International Journal of Environment and Climate Change

Volume 14, Issue 4, Page 93-99, 2024; Article no.IJECC.111339
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Agronomic Performance of Rice Genotypes under Direct Seeded Rice *(Oryza sativa L.)*

S. Vinoothna [a*], Y. Parimala [b], M. Pallavi [a] and Y. Bharathi [a]

[a] Department of Seed Science and Technology, Seed Research and Technology Centre (SRTC), Rajendranagar, Professor Jayashankar Telangana State Agricultural University, Hyderabad (Telangana), India.
[b] Agricultural Research Station, Tandur, Professor Jayashankar Telangana State Agricultural University, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2024/v14i44100

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/111339

Original Research Article

Received: 01/11/2023
Accepted: 04/01/2024
Published: 04/04/2024

ABSTRACT

The twenty rice genotypes were evaluated for their performance under Dry Direct Seeded Rice (DDSR) system of cultivation. All the growth, yield and yield attributes except for days to 50% flowering showed significant variation among the genotypes indicating variability among the genotypes under study. The genotype WGL 915 recorded maximum plant height, panicle length, 1000 seed weight, seed yield per plant, seed yield per plot and seed yield per ha, while WGL 44 recorded maximum productive tillers per m^2. WGL 915, JGL 24423, WGL 1246, JGL 1798 and KNM 733 genotypes recorded higher yields under DDSR system of cultivation among the genotypes under study.

Keywords: Genotypes; rice; yield; DDSR.

**Corresponding author: E-mail: SADHUVINOOTHNA29081998@GMAIL.COM;*

1. INTRODUCTION

Rice is a dominant food for more than half of the global population and principal source of livelihood. The area, production and productivity of rice in Telangana state is 31.86 lakh ha, 102.17 lakh tones and 3206 kg/ha respectively [1]. Increasing water scarcity, rising production costs and labour shortage are threatening food production in conventional transplanted rice system resulting in drastic shift to direct seeding of rice.

Dry Direct Seeding of rice (DDSR) involves dry-seeding onto well prepared seed beds at a field capacity level. However, direct seeded crop is detrimental due to severe weed infestations, especially during the seedling establishment period which subsequently reduces crop growth and yields in this system. The crop establishment under direct seeding is governed by several factors like soil physical and chemical properties, land preparation, seed viability and genotypic characteristics for seedling vigour, seeding depth and water management [2,3].

Direct seeding could be an attractive alternative for the traditional rice cultivation, however poor germination, uneven crop stand and high weed infestation are the bottlenecks for the adoption of the technology [4]. Successful implementation of DDSR is the need of the hour, thus thrust should be laid on identification of suitable varieties with superior performance under DDSR. Further identification of characters associated with their superior performance will help in developing varieties suitable for cultivation under DDSR. Different rice varieties show varied performance under the DDSR ecosystem, hence there is a need to identify varieties suitable for DDSR.

2. METHODOLOGY

An experimental trial comprising 20 rice genotypes developed at PJTSAU was carried out during *Kharif* 2022 at Seed Research and Technology Centre, PJTSAU, Hyderabad. The rice genotypes were sown in five rows of five meter length keeping row to row spacing of 25 cm and plant to plant spacing of 10 cm in two replications in a Randomized Block Design. The recommended packages of practices were followed to raise the crop. The following observations were collected.

The data on days to 50% flowering and seed yield per plot was collected on plot basis, while plant dry weight at 15 and 30 DAS was collected from ten plants selected randomly and oven dried at 80 ± 1 °C for 24 h and weighed. The data on plant height, number of tillers per hill, and panicle length were collected from randomly selected ten plants per at physiological maturity. The seed bearing panicles at the time of physiological maturity per m^2 were considered as productive tillers. The number of filled grains per panicle was counted from ten panicles selected randomly from each replication of a variety and spikelet fertility was assessed by using the following formula

$$\text{Spikelet Fertility (\%)} = \frac{\text{No. of filled grains per spikelet}}{\text{Total no. of grains in the spikelet}} \times 100$$

The crop was harvested at maturity, sundried and threshed manually. The seed yield per plot was calculated and later converted too seed yield per ha. The data recorded were tabulated and analysed statistically using Fischer's analysis of variance technique and least significant difference (LSD) test at 5% probability level was applied to compare differences among treatment mean [5].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

A significant variation was observed for dry weight at 15 and 30 DAS, plant height and number of tillers per hill (Table 1). The maximum dry weight at 15 and 30 DAS was observed in KNM 118 (1.271 g and 2.47 g respectively) and the genotypes JGL 28545, RNR 10754, RNR 11718, WGL 14, WGL 962, WGL 1246, KNM 733 and KPS 2874 were found on par with the best variety. A study on 31 rice genotypes by Akshitha et al. [6] for seedling vigour traits revealed a significant genotypic variability for dry weight with highest heritability. Teng et al. [7] and Fauzi et al. [8] also reported that heavier seeds produced higher seedling dry weight with higher leaf area resulting in faster canopy and higher photosynthetic activity and thereby have greater potential to compete with weeds under DDSR.

The highest plant height was recorded in the variety WGL 915 (122.99 cm) and the variety RNR 15435 (121.72 cm) was found on par, while lowest plant height was found in WGL 962 (85.45 cm). Similar variation in plant height under direct sowing was observed by Goyal et al. [9] and

Table 1. Analysis of variance for growth, yield and yield attributes of rice genotypes under DDSR system

Source of variation	df	Dry weight of the plant 15 DAS (g)	Dry weight of the plant 30 DAS (g)	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	No. of tillers per hill	No. of productive tillers per m^2	No. of filled grains per panicle	Spikelet fertility percentage	1000 seed weight (g)	Seed yield per plant (g)	Seed yield per plot (kg)	Seed yield per hectare (t)
Variety (A)	19	0.061 **	0.227 **	79.8700	233.899**	11.970 **	6.401**	5100.320 **	2003.880 **	45.164 *	49.400**	13.990 **	0.256**	0.654**
Error	19	0.003	0.017	0.0001	18.601	2.438	1.187	262.244	503.607	15.206	0.000	1.335	0.020	0.051
Total	39	0.031	0.120	38.9130	123.453	7.054	3.702	2630.751	1236.057	29.448	24.068	7.521	0.135	0.344

, represent significance at 0.05 and 0.01 levels probability respectively*

Table 2. Mean performance of rice genotypes for growth, yield and yield attributes under DDSR system

Variety	Dry weight of plant at 15 DAS (g)	Dry weight of plant at 30 DAS (g)	Days to 50% flowering	Plant height (cm)	No. of productive tillers per m^2	Panicle length (cm)	No. of tillers per hill	No. of filled grains per panicle	Spikelet fertility (%)	1000 seed weight (g)	Seed Yield per plant (g)	Seed Yield per plot (kg)	Seed yield (t/ha)
JGL 1798	0.81	2.08	88	95.37	383	21.55	11	209	79.68	15.22	27.12	3.91	6.26
JGL 384	1.10	2.09	96	99.60	365	22.40	10	150	82.94	14.37	22.61	3.58	5.73
JGL 24423	0.96	1.69	87	92.83	346	21.05	10	132	80.19	25.64	27.33	4.07	6.51
JGL 28545	1.25	2.36	97	97.73	459	19.90	15	126	75.24	15.37	24.43	3.26	5.22
KNM 118	1.27	2.47	85	95.83	398	19.85	13	132	91.16	27.07	26.63	3.75	6.00
KNM 1638	1.04	1.83	86	95.61	363	20.80	11	162	78.93	15.95	22.79	3.51	5.62
KNM 733	0.85	2.30	93	95.24	441	21.10	15	139	82.12	16.44	27.29	3.86	6.18
KPS 2874	0.86	2.30	103	104.38	358	22.05	12	161	78.17	15.37	24.29	3.75	5.99
KPS 6251	1.16	2.07	85	94.76	324	20.05	11	152	79.52	18.48	19.93	3.14	5.02
RNR 10754	1.20	2.20	83	91.80	321	18.35	9	119	87.96	23.04	22.56	3.18	5.09
RNR 15048	1.13	2.18	90	112.83	450	23.75	14	218	81.82	12.38	21.96	3.52	5.63
RNR 11718	1.18	2.29	95	99.42	364	22.00	13	127	75.34	19.67	21.81	3.05	4.88
RNR 15435	0.74	1.81	90	121.72	351	27.20	11	106	86.32	20.66	19.90	2.76	4.42
WGL 20471	0.95	1.32	85	100.40	450	20.15	13	141	91.58	21.05	23.30	3.47	5.55
WGL 14	1.17	1.60	98	111.37	460	21.65	14	121	79.39	15.35	24.91	3.55	5.68
WGL 44	0.92	1.43	104	96.84	465	20.50	15	124	80.53	14.77	22.86	3.50	5.60
WGL 915	0.91	1.88	98	122.99	402	27.40	12	139	75.58	31.04	28.61	4.08	6.53
WL 962	1.26	1.85	88	85.45	429	17.65	12	122	85.62	13.74	22.12	3.23	5.17
WGL 1119	0.83	1.42	85	87.73	453	19.85	14	122	79.74	15.88	27.48	3.70	5.92
WGL 1246	1.23	1.97	92	111.98	460	22.70	14	205	83.45	16.08	26.81	3.97	6.35

Table 3. Mean, range, standard deviation and coefficient of variation for the growth, yield and yield attributes of rice genotypes under DDSR system

S.no	Character	Mean	Range	CV (%)
1	Dry weight of plant at 15 DAS (g)	1.04	0.73 to 1.27	4.876
2	Dry weight of plant at 30 DAS (g)	1.96	1.32 to 2.47	6.742
3	Days to 50% flowering (no)	91	83 to 104	0.000
4	Plant height (cm)	100.99	85.45 to 121.72	4.270
5	No. of productive tillers per m^2 (no)	402	320 to 465	4.028
6	Panicle length (cm)	21.50	17.65 to 27.40	7.263
7	No. of tillers per hill (no)	12.45	9 to 15	10.363
8	No. of filled grains per panicle (no)	145	106 to 218	15.452
9	Spikelet fertility (%)	81.76	75.24 to 91.58	4.769
10	1000 seed weight (g)	18.38	12.38 to 31.04	0.059
11	Seed Yield per plant (g)	24.24	19.9 to 28.61	4.768
12	Seed Yield per plot (kg)	3.54	2.76 to 4.08	3.992
13	Seed yield (t/ha)	5.67	4.42 to 6.53	4.002

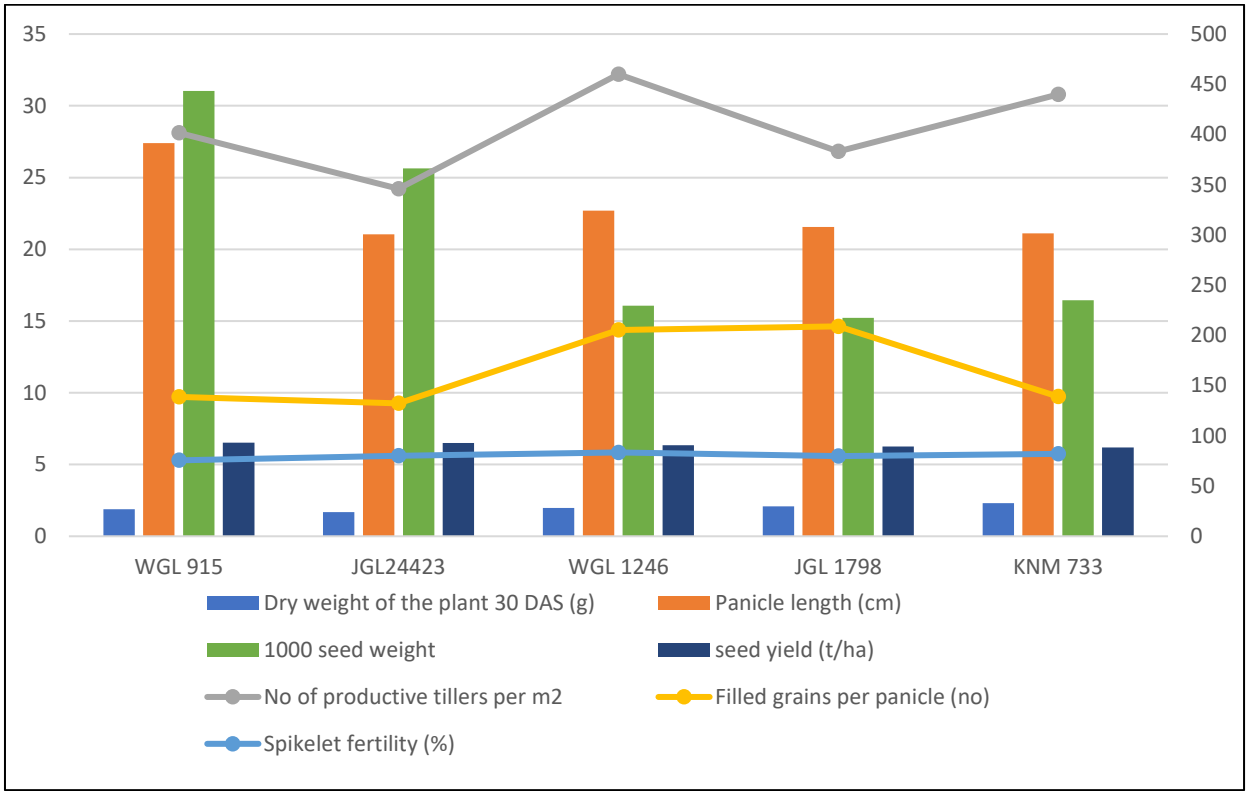

Fig. 1. Mean performance of rice genotypes showing superior performance under DDSR system

Fauzi et al. [10] who attributed this variation in plant height among rice genotypes to both cultivation system and phenology of each genotype. The varieties JGL 28545, KNM 733 and WGL 44 (15) recorded maximum number of tillers per hill, followed by KNM 118, RNR 15048, WGL 20471, WGL 14, WGL 1119 and WGL 1246 which were found to be on par. The lowest no. of tillers per hill was found in RNR 10754 (9). The results are in conformity with the findings of Anusha et al. [11] that early vigour genotypes showed high crop growth rate during pre-anthesis period which is reflected as higher number of tillers in vigorous genotypes compared to less vigorous genotypes.

3.2 Yield and Yield Attributes

There was a significant difference for panicle length, number of productive tillers per m^2, number of filled grains per panicle, spikelet fertility and seed yield, while days to 50% flowering showed a non-significant variation (Table 1). The days to 50% flowering, however ranged from 85 to 104 with a mean of 91. The panicle length was found to be maximum in WGL 915 (27.40 cm), followed by RNR 15435 (27.20 cm) which was on par and lowest in the variety WGL 962 (17.65 cm) (Table 2). The results were in conformity with findings of Uzair et al. [12] and Kavya et al. [13] who attributed that the variation in panicle length might be due to genetic potentiality of the rice genotypes under study.

The no. of productive tillers per m^2 was found to be maximum in WGL 44 (465) while the genotypes JGL 28545, KNM 733, RNR 15048, WGL 20471, WGL 14, WGL 1119 and WGL 1246 were on par. Maximum number of filled grains per panicle was recorded in RNR 15048 (218), while the genotypes JGL 1798 and WGL 1246 were on par and minimum number of filled grains per panicle was recorded in RNR 15435 (106). WGL 915 (31.04 g) recorded a maximum test weight, while none of the genotypes were found on par with the best genotype. RNR 15048 (12.38) recorded minimum test weight among the genotypes under study (Table 2).

A highest spikelet fertility was found in WGL 20471 (91.58 %) and the genotypes KNM 118, RNR 10754, RNR 15435, WGL 962 and WGL 1246 were found on par, while lowest value was recorded in JGL 28545 (75.24). WGL 915 (28.61) recorded maximum single plant yield followed by JGL 1798, JGL 24423, KNM 118, KNM 733, WGL 1119 and WGL 1246 which were on par and RNR 15435 recorded lowest seed yield per plant. The seed yield per plot and seed yield per ha was found maximum in WGL 915 (4.08 kg, 6.528 t) and the genotypes JGL 1798, JGL 24423, KNM 733 and WGL 1246 were found on par, however lowest yield was recorded in RNR 15435 (2.76 kg, 4.416 t).

4. CONCLUSION

The rice genotypes WGL 915, JGL 24423, WGL 1246, JGL 1798 and KNM 733 showed higher yields in comparison to other genotypes under study. The genotypes with higher 1000 seed weight had moderate number of productive tillers per m^2 and number of filled grains per panicle, while genotypes with moderate 1000 seed weight had higher number of productive tillers per m^2 and number of filled grains per panicle. These genotypes with superior performance can be evaluated in multilocation trials to further evaluate the performance before recommending for DDSR cultivation system as the adoption of this system by farmers in field level is the need of the hour to combat the scarcity of labour and to improve the benefit cost ratio for marginal farmers.

5. FUTURE LINE OF WORK

The identified genotypes can be validated by conducting multilocation trials in different geographical locations representing all the rice growing tracts of Telangana state. Identification of markers associated with seedling vigour and yield in Direct seeded rice through molecular studies. Artificial intelligence and IOT models can be integrated with the markers for identification of genotypes with higher yield and vigour.

ACKNOWLEDGEMENT

We are grateful to the Professor Jayashankar Telangana State Agriculture University for the Financial support, Department of Seed Science and Technology, Agriculture Research Institute, Seed Research and Technology Centre for Providing all the facilities required for the crop growth and later stages.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. India Stat; 2020-21. Available:https://www.indiastat.com. Area, Production and Productivity of rice (India stat. 2020-2021).
2. Ladha JK, Kumar V, Alam M, Sharma S, Gathala M, Chandna P, Saharawat YS, Balasubramanian V. Integrating crop and resource management technologies for enhanced productivity, profitability and sustainability of the rice-wheat system in South Asia. In: Ladha, J.K. (Ed.), Integrated Crop and Resource Management in the Rice-Wheat System of South Asia. International Rice Research Institute, Los Banos, Philippines. 2009;69-108.
3. Tripathi SC, Mongia AD, Shoran J. Resource conservation technologies and cropping system diversification opportunities. Conservation Agriculture: Status and Prospects. 2005;72-78.
4. Sandhu N, Ankush AP, Singh J, Raigar OP, Bains S, Jindal T, Singh MP, Sethi M, Pruthi G, Augustine G, Verma VK. Integrating association mapping, linkage mapping, fine mapping with RNA seq conferring seedling vigor improvement for successful crop establishment in deep sown direct-seeded rice. Rice. 2023; 16(1):46.
5. Steel RGD, Torrie JH. Principles and procedures of statistics. Principles and procedures of statistics; 1960.
6. Akshitha B, Senguttuvel P, Latha VH. Yamini KN, Rani KJ, Beulah P. Variability and correlation analysis for seedling vigour traits in rice (*Oryza sativa L*.) genotypes. International Journal of Current Microbiology and Applied Sciences. 2020;9(7):2877-2887.
7. Teng S, Vergara BS, Alejar AA. Relationship of grain length, width, and weight to seedling vigor in rice (*Oryza sativa* L.). Philippines Journal of Crop Sciences. 1992;17(1):17-20.
8. Fauzi AR, Junaedi A, Lubis I, Ghulamahdi M, Aswidinnoor H. Relationship of size and shape rice seed to early seedling vigor traits. In IOP Conference Series: Earth and Environmental Science. 2021;694(1): 012039.
9. Goyal A, Sharma PC, Munjal R, Krishnamurthy SL, Jat HS, Lokeshkumar BM, Kumar V. Identifying Rice Genotypes Suitable for Aerobic Direct-Seeded Conditions. Environmental Sciences Proceedings. 2022;16(1):68.
10. Fauzi AR, Junaedi A, Lubis I, Ghulamahdi M, Aswidinnoor H, Sakagami JI. Evaluation of rice genotypes on seed attributes and agronomic performance for developing direct-seeded cultivar. AIMS Agriculture and Food. 2022;7(1):1-21.
11. Anusha PL, Umamahesh V, Rao PV, Rao GR, Rao MS. Physiological and biochemical characterization of rice (*Oryza sativa*) genotypes suitable for dry direct sowing condition. Crop Research. 2020;55(5 and 6):189-201.
12. Uzair M, Patil SB, Zhang H, Kumar A, Mkumbwa H, Zafar SA, Chun Y, Fang J, Zhao J, Khan MR, Yuan S. Screening direct seeding-related traits by using an improved mesocotyl elongation assay and association between seedling and maturity traits in rice. Agronomy. 2022;12(4):975.
13. Kavya Y, Trimurtulu N, Gopal AV, Vani PM, Prasad NVVSD. Influence of carrier-based microbial consortia on the growth and yield attributes of sorghum (*Sorghum bicolor* (L.) Moench). Applied Biological Research. 2020;22(2):109-117.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/111339