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Physiological Performance of Different Rice Hybrids under Agroclimatic Conditions of Uttar Pradesh

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A field in the kharif season of 2021, a field experiment was conducted at Sam higginbottom University of Agricultural Technology And Sciences, Prayagraj, with the purpose of evaluating ten rice hybrids (UR-26, UR-27, UR-28, UR-29, UR-30, UR-31, UR-32, UR-33, UR-34, and UR-35) under Uttar Pradesh's agro-climatic conditions. The study aimed to assess their growth, productivity, and grain quality attributes. The experiment addressed a gap in knowledge regarding which rice hybrids perform best in the specific agro-climatic conditions. By comparing these hybrids, the study sought to provide insights into selecting the most suitable varieties for maximizing agricultural productivity in the region. Among the hybrids evaluated, UR-32 demonstrated exceptional performance and exhibited superior grain quality characteristics including better hulling, milling, and head rice recovery rates. These results highlight UR-32 as a promising choice for farmers in Uttar Pradesh seeking to optimize both yield and grain quality during the kharif season.

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In conclusion, the study not only filled a research gap by identifying the top-performing rice hybrid under Uttar Pradesh's agro-climatic conditions but also provided valuable data for enhancing agricultural practices and crop selection strategies in the region

Keywords: Hybrid rice; varietal response; growth parameters; yield attributes.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most crucial cereal crops globally, serving as a staple food for a significant portion of the world's population. In India, particularly in states like Uttar Pradesh (U.P.), rice cultivation plays a pivotal role in agriculture, economy, and food security [1]. However, the productivity and quality of rice are greatly influenced by the specific agro-climatic conditions prevalent in the region [2-4]. The physiological performance of rice hybrids is a subject of extensive research, as it directly impacts crop yield, grain quality, and overall agricultural sustainability. Understanding how different rice hybrids adapt and perform under specific agro-climatic conditions is essential for recommending the most suitable varieties to farmers. This knowledge helps optimize agricultural practices, improve yield potentials, and enhance food security [5,6].

Uttar Pradesh, with its diverse agro-climatic zones, presents a unique environment for evaluating the performance of rice hybrids. Factors such as temperature, rainfall pattern, soil type, and disease prevalence significantly influence the growth, development, and productivity of rice crops [7-9]. Therefore, conducting field experiments to assess the physiological responses of rice hybrids under these conditions is crucial for advancing agricultural research and promoting sustainable rice production.

This study aims to contribute to the existing knowledge by evaluating ten rice hybrids (UR-26, UR-27, UR-28, UR-29, UR-30, UR-31, UR-32, UR-33, UR-34, and UR-35) under the agro-climatic conditions of Uttar Pradesh during the kharif season of 2021 [10]. The research focuses on analyzing growth parameters, yield attributes, grain quality, and overall performance of these hybrids. By identifying the hybrid(s) that demonstrate superior physiological characteristics and yield potential, this study intends to provide valuable insights for farmers, researchers, and policymakers involved in rice cultivation and agricultural development in Uttar Pradesh.

Ultimately, this research aims to fill a gap in understanding and contribute to the selection and adoption of high-performing rice hybrids tailored to Uttar Pradesh's agro-climatic conditions, thereby fostering sustainable agricultural practices and enhancing food security in the region.

2. MATERIALS AND METHODS

During the 2021 kharif season, a field trial was conducted at Crop Research Farm, Department of Agriculture, SamHigginbittom University of Agricultural Technology and Sciences. The location of the experiment was between 25°N latitude, 72.5°E latitude. The climate was characterized by an alternating hot rainy season from late June to the beginning of September, with average temperatures ranging from 38°C to 50°C.The soil was composed of sandy loam with a pH of 7.2, EC of 0.14 dSm^{-1}, organic carbon of 0.38%, available N of 225 kg, P of 19.5 kg ha^{-1} , K of 340 kg, S of 16.8 ppm, and Zn of 0.51 ppm. The trial was conducted in a Randomized Block Design (RBD), with 10 treatments and three replications. The treatment was made up of Hybrids (T1 = 26, T2 = 27, T3 = 28, T4 = 29, T5 = 30, T6 = 31, T7 = 32, T8 = 33, T9 = 34, T10 = 35). The seedlings of 20 days old were transplanted into the main field at an average spacing of 20x10cm. The recommended fertilizer dose was 120:60:60 kg $N_1P_2O_5$,K_2O Kg ha^{-1}). We used 100% full dose of phosphorus and potassium, while 50% of nitrogen was applied at planting as a basal dose. The remaining nitrogen was spread out in two equal amounts as top dressing during the active (tillering and panicle initiation) stage. We also used 25 kg of zinc and 25 kg of sulphur as a basal dose to correct zinc and sulphur deficiencies. Irrigation was done at a 10-12 day interval to avoid flooding, but other normal cultural practices like weeding at 30 DAT and 45 DAT were also followed. Each plot had one quadrate of 1 m^2 harvested, and the results and data were analysed separately using analysis of variation. The difference between treatment means was compared using a least significant difference test with a 5% probability level.

3. RESULTS AND DISCUSSION

3.1 Plant Height (Cm)

Plant height is not directly related to yield, especially for grain crops, but it does show how important nutrients are for the plant's metabolism. The highest plant height was measured as 118.29 cm in T 5 (UR 30), followed by 117.81 cm in T6 (UR 31) and the lowest was 104.52 cm in T1 (UR 26) (90 DAT). The increased height could be because of the genetic makeup of the plant. It could also be because the plant is first generation hybrid, which means it has more vigor. The increase in plant height could also be because of the same amount of nutrients being available to the crop, especially nitrogen, for a longer time during its growth. Deshpande et al. 2011, Haque et al., 2015.

3.2 Plant dry Weight (g/hill)

The maximum plant dry weight was observed as 52.43g in T10 (UR 35) and the minimum plant dry weight was recorded as 48.43 g in T 9 (UR 34) as the 90 DAT level. The increased plant dry weight in various hybrids may be attributed to a higher assimilatory surface, resulting in increased dry matter production, and efficient translocation and dissemination of photosynthates. The accumulation of dry matter is dependent on the photosynthesis and respiratory rate during vegetative growth.

3.3 Crop Growth Rat (g/m^2/day) and Relative Growth Rate (g g^{-1} day^{-1})

Crop growth rates (g m^{-2}-day^{-1}) of hybrid rice were found to be non-significant between treatments at different intervals (0-15), (15-30), (30-45), (45-60), (60-75), and (75-90) DAT. Similarly, Relative growth rates (g g^{-1} day^{-1}) of hybrids (0-15), (15-30), (30-45), (45-60), (60-75) and (75-90) DAT were found to show non-significant differences between treatments. However, the largest percentage decrease in CGR and RGR were observed in T8 (UR 33) and T2 (UR 27), with a minimum CGR of 35.67 in T9 (UR 34) and a minimum RGR of 0.021 in T6 (UR 31). The prevalence of low temperature and low humidity during the growth and reproductive stages of hybrid rice, particularly during the flag leaf stage, may be a contributing factor to the non-significant difference between treatments. Similar findings can be seen in Yadav et al. (2004).

3.4 Grain Yield/Hill

Treatments T7 (UR 32) had the highest grain yield per hill at 28.14g, followed by T10 (UR35) and T3 (UR 28) at 27.10g and 26.42g respectively, while Treatment T1 had the lowest grain yield (18.48g) at UR 26. Hybrid rice accumulates more dry matter during the early and mid-growth stages, resulting in more spikelet's per panicle. As a result, hybrids (UR 32) have larger panicles with more spikelet's panicles^{-1}. These factors result in yields typically 15% or more higher than ordinary rice.

3.5 Grain Yield (T/Ha)

The highest grain yield was observed at 6.34 tonnes per hectare (ha^{-1}) in Treatment T 7 (UR 32), followed by a yield of 6.14 tonnes per hectare in Treatment T4 (UR 29), and the lowest grain yield (4.25 tonnes per hectare) was reported in Treatment T5 (UR 30).

Table 1. Evaluating the physiological parameters of different rice hybrids

	90 DAT		60-75 DAT		90 DAT	
Hybrids	**Plant height (cm)**	**Dry weight (g/hill)**	**CGR**	**RGR**	**Yield/hill**	**Yield (t ha^{-1})**
UR-26	104.52	50.21	38.46	0.022	18.48	5.43
UR-27	110.34	51.63	40.34	0.025	23.22	5.51
UR-28	113.78	49.36	40.48	0.023	26.42	5.49
UR-29	105.21	50.76	37.72	0.022	20.38	6.14
UR-30	118.29	52.74	40.56	0.023	23.45	4.25
UR-31	117.84	49.21	37.32	0.021	21.83	5.45
UR-32	120.37	53.33	40.08	0.024	28.14	6.34
UR-33	116.6	48.43	35.95	0.022	23.18	5.65
UR-34	116.63	46.91	35.67	0.024	23.47	5.56
UR-35	107.58	52.43	37.91	0.024	27.1	5.25
F-test	S	S	NS	NS	S	S
SEm±	1.05	1.02	1.01	0.001	0.89	0.12
CD (P=0.05)	3.01	2.54	-	-	2.67	0.48

4. CONCLUSION

The In the context of evaluating the physiological performance of different rice hybrids under the agroclimatic conditions of Uttar Pradesh, the highest grain yield of 6.34 tonnes per hectare (ha^-1) was observed in Treatment T7 (UR 32). Following closely was Treatment T4 (UR 29) with a yield of 6.14 tonnes per hectare, while Treatment T5 (UR 30) recorded the lowest grain yield at 4.25 tonnes per hectare.

This variation in grain yield reflects the distinct physiological responses of each rice hybrid to the specific agroclimatic conditions prevailing in Uttar Pradesh. UR 32, which achieved the highest yield, likely exhibited superior traits such as better adaptation to local soil and climate, efficient nutrient uptake, enhanced photosynthetic capacity, and possibly greater resistance to pests and diseases prevalent in the region. Conversely, UR 30, with the lowest yield, may have encountered challenges such as suboptimal environmental conditions, susceptibility to stress factors, or limitations in its genetic potential for yield under the specific conditions of the study.

Understanding these physiological differences is crucial for optimizing rice production in Uttar Pradesh. By identifying hybrids like UR 32 and UR 29 that demonstrate robust performance in terms of grain yield under local conditions, farmers and agricultural researchers can make informed decisions to enhance productivity and ensure sustainable rice cultivation practices tailored to the region's agroclimatic nuances.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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