 9 hybrids each replicated thrice. Based on the objectives taken maximum plant height (66.53 cm), number of tillers/hill (9.88), plant dry weight (27.67 g/plant), Crop Growth Rate at 60-80 DAS (25.69 g/m^2/day), tillers/m^2 (395.2), panicle length (27.74 cm), filled grains (106.96), grain yield/hill (30.94 g), seed yield (6.83 t/ha), stover yield (12.77 t/ha) and harvest index (38.86 %) were recorded significantly higher in hybrid R-120. Further, the maximum gross returns (INR 162533.00/ha) and net returns (INR 108487.00/ha) and B:C (2.01).

Keywords: Kharif, hybrid rice, hybrid response, yield attributes, growth attributes, economics

1. Introduction

Rice (*Oryza sativa* L.) the increasing prosperity, changing food patterns, and population increase around the world are driving up demand for rice. According to UN/FAO projections, there would need to be a 70% increase in global food production by 2050 and a 40% increase by 2030. (FAO, 2018) [5]. Therefore, in order to feed the growing population, rice output in India and a number of other Asian nations needs to treble by 2025. Scientists studying rice are confronted with the dilemma of boosting productivity while maintaining environmental sustainability in light of the growing population and food demand. One option to increase rice yield and productivity is to take use of heterosis.

With an area of 43.79 million hectares, 112.91 million tonnes of rice produced, and 2.572 t/ha of productivity, India is one of the world's leading rice-growing nations (Directorate of Economics and Statistics, 2017-2018). 5.9 million hectares and 13.27 million tonnes of production, or 14.63 million tons, are produced in Uttar Pradesh with an average productivity of 2447 kg/ha (Agriculture Statistics, 2016). With rice making up around 24% of India's total planted land, it is the most important cereal food crop. With rice making up around 24% of India's total planted land, it is the most important cereal food crop. It makes for 42% of the nation's overall production of food grains and 45% of its total production of cereals. In 2010 India's rice production was 120.62 million tonnes, or 44 million hectares: China's yield was 197.21 million tonnes. In 2017–18, Uttar Pradesh and India had respective area, productivity, and productivity of 5.81 million hectares, 13.21 million tonnes, and 2283 kg/ha, and 43.79 million hectares, 112.91 million tonnes, and 2578 kg/ha.

The amino acid profile of rice indicates that it is rich in glutamic acid and aspartic acid, with the highest quality cereal protein being rich in lysine (3.8%), 3% fiber, 1.0 mg iron, and 0.5 mg zinc. Rice's nutritional composition is 80% carbs and 7-8% protein (Juliano *et al*., 1985) [6]. According to the Department of Economics and Social Affairs (2018), the world's population, which is currently 7.55 billion, is predicted to increase to 8.1 billion by 2025 and 9.6 billion by 2050.

With an average yield of 4.6 tonnes/ha and an annual production of over 748 million tonnes, rice is currently grown on 159 million hectares worldwide (FAO, 2018) [5].

In nations where arable land is used for rice production, hybrid rice technology is crucial for ensuring food security. Since Shull first used the term heterosis in 1908, hybrid rice has progressed. In order to meet the world's food needs, heterozymes have a significant deal of promise for increasing economic yield (Mishra *et al*., 2003) [14]. Currently, 20 countries are involved in research and development related to hybrid rice. Although 10 of these nations have already commercialized the technology, all of these nations still have very small areas planted with hybrid rice when compared to China. The population is growing steadily, land is getting harder to come by, and labor is inexpensive. The cultivation of hybrid rice involves intricate procedures, particularly in terms of agronomic management, which varies significantly from traditional types. Many nations that produce rice have indicated interest in using the technology, despite its recent development, to increase food security. In 2010, 1.7 million hectares of hybrid rice were planted, adding 1.5 to 2.5 million metric tons to India's rice production. It made approximately 3.86 percent of India's rice-growing region. Eastern Indian states including Uttar Pradesh, Jharkhand, Bihar, and Chhattisgarh account for more than 80% of India's total hybrid rice acreage, with smaller portions found in Madhya Pradesh, Assam, Punjab, and Haryana. Since rice is a major source of revenue in eastern India, a significant increase in yield made possible by this technique will have a significant influence not only on the region's economy but also on household food and nutritional security. Given this, hybrid rice has been designated as one of the elements of the Government of India's (GOI) National Food Security Mission (NFSM), which aims to increase rice output by 10 mt by 2011–12. (Prasad *et al*., 2011) [11].

2. Materials and Methods

2.1 Study Area Description

At the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.), which is situated at 25024' 42" N latitude, 810 50' 56" E longitude, and 98 m above mean sea level, the experiment was conducted during the Kharif season of 2023. This region is located approximately 5 kilometers from Prayagraj city on the right bank of the Yamuna River beside Prayagraj Rewa Road. The texture of the soil in the experimental field was sandy loam: the soil reaction was almost neutral (pH 7.8), the organic carbon content was medium (0.35%), the nitrogen availability was medium (243 kg/ha), the available phosphorus content was low (20.10 kg/ha), and the available phosphorus content was medium (105.0 kg/ha).

2.2 Treatments and Design

Three replications of the experiment were conducted using Random Block Design (RBD). Nine hybrids make up the experiment: T_1: UR-100, T_2: UR-110, T_3: UR-120, T_4: UR-130, T_5: UR-140, T_6: UR-150, T_7: UR-160, T_8: UR-170, and T_9: UR-175. During the field experiment, observations were made about growth, yield attributes, and economics.

2.3 Experimental Procedure

To meet the needs for potassium, phosphorous, and nitrogen, the fertilizer sources were urea, DAP, MOP, and ZnSO4. In accordance with the treatment specifications, the appropriate doses of nitrogen (120 kg/ha), potassium (60 kg/ha), and phosphorus (60 kg/ha) were administered. Just prior to the final puddling, a base dose of fertilizer was applied. This was followed by two top dressings of 1/4th nitrogen, a half dose of nitrogen, and a full dose of potassium and phosphorus. Following the treatment combination, sowing timing and spacing are maintained. At harvest, a number of plant growth characteristics were recorded, and following harvest, a number of yield parameters were recorded.

2.4 Data Analysis

Utilizing analysis of variance (ANOVA) at the 0.05% probability level, all gathered data were statistically examined.

3. Results and Discussion

3.1 Evaluation on growth attributes

The collected and examined data regarding the growth parameters showed that the rice hybrid UR-120 had significantly higher values for the following: plant height (66.53 cm), which was statistically comparable to that of UR-160 and UR-150: number of tillers per hill (10.52), which was statistically comparable to that of UR-110 and UR-170: and plant dry weight (27.67 g), which was statistically comparable to that of UR-130 and UR-110. Haque *et al*. (2015) [8] have reported that a significant contributing factor is the genetic makeup of the variety. The coordinated availability of all the necessary plant nutrients, particularly nitrogen, for a longer amount of time during the growth stage may also be the cause of an increase in plant height. The rate of photosynthesis and respiration, which ultimately raises plant development in terms of height, leaf area, tiller/hill, etc., is most likely the cause of the greatest dry matter accumulation. Thus, Kumar (2016) also observed that a therapy that reached maximum growth also accumulated height and dry matter.

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

Hybrids	Plant height (cm)	Tillers/hill (No.)	Dry Weight (g)	Days to 50% flowering	Days to Maturity
UR-100	58.81	10.20	26.17	62.33	99.33
UR-110	59.82	10.42	26.44	67.33	106.67
UR-120	66.53	10.52	27.67	66.33	103.00
UR-130	55.95	10.11	27.06	52.67	96.67
UR-140	60.59	10.22	25.38	54.00	104.33
UR-150	61.00	10.12	24.57	67.33	104.34
UR-160	65.11	10.11	23.71	82.33	100.00
UR-170	60.51	10.24	26.18	68.00	103.67
UR-175	55.26	10.15	25.66	51.33	104.00
F-test	S	S	S	S	S
SEm ±	1.87	0.42	0.77	1.17	0.86
CD(P=0.05)	5.57	1.26	2.33	3.47	2.58

3.2 Evaluation on Yield and Yield Attributes
In terms of yield attributes, the hybrid UR-120 has significantly outperformed UR-175 and UR-110 in the following statistically: effective tillers (395.2 /m2), panicle length per hill (29.55 cm), grain yield (6.83 t/ha), harvest index (38.86%), and panicle length per hill (29.55 cm). UR-150 hybrid has recorded a significantly higher number of filled grains per panicle (106.96) compared to UR-140 and UR-160, while UR-130 hybrid has recorded a significantly higher straw yield (14.07 t/ha) compared to UR-175 and UR-150 hybrid. These results are statistically comparable. Grain yield (t/ha), straw yield (t/ha), panicle length (cm), effective tiller per m2, and harvest index (%) have all increased as a result of yield attributes.

Table 2: Effect on growth attributes of private sector rice (*Oryza sativa* L.) genotypes under agro-climatic conditions 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-100	370	26.73	94.80	5.05	11.57	30.45
UR-110	387	25.91	96.20	6.00	11.77	33.83
UR-120	395.2	29.55	94.27	6.83	10.78	38.86
UR-130	368.29	27.68	96.53	4.94	14.07	25.91
UR-140	369.6	25.57	106.47	5.24	11.61	32.22
UR-150	379.2	25.42	106.96	6.04	12.77	33.55
UR-160	378.4	26.61	104.24	5.80	9.53	38.61
UR-170	368	26.02	95.68	5.88	10.15	37.76
UR-175	393	28.60	101.00	5.36	13.00	31.59
F-test	S	S	S	S	S	S
SEm ±	5.9	0.78	2.98	0.39	0.67	0.83
CD(P=0.05)	16.82	2.34	8.8	1.73	2.06	2.51

3.3 Economics
Hybrid UR-120 has a maximum gross return of 16,2523 INR/ha, a maximum net return of 10,8487 INR/ha, and a maximum benefit-cost ratio of 2.01, according to tabulated data.

Table 3: Effect on Economics of private sector rice (*Oryza sativa* L.) genotypes under agro-climatic conditions of Prayagraj U.P.

Hybrids	Gross Return (INR/ha)	Net Returns (INR/ha)	B:C Ratio
UR-100	126020	71974	1.33
UR-110	155233.3	101187.3	1.87
UR-120	162533.3	**108487.3**	**2.01**
UR-130	115706.7	61660.67	1.14
UR-140	126820	72774	1.35
UR-150	145583.3	91537.33	1.69
UR-160	127530	73484	1.36
UR-170	139516.7	85470.67	1.58
UR-175	129923.3	75877.33	1.40

4. Conclusion
The results of this field experiment lead to the recommendation that, among the rice hybrids, UR-120 rice hybrid be used since, in the Prayagraj, Uttar Pradesh, agro-climatic zone, it was shown to be more adaptable, productive, and profitable than other rice hybrids.

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