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Growth and Yield of Rice (*Oryza sativa* L.) under Agro-climatic Zone of Prayagraj, India

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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 done on sandy loamy soil at Crop Research Farm, Naini Agriculture Institute, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experiment was designed in Randomised Block Design and replicated three times, using ten hybrids, R-205, R-210, R-212, R-218, R-242, R-248, R-256, R-300, R-305, and R-311. Results indicates that R-305 significantly enhanced the growth parameters Days to 50% Flowering (74.66 DAT), Days to maturity (106.93 DAT), Filled grains/panicle (175.82), Unfilled grains/panicle (48.39), and Grain yield/hill (28.82 g/ha) in the field trial. R-305 also had the highest gross return (INR 200625/ha), net return (INR 151579/ha), and B:C ratio (3.09). R-311 had the shortest amount of Days to 50% flowering (68.00 DAT), Days to maturity (92.71 DAT), and unfilled grains/panicle (27.25). It was determined that the hybrid R-305 produced the highest grain yield. It also achieved the highest gross return, net return, and B:C ratio.

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1. INTRODUCTION

One of the most important staple grains in the world, rice (*Oryza sativa* L.) provides the majority of the world's population with carbohydrates. However, Asia produces and consumes 90% of the world's rice. It generates 43% of the nation's total gross cropped land, 46% of all cereal production, and comes in second place behind China in terms of rice production. The rice plant is classified genetically as belonging to the poaceae (genus Oryza, family Gramineae).

“The genus has 24 species, 22 of which are wild and 2 of which are domesticated, namely Oryza sativa L. and Oryza glaberimma. On the continents of Asia, America, and Europe, every species is grown. India has 44.2 million ha of land, producing 118.87 million tonnes on an average of 2.3 tonnes per ha” [1].

“5.9 million hectares in Uttar Pradesh, with an average productivity of 2447 kg/ha and a production of 14.63 million tonnes" [2]. "Rice is now grown on 159 million hectares worldwide, with an annual production of around 748 million tonnes and an average productivity of 4.68 tonnes/ha” [3].

“Rice includes 80% carbs, 7-8% protein, and an amino acid profile that shows it is high in glutamic acid and aspartic acid, as well as lysine (3.8%), 3% fibre, iron 1.0 mg, and zinc 0.5 mg” [4].

“The output and quality of rice, which is utilised for feed and industrial uses, were significantly improved by rice hybrids. If the management level is greater than 60%, hybrid rice growing is commercially viable. Hybrids are non-lodging, have considerable pest and disease resistance, are short-lived, respond well to stress and various climatic conditions, and have a longer shelf life. Out of the 43 million hectares that are being grown for rice, about 3 million are hybrids. Due to the pressing requirement for high yielding rice types due to population growth, rice hybrids break yield boundaries and produce 15–20% more” [5].

The history of hybrid rice improvement began in 1908, when Shull invented the term heterosis. Heterotic hybrids have a high potential for increasing economic yield in order to meet global food demands [6].

2. MATERIALS AND METHODS

This experiment was carried out during the 2022 kharif season at the Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (U.P.), which is located at 250 28' 42" N latitude, 810 50' 56" E longitude, and 98 m altitude above mean sea level. “This area is located on the Yamuna River's right bank, along the Prayagraj-Rewa Road, about 5 km from Prayagraj city. Organic carbon (0.87%), accessible nitrogen (225 kg/ha), phosphorus (41.8 kg/ha), and potassium (261.2 kg/ha) are the most abundant elements. The region has a semi-arid subtropical climate. One hand weeding was performed 35 days following sowing to prevent crop-weed competition. Two irrigations were administered at 40-day intervals. The growth characteristics observations were recorded using conventional technique at 20-day intervals and displayed at 100 DAS. Yield metrics were measured on harvest day, November 23rd, 2022. All of the parameters were recorded and statistically analysed using appropriate analysis of variance techniques” as described by [7].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Days to 50% flowering

The data pertaining days to 50% flowering clearly shows that significantly minimum days to 50% flowering was observed in R-311 (68.00 DAT). While the maximum days to 50% flowering was recorded under variety R-305 (74.66 DAT). However, R-300 (72.66 DAT) and R-210 (72.33 DAT) were statistically at par with R-305.

Days to 50% flowering were shortened by the variety's quicker growth rate, which led to shorter days to 50% flowering. The variety's innate tendency to require a minimum number of days for 50% of its flowers to open, however, may be the other factor. The degree of phenotypic diversity brought on by gene action is measured by heritability [8].

3.1.2 Days to maturity

The data pertaining to days to maturity clearly shows that significantly minimum days to

maturity was observed in R-311 (92.71 DAT). While the maximum days to maturity was recorded under variety R-305 (106.93 DAT). However, R-300 (104.46 DAT), R-256 (102.50 DAT), R-248 (101.50 DAT) and R-452 (100.63 DAT) were statistically at par to R-305.

Days to maturity were shortened by the variety's higher growth rate, which results in shorter days to reach the maturity stage. Crops reach maturity 20 to 30 days after 50% flowering. The alternative explanation, however, may be related to the variety's innate tendency to mature in a minimum number of days. The degree of phenotypic diversity brought on by gene action is measured by heritability. For variables including plant height, number of panicles or spikelets, days to maturity, and spikelet number, high heritability was found in the current study [9].

3.2 Yield Parameters

3.2.1 Filled grains/panicle

The highest significant number of filled grains/panicle (175.82) was recorded under the hybrid R-305. However, R-300 (170.97), R-256 (167.84) and R-248 (162.40) were statistically at par with R-305.

“The most likely explanation is that hybrid rice grows long roots and broad leaves, allowing it to absorb more nutrients and yield more grains. It is appropriate for the local climate, particularly during the grain-filling stage of panicle development” [10].

3.2.2 Unfilled grains/panicle

The minimum number of unfilled grains/panicle (27.25) was recorded under the treatment R – 311. The significantly highest unfilled grains/panicle (48.39) was recorded under the treatment R-305. However, R-300 (46.22) was statistically at par with R-305.

It's possible that this is the case because hybrid rice has long roots and broad leaves, which allow it to absorb more nutrients and produce more grains. [10]. The greater percentage of unfilled grain was likely caused by the extremely unfavourable environment, delayed planting, and subsequent increase in bug, pest, and water shortage incidences at the time of grain filling stage. The current findings concur with those made by [11].

3.2.3 Test weight (g/hill)

The data showed the highest test weight was observed in R-305 (24.33 g/hill). However, R-300 (23.85 g/hill), R-256 (23.48 g/hill) and R-248 (23.39 g/hill) were statistically at par with R-305.

3.2.4 Grain yield/hill

The data showed the highest grain yield/hill was observed in R-305 (28.82 g/hill). However, R-300 (27.24 g/hill), R-256 (26.11 g/hill), R-248 (25.69 g/hill), R-242 (24.97 g/hill) were statistically at par with R-305.

The better nutrient utilisation may be the cause of the increased grain yield/hill under variety. The hybrids with short maturing times and large yields have the potential to produce the most grain of all the kinds. Another explanation for the high yield of the variety may be enhanced growth characteristics that result in increased grain production [12].

Table 1. Field evaluation of different varieties on growth attributes of Rice Hybrids

S. No.	Hybrids	Days to 50% flowering (No.)	Days to maturity(No.)
1.	R-205	70.33	93.59
2.	R-210	72.33	95.18
3.	R-212	72.00	96.86
4.	R-218	72.00	98.11
5.	R-242	71.66	100.63
6.	R-248	72.00	101.50
7.	R-256	70.66	102.50
8.	R-300	72.66	104.46
9.	R-305	74.66	106.93
10.	R-311	68.00	92.71
	F-test	S	S
	SEm±	0.84	2.87
	CD (p=0.05)	2.52	8.55

Table 2. Field evaluation of different varieties on yield attributes of Rice Hybrids

S. No.	Hybrids	Filled grains (No.)	Unfilled grains (No.)	Grain Yield/Hill (g/hill)
1.	R-205	145.21	33.17	20.99
2.	R-210	148.02	35.53	21.80
3.	R-212	151.53	38.26	22.61
4.	R-218	155.84	40.21	23.80
5.	R-242	158.81	41.51	24.97
6.	R-248	162.40	43.37	25.69
7.	R-256	167.84	44.66	26.11
8.	R-300	170.97	46.22	27.24
9.	R-305	175.82	48.39	28.82
10.	R-311	143.19	27.25	19.33
	F-test	S	S	S
	SEm±	5.75	1.22	0.70
	CD (p=0.05)	17.09	3.63	2.10

4. ECONOMICS

Table 3. Field evaluation of different varieties on Economics of Rice Hybrids

S. No.	Hybrids	Economics			
		Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1.	R-205	49046	148305	99259	2.02
2.	R-210	49046	157420	108374	2.20
3.	R-212	49046	161135	112089	2.28
4.	R-218	49046	167840	118794	2.42
5.	R-242	49046	175745	126699	2.58
6.	R-248	49046	181825	132779	2.70
7.	R-256	49046	186680	137634	2.80
8.	R-300	49046	193165	144119	2.93
9.	R-305	49046	200625	151579	3.09
10.	R-311	49046	135050	86004	1.75

“The result showed that (Table 3) the maximum gross return (200625 INR/ha), net return 151579 INR/ha) and B:C ratio (3.09) was recorded in R-305 as compared to other Hybrids” [13].

5. CONCLUSION

Based on the finding of this study it is concluded that the hybrid R-305 produced the highest grain yield. Additionally, it generated the highest net return, gross return, and B:C ratio.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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