Original Research Article

AGRONOMIC EVALUATION OF RICE(Oryza sativa L.) HYBRIDS UNDER AGRO- CLIMATIC CONDITIONS OF PRAYAGRAJ

Abstract

A field experiment was conducted during the Kharif season of 2022 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.). The experimental site is situated at coordinates 25024' 42" N latitude, 810 50' 56" E longitude, and an altitude of 98 meters above mean sea level. It is located on the right side of the Yamuna River, alongside Prayagraj Rewa Road, approximately 5 km away from Prayagraj city. The soil in the experimental plot was sandy loam in texture with a nearly neutral pH of 7.1. The soil analysis revealed the following nutrient levels: organic carbon (0.75%), available nitrogen (269.96 kg/ha), available phosphorus (33.10 kg/ha), and available potassium (336 kg/ha). The experiment followed a Randomized Block Design, with 10 different hybrids, each replicated three times. Among the hybrids tested, hybrid R-305 exhibited significantly higher values for various parameters, including maximum plant height (110.43 cm), plant dry weight (49.45 g/plant), tillers per square meter (366.23), panicle length (29.73 cm), filled grains (250.87), grain yield per hill (31.37 g) and grain yield per hectare (5.52 t), as well as straw yield (10.51 t/ha). However, hybrid R-400 had the highest number of tillers (14.89), while R-311 showed the highest crop growth rate (32.63 g/m2/day). Hybrid R-405 exhibited a higher test weight (25.87 g), R-410 had more unfilled grains (52.36), and R-458 had a longer duration to 50% flowering (52.39) and maturity (87.67). In terms of economic considerations, hybrid R-305 recorded the maximum gross returns (₹ 130,890.40/ha), net returns (₹ 81,844.00/ha), and a B:C ratio of 1.67, indicating its superior profitability compared to other hybrids.

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

INTRODUCTION

Rice (*Oryza sativa L.*) is a crucial cereal food crop in India, covering approximately 24% of the country's gross cropped area. It contributes 42% to the total food grain production and 45% to the total cereal production. India has a rich history of rice cultivation and ranks first in terms of rice cultivation area and second in rice production, following China (**Yadav *et al.*, 2010**). Over the past three decades, India's net sown area has remained stagnant at around 142 million hectares, indicating the saturation of land resources for cultivation (India, MoAFW 2018). In Uttar Pradesh, the rice cultivation area is 5.9 million hectares, with a production of 13.27 million tonnes and an average productivity of 2447 kg/ha, resulting in a total

production of 14.63 million tonnes (Agriculture Statistics 2016). To enhance yield and productivity, various strategies have been implemented, including conventional hybridization and selection procedures, ideotype breeding, hybrid breeding, wide hybridization, and genetic engineering. Among these options, adopting hybrid rice breeding technology has emerged as a practical and sustainable approach. Hybrid rice typically exhibits a yield advantage of 20-30% over non-hybrid rice cultivars (Lin and Yuan, 1980; Shen, 1980). More than 80% of the total hybrid rice area is concentrated in eastern Indian states such as Uttar Pradesh, Jharkhand, Bihar, and Chhattisgarh, with smaller areas in states like Madhya Pradesh, Assam, Punjab, and Haryana. The adoption of hybrid rice technology has resulted in planting hybrid rice on 1.3 million hectares of land and an additional rice production of 1.5 to 2.5 million tonnes. Given the increasing population, there is an urgent need for high-yielding rice varieties, as yields have already stagnated. Hybrid rice offers a breakthrough by providing a 15-20% higher yield. However, growing hybrid rice is a complex process, and the agronomic management of hybrid rice differs significantly from that of conventional varieties. Although the technology is relatively new, many rice-producing countries have shown interest in adopting it to improve food security. In 2010 alone, hybrid rice was planted on an area of 1.7 million hectares in India, resulting in an additional rice production of 1.5 to 2.5 million tonnes.

MATERIALSANDMETHODS:

The field experiment was conducted during the Kharif season of 2022 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.). The experimental site is located at coordinates 25024' 42" N latitude, 810 50' 56" E longitude, and an altitude of 98 meters above mean sea level. It is situated on the right side of the Yamuna River, adjacent to Prayagraj Rewa Road, approximately 5 km away from Prayagraj city.The soil in the experimental plot was sandy loam in texture, with a nearly neutral soil reaction (pH 7.1). The soil analysis revealed the following nutrient levels: organic carbon (0.75%), available nitrogen (269.96 kg/ha), available phosphorus (33.10 kg/ha), and available potassium (336 kg/ha).The experiment followed a Randomized Block Design with 10 hybrids, each replicated three times. The hybrids studied were R 305, R 311, R 315, R 400, R 405, R 410, R 458, R 462, R 504, and R 510. Various growth parameters were observed at harvest, including plant height (cm), number of tillers per hill, plant dry weight per hill (g/hill), days to maturity, effective tillers per square meter, filled grains per panicle, grain yield per hectare (t/ha), straw yield per hectare (t/ha), and harvest index (%).Statistical analysis was performed to test the significance of the data, and the experiment findings are summarized below, taking scientific reasoning into account.

RESULTSANDDISCUSSION

A.GrowthAttributes:

Plant Height: At 100 days after transplanting (DAT), the tallest plant height was recorded in hybrid R-305, measuring 110.43 cm. Hybrid R-410 (108.84 cm) and R-504 (107.77 cm) exhibited statistically similar plant heights to R-305. Increase in plant height may also be due to synchronized availability of all the essential plant nutrients especially nitrogen for a longer period during growth stages (**Singh *et al.*, 2019**).This finding is consistent with the results reported by **Deshpande and Devasenpathy in 2011.**

Number of Tillers: At 100 days after transplanting (DAT), hybrid R-400 exhibited the highest number of tillers, recording 14.89 tillers. However, hybrids R-305 (13.50), R-315 (14.51), and R-410 (14.57) showed no significant statistical difference compared to R-400. The observed variations in tiller numbers could be attributed to the genetic makeup of the high-yielding varieties, which may be influenced by heredity. Additionally, adequate nutrient availability could have played a role. These finding align with the results reported by **chowdhery et al (1993)**.

Plant Dry Weight: At 100 days after transplanting (DAT), hybrid R-305 exhibited the highest plant dry weight, measuring 49.45 g. However, hybrids R-410 (48.99 g/plant) and R-504 (47.86 g/plant) showed no significant statistical difference compared to R-305. The maximum accumulation of dry matter in the plants can be attributed to the rates of photosynthesis and respiration, which ultimately contribute to increased plant growth, including plant height, leaf area, and tillers per hill. Similar findings have been reported by **Kumar in 2016**, confirming the relationship between plant growth and dry matter accumulation.The other reason of high dry matter accumulation in might be due to the significant increase in morphological parameters which responsible for the photosynthetic capacity of the plant thereby increasing the straw yield. The result conformed with **Bozorgi *et al.*(2011).**

B. YieldAttributes

Days to Maturity: The data obtained regarding days to maturity clearly indicates that hybrid R-458 exhibited the significantly shortest duration to maturity, recording 87.67 days after transplanting (DAT). Hybrid R-462 (92.03 DAT) and R-510 (91.16 DAT) showed no significant statistical difference compared to R-458. On the other hand, hybrid R-311 had the longest duration to maturity, reaching 107.85 DAT.
The variation in days to maturity can be attributed to the faster growth characteristics of certain varieties, allowing them to reach the maturity stage in a shorter period. Generally, crops mature approximately 20-30 days after reaching 50% flowering. Additionally, the genetic makeup of the variety itself may contribute to the shorter duration to maturity. Heritability, which measures the extent of phenotypic

variation influenced by genes, was observed to be high for traits such as plant height, number of spikelets per panicle, and days to maturity. Similar results have been reported by **Haque *et al.* in 2015.**

Tillers/m^2: Hybrid R-305 exhibited the significantly highest number of tillers per square meter, with 366.23 tillers/m^2. Hybrid R-400 (354.67 tillers/m^2) and R-462 (328.54 tillers/m^2) showed no significant statistical difference compared to R-305. The high tillering capacity of the high-yielding varieties may explain the observed results. This finding is consistent with the findings reported by **Yadav *et al.* in 2004.** According to **Wang *et al.* in 2016,** the unequal distribution of photosynthetically active radiation (PAR) can result in heterogeneity in individual tiller yields. Early emerging superior tillers can take up the uppermost light source, shading the late emerging tillers under limited light conditions.

Filled grains: Hybrid R-305 exhibited the highest significant number of filled grains per panicle, with a count of 250.87. Hybrid R-311 (241.17) and R-410 (234.87) showed no significant statistical difference compared to R-305. This can be attributed to the characteristic of hybrid rice to develop long roots and broad leaves, which enable them to absorb more nutrients and produce a higher number of grains. These traits are well-suited to the prevailing climatic conditions, particularly during the grain-filling stage of panicle development. Similar findings have been reported by**Bhuiyan *et al.* in 2014.**

Grain Yield: The data indicates that hybrid R-305 achieved the significantly highest grain yield, measuring 5.52 tonnes per hectare (t/ha). Hybrid R-410 (5.08 t/ha) showed no significant statistical difference compared to R-305. Grain yield demonstrated a strong positive correlation with variables such as tillers per hill, panicle length, and harvest index. These findings are consistent with the results reported by **Rahman *et al.* in 2013,** further supporting the relationship between these factors and grain yield.

Straw Yield: The data reveals that hybrid R-305 achieved the significantly highest straw yield, measuring 10.51 tonnes per hectare (t/ha). Hybrid R-311 (10.03 t/ha), R-400 (9.52 t/ha), and R-410 (10.00 t/ha) showed no significant statistical difference compared to R-305. These results align with the findings reported by **Padmavathiin 1997**, which indicate that hybrid rice has the ability to effectively utilize nitrogen through enhanced nutrient uptake and physiological growth, leading to increased straw yield.

Harvest Index: The data indicates that hybrid R-305 achieved a significantly higher harvest index of 34.44%. Hybrid R-315 (34.35%), R-410 (33.69%), R-458 (33.45%), and R-462 (32.94%) showed no significant statistical difference compared to R-305. The increase in harvest index can be attributed to a higher rate of translocation of photosynthates to grains during the grain-filling stage. Harvest index serves

as a reflection of the physiological capacity of a crop variety to effectively mobilize and translocate photosynthates to the sink. In a study conducted by **Marri *et al.* in 2005,** they found a negative correlation between harvest index and plant height, but a positive correlation with grain number per panicle, grain number per plant, percentage of spikelet fertility, and yield per plant in rice.

CONCLUSION

Based on the concluded experiment, it was determined that hybrid R-305 exhibited superior productivity and economic feasibility. However, it is important to note that these findings are based on research conducted within a single season. To obtain more precise and reliable results, further trials and experiments are required to validate these findings.

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Table.1Field evaluation of hybrid rice on growth parameters of rice hybrid

Hybrids	Plant height (cm)	Number oftillers/hills	Dry weight (g/plant)
R 305	110.43	13.5	49.45
R 311	106.77	13.41	46.73
R 315	101.63	14.51	45.04
R 400	102.93	14.89	42.45
R 405	106.37	10.48	44.88
R 410	108.84	14.57	48.99
R 458	105.6	10.32	45.96
R 462	104.7	13.04	44.43
R 504	107.77	11.39	47.86
R 510	100.58	10.6	44.89
F-test	S	S	S
SEm±	1.14	0.40	0.76
CD (P=0.05)	3.43	1.39	2.45

Table.2Field evaluation of rice hybrids on yield attributes and yield

Treatments	Daystomaturity	Tillers/meter^2	Filled grains	Grain Yield (t/ha)	Straw yield (t/ha)	Harvest Index (%)
R-305	96.72	366.23	250.87	5.52	10.51	34.44
R-311	107.85	245.33	241.17	4.75	10.03	32.14
R-315	89.39	253.33	212.43	3.95	7.45	34.65
R-400	102.47	354.67	192.26	3.73	9.52	28.15
R-405	103.26	313.67	161.67	3.39	7.59	30.87
R-410	100.56	303.33	234.87	5.08	10.00	33.69
R-458	87.67	294.78	216.23	3.77	7.50	33.45
R-462	92.03	328.54	180.87	4.42	9.00	32.94
R-504	100.83	254.67	203.34	3.23	8.83	26.78
R-510	91.16	324.80	175.33	3.63	8.28	30.48
F-test	S	S	S	S	S	S
SEm±	1.60	13.45	6.95	0.23	0.30	0.91
CD (P=0.05)	4.83	41.07	20.62	0.69	1.01	1.73