E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(12): 121-125
Received: 08-09-2024
Accepted: 12-10-2024

P Spandana Bhatt
Scientist, Institute of Rice Research, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

MV Ramana
Principal Scientist, Institute of Rice Research, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

YC Mohan
Principal Scientist, Institute of Rice Research, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

L Krishna
Principal Scientist, Institute of Rice Research, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

TK Babu
Scientist, Institute of Rice Research, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

NRG Varma
Principal Scientist, Institute of Rice Research, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

Corresponding Author:
P Spandana Bhatt
Scientist, Institute of Rice Research, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

Performance of different rice genotypes under variable sowing times in climatic condition of Southern Telangana Zone

P Spandana Bhatt, MV Ramana, YC Mohan, L Krishna, TK Babu and NRG Varma

DOI: https://doi.org/10.33545/2618060X.2024.v7.i12b.2102

Abstract
A field experiment was conducted during Kharif, 2019 at Institute of Rice Research, Rajendranagar, and Hyderabad in Telangana state. The experiment was laid out in split plot design with consisting of four sowing dates in main plots i.e. June 2nd week, July 1st week, July 3rd week and August 1st week and 4 pre released rice cultures RNR 21278, JGL 28545, KNM 1638, WGL 962 and two check varieties KNM 118 and RNR 15048. Significantly higher mean grain yield was obtained when sowing was recorded with D1: June 2nd week (7071 kg/ha) which was at par with D2: July 1st week (6396 kg/ha). D2 July 1st week sowing was in turn at par with D3: July 3rd week (6107 kg/ha) and D4: August 1st week sowing recorded significantly lower yield (4572 kg/ha), thus for the tested cultures June 2nd week sowing was found optimum. Among the varieties V3 (KNM 1638) variety (6425 kg/ha) recorded significantly higher grain yield and was on par with V6 (RNR 15048) (6310 kg/ha), V1 (RNR 21278) (6242 kg/ha) and V2 (JGL 28545) (6111 kg/ha).

Key words: Cultures, rice, dates of sowing and varieties, transplanted rice

Introduction
Rice (*Oryza sativa* L.) is one of the world's major staple food crops, forms the staple diet of billions of people and provides 70% direct employment to the rural India. To maintain the food security of Asia, its cultivation is crucial as more than 90% of rice production and consumption is in this continent. Rice contributes 32-59% of the dietary energy and 25-44% of the dietary protein in 39 countries. The projected demand for rice is to be increased by 70 % in next 30 years to maintain present per capita availability (69 kg/annum) considering the productivity of land constant.

In world during 2022-23, about 1650.38 lakh ha (4078 lakh acres) area was covered under paddy with production of 5178 lakh tonnes and yield 4704 kg/ha (1903 kg/acre). Top most cultivating countries of paddy in the world are India 464 lakh ha (1146.60 lakh acres), China 296.9 lakh ha (733.6 lakh acres), Bangladesh 116.9 lakh ha (288.9 lakh acres), Thailand 114.8 lakh ha (283.8 lakh acres), Indonesia 104.5 lakh ha (258.3 lakh acres), Vietnam 70.9 lakh ha (175.2 lakh acres), Myanmar 69 lakh ha (170.5 lakh acres), Philippines 48.0 lakh ha (118.70 lakh acres), Nigeria 45.8 lakh ha (113.2 lakh acres) and Pakistan 29.8 lakh ha (73.5 lakh acres). Among the countries, China and India are the world's 1st and 2nd largest producers with approximately 2100.71 lakh tonnes and 1962.46 lakh tonnes production respectively. (https://pjtsau.edu.in/agri-marketing-intelligence)

The leading rice producing states in India as per the final advance estimates of 2023-24 were Telangana with 168.74 lakh tonnes production followed by Uttar Pradesh 159.90 lakh tonnes, West Bengal 156.87 lakh tonnes, Punjab 143.56 lakh tonnes, Odisha 84.74 lakh tonnes and Chhattisgarh 97.03 lakh tonnes. In Telangana during 2024-25 Vanakalam (Kharif) season paddy crop coverage is about 26.50 lakh hectares (65.49 lakh acres) as against 26.15 lakh hectares (64.61 lakh acres) covered during corresponding period of last year.

Major paddy growing districts in Telangana are Nalgonda 2.74 lakh ha (5.12 lakh acres), Suryapet 1.91 ha (4.72 lakh acres), Nizamabad 1.73 lakh ha (4.29 lakh acres), Siddipet 1.48 lakh ha (3.68 lakh acres), Kamareddy 1.27 ha (3.15 lakh acres) and Jagityal 1.28 lakh ha (3.16 lakh acres). According to final Advance Estimates of Production of Food grains for 2023-24, rice production estimate was 168.74 lakh tonnes in Telangana State. (https://pjtsau.edu.in/agri-marketing-intelligence.html)

Crop yield is the result of coordinated influence of genotype and weather variables. Time of sowing is the one of the key agronomic input to increase the yield of any variety. Even slight changes in transplanting time substantially changes grain yields, growth duration and grain quality due to changes of air temperature and solar radiation (BRRI, 2003) [5].

Rice is basically a short-day plant. It initiates panicle primordia in response to short photoperiods. Panicle primordia may be initiated late or they may not develop when the plant is subjected to long photoperiods. Small seasonal differences in day length in the tropics were thought to be unimportant in controlling plant behaviour. Later work, however, demonstrated that rice is the god example for those small differences in day length an effect yield. Hence the present study, 'performance of different rice genotypes under variable sowing times in climatic condition of southern Telangana Zone" was carried out.

Materials and Methods

The investigation was carried out during *Kharif* 2019 at Institute of Rice Research, Professor Jayashankar State Agricultural university, Rajendranagar, Hyderabad, situated at an altitude of 542.3 m above MSL at 17°19' N latitude and 78°23' E longitude. It is in the Southern Telangana agro-climatic zone of Telangana state. According to Troll's climatic classification, it falls under semi-arid tropics (SAT). The soil of the experiment cites was clay loam in texture. Low in available Nitrogen (204 kg ha^{-1}), high in phosphorus (96 kg ha^{-1}) and potash content (591 kg ha^{-1}). The experiment was laid out in split plot design with three replications. Treatments consist of four dates of sowing i.e., June 2nd week, July 1st week, July 3rd week and August 1st week. Transplanting was done with respective 25 days old seedling with 2-3 seedlings per hill. Cultures in sub plot consist of RNR 21278, JGL 28545, KNM 1638, KNM 118, WGL 962 and RNR 15048. Row to row distance was 20 cm and plant to plant 15 cm was maintained. Recommended dose of 120-60-40 kg NPK were supplied to the crop. The recommended dose of 60 kg P_2O_5, half of the recommended K_2O and 1/3rd of nitrogen were applied as basal dose. Remaining nitrogen was applied in two equal splits at 20 days after planting and at panicle primordial initiation (PI) stage. Remaining potash was applied at PI stage along with nitrogen. A thin film of water was maintained at the time of transplanting. Later, a submergence depth of 5 ± cm was maintained up to tillering stage later 2+cm maintained up to physiological maturity. Ten days before harvest the water was drained off from the field to facilitate ripening and maturity. Harvesting was done at physiological maturity, judged visually when about 95 per cent grains were turned into golden color. Initially the border rows were harvested. Later the net plot hills were harvested and bundled. The post-harvest observations were recorded from the harvest samples. The hills from net plot area were threshed and winnowed. After sun drying, the net plot grain yields and straw were recorded treatment wise and reported in kg ha^{-1}.

Plant height was measured from ten tagged hills by measuring length from the basal node of the plant to the tip of the longest leaf at harvest. Mean height was presented as cm. Four samples of 2×2 hills were ear marked at random at four places in each treatment for tiller count. The wooden peg was fixed at the centre of four hills. Totally, sixteen hills per plot were considered for tiller count. The total number of tillers was presented as number m^{-2}. Ten panicles were selected randomly from the net plot area for recording the panicle length. It was measured from the base of the primary rachis to top most spikelet and average was calculated to get the mean length of panicle. Weight of ten sampled panicles was recorded and mean values were calculated. Total number of spikelets from same ten panicles was counted and filled grains were separated and counted and then mean values were reported. Dried seed samples were drawn randomly from each treatment and 1000 grains were counted and weight was recorded in grams. The grain yield from each net plot area treatment wise was weighed and expressed as kg ha^{-1}. Data on different characters *viz*., growth and yield components and yield, were subjected to analysis of variance procedures as outlined for randomized block design, factorial concept. Statistical significance was tested by F–value at 0.05 level of probability and critical difference was worked out where ever the effects were significant.

Results

Plant height (cm)

The data pertaining to plant height of rice across different dates of sowing and pre released cultures were analyzed statistically and presented in Table 1. Different dates of sowing and pre released cultures showed significant influence on plant height at harvest. Among different dates of sowing significantly highest plant height was recorded in July 3rd week sowing (107 cm) and was on par with June 2nd week sowing (106 cm) followed by August 1st week sowing (104 cm) and significantly shortest plant height was recorded in July 1st week sowing (101 cm). Higher plant height in early sowing dates might be due to prolonged vegetative growth whereas in late sown crop decreased vegetative growth restricted the plant height. The present results substantiate the findings of Pandey *et al*. (2007) [8].

Among the cultures significantly tall plants were registered with RNR 15048 (118 cm) followed by KNM 118 (108 cm) followed by WGL 962 (103 cm), further followed by JGL 28545 (101 cm) and KNM 1638 (101 cm). Significantly lower plant height was recorded with RNR 21278 (96 cm). Interaction effect of plant height with dates of sowing and pre released cultures was significant. The results consistent with the findings of Anil1and Sreedhar (2020) [2].

No of tillers/m^2 at maturity

The data pertaining to No of tillers/m^2 at maturity of rice across different dates of sowing and pre released cultures were analyzed statistically and presented in Table 1. Among different dates of sowing, June 2nd week recorded significantly higher No of tillers/m^2 (460) followed by July 1st week sowing (372) followed by July 3rd week sowing (349) and lowest No of tillers/m^2 (313). Among the pre released cultures JGL 28545 (404) recorded significantly highest No of tillers/m^2 and was on par with KNM 1638 (389) followed by RNR 15048 (383) which was inturn on par with WGL 962 (372) followed by RNR 21278 (361). Significantly lowest No of tillers/m^2 recorded with KNM 118 (331). Interaction effect of plant height with dates of sowing and pre released cultures was not significant. These results were in accordance with the findings of Anil *et al*. (2022) [3] who reported significantly highly significant difference in number of $tiller^{-2}$ due to variety, dates of sowing and their interaction.

Number of Ear bearing tillers/m^2

The data pertaining to No of Ear bearing tillers/m^2 at maturity of rice across different dates of sowing and pre released cultures were analyzed statistically and presented in Table 1.

No of Ear bearing tillers/m^2 at maturity of rice was significantly influenced by different dates of sowing of rice. Significantly more no of ear bearing tillers/m^2 was recorded with crop sown on July 1st week (342) but was on par with June 2nd week sowing (337), followed by July 3rd week (327). Significantly low no of ear bearing tillers/m^2 recorded in August 1st week sowing (278). Number of panicles per unit area is the most important component of rice yield. It accounted for 89% of the variation in grain yield (Yoshida *et al*., 1972) [13]. Interaction was significant with dates of sowing and pre released cultures.

Panicle length and panicle weight

Panicle length was not influenced significantly across dates of sowing of the rice and it was significantly influenced with pre released cultures. RNR 15048 registered significantly lengthiest panicles (24.6 cm), followed by KNM 1638 (23.1), followed by KNM 118 (22.1 cm) and was on par with JGL 28545 (21.9 cm) RNR 21278 (20.8 cm). Significantly lower panicle length was recorded in WGL 962 (20.0 cm). These results are in agreement with those obtained by Singh *et al*. (2007) [8].

The data pertaining to panicle weight of rice across different dates of sowing and different pre released cultures were analyzed statistically and presented in Table 2. Significantly more panicle weight was recorded with crop sown on June 2nd week (3.61 g) followed by July 1st week (3.24 g) and was on par with July 3rd week (3.11 g) which was inturn on par with August 1st week (3.08 g). Among the pre released cultures, variety RNR 15048 recorded significantly highest panicle weight (3.47 g) followed by RNR 21278 (3.29 g) and was on par with KNM 1638 (3.25 g) and JGL 28545 (3.21 g). Interaction was significant with sowing across the date with pre released cultures. The results consistent with the findings of Spandana *et al*. (2024).

Total number of spikelets/panicle

The data pertaining to Total number of spikelets/panicle of rice across different dates of sowing and different pre released cultures were analyzed statistically and presented in Table 2. Significantly more spikelets panicle^{-1} was noticed with crop sown on July 1st week (272) and was on par with June 2nd week (265) followed by July 3rd week (255) which was inturn on par with August 1st week (243). The variation in total number of spikelets/panicle across the different dates of sowing may be due to different photosynthetic ability during that time and also having more sink capacity during that time of sowing. The present result was in agreement with observations made by Chengde (2017) [6].

RNR 15048 recorded significantly higher total number of spikelets/panicle (317) and was on par with KNM 1638 (302) followed by WGL 962 (286), RNR 21278 (249), JGL 28545 (216). Significantly lowest total number of spikelets/panicle recorded with KNM 118 (183). The variation in total number of spikelets/panicle across the different cultures may be due to grain type. Interaction was significant with sowing across the date with pre released cultures.

Number of filled spikelet/panicle

The data pertaining to Total number of filled spikelets/panicle of rice across different dates of sowing and different pre released cultures were analyzed statistically and presented in Table 2.

Significantly more filled spikelets panicle^{-1} was noticed with crop sown on July 1st week (251) and was on par with June 2nd week (243) and June 2nd week (235.1) followed by August 1st week (222). The variation in total number of spikelets/panicle across the different dates of sowing may be due sink capacity and favorable environment. The present result was in agreement with observations made by Bashir (2010) [1].

RNR 15048 recorded significantly higher total number of spikelets/panicle (287.8) and was on par with KNM 1638 (KNM 1638), and WGL 962 (262), followed by RNR 21278 (229.8), followed by JGL 28545 (199.3). Significantly lowest total number of spikelets/panicle recorded with KNM 118 (168.1). Interaction was significant with sowing across the date with pre released cultures.

1000 grain weight (g)

The data pertaining to 1000 grain weight (g) of rice across different dates of sowing and different pre released cultures were analyzed statistically and presented in Table 2. Different sowing windows didn't effect the 1000 grain weight (g) significantly as the 1000 grain weight is predominantly genetically character of the variety. Variety KNM 118 recorded significantly highest 1000 grain weight (g) i.e. 23.46 followed by KNM 1638 (14.16 g) followed by JGL 28545 (13.53) further followed by RNR 21278 (2.68) which was on par with WGL 962 (12.53 g) and RNR 15048 (12.09 g). Interaction was not significant with sowing across the date and with pre released cultures. These results are in agreement with the findings of the Khalifa (2009) [7].

Grain yield (kg/ha)

The data pertaining to grain yield (kg/ha) of rice across different dates of sowing and different pre released cultures were analyzed statistically and presented in Table 2. Grain yield followed decreasing trend from June 2nd week sowing to later sowings. Significantly more grain yield (kg/ha) was noticed with crop sown on June 2nd week sown crop (7071) and was on par with July 1st week sown crop (6396) which was inturn on par with July 3rd week sown crop (6107). Significantly low yield was recorded with August 1st week sown crop (4572).

Among pre released cultures significantly highest grain yield was recorded with KNM 1638 (6425) and was on par with the variety RNR 15048 (6310), RNR 21278 (6242), JGL 28545 (6111) followed by WGL 962 (5794) and which was in turn on par with KNM 118 (5337).

Interaction was significant with sowing across the date and with pre released cultures.

In June 2nd week sowing KNM

1638 (8323), WGL 962 (7316), RNR 15048 (7729) recorded significantly highest grain yield and their yields decreased in subsequent sowings. At July 1st week sowing all the cultures recorded on par yields and highest being RNR 21278 (6746). July 3rd week recorded on par grain yield in all the varieties except KNM 118 and WGL 962 which were recorded significantly lower yield symbolizing this sowing window is not suitable for these cultures. August 1st week sowing significantly decreased grain yield in all the cultures. The present result was in agreement with observations made by Shah *et al*., (2005) [10], Ramana *et al*., (2007) [9] and Akbar (2010) [4].

Table 1: Growth and yield attributes of pre released rice cultures as influenced by different dates of sowing during Kharif 2019

Treatments	Plant height (cm) at maturity	No of tillers/m^2 at maturity	Ear Bearing Tillers /m2	Panicle length (cm)	Panicle weight (g)
Main plot: Date of sowing					
D1 - June 2nd week	106	460	337	22.17	3.61
D2 - July 1st week	101	372	342	22.02	3.24
D3 - July 3rd week	107	349	327	22.07	3.11
D4- August 1st week	104	313	278	22.23	3.08
SEM ±	0.44	12.41	3.53	0.22	0.04
CD (P=0.05)	1.5	42.8	12.2	NS	0.14
Sub-plot: Pre-Released Cultures					
V1: RNR 21278	96	361	299	20.8	3.29
V2: JGL 28545	101	404	329	21.9	3.21
V3: KNM 1638	101	389	358	23.1	3.25
V4: KNM 118	108	331	286	22.1	3.14
V5: WGL 962	103	372	328	20.0	3.18
V6: RNR 15048	118	383	324	24.6	3.47
SEM ±	0.4	7.27	2.97	0.35	0.31
CD (P=0.05)	1.16	20.7	8.51	1.02	0.08
Interaction (D X V)					
SEM ±	1.08	12.4	8.66	0.55	0.1
CD (P=0.05)	2.44	NS	18.07	2.08	0.19
Interaction (V X D)					
SEM ±	0.86	18.1	6.48	0.69	0.07
CD (P=0.05)	2.6	NS	19.68	2.01	0.21

Table 2: Yield attributes and grain yield of pre released rice cultures as influenced by different dates of sowing during Kharif 2019

Treatments	Total number of spikelets/panicle	Number of filled Spikelet/panicle	1000 Grain weight (g)	Grain yield (kg/ha)
Main plot: Date of sowing				
D1 - June 2nd week	265	243.0	14.61	7071
D2 - July 1st week	272	251.0	14.71	6396
D3 - July 3rd week	255	235.1	14.95	6107
D4- August 1st week	243	222.0	14.7	4572
SEM ±	4.63	4.62	0.07	240.4
CD (P=0.05)	16.0	15.9	NS	829
Sub-plot: Pre-Released Cultures				
V1: RNR 21278	249	229.8	12.68	6242
V2: JGL 28545	216	199.3	13.53	6111
V3: KNM 1638	302	282.8	14.16	6425
V4: KNM 118	183	168.1	23.46	5337
V5: WGL 962	286	262.0	12.53	5794
V6: RNR 15048	317	287.8	12.09	6310
SEM ±	8.82	8.9	0.21	164
CD (P=0.05)	25.2	25.4	0.61	469
Interaction (D X V)				
SEM ±	11.3	11.3	0.18	588.8
CD (P=0.05)	51.2	51.7	Ns	1014
Interaction (V X D)				
SEM ±	16.7	16.9	0.4	384.2
CD (P=0.05)	48.67	49	NS	1187

Table 3: Grain yield interaction between dates of sowing and pre released cultures during Kharif, 2019

	RNR 21278	JGL 28545	KNM 1638	KNM 118	WGL 962	RNR 15048	Mean
D1 - June 2nd week	6515	6243	8323	6304	7316	7729	7071
D2 - July 1st week	6746	6547	6214	6461	6494	5912	6396
D3 - July 3rd week	6841	6562	6899	4815	4925	6602	6107
D4- August 1st week	4864	5093	4264	3770	4443	4997	4572
Mean	6242	6111	6425	5337	5794	6310	

Conclusions

In southern Telangana Zone, Significantly higher mean grain yield was obtained when sowing was recorded with D1: June 2nd week (7071 kg/ha) which was at par with D2: July 1st week (6396 kg/ha). D2 July 1st week sowing was in turn at par with D3: July 3rd week (6107 kg/ha) and D4: August 1st week sowing recorded significantly lower yield (4572 kg/ha), thus for the tested cultures June 2nd week sowing was found optimum.

Among the varieties V3 (KNM 1638) variety (6425 kg/ha) recorded significantly higher grain yield and was on par with V6 (RNR 15048) (6310 kg/ha), V1 (RNR 21278) (6242 kg/ha) and V2 (JGL 28545) (6111 kg/ha).

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