Original Research Article

Determination of yield and economics of Rice (*Oryza sativa* L.) Hybrids Under Agro-Climatic Conditions of Prayagraj

Comment [Ma1]: Evaluation of yield and economic parameters of rice hybrids uder Agro-Climatic Conditions of Prayagraj

ABSTRACT

A field experiment was conducted at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) during *Kharif*, 2022. 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 40 hybrids each replicated thrice. ~~Based on the objectives taken~~The ~~maximum~~ plant height (130.14 cm), number of tillers (16.68), plant dry weight (58.85 g/plant), tillers/m^2 (392.54), panicle length (28.41 cm), filled grains (252.45), grain yield/hill (28.63 g), test weight (25.63 g), and stover yield (12.77 t/ha) were recorded ~~significantly higher~~ in hybrid R-190. Further, the ~~maximum~~ gross returns (₹ 149730/ha) and net returns (₹ 100684.00/ha) and B:C ratio ~~was highest in~~(2.05) were recorded ~~significantly higher~~ in hybrid R-458

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Keywords:*Hybrid Rice, Growth, Yield parameters Economics, Kharif, U.P.*

1. Introduction:

"Rice is one of the world's most significant staple food crops, feeding two-thirds of the world's population." India is ~~a large~~rice producer. ~~Rice, a complex carbohydrate, feeds more than half of the world's population, mostly in Asia.Other complex carbohydrates, such as whole grains, legumes, fruits, and vegetables, are important sources of energy for the body as well as crucial elements such as fibre, vitamins, and minerals, which are required for optimal health and disease prevention. "~~Rice is a nutritious staple food that contains 27% dietary calories, 20% dietary protein, and 3% dietary fat." [2]. It provides the body with glucose, which is required for normal brain and body function." Many companion animals and humans rely on it for the majority of their daily calories." [1]. India ~~farmed~~ rice on 44 million hectors of land with total rice output of 130.29 million tonnes in 2021-22, up by 3%

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from the previous year's 118.87 million tonnes. West Bengal is the leading producer of rice, with 14.76 million tonnes produced." [3]. "It is 13.85 million tonnes above the five-year average of 116.44 million tonnes." With an output of 2600 kilogrammes per hectare, it is India's highest rice-producing state. Uttar Pradesh is second in the country in rice production, with 14.02 million tonnes produced." [4].

Rice ~~yields~~ could be further increased by ~~using~~ hybrid rice. Thus, extending hybrid rice ~~agricultural~~areas could be a viable and cost-effective method for meeting future rice demand from a growing population [5]. Hybrid rice~~outperforms~~ standard high-yielding cultivars by 20-30%.[6]. ~~Hybrid rice makes the most significant contribution to boosting yield per unit area.~~ The yield advantage of 15-20% over the finest pure line varieties (6.5 t/ha vs. 5.4 t/ha) proved to be the determining factor in hybrid rice technology's widespread acceptance. More than 80% of total hybrid rice acreage is in eastern Indian states like Uttar Pradesh, Jharkhand, Bihar, and Chhattisgarh, with only a little percentage in states like M.P, Assam, Punjab, and Haryana. ~~The current situation of hybrid rice in India, as well as the major challenges and potential for this novel technology.Despite the fact that already manufactured varieties and hybrids have a great output potential, their performance is inconsistent even in less diversified growing environments.[7].~~ Environmental factors have a major impact on genotypic yield manifestations, resulting in variability in performance due to genotype x environment interactions [8]. In order to feed India's ever-increasing population, an effective varietal selection plan for high-yielding characteristics must be implemented. As a result, evaluating the discovery and selection of high-yielding variations and quality ~~qualities~~ in rice among the present lines is crucial.

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2. MATERIALS AND METHODS:

This experiment was conducted during the *kharif* season of 2022 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 right bank of the Yamuna River, 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-days intervals. The growth characteristics observations were recorded using conventional technique at 15-day

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intervals and displayed at 90 DAS. Yield metrics were measured on harvest day, November 23rd, 2022. All of the parameters were recorded and statistically analyzed using appropriate analysis of variance techniques as described by Gomez and Gomez (1984) [9].

3. RESULT AND DISSCUSSION:

3.1 Growth parameters

3.1.1 Plant height (cm)

At 90 DAT the ~~significantly~~ highest plant height was observed in Rice hybrid R 190 (130.14cm). However, treatments Rice hybrid R 77 (131.24), ~~Rice hybrid~~ R 111 (129.24), ~~Rice hybrid~~ R 212 (128.65), ~~Rice hybrid~~ R 405 (128.25), ~~Rice hybrid~~ R 458 (129.24), ~~Rice hybrid~~ R 607 (127.45), were statistically at par with Rice hybrid R 190. According to [10], the genetic makeup of the cultivar is a crucial contributing factor. Increased plant height may possibly be due to the synchronized availability of all critical plant nutrients, particularly nitrogen, for a longer amount of time during growth phases [11]. Furthermore, [12] showed that the cause of maximum plant height could be related to more advantageous weather circumstances, which was criticized by the higher growing degree days and hydrothermal units achieved in these hybrids.

3.1.2 Numbers of tillers/hill

At 90 DAT the significantly higher number of tillers was observed in Rice hybrid R 190 (16.68) However, Rice hybrid R170 (15.94), R 242 (16.01), ~~Rice hybrid~~ R 311 (16.68), ~~Rice hybrid~~ R 400 (15.81), ~~Rice hybrid~~ R 605 (16.01) were statistically at par with Rice hybrid R 190. Significant disparities may be linked to differences in the genetic make-up of high-producing types, which may be influenced by heredity. A comparison of rice hybrid performance revealed that R-305 produced considerably more tillers per hill. The changes in growth parameters between cultivars are primarily due to genetic differences [13].

3.1.3 Plant dry Weight (g/plant)

At 90 DAT the ~~significantly~~ highest dry weight was observed in Rice hybrid R 190 (58.85g). However, Rice hybrid R 127 (57.96), ~~Rice hybrid~~ R 504 (57.75), ~~Rice hybrid~~ R 600 (57.94), ~~which~~were statistically atpar with ~~R 504~~. The most likely reason of maximum dry matter accumulation is higher photosynthesis and respiration rate, which supports plant development by increasing plant height, leaf area, and tillers/hill, among other things. As a result, the therapy that achieved the greatest development also gathered the most dry matter.

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[14] reported a similar outcome. Another explanation for higher dry matter buildup in could be a significant increase in morphological characteristics important for the plant's photosynthetic capacity, resulting in enhanced straw yield. The results were consistent with [15].

3.2 Yield parameters:

3.2.1 Number of Tillers/meter^2

The highest tillers/m^2 was found non-significant. However maximum Number of Tillers/meter^2 observed in Rice hybrid R 190 (392.54 tillers/m^2) and minimum was found in Rice hybrid R 107(252.69). High tillering capacity is the most likely reason for high-producing cultivars. Similar findings are reported in [16], [17]. Under limited light conditions, the unequal distribution of photo-synthetically active radiation (PAR) was discovered to be the source of diversity in individual tiller yields, since early emerging superior tillers pre-empted the uppermost light source and shaded the late-appearing tillers. Improved root growth stimulation for anchoring resulted in increased tiller output. It increases nutrition and water intake, resulting in more tillers and dry matter buildup [12].

3.2.2 Panicle Length

The maximum panicle length/hill was recorded ~~under~~ Rice hybrid R 190 (28.41)~~.~~ ~~However,~~ minimum panicle length was found in Rice hybrid R 607 (20.33 cm). The nitrogen level of hybrid rice has a significant effect on panicle length. The wide variation in panicle length across hybrid rice varieties may be due to genetic differences. The findings support those of [18].

3.2.3 Grain yield (t/ha)

The data showed that the ~~significantly~~ highest grain yield/ha was observed in Rice hybrid R 190 (5.95 t/ha). However, Rice hybrid R 77 (4.31), ~~Rice hybrid~~ R170(4.25), ~~Rice hybrid~~ R 218 (4.87), ~~Rice hybrid~~ R 458 (5.51), and ~~Rice hybrid~~ R 600 (4.87) were statistically at par with Rice hybrid R 190. Grain yield per plot, grain yield/meter^2, and grain yield/ha, tillers/hill, panicle length, and harvest index all had a substantial correlation with grain yield per plant. These findings back up the conclusions of [18]. Higher yield quality could be due to improved growth and development factors, resulting in more grain yield. As a result, [19] work is conformed to.

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3.2.4 Straw yield (t/ha)

The data showed that the ~~significantly~~ highest straw yield/ha was observed in Rice hybrid R 190 (12.77 t/ha). However, Rice hybrid R 107 (12.26), ~~Rice hybrid~~ R165 (12.03), ~~Rice hybrid —~~ R-300 (11.72), ~~Rice hybrid~~ R 458 (12.51), ~~Rice hybrid~~ R 600 (12.51), were statistically at par with Rice hybrid R 190. According to Padmavathi's 1997 research, the ability of hybrid rice to utilize more nitrogen through the expression of enhanced growth as a result of the beneficial influence on nutrient uptake and physiological growth boosts straw production. High dry matter accumulation could be ascribed to a significant increase in morphological characteristics that control the plant's photosynthetic capacity, hence increasing straw output. The results were consistent with those reported by (2011) [15].

Economics:

The result showed that [Table 3] the ~~maximum~~ gross return (149730.00 INR/ha), net return (100684.00 INR/ha), and B:C ratio (2.05) was recorded in R-458 as compared to other Hybrids.

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4. CONCLUSION:

It is concluded that hybrid R-190 was found to be best for obtaining maximum grain yield. R-458 fetched the maximum gross return, net return, and B:C ratio.

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S. No.	Hybrids	Plant Height (cm)	Tillers/hill	Dry weight (g)
1.	Rice hybrid R 24	123.47	14.87	53.29
2.	Rice hybrid R 40	125.47	13.54	56.96
3.	Rice hybrid R 48	125.65	12.94	51.89
4.	Rice hybrid R 52	126.14	11.27	49.44
5.	Rice hybrid R 77	131.24	15.07	52.74
6.	Rice hybrid R 107	125.85	14.74	50.63
7.	Rice hybrid R 111	129.24	14.2	49.2
8.	Rice hybrid R 120	122.47	14.74	55.27
9.	Rice hybrid R 127	122.14	11.87	57.96
10.	Rice hybrid R 145	126.65	13.14	51.18
11.	Rice hybrid R 151	119.25	11.2	52.16
12.	Rice hybrid R 160	125.94	15.27	50.36
13.	Rice hybrid R165	119.54	13.94	52.44
14.	Rice hybrid R170	120.47	15.94	57.91
15.	Rice hybrid R 180	122.5	14.07	50.2
16.	Rice hybrid R 190	130.14	16.68	58.85
17.	Rice hybrid R 196	128.14	12.3	51.74
18.	Rice hybrid R 205	124.9	13.88	55.86
19.	Rice hybrid R 210	125.24	14.81	54.83
20.	Rice hybrid R 212	128.65	12.48	51.31
21.	Rice hybrid R 218	116.47	14.68	49.51
22.	Rice hybrid R 242	120.48	16.01	52.05
23.	Rice hybrid R 248	115.24	14.81	55.47
24.	Rice hybrid R 256	121.14	12.48	51.25
25.	Rice hybrid R 300	123.47	14.94	52.63
26.	Rice hybrid R 305	125.24	11.94	54.71
27.	Rice hybrid R 311	126.15	16.68	51.05
28.	Rice hybrid R 315	116.18	12.01	53.27
29.	Rice hybrid R 400	122.4	15.81	50.27
30.	Rice hybrid R 405	128.25	13.48	48.75
31.	Rice hybrid R 410	124	11.74	55.37
32.	Rice hybrid R 458	129.24	14.68	53.57
33.	Rice hybrid R 462	120.47	14.94	50.62
34.	Rice hybrid R 504	119.25	13.88	57.75
35.	Rice hybrid R 510	124.15	11.94	51.75
36.	Rice hybrid R 600	124.85	14.88	57.94
37.	Rice hybrid R 603	124.25	14.68	48.51
38.	Rice hybrid R 605	125.65	16.01	49.67
39.	Rice hybrid R 607	127.45	14.81	56.11
40.	Rice hybrid R 610	125.35	12.48	51.45
	F-test	S	S	S
	SEm±	0.55	0.56	0.98
	CD(P =0.05)	1.72	0.32	2.35

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

TreatmentNo.	TreatmentCombinations	Tiller/m^2	Panicle length (cm)	Grain yield (t/ha)	Straw yield (t/ha)
1.	Rice hybrid R 24	363.55	27	3.56	10.03
2.	Rice hybrid R 40	302.3	27.33	4.94	9.93
3.	Rice hybrid R 48	357.97	25.67	3.32	7.53
4.	Rice hybrid R 52	307.69	23.67	3.35	10.13
5.	Rice hybrid R 77	282.69	26.33	4.31	11.23
6.	Rice hybrid R 107	252.69	27.46	4.09	12.26
7.	Rice hybrid R 111	321.02	24.68	4.15	10.9
8.	Rice hybrid R 120	299.35	23.34	3.07	9.83
9.	Rice hybrid R 127	249.35	22.56	3.2	10.92
10.	Rice hybrid R 145	357.69	20.33	4.25	10.76
11.	Rice hybrid R 151	259.35	26.67	3.25	10.03
12.	Rice hybrid R 160	281.3	24.89	3.27	8.62
13.	Rice hybrid R165	322.64	23.34	2.01	12.03
14.	Rice hybrid R170	314.64	26.59	4.25	10.23
15.	Rice hybrid R 180	283.64	20.32	4.32	9.72
16.	Rice hybrid R 190	392.54	28.41	5.95	12.77
17.	Rice hybrid R 196	303.3	22.56	3.21	10.45
18.	Rice hybrid R 205	364.64	20.33	3.36	9.67
19.	Rice hybrid R 210	245.27	26.67	3.56	10.52
20.	Rice hybrid R 212	253.87	24.89	3.19	9.76
21.	Rice hybrid R 218	254.64	23.45	4.87	10.45
22.	Rice hybrid R 242	313.64	23.8	3.25	7.72
23.	Rice hybrid R 248	327.97	23.8	3.27	10.62
24.	Rice hybrid R 256	304.97	20.46	2.01	7.72
25.	Rice hybrid R 300	302.3	21.58	3.21	11.72
26.	Rice hybrid R 305	357.97	25.81	3.25	10.62
27.	Rice hybrid R 311	307.69	21.47	4.27	9.45
28.	Rice hybrid R 315	282.69	20.46	2.01	10.72
29.	Rice hybrid R 400	252.69	21.58	3.21	8.31
30.	Rice hybrid R 405	321.02	24.81	4.32	9.72
31.	Rice hybrid R 410	299.35	21.47	3.32	10.92
32.	Rice hybrid R 458	249.35	23.46	5.51	12.51
33.	Rice hybrid R 462	357.69	25.8	3.08	9.67
34.	Rice hybrid R 504	259.35	27.13	4.13	10.52
35.	Rice hybrid R 510	319.69	24.59	3.11	9.76
36.	Rice hybrid R 600	364.02	20.32	4.87	12.51
37.	Rice hybrid R 603	301.02	23.45	3.19	7.72
38.	Rice hybrid R 605	357.97	22.56	3.65	10.62
39.	Rice hybrid R 607	307.69	20.33	3.25	9.56
40.	Rice hybrid R 610	282.69	26.67	3.27	10.32
	F-test	NS	S	S	S
	SEm±	1.42	18.66	1.08	0.55
	CD(P =0.05)	-	56.09	3.25	1.65

S. No.	Treatments	Cost of Cultivation	Gross Return	Net Return	B:C Ratio

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

1.	Rice hybrid R 24	49046	101290	52244	1.07
2.	Rice hybrid R 40	49046	136790	87744	1.79
3.	Rice hybrid R 48	49046	88990	39944	0.81
4.	Rice hybrid R 52	49046	116590	67544	1.38
5.	Rice hybrid R 77	49046	100690	51644	1.05
6.	Rice hybrid R 107	49046	118580	69534	1.42
7.	Rice hybrid R 111	49046	115700	66654	1.36
8.	Rice hybrid R 120	49046	90890	41844	0.85
9.	Rice hybrid R 127	49046	102310	53264	1.09
10.	Rice hybrid R 145	49046	117280	68234	1.39
11.	Rice hybrid R 151	49046	95090	46044	0.94
12.	Rice hybrid R 160	49046	91260	42214	0.86
13.	Rice hybrid R165	49046	76290	27244	0.56
14.	Rice hybrid R170	49046	94890	45844	0.93
15.	Rice hybrid R 180	49046	115560	66514	1.36
16.	Rice hybrid R 190	49046	111560	62514	1.27
17.	Rice hybrid R 196	49046	122530	73484	1.50
18.	Rice hybrid R 205	49046	96210	47164	0.96
19.	Rice hybrid R 210	49046	102760	53714	1.10
20.	Rice hybrid R 212	49046	93080	44034	0.90
21.	Rice hybrid R 218	49046	128750	79704	1.63
22.	Rice hybrid R 242	49046	88160	39114	0.80
23.	Rice hybrid R 248	49046	97260	48214	0.98
24.	Rice hybrid R 256	49046	63360	14314	0.29
25.	Rice hybrid R 300	49046	96060	47014	0.96
26.	Rice hybrid R 305	49046	100160	51114	1.04
27.	Rice hybrid R 311	49046	93750	44704	0.91
28.	Rice hybrid R 315	49046	72360	23314	0.48
29.	Rice hybrid R 400	49046	89130	40084	0.82
30.	Rice hybrid R 405	49046	115560	66514	1.36
31.	Rice hybrid R 410	49046	99160	50114	1.02
32.	Rice hybrid R 458	49046	149730	100684	2.05
33.	Rice hybrid R 462	49046	90610	41564	0.85
34.	Rice hybrid R 504	49046	114160	65114	1.33
35.	Rice hybrid R 510	49046	91480	42434	0.87
36.	Rice hybrid R 600	49046	104350	55304	1.13
37.	Rice hybrid R 603	49046	86960	37914	0.77
38.	Rice hybrid R 605	49046	129260	80214	1.64
39.	Rice hybrid R 607	49046	93680	44634	0.91
40.	Rice hybrid R 610	49046	96360	47314	0.96

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