International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(8): 38-42
www.biochemjournal.com
Received: 13-06-2025
Accepted: 16-07-2025

Bheemanapally Thriveni
PG Scholar, Department of Genetics and Plant Breeding, Agricultural College, Jagtial, PJTAU, Hyderabad, India

T Srikanth
Assistant Professor, Department of Genetics and Plant Breeding, Agricultural College, Warangal, PJTAU, Hyderabad, India

P Madhukar
Scientist, Plant Breeding, RARS, Polasa, PJTAU, Hyderabad, India

D Saida Naik
Professor & Head, Department of Crop Physiology, PJTAU, Hyderabad, India

Corresponding Author:
Bheemanapally Thriveni
PG Scholar, Department of Genetics and Plant Breeding, Agricultural College, Jagtial, PJTAU, Hyderabad, India

Assessment of standard heterosis for yield traits in rice (*Oryza sativa* L.) hybrids

Bheemanapally Thriveni, T Srikanth, P Madhukar and D Saida Naik

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i8Sa.5088

Abstract
Standard heterosis plays a vital role in hybrid rice breeding, enabling the evaluation of hybrid performance relative to established check varieties. In this study, 36 rice hybrids were evaluated against three standard checks (US 312, RNR 15048 and JGL 24423) for 16 traits, including nine yield and yield-related traits and seven grain quality traits. Significant negative standard heterosis for days to 50% flowering and plant height suggests potential for early maturity and lodging resistance. Positive significant heterosis was observed for traits such as 1000-grain weight and grain yield per plant. Specific hybrids showed promise for breeding programs focused on enhancing productivity and grain quality.

Keywords: Rice hybrids, standard heterosis, yield traits, grain quality, check varieties, *Oryza sativa*

1. Introduction
Rice (*Oryza sativa* L., 2n = 24), a member of the Poaceae family, is one of the most important staple food crops globally and serves as the foundation of food and nutritional security, particularly in Asia. It is the primary source of dietary energy for more than half of the global population.

As of the most recent estimates (INDIASTAT, 2023-24), global rice cultivation spans around 168.4 million hectares with a total production of 520.5 million tonnes. In India, rice occupies an area of 47.83 million hectares, producing 137.8 million tonnes with an average productivity of 2.88 t ha^{-1}. The state of Telangana contributes significantly to national production, cultivating rice on approximately 4.685 million hectares and achieving a production of 16.874 million tonnes with a productivity of 3.60 t ha^{-1}. With a rapidly growing population and limited scope for horizontal expansion of land, enhancing rice productivity through vertical improvement especially genetic enhancement—is vital to meet future food demands and ensure sustainability under changing climatic conditions.

In this context, hybrid rice technology has emerged as one of the most promising approaches to enhance yield potential and resource-use efficiency in rice cultivation. By exploiting F_1 heterosis, which arises from crosses between genetically diverse parental lines, hybrid rice varieties outperform conventional high-yielding inbred lines in terms of biomass, tillering ability, grain number and stress resilience. Globally, the foundation for hybrid rice was laid in China, where Dr. Yuan Longping developed the first commercial hybrid rice variety in 1976. This innovation triggered a global shift in rice breeding strategies, especially in countries facing stagnating yields.

In India, the hybrid rice development program was initiated in 1989 under the National Hybrid Rice Program (NHRP). Since then, the country has made considerable progress, with over 125 hybrid rice varieties released for commercial cultivation by 2023. These hybrids span both public and private sector efforts and cater to a wide range of agro-climatic zones, consumer preferences and end-use markets. Hybrid rice varieties in India have demonstrated a yield advantage of 1a5-20% over the best-performing inbred varieties, confirming their role in enhancing rice production and productivity (ICAR-IIRR, 2023).

However, despite its potential, the adoption of hybrid rice in India has been relatively modest due to several challenges, including poor grain quality, lack of suitable parental lines and insufficient information on heterotic patterns. To overcome these constraints, systematic evaluation of newly developed hybrids for their per se performance and standard heterosis is essential. Standard heterosis, or commercial heterosis, refers to the superiority of hybrid performance relative to established check varieties, offering a practical benchmark for varietal release and commercialization.

Given this background, the present investigation was undertaken to assess standard heterosis in a diverse set of 36 rice hybrids evaluated for yield components. The study involved three popular and widely cultivated check varieties—US 312, RNR 15048 and JGL 24423 to provide reference benchmarks for evaluating hybrid performance. The main objective was to identify promising hybrid combinations that exhibit significant standard heterosis over the checks, thereby offering potential for future commercial cultivation and hybrid rice development programs in India and similar rice-growing ecosystems.

2. Materials and Methods

2.1 Experimental Site and Plant Material

The present study was conducted during the Kharif 2023 season at the RARS, Polasa, Jagtial. The experimental site is situated in the Northern agro-climatic zone of Telangana, characterized by tropical conditions.

A total of 36 rice hybrids were developed using the line × tester mating design involving 6 CMS (A) lines and 6 restorer (R) lines. Three widely grown and agronomically superior check varieties US 312, RNR 15048 and JGL 24423 were used as standard checks for heterosis analysis. The study aimed to assess the standard heterosis of these hybrids for 16 traits comprising both yield components and grain quality attributes.

2.2 Experimental Design and Crop Management

The experimental material was evaluated in a Randomized Complete Block Design (RCBD) with three replications. Each hybrid and check was sown in three-row plots, each row of 3 meters length with a spacing of 20 cm between rows and 15 cm between plants. Recommended agronomic practices were followed uniformly to ensure healthy crop growth and minimize environmental variability. Regular pest and disease management protocols were applied throughout the crop season.

2.3 Traits Recorded

Observations were recorded on nine yield and yield-contributing traits and seven grain quality traits, Days to 50% flowering, Plant height (cm), Number of productive tillers per plant, Panicle length (cm), Total number of grains per panicle, Number of filled grains per panicle, 1000-grain weight (g), Grain yield per plant (g,)Spikelet fertility (%). Data on morphological traits were recorded from five randomly selected competitive plants per plot. Standard heterosis was estimated for each trait by comparing the mean performance of hybrids with that of standard checks using the formula: Standard Heterosis (%) = ((F1-Check)/Check) × 100. Significance of heterosis was tested using analysis of variance (ANOVA) followed by t-tests at 5% and 1% probability levels. All statistical analyses were performed using Windowstat software.

3. Results and Discussion

3.1 Days to 50% Flowering

Out of 36 hybrids, 23 showed significant negative standard heterosis over US 312, indicating earliness—a desirable trait. No hybrids showed significant heterosis over RNR 15048, while three showed negative significant heterosis over JGL 24423. These results suggest that US 312 is the most appropriate check for this trait. Similar observations were made by Parimala *et al.* (2018) [3] and Meena *et al.* (2021) [2].

3.2 Plant Height

Significant negative heterosis was found in 26 hybrids over US 312 and 27 over RNR 15048. Fourteen hybrids showed similar trends over JGL 24423, indicating these checks as optimal for reducing plant height. This supports findings by Saikiran *et al.* (2020) [4] and Samonte *et al.* (2023) [5].

3.3 Number of Productive Tillers per Plant

None of the hybrids exhibited significant positive heterosis over the checks. However, three hybrids showed positive non-significant heterosis (Table 1). This indicates the checks are well suited for this trait. These results corroborate Waza *et al.* (2016) [7] and Raj *et al.* (2021) [3].

3.4 Panicle Length

Only three hybrids showed significant positive heterosis over RNR 15048 and one over JGL 24423, affirming RNR 15048 as the best check for this trait. This agrees with results reported by Azad *et al.* (2022) [1].

3.5 Total Number of Grains per Panicle

Two hybrids showed positive significant heterosis over US 312, seven over RNR 15048 and 15 over JGL 24423. JGL 24423 emerged as the most reliable check for this trait.

3.6 Filled Grains per Panicle

Similar to total grains, 15 hybrids showed significant heterosis over JGL 24423, highlighting its suitability as a standard check for this trait as well.

3.7 1000-Grain Weight

Seven hybrids showed significant positive heterosis over US 312 and 33 over RNR 15048, confirming RNR 15048 as the optimal check. No hybrid outperformed JGL 24423 significantly.

3.8 Grain Yield per Plant

Six hybrids displayed significant heterosis over RNR 15048 and four over US 312. None surpassed JGL 24423. These results suggest RNR 15048 is a robust check for yield traits, as confirmed by Nagamani *et al.* (2022) [8].

3.9 Spikelet Fertility

Two hybrids showed significant heterosis over US 312 and JGL 24423, identifying US 312 as the most suitable check, followed by JGL 24423. This is consistent with findings by Mohan *et al.* (2021) [9].

Table 1: Estimates of heterosis over standard check for yield and yield contributing traits in rice.

S. No.	Crosses	Days to 50% flowering			Plant height(cm)			No. of productive tillers per/plant		
		Checks			Checks			Checks		
		US 312	RNR 15048	JGL 24423	US 312	RNR 15048	JGL 24423	US 312	RNR 15048	JGL 24423
1	RMS7A X ZINCORICE	-4.78	4.18	2.40	-5.18	-6.47	2.56	-5.56	-5.56	-5.56
2	RMS7A X SURABHI	0.96	10.45 *	8.56 *	-16.31 **	-17.45 **	-9.48	-11.11	-11.11	-11.11
3	RMS7A X CGZR-2	-9.55 *	-1.05	-2.74	-12.25 *	-13.44 **	-5.09	2.78	2.78	2.78
4	RMS7A X IET 28701	-15.29 **	-7.32	-8.90 *	-13.60 **	-14.77 **	-6.54	-8.33	-8.33	-8.33
5	RMS7A X IET 28703	-13.69 **	-5.57	-7.19	-21.05 **	-22.12 **	-14.60 **	-16.67 **	-16.67 **	-16.67 **
6	RMS7A X IET 28704	-10.83 **	-2.44	-4.11	-20.83 **	-21.90 **	-14.36 **	-8.33	-8.33	-8.33
7	RMS 9A X ZINCORICE	-8.28 *	0.35	-1.37	-17.02 **	-18.14 **	-10.24 *	-16.67 **	-16.67 **	-16.67 **
8	RMS 9A X SURABHI	9.55 *	19.86 **	17.81 **	-8.93	-10.16 *	-1.49	-16.67 **	-16.67 **	-16.67 **
9	RMS 9A X CGZR-2	11.15 **	21.60 **	19.52 **	-8.06	-9.31	-0.55	-8.33	-8.33	-8.33
10	RMS 9A X IET 28701	0.64	10.10 *	8.22 *	14.75 **	13.19 **	24.12 **	0.00	0.00	0.00
11	RMS 9A X IET 28703	0.64	10.10 *	8.22 *	22.04 **	20.38 **	32.01 **	-5.56	-5.56	-5.56
12	RMS 9A X IET 28704	-10.51 **	-2.09	-3.77	-4.77	-6.06	3.01	-8.33	-8.33	-8.33
13	JMS17A X ZINCORICE	-8.28 *	0.35	-1.37	-23.35 **	-24.39 **	-17.09 **	-13.89 *	-13.89 *	-13.89 *
14	JMS17A X SURABHI	-11.78 **	-3.48	-5.14	-15.11 **	-16.26 **	-8.18	-8.33	-8.33	-8.33
15	JMS17A X CGZR-2	-8.60 *	0.00	-1.71	-21.91 **	-22.97 **	-15.54 **	-16.67 **	-16.67 **	-16.67 **
16	JMS17A X IET 28701	-9.55 *	-1.05	-2.74	-6.33	-7.60	1.31	-8.33	-8.33	-8.33
17	JMS17A X IET 28703	-6.05	2.79	1.03	-4.54	-5.84	3.25	-5.56	-5.56	-5.56

*Significant at 5 percent level **Significant at 1 percent level ***Significant at 0.1 percent level

S. No.	Crosses	Days to 50% flowering			Plant height(cm)			No. of productive tillers/plant		
		Checks			Checks			Checks		
		US 312	RNR 15048	JGL24423	US 312	RNR15048	JGL 24423	US 312	RNR15048	JGL 24423
18	JMS17A X IET 28704	-8.92 *	-0.35	-2.05	-22.55 **	-23.60 **	-16.23 **	-8.33	-8.33	-8.33
19	JMS13A X ZINCORICE	-10.19 **	-1.74	-3.42	-21.22 **	-22.28 **	-14.78 **	-16.67 **	-16.67 **	-16.67 **
20	JMS13A X SURABHI	-13.38 **	-5.23	-6.85	-24.12 **	-25.15 **	-17.92 **	-8.33	-8.33	-8.33
21	JMS13A X CGZR-2	-11.15 **	-2.79	-4.45	-20.72 **	-21.79 **	-14.24 **	-8.33	-8.33	-8.33
22	JMS13A X IET 28701	-14.01 **	-5.92	-7.53	-9.92 *	-11.14 *	-2.56	-8.33	-8.33	-8.33
23	JMS13A X IET 28703	-9.55 *	-1.05	-2.74	-6.05	-7.32	1.63	-11.11	-11.11	-11.11
24	JMS13A X IET 28704	-7.96 *	0.70	-1.03	-11.42 *	-12.62 **	-4.19	-8.33	-8.33	-8.33
25	RMS5A X ZINCORICE	6.69	16.72 **	14.73 **	-21.88 **	-22.94 **	-15.50 **	-16.67 **	-16.67 **	-16.67 **
26	RMS5A X SURABHI	7.01	17.07 **	15.07 **	-19.96 **	-21.05 **	-13.43 *	-13.89 *	-13.89 *	-13.89 *
27	RMS5A X CGZR-2	-8.92 *	-0.35	-2.05	-15.45 **	-16.60 **	-8.55	-16.67 **	-16.67 **	-16.67 **
28	RMS5A X IET 28701	-14.97 **	-6.97	-8.56 *	-9.82 *	-11.04 *	-2.46	-8.33	-8.33	-8.33
29	RMS5A X IET 28703	-15.61 **	-7.67	-9.25 *	-9.47 *	-10.70 *	-2.08	8.33	8.33	8.33
30	RMS5A X IET 28704	7.32	17.42 **	15.41 **	-18.30 **	-19.41 **	-11.63 *	-16.67 **	-16.67 **	-16.67 **
31	CMS 52 X ZINCORICE	-9.87 *	-1.39	-3.08	-32.63 **	-33.54 **	-27.13 **	-16.67 **	-16.67 **	-16.67 **
32	CMS 52 X SURABHI	-5.73	3.14	1.37	-16.86 **	-17.99 **	-10.07	-8.33	-8.33	-8.33
33	CMS 52 X CGZR-2	-3.82	5.23	3.42	-13.53 **	-14.70 **	-6.47	-16.67 **	-16.67 **	-16.67 **
34	CMS 52 X IET 28701	-9.87 *	-1.39	-3.08	-7.04	-8.30	0.55	-8.33	-8.33	-8.33
35	CMS 52 X IET 28703	-10.83 **	-2.44	-4.11	-13.44 **	-14.61 **	-6.37	-8.33	-8.33	-8.33
36	CMS 52 X IET 28704	6.37	16.38 **	14.38 **	-21.18 **	-22.25 **	-14.74 **	-16.67 **	-16.67 **	-16.67 **

*Significant at 5 percent level **Significant at 1 percent level ***Significant at 0.1 percent level

S. No.	Crosses	Panicle length (cm)			Total no. of grains per panicle			Filled grains per panicle		
		Checks			Checks			Checks		
		US 312	RNR 15048	JGL 24423	US 312	RNR 15048	JGL 24423	US 312	RNR 15048	JGL 24423
1	RMS7A X ZINCORICE	-13.26*	2.89	-7.34	-5.47	14.61 **	44.13 **	-5.58	-11.71 **	39.15 **
2	RMS7A X SURABHI	-18.14**	-2.90	-12.55*	-42.36 **	-30.12 **	-12.12 *	-31.64 **	-36.08 **	0.75
3	RMS7A X CGZR-2	-11.98*	4.41	-5.97	-5.22	14.91 **	44.51 **	-4.74	-10.92 **	40.40 **
4	RMS7A X IET 28701	-8.14	8.96	-1.87	-32.05 **	-17.62 **	3.60	-34.18 **	-38.45 **	-2.99
5	RMS7A X IET 28703	-19.21**	-4.17	-13.69*	-54.66 **	-45.03 **	-30.87 **	-54.99 **	-57.91 **	-33.67 **
6	RMS7A X IET 28704	-12.68*	3.58	-6.72	-49.32 **	-38.55 **	-22.73 **	-49.92 **	-53.16 **	-26.18 **
7	RMS 9A X ZINCORICE	-19.32**	-4.29	-13.81*	-61.99 **	-53.92 **	-42.05 **	-61.25 **	-63.77 **	-42.89 **
8	RMS 9A X SURABHI	-15.37**	0.39	-9.59	-47.20 **	-35.99 **	-19.51 **	-35.03 **	-39.24 **	-4.24
9	RMS 9A X CGZR-2	-18.38**	-3.19	-12.81*	-43.60 **	-31.63 **	-14.02 *	-35.19 **	-39.40 **	-4.49
10	RMS 9A X IET 28701	7.01	26.93**	14.32*	-44.22 **	-32.38 **	-14.96 *	-44.67 **	-48.26 **	-18.45 **
11	RMS 9A X IET 28703	-2.20	16.01*	4.48	-51.43 **	-41.11 **	-25.95 **	-51.27 **	-54.43 **	-28.18 **
12	RMS 9A X IET 28704	-17.44**	-2.07	-11.80*	-59.13 **	-50.45 **	-37.69 **	-52.96 **	-56.01 **	-30.67 **
13	JMS17A X ZINCORICE	-18.27**	-3.05	-12.69*	-27.45 **	-12.05 *	10.61	-25.89 **	-30.70 **	9.23
14	JMS17A X SURABHI	-16.29**	-0.70	-10.57	21.49 **	47.29 **	85.23 **	23.52 **	15.51 **	82.04 **
15	JMS17A X CGZR-2	-17.34**	-1.95	-11.69*	-27.08 **	-11.60 *	11.17	-30.29 **	-34.81 **	2.74
16	JMS17A X IET 28701	-6.86	10.48	-0.50	-8.82 *	10.54 *	39.02 **	-13.20 **	-18.83 **	27.93 **
17	JMS17A X IET 28703	-6.15	11.32	0.26	-12.67 **	5.87	33.14 **	-8.80 *	-14.72 **	34.41 **

*Significant at 5 percent level **Significant at 1 percent level ***Significant at 0.1 percent level

S. No.	Crosses	Panicle length (cm)			Total no. of grains per panicle			Filled grains per panicle		
		Checks			Checks			Checks		
		US 312	RNR 15048	JGL24423	US 312	RNR15048	JGL 24423	US 312	RNR15048	JGL 24423
18	JMS17A X IET 28704	-13.14*	3.02	-7.21	-33.91 **	-19.88 **	0.76	-38.07 **	-42.09 **	-8.73
19	JMS13A X ZINCORICE	-16.29**	-0.70	-10.57	-26.83 **	-11.30 *	11.55 *	-26.23 **	-31.01 **	8.73
20	JMS13A X SURABHI	-19.20**	-4.16	-13.68*	-10.43 **	8.58	36.55 **	2.71	-3.96	51.37 **
21	JMS13A X CGZR-2	-9.08	7.84	-2.87	-12.05 **	6.63	34.09 **	-11.84 **	-17.56 **	29.93 **
22	JMS13A X IET 28701	3.84	23.17**	10.93	-27.20 **	-11.75 *	10.98	-28.93 **	-33.54 **	4.74
23	JMS13A X IET 28703	-14.66**	1.23	-8.83	-19.63 **	-2.56	22.54 **	-6.94	-12.97 **	37.16 **
24	JMS13A X IET 28704	-16.16**	-0.55	-10.44	-34.04 **	-20.03 **	0.57	-35.36 **	-39.56 **	-4.74
25	RMS5A X ZINCORICE	-25.26**	-11.35	-20.16**	-41.99 **	-29.67 **	-11.55 *	-44.33 **	-47.94 **	-17.96 **
26	RMS5A X SURABHI	-18.50**	-3.33	-12.94*	-15.65 **	2.26	28.60 **	-14.72 **	-20.25 **	25.69 **
27	RMS5A X CGZR-2	-15.37**	0.39	-9.59	5.96	28.46 **	61.55 **	20.14 **	12.34 **	77.06 **
28	RMS5A X IET 28701	-11.51*	4.96	-5.47	-29.32 **	-14.31 **	7.77	-24.53 **	-29.43 **	11.22
29	RMS5A X IET 28703	-7.68	9.50	-1.38	-29.32 **	-14.31 **	7.77	-19.46 **	-24.68 **	18.70 **
30	RMS5A X IET 28704	-14.66**	1.23	-8.83	-37.52 **	-24.25 **	-4.73	-40.78 **	-44.62 **	-12.72 *
31	CMS 52A X ZINCORICE	-31.09**	-18.26**	-26.38**	-37.64 **	-24.40 **	-4.92	-36.21 **	-40.35 **	-5.99
32	CMS 52A X SURABHI	-9.87	6.91	-3.72	-2.48	18.22 **	48.67 **	0.51	-6.01	48.13 **
33	CMS 52A X CGZR-2	-13.03*	3.16	-7.09	16.89 **	41.72 **	78.22 **	57.02 **	46.84 **	131.42 **
34	CMS 52A X IET 28701	-10.12	6.62	-3.98	-12.17 **	6.48	33.90 **	-16.24 **	-21.68 **	23.44 **
35	CMS 52A X IET 28703	-16.29**	-0.70	-10.57	-12.92 **	5.57	32.77 **	-12.69 **	-18.35 **	28.68 **
36	CMS 52A X IET 28704	-23.87**	-9.69	-18.67**	-53.54 **	-43.67 **	-29.17 **	-47.55 **	-50.95 **	-22.69 **

*Significant at 5 percent level **Significant at 1 percent level ***Significant at 0.1 percent level

S. No.	Crosses	1000 grain weight(g)			Grain yield per plant(g)			Spikelet fertility (%)		
		Checks			Checks			Checks		
		US 312	RNR 15048	JGL 24423	US 312	RNR 15048	JGL 24423	US 312	RNR 15048	JGL 24423
1	RMS7A X ZINCORICE	-39.89 **	-5.55	-56.75 **	-10.36	2.62	-31.13**	1.45	-21.64 **	-1.90
2	RMS7A X SURABHI	-31.18 **	8.14	-50.48 **	-22.89**	-11.73	-40.76**	18.07	-8.80	14.17
3	RMS7A X CGZR-2	-37.15 **	-1.24	-54.78 **	-24.94**	-14.07	-42.33**	4.33	-19.42 *	0.88
4	RMS7A X IET 28701	-11.16	39.6 **	-36.08 **	-35.09**	-25.69**	-50.13**	-3.43	-25.41 **	-6.62
5	RMS7A X IET 28703	15.1 *	80.85 **	-17.19 **	-42.95**	-34.69**	-56.17**	-0.42	-23.08 **	-3.72
6	RMS7A X IET 28704	9.35	71.81 **	-21.33 **	-44.98**	-37.01**	-57.73**	-1.26	-23.74 **	-4.53
7	RMS 9A X ZINCORICE	-9.88	41.6 **	-35.16 **	-32.17**	-22.35**	-47.89**	2.28	-21.00 **	-1.10
8	RMS 9A X SURABHI	-11.05	39.76 **	-36.0 **	-7.27	6.15	-28.76**	22.84 *	-5.12	18.77 *
9	RMS 9A X CGZR-2	-21.35 **	23.59 *	-43.41 **	-23.38**	-12.28	-41.13**	14.71	-11.39	10.92
10	RMS 9A X IET 28701	23.43 **	93.94 **	-11.2 *	-6.24	7.34	-27.96**	-0.79	-23.37 **	-4.08
11	RMS 9A X IET 28703	11.74	75.57 **	-19.61 **	-28.39**	-18.02*	-44.98**	0.13	-22.66 **	-3.19
12	RMS 9A X IET 28704	20.9 **	89.96 **	-13.02 **	-27.31**	-16.79*	-44.15**	14.95	-11.21	11.15
13	JMS17A X ZINCORICE	-0.36	56.56 **	-28.31 **	-48.16**	-40.65**	-60.17**	2.04	-21.18 **	-1.33
14	JMS17A X SURABHI	-20.36 **	25.13 **	-42.7 **	-6.37	7.19	-28.06**	1.42	-21.66 **	-1.93
15	JMS17A X CGZR-2	-15.23 *	33.19 **	-39.01 **	-22.43**	-11.20	-40.40**	-4.29	-26.07 **	-7.45
16	JMS17A X IET 28701	0.41	57.78 **	-27.76 **	-26.26**	-15.58*	-43.34**	-4.93	-26.57 **	-8.08
17	JMS17A X IET 28703	7.01	68.14 **	-23.01 **	-11.64	1.16	-32.11**	4.09	-19.60 *	0.64

*Significant at 5 percent level **Significant at 1 percent level ***Significant at 0.1 percent

S. No.	Crosses	1000 grain weight(g)			Grain yield per plant(g)			Spikelet fertility (%)		
		Checks			Checks			Checks		
		US 312	RNR 15048	JGL24423	US 312	RNR15048	JGL 24423	US 312	RNR15048	JGL 24423
18	JMS17A X IET 28704	2.41	60.91 **	-26.32 **	-29.33**	-19.10**	-45.71**	-6.68	-27.91 **	-9.76
19	JMS13A X ZINCORICE	7.42	68.79 **	-22.71 **	-51.23**	-44.17**	-62.53**	0.76	-22.17 **	-2.58
20	JMS13A X SURABHI	-14.1 *	34.97 **	-38.2 **	-15.19*	-2.91	-34.84**	14.53	-11.53	10.74
21	JMS13A X CGZR-2	-11.31	39.36 **	-36.19 **	5.85	21.18**	-18.68**	-0.07	-22.81 **	-3.38
22	JMS13A X IET 28701	-1.55	54.69 **	-29.17 **	19.60**	36.91**	-8.11	-2.67	-24.82 **	-5.89
23	JMS13A X IET 28703	16.06 **	82.36 **	-16.5 **	13.64*	30.10**	-12.69*	15.44	-10.83	11.62
24	JMS13A X IET 28704	4.85	64.76 **	-24.56 **	-31.38**	-21.44**	-47.28**	-2.23	-24.48 **	-5.46
25	RMS5A X ZINCORICE	-14.55 *	34.27 **	-38.52 **	-44.01**	-35.90**	-56.98**	-4.29	-26.07 **	-7.46
26	RMS5A X SURABHI	-24.27 **	18.99 *	-45.52 **	-0.30	14.14	-23.40**	0.82	-22.13 **	-2.52
27	RMS5A X CGZR-2	12.45 *	76.68 **	-19.1 **	-11.39	1.44	-31.92**	13.17	-12.58	9.43
28	RMS5A X IET 28701	-9.62	42.01 **	-34.98 **	-44.76**	-36.76**	-57.56**	6.53	-17.72 *	3.01
29	RMS5A X IET 28703	6.47	67.3 **	-23.4 **	29.21**	47.92**	-0.73	14.03	-11.92	10.26
30	RMS5A X IET 28704	6.09	66.7 **	-23.67 **	-14.84*	-2.51	-34.57**	-5.19	-26.77 **	-8.33
31	CMS 52A X ZINCORICE	-11.84 *	38.52 **	-36.57 **	-50.04**	-42.80**	-61.61**	1.94	-21.26 **	-1.43
32	CMS 52A X SURABHI	-14.77 *	33.92 **	-38.68 **	11.64	27.80**	-14.23**	2.84	-20.57 **	-0.57
33	CMS 52A X CGZR-2	-17.27 **	30.0 **	-40.48 **	23.48**	41.37**	-5.13	33.94 **	3.46	29.51 **
34	CMS 52A X IET 28701	6.18	66.84 **	-23.61 **	-18.29**	-6.46	-37.22**	-4.81	-26.48 **	-7.96
35	CMS 52A X IET 28703	20.18 **	88.83 **	-13.54 **	-10.66	2.28	-31.36**	0.16	-22.64 **	-3.15
36	CMS 52A X IET 28704	23.41 **	93.91 **	-11.21 *	-45.30**	-37.38**	-57.98**	12.90	-12.80	9.16

*Significant at 5 percent level **Significant at 1 percent level ***Significant at 0.1 percent level

4. Conclusion
This study highlights the value of standard heterosis in identifying superior rice hybrids. US 312 was ideal for early flowering, plant height and spikelet fertility. RNR 15048 was optimal for 1000-grain weight and grain yield, while JGL 24423 served as a reliable check for panicle traits. These findings offer insights for selecting elite hybrids in rice hybrid development programs.

5. Acknowledgements
The work was conducted as a part of the research work of M.Sc. student of the Professor Jayashankar Telangana Agricultural University.

6. Authors contribution
All the authors have contributed equally.

7. Research content
The research content in this manuscript is original and has not been published or submitted elsewhere for publication.

8. Funding
The financial assistance for the said experiments was provided by Professor Jayashankar Telangana Agricultural University.

9. Ethical approval
Not applicable

10. Conflict of Interest
Authors have no conflict of interest.

11. Data availability
Not applicable

12. References

1. Azad AK, Begum H, Hasanuzzaman M. Evaluation of rice hybrids for yield and quality traits under field conditions. Euphytica. 2022;218:57.
2. Meena RK, Verma V, Singh P. Standard heterosis analysis in rice (*Oryza sativa* L.). Journal of Cereal Research. 2021;13(1):11-17.
3. Parimala K, Rajeswari S, Manonmani S. Performance of rice hybrids for yield and component traits. Oryza. 2018;55(2):116-122.
4. Saikiran B, Ramesha MS, Sudheer S, Latha P, Balachandran SM, Bindu B, *et al.* Assessment of heterosis in rice using line × tester analysis. Indian Journal of Genetics and Plant Breeding. 2020;80(2):210-217.
5. Samonte SOP, Wilson LT, McClung AM. Hybrid rice evaluation for yield and plant architecture. Field Crops Research. 2023;295:108929.
6. Singh A, Yadav M, Sharma S, Kumar R, Kumar A, Tiwari A, *et al.* Heterosis and combining ability in rice. Journal of Rice Research. 2020;13(1):45-52.
7. Waza AH, Lone RA, Sharma R, Mir MA, Wani SA, Bhat MA, *et al.* Studies on heterosis for yield-related traits in rice. International Journal of Agricultural Sciences. 2016;8(55):2906-2909.
8. Nagamani HS, Sarojadevi H. Tomato leaf disease detection using deep learning techniques. International Journal of Advanced Computer Science and Applications. 2022;13(1).
9. Mohan D, Mente A, Dehghan M, Rangarajan S, O'Donnell M, Hu W, Dagenais G, Wielgosz A, Lear S, Wei L, Diaz R. Associations of fish consumption with risk of cardiovascular disease and mortality among individuals with or without vascular disease from 58 countries. JAMA internal medicine. 2021 May 1;181(5):631-649.