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Evaluation of Rice (*Oryza sativa*) Hybrids under Agro-climatic Zones of Prayagraj, India

Akhil Kandakatla [a++*], Vikram Singh [a#] and Shruti Grace George [a†]

[a] *Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj – 211007, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

During *Kharif*, 2022 a field experiment was conducted at Crop Research Farm, Naini Agriculture Institute, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Soil was found to be sandy loamy soil.

The experiment was designed in a randomized block of three replicates and ten treatments using the rice hybrid cultivars: R - 24, R - 40, R - 48, R - 52, R - 77, R - 107, R - 111, R - 120, R - 127, R - 145. The experimental results revealed that R - 48 has significantly increased the growth parameters *viz.*, Plant height (111.25 cm), Number of tillers (14.50), Plant dry weight (38.43 g) and yield attributes as Number Tillers/m^2 (338.65), Panicle length (29.60 cm), Grain yield (5.16 t/ha) and Straw yield (13.31 t/ha). Also maximum gross return (₹116264 /ha), net return (₹67218/ha), and benefit cost ratio (1.37). Therefore, the rice hybrid R-48 would be able recommended to farmers after further trails.

[++] *M.Sc. Scholar;*
[#] *Associate Professor;*
[†] *Ph. D Scholar;*
**Corresponding author: E-mail: akhilkandakatla2531@gmail.com, 21msagro185@shiats.edu.in;*

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1. INTRODUCTION

The rice plant belongs to the genus *Oryza* L., of family Poaceae (Graminae). The *Oryza* genus contains four species complexes: *O. sativa* L., *O. officinalis* Wall., O*. ridley* Hook. *f*., and the species *O. granulata* Nees & Arn. ex G. Watt There are three *Oryza sativa* types: Indica, Japonica and Javanica. The Indica rice type (*O. sativa* subsp. *indica* Shig. Kato) is grown throughout the tropical and sub-tropical region, The Indica rice is grown in around 90% of world rice area. The Japonica rice type (*O. sativa* subsp. *japonica* Shig. Kato) is grown throughout the temperate zone. The Javanica rice type is the name given to *O. sativa* subsp. *japonica* growing mainly in the part ofIndonesia.

IRRI [1] stated that rice is one of the staple grains and more than 3.5 billion people consume more than 20% of their daily calorie intake from rice. IIt is the most important crop in India, accounting for about 24% of the cultivated area in the country. Its crops account for 42% of the country's total crop and 45% of the entire crop. About 55 percent of the crops are irrigated, accounting for 75 percent of the world's crop [2]. Virmani et al*.* [3] reported that about 20-30% yield advantage over conventional high yielding varieties.

China and India are the world's largest rice growing countries. Krishna Kumar et al. [4] stated that India has 42.2 million hectares of rice cultivation and China produces 110.9 million tons compared to 187 tons. 45 million tons of rice was produced in the 33.1 million area hectares. India has a long history of rice cultivation, the cultivation area is first in the world and rice production is second only to China [5]. It is estimated that the crop should increase to 114 million tons by 2035, but farmers must achieve this under the threat of climate change [6], agriculture and water, and increase the price of all materials. Increasing global food production while minimizing adverse impacts on resources and the environment is the toughest challenge for food security [7].

2. MATERIALS AND METHODS

During kharif season 2022 a field experiment was carried out at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, (U.P.), India, which is located at 25^0 28' 42" N latitude, 81^0 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 region has a subtropical semi-arid climate**.**. The experimental field had a sandy loam texture and organic carbon (0.87%), available Nitrogen (225.01 kg/ha), Phosphorus (41.79 kg/ha) and Potassium (261.11 kg/ha).

The experiment (270 m^2) was conducted in Randomized block design consisting of 10 hybrids (R-24, R - 40, R - 48, R - 52, R - 77, R - 107, R - 111, R - 120, R - 127, R - 145) with three replications and was assigned randomly in each replication.

To reduce crop competition with weeds, onehanded weed control was performed 35 days after sowing (DAS). Water it twice every 40 days. Observations of growth behavior were recorded at 20day intervals using standard methods and expressed as 100 DAS. The results were observed on the 23 November 2022 harvest day. Statistical analysis was performed using analysis of variance on all traits recorded using Gomez and Gomez [8].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Plant height (cm)

In 100 DAS, greater plant height (111.25 cm) was observed in R-107 (Table 1). However, R-40 (110.73 cm) and R-127 (110.28 cm) are included in R-107. Haque et al. also reported that the genetic composition of animals had a major influence [9]. The increase in plant height may be due to the simultaneous introduction of important plant nutrients, particularly nitrogen, from crops over a long growing period. The results are consistent with Deshpande and Devasenpathy [10]. In addition, the reason for the maximum height of the plant may be its better exposure to weather conditions.Bahur et al. [11] found that these hybrids reach higher growth stages and hydrothermal units.

3.1.2 Numbers of tillers/hill

At 100 DAT the maximum number of tillers was observed in R-48 (14.50) (Table 1). However, R -

Table 1. Field evaluation of growth attributes of rice hybrids at 100 days after sowing

		Growth parameters at 100 DAS		
S. No	**Hybrids**	**Plant Height(cm)**	**Tillers/hill(No.)**	**Dry weight(g)**
1.	R - 24	108.34	13.17	33.36
2.	R - 40	110.73	13.30	32.69
3.	R - 48	104.97	14.50	38.43
4.	R - 52	103.68	10.97	3398
5.	R - 77	108.24	12.34	33.76
6.	R - 107	111.25	10.43	37.44
7.	R - 111	107.30	11.70	35.45
8.	R - 120	104.20	10.50	34.57
9.	R - 127	110.28	14.30	35.21
10.	R - 145	103.20	11.97	32.93
	F-test	S	S	S
	SEm±	1.35	0.47	0.78
	CD (p=0.05)	4.01	1.39	2.34

Table 2. Field evaluation of yield attributes of rice hybrids at 100 days after sowing

		Growth Parameter		at 100 DAS	
S. No.	**Hybrids**	**No. Tillers/m^2**	**Panicle length (cm)**	**Grain yield (t/ha)**	**Straw yield(t/ha)**
1.	R - 24	273.81	25.28	3.14	9.46
2.	R - 40	320.63	28.23	4.73	10.59
3.	R - 48	338.65	29.60	5.16	13.31
4.	R - 52	280.22	24.99	3.66	8.83
5.	R - 77	254.22	26.29	4.85	10.17
6.	R - 107	307.43	29.12	3.47	8.34
7.	R - 111	308.88	27.59	3.64	9.84
8.	R - 120	323.74	25.43	2.43	7.10
9.	R - 127	246.36	23.20	3.37	9.98
10.	R - 145	255.43	20.20	2.90	12.25
	F-test	S	S	S	S
	SEm±	9.89	0.76	0.19	0.53
	CD (p=0.05)	29.40	2.27	0.59	1.58

Table 3. Field evaluation of different varieties on economics of rice hybrids

S. No.	Hybrids	Cost of cultivation (INR/ha)	Economics		
			Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1	R - 24	49046	71444	22398	0.45
2	R - 40	49046	106081	57035	1.16
3	R - 48	49046	116264	67218	1.37
4	R - 52	49046	82,222	33176	0.67
5	R - 77	49046	108343	59297	1.20
6	R - 107	49046	77941	28895	0.58
7	R - 111	49046	82196	33150	0.67
8	R - 120	49046	55085	6039	0.12
9	R - 127	49046	68463	19418	0.39
10	R - 145	49046	107250	58204	1.18

127 (14.30), R - 40 (13.30), and R - 24 (13.17) were statistically at par with R - 48. A relative analysis of the performance of rice hybrids exhibited that R-48 recorded maximum tillers/hill. The significant difference may be due to the genetic diversity of high yielding crops that may be affected by heredity.

3.1.3 Plant dry weight (g)

At 100 DAT the maximum dry weight was recorded in R-48 (38.43 g/plant) (Table 1). However, R-107 (37.44 g/plant), were statistically at par with R-48. Dry matter production ultimately depends on the growth of the plant, tree, leaves and tillers/hills etc. It depends on photosynthesis and respiration, which causes it to increase in height. Therefore, the processes that achieved the best growth also retained more dry matter. Kumar [12] reported similar results for dry matter. Another reason for dry problems may be increased hay yield due to the importance of morphological increase that is not responsible for the photosynthetic capacity of the plant. Results Bozorgi et al. [13].

3.2 Yield Parameters

3.2.1 Number of tillers/meter^2

The maximum value was observed in R - 48 (338.65 tillers/m2), (Table 2). R - 40 (320.63 tillers/m2) and R - 120 (323.74 tillers/m2) were statistically at par with R - 48. The high tillering capacity is the probable reason for high yielding varieties. Similar findings are also described by Yadav et al. [14]. Wang et al. [15] reported that the uneven distribution of photosynthetically active radiation (PAR) is the source of individual tiller efficiency heterogeneity, as earlyemerging dominant siblings avoid the topmost light and late-emergent siblings are shaded in low light.

3.2.2 Panicle length

In Table 2 is shown the recorded significantly higher in panicle length (29.60 cm) in R-48. However, R-107 (29.12 cm) and R-40 (28.23cm) were statistically at par with R-48. The nitrogen level exert a significantly favorable effect on panicle length on rice hybrids. The difference in the length of the panicle of hybrid rice species can also be attributed to their genetic composition. The results confirmed the findings of Rahman et al. [16].

3.2.3 Grain yield (t/ha)

The data (Table 2) showed the significantly highest grain yield in R-48 (5.16 t/ha). R-40 (4.73 t/ha) and R-77 (4.85 t/ha) were statistically at par with R-48. The higher yield per mound under cultivars may be due to proper use of nutrients. Short-term hybrids can produce the largest crops compared to other varieties. Another reason for the high yield of R-48 is more crops due to better growth . Similar findings have been reported by Ranjitha et al. [17]. Straw yield (t/ha).

The data in Table 2 showed that R-48 had the best hay yield (13.31 t/ha). However, R-145 (12.25 t/ha) was analyzed compared to R-48. According to Padmavathi's (1997) findings, hybrid rice's ability to use more nitrogen is due to good growth, good nutritional value and good physical health and increased hay yield [18,19].

3.3 Economics

The result showed (Table 3) that the maximum gross return (116264 INR/ha), net return (67218 INR/ha) and B: C ratio (1.37) was recorded in R-48 as compared to other rice hybrids.

4. CONCLUSION

The concluded experiment showed that the rice hybrid R-48 was found to be the best for obtaining maximum grain yield. It also achieved the best total return, net return and cost-to-profit compared to other hybrids. Because this discovery is from research done in one season. More experiments are needed to more clearly confirm the results. Rice hybrid R-48 can be recommended to farmers after additional testing.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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