Current Journal of Applied Science and Technology

39(26): 77-84, 2020; Article no.CJAST.60373
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Evaluation of Pre Released Rice (*Oryza sativa* L.) Genotypes under Different Sowing Dates in Rainy Season

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Authors' contributions

This work was carried out in collaboration between both authors. Author DA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SS managed the analyses of the study and one of the contributor of pre released rice genotypes. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2020/v39i2630907
Editor(s):
(1) Dr. Frédéric Ngezahayo, Ecole Normale Supérieure, Burundi.
Reviewers:
(1) Gowon Kerter Eric, University of Technology Yola, Nigeria.
(2) Victor Tolulope Fabunmi, University of Ibadan, Nigeria.
(3) Mutaz Mohamed Ahmed Elshiekh, Ahfad University, Sudan.
Complete Peer review History: http://www.sdiarticle4.com/review-history/60373

Original Research Article

Received 15 June 2020
Accepted 22 August 2020
Published 03 September 2020

ABSTRACT

Field experiments were conducted to evaluate the pre released rice genotypes under different sowing windows on clay soils of agricultural research station, Kunaram, Telangana state, India during two consecutive rainy seasons of 2018 and 2019.The experiment was laid out in strip plot design with three replications. The treatments comprised of three sowing dates i.e. 20thJune, 5thJuly and 20thJuly in horizontal factor and four genotypes i.e. KNM 733, RNR 15048, KNM 1638 and KNM 118 in vertical factor. The pooled data results indicated that, among the genotypes the genotype KNM 1638 sown on 5th July recorded maximum growth parameters and highest grain yield (7455 kg ha^{-1}) and followed by sown on 20th June. In respect of economics of treatment combinations, the highest net returns (Rs.75,326 ha^{-1}), gross returns (Rs.1,35,326 ha^{-1}) and B:C (2.26) ratio were obtained when rice crop was sown during 5th July with the genotype KNM1638 and followed by sown on 20th June with the genotype KNM 1638.

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Keywords: Genotypes; sowing; yield; dates; economics.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important staple food grain crops of the world, which constitute the principle food for 60 per cent of the world's population and 2/3rd of Indian population [1]. Rice is intensively grown in 88 countries across the world on an area about 160.01million hectares with annual production of 465.48 million tones. In India rice is grown in 44.60 million hectares, the production level is 112.91 million tones and the productivity is about 2432 kg ha^{-1} (Agricultural statistics at a glance-2018) [2]. More than 80 per cent of the world's rice is produced and consumed in Asia [3] where it is an integral part of culture and tradition. Rice, it is believed, is associated with wet, humid climate, though it is not a tropical plant. It is probably a descendent of wild grass that was most likely cultivated in the foothills of the far Eastern Himalayas.

Time of sowing is the most important factor in influencing the crop yield. Performance of a genotype entirely depends upon the time of planting. Delay in planting generally results in yield reduction which cannot be compensated by any other means. Early date of sowing is the best time of sowing for important properties such as maximum tillering, panicle initiation, chlorophyll content, leaf area index, sink capacity, panicle length, number of panicles/m^2, and grain yield [4]. Delay in planting from15 June to 15 July decreased leaf area index (10%) [5]. At a specific location, maximum grain yield can be achieved by planting the crop at the optimum time, which may vary from variety to variety. Early transplanting dates increase the physiological parameter and grain of rice as compared to late planting [6].

Varieties play a unique role in maximizing yield by improving the input- use efficiency as the genetic potential of variety limits the expression of its yield and affects plant growth in response to environment condition. The genotype KNM 733 is a short slender, short duration, non-shattering and good quality traits with high yield potential and the genotype KNM 1638 is an early duration, medium slender and non-lodging culture with high yield potential.

Objective of this experiment was to find out the Performance of pre released rice cultures KNM 733 & KNM 1638 with best checks (RNR 15048&KNM 118) under different dates of sowing in Northern Telangana Region.

2. MATERIALS AND METHODS

A field experiment was conducted for two consecutive rainy seasons of 2018 and 2019 at Agriculture Research Station, Kunaram situated at an altitude of 231 m above mean sea level at 18.5272^{o}' N latitude and 79.4943^{o}f' E longitude. The soil of the experiment sites was clay in texture, saline in reaction. It was normal electrical conductivity (0.42 dS m^{-1}) and just below neutral in reaction (pH 6.5). The organic carbon content was low (0.56-0.60%) while medium in available Nitrogen and phosphorus respectively but high in potash content (314-611 kg ha^{-1}). The experiment was laid out in strip plot design replicated thrice. The treatments combination comprised three sowing dates in the horizontal factor *viz.*20th June, 5th July and 20th July, and four genotypes in the vertical factor *viz.* KNM 733, RNR 15048, KNM 1638 and KNM 118. The net size of each plot was 27 m^2 (6.0 × 4.5 m). Row to row and plant to plant distance was made at 15 cm apart and seedlings were transplanted according to different dates of sowings. Seeds were sown at the rate of 50 kg ha^{-1} in each date of sowing in the nursery. The seeds were treated with bavistin @ 2g kg^{-1} seed before sowing. One third of the recommended dose of nitrogen (120 kg ha^{-1}), full dose of phosphorus (60 kg ha^{-1}) and half dose of potash (30 kg ha^{-1}) were applied at after main field preparation, and the remaining nitrogen was top-dressed in two equal splits dose, at active tillering (18 -20 DAT), and at panicle initiation stage The remaining half of the potassium applied at panicle initiation stage in the D_1, D_2 and D_3 transplanted plots. For effective weed management, oxadiargyl (70 grams *a.i.*ha^{-1}) was used in moist condition at morning sunshine hours in all the treatments just after D_1, D_2 and D_3 transplanted fields. Zinc sulphate (2 grams $liter^{-1}$) was sprayed to foliage at 25 and 30 DAT to avoid zinc deficiency in the crop. Irrigation was applied @ 5 cm at 7 to 8 days interval to maintain soil moisture at field capacity from sowing to one week before harvest during dry spells in the season. The plant height, tillers production and dry matter accumulation were recorded at tiller initiation, maximum tillering, panicle initiation, 50 % flowering and maturity stage of the crop growth. The gall midge incidence (%) was recorded at 40 days after transplanting. The yield attributes and grain yield

was recorded at harvest and sun dried straw yield was recorded 15 days after harvest.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Plant height

The crop sown on 20th June recorded maximum plant height (112.0 cm) and successive delay in sowing by 15 days (July 5th to July 20th). Plant height is directly proportional to the length of the vegetative phase of the crop. Increased plant height in earlier planting dates was due to availability of prolonged period for vegetative growth [7]. The interaction effect of dates of sowing and varieties on plant height was significant. The highest plant height (125.0 cm) was recorded with the variety RNR-15048, when it was sown on 20th June followed by other short duration genotypes respectively. The difference in plant height among the genotypes was due to their varied vegetative growth period. These results are in accordance with the findings of Dileep et al. [8], because of photosensitivity.

3.1.2 Number of tillers per square meter

Among the dates of sowings, the crop sown on 5th July produced maximum number of effective tillers m^{-2} (357) and there is no significantly difference was observed crop sown on 20th June and 20th July date sown crop. The more number of tillers m^{-2} in early sown crop was due to the fact that the rice genotypes had longer duration for their vegetative growth compared to those sown late in the season. Ashem et al. [9] and Changmai [10] also reported that significant reduction in tiller production with delay in transplanting. Among the short duration genotypes *viz*., RNR 15048 and KNM 1638 registered higher number of effective tillers m^{-2} and were on par with each other and significantly superior over KNM 733 and KNM 118 varieties. It might be due to more relative growth rate and biomass production resulted in intra plant competition among the tillers for growth resources lead to more mortality of tillers when compared to short and extra short duration cultivars [11]. The results are in close conformity with Birhane [12], who also found highly significant difference in number of effective tiller $plant^{-1}$ due to variety, method of planting and their interaction.

3.1.3 Total dry matter per square meter

There was no significant difference in dry matter accumulation noticed from 20th June to July 5th and a significant reduction was observed only in the crop sown late on July 5th.The early sown crop might have better opportunity to experience favorable cardinal temperature, rainfall, solar radiation resulted in higher plant height thereby accumulation of more dry matter compared to late sown crop. Several studies evidently proved that, a marked decrease in dry matter accumulation with delay in sowing of rice. Among the genotypes, the genotype of KNM 1638 accumulated more dry matter m^{-2} (1302 gm^{-2}) and was on par with the genotype of KNM 733 (1249 gm^{-2}) and significantly superior over rest of the check varieties respectively. The difference in dry matter accumulation among the genotypes might be due to their genetic potential and differential plant height. Similar results were obtained by Dileep et al. [8].

3.1.4 Gall midge incidence (%)

The data revealed there was no significant difference was observed in different dates of sowings with respect to gall midge incidence but the low incidence of gall midge (6.06) was observed when crop was sown on 5th July. Chaudhari et al. [13], also observed that the early planting significantly reduced the incidence of gall midge followed by normal planting and highest incidence was exhibited in late planting in rice. Among the short duration genotypes the low incidence of gall midge (4.73) was observed with the genotype KNM 1638 which was closely followed by followed KNM 733 (6.23). These results are conformity with the Atanu seni and Bhimasen naik [14].

3.2 Yield Parameters and Yield

3.2.1 Number of panicles per square meter

The crop sown on 20th June produced maximum number of panicles m^{-2} (335) and it is on par with the crop sown on 20th July and significantly difference with the 5th July date sown crop. Among the short duration genotypes KNM 1638 registered higher number of panicles m^{-2} (338) and were on par with KNM 118 and significantly superior over KNM 733 and RNR 15048 genotypes. Back et al. [15], also observed that panicle and spikelet numbers m^{-2} were greater with early sowing.

3.2.2 Number of filled grains per panicle

The crop sown on 20th June produced more number of filled grains panicles^{-1} (223) and it was on par with the crop sown on 5th July and significantly difference with the 20th July sown crop (Table 2). Late sowing shortened the growth period of the plant which reduced the number of grains panicle^{-1} than early sown crop under aerobic culture [16]. Among the genotypes the KNM 1638 was recorded significantly the highest number of filled grains panicle^{-1} (245) and which was on par with the genotype RNR 15048 and significantly superior to KNM 733 and KNM 118. The number of spikelet's panicle^{-1} is basically genetic feature of a variety. These results are in close conformity with Balaji naik et al. [17], who also observed significantly differences in number of filled spikelet's panicle^{-1} due to varieties and sowing times in aerobic rice system.

3.2.3 Test weight (1000 grain weight)

The crop sown on 20th June recorded more 1000 grain weight (18 g) and was significantly superior to 5 th July and July 20th sown crop. Higher test weight obtained from the crop sown in June month might be attributed to well distribute rainfall, sufficient soil moisture, optimum photoperiod available for crop growth and development. These results are in line with the findings of Muhammad et al. [16]. Among the genotypes, the genotype KNM 118 recorded significantly the highest 1000 grain weight (26.8g) over the other genotypes KNM 733, KNM 1638 and RNR 15048. These results clearly indicated that, the 1000 grain weight is a varietal feature which might be affected least with the environmental conditions.

3.2.4 Grain yield (Kg ha^{-1})

Significantly more grain yield (6879 kg ha^{-1}) was realized from the crop sown on 5 th July and which is on par with the crop sown on 20 th June and was significantly difference with the grain yield of crop. The rice crop was sown on 20 th June and 5 th July recorded the higher grain yield it was mainly due to higher effective tillers and spikelet panicle^{-1} compared to late sown on 20 th July (Table 2.). Chendge et al. [1], reported that the increased yield might be due to result of

Table 1. Growth and yield attributes of pre released rice cultures as influenced by different dates of sowing during rainy *season* (Pooled data of 2 years)

Treatments	Plant height (cm)	No. of tillers m^{-2}	Dry matter production (g m^{-2})	No. of days to				Gall Midge (%)
				Maximum tillering	Panicle Initiation	50% Flowering	Maturity	
Main plot: Date of sowing								
20th June	112	343	1224	67	86	91	120	7.79
5th July	111	357	1290	68	83	88	116	6.06
20th July	108	344	1164	67	84	89	120	8.28
SEm ±	0.36	3.4	21.37	0.20	0.17	0.10	0.13	0.64
CD (P = 0.05)	1.43	NS	83.92	NS	0.65	0.40	0.52	NS
Sub-plot: Pre released cultures								
KNM 733	107	328	1249	65	81	86	116	6.23
RNR 15048	125	357	1171	74	91	97	125	8.81
KNM 1638	101	367	1302	69	86	91	122	4.73
KNM118	107	339	1181	62	79	83	111	9.72
SEm ±	0.25	2.8	27.43	0.08	0.09	0.13	0.18	0.59
CD (P = 0.05)	0.85	9.6	94.94	0.27	0.30	0.44	0.64	2.02
Interaction (D X V)								
SEm ±	0.47	10.0	41.9	0.36	0.17	0.24	0.23	1.3
CD (P = 0.05)	1.45	NS	129.0	1.10	0.53	0.75	0.71	NS
Interaction (V X D)								
SEm ±	0.49	8.3	37.4	0.32	0.20	0.21	0.21	1.15
CD (P = 0.05)	1.68	NS	129.7	1.12	0.69	0.72	0.73	NS

Table 2. Yield attributes of pre released rice cultures as influenced by different dates of sowing during rainy season (Pooled data of 2 years)

Treatments	No. of panicles m^{-2}	Panicle length (cm)	No. of filled grains $panic^{1}$	Grain yield (kg ha^{1})	Straw yield (kg ha^{-1})	Test weight (g)	Harvest index (%)	Net returns	B:C Ratio
Main plot: Date of sowing									
20th June	335	26.4	223	6761	7310	18.0	48.1	62,719	2.05
5th July	303	25.3	222	6879	7326	17.4	48.5	64,846	2.08
20th July	329	25.6	194	6280	7168	17.5	46.8	53,988	1.90
SEm ±	3.75	0.23	3.13	41.2	113.0	0.03	0.39	748.03	1.02
CD (P = 0.05)	14.74	NS	12.30	161.8	NS	0.12	NS	2,937.0	0.05
Sub-plot: Pre released cultures									
KNM 733	316	26.4	223	6792	7328	15.4	48.1	63,268	2.05
RNR 15048	306	26.6	239	6208	6924	13.0	47.3	52,674	1.88
KNM 1638	338	24.7	245	7144	7739	15.3	48.0	69,662	2.16
KNM118	330	25.4	145	6417	7082	26.8	47.6	56,466	1.94
SEm ±	3.84	0.16	4.94	82.2	106.4	0.03	0.17	1,491.0	0.02
CD (P = 0.05)	13.30	0.57	17.08	284.4	368.2	0.11	0.60	5,162.0	0.09
Interaction (D X V)									
SEm ±	7.01	0.22	5.62	106.4	163.9	0.05	0.51	1,931.0	0.03
CD (P = 0.05)	21.59	0.67	17.32	327.9	NS	0.17	NS	5,951.0	0.10
Interaction (V X D)									
SEm ±	6.35	0.26	5.15	89.8	161.3	0.05	0.53	1,629.0	0.03
CD (P = 0.05)	21.98	0.91	17.83	311.1	NS	0.17	NS	5,646.0	0.09

Table 3. Interaction effect of dates of sowing & varieties on grain yield (kg ha^{-1}) of rice cultures (Pooled data)

Dates of sowing	Varieties				
	KNM-733	RNR-15048	KNM-1638	KNM-118	Mean
20th June	6889	6554	7364	6238	6761
5th July	6997	6379	7456	6682	6879
20th July	6489	5691	6612	6330	6280
Mean	6792	6208	7144	6417	
SEm ±	106.0				
CD (P = 0.05)	327.0				

optimum growth and development parameters and yield contributes associated with 23rd meteorological week of sowing followed by 24th meteorological week treatment, which associated with favorable weather condition responsible for more growth and development resulted in more storage of photosynthates in the grain in early sown crop. Among the genotypes tested the genotype KNM 1638 produced more grain yield (7144 kg ha^{-1}) and which in turn significantly superior to other variety KNM 733 (6792 kg ha^{-1}) and check genotypes KNM 118 (6417 kg ha^{-1}) and RNR 15048 (6208 kg ha^{-1}). The genotype KNM 1638 was performed better due to more conversion of photosynthates into economic produce, which resulted in higher yield attributing characters in the respective varieties. Similar results were reported by Pandey et al. [18] and Ramana et al. [19]. So, it would be better to choose short duration genotype KNM 1638 and follow optimum sowing dates from second forthright of June to first week of July under irrigated conditions of northern Telangana zone.

Table 4. Yield and economics of rice cultures as affected by different treatment combinations

Treatments	Grain yield (kg ha^{-1})			Gross Returns (Rs. ha^{-1})			Net Returns (Rs. ha^{-1})			B:C Ratio		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
D1V1	7285	6493	6889	1,32,223	1,17,848	1,25,035	72,223	57,848	65,035	2.20	1.96	2.08
D1V2	6634	6474	6554	1,20,407	1,17,503	1,18,955	60,407	57,503	58,955	2.01	1.96	1.98
D1V3	8149	6578	7364	1,47,904	1,19,391	1,33,648	87,904	59,391	73,648	2.47	1.99	2.23
D1V4	6522	5954	6238	1,18,374	1,080,65	1,13,220	58,374	48,065	53,220	1.97	1.80	1.89
D2V1	7514	6481	6998	1,36,379	1,17,630	1,27,005	76,379	57,630	67,005	2.27	1.96	2.12
D2V2	6743	6015	6379	1,22,385	1,09172	1,15,779	62,385	49,172	55,779	2.04	1.82	1.93
D2V3	7587	7325	7456	1,37,704	1,32,949	1,35,326	77,704	72,949	75,326	2.30	2.22	2.26
D2V4	6204	7161	6683	1,12,603	1,29,972	1,21,287	52,603	69,972	61,287	1.88	2.17	2.02
D3V1	5113	7865	6489	92,801	1,42,750	1,17,775	32,801	82,750	57,775	1.55	2.38	1.96
D3V2	4422	6960	5691	80,259	1,26,324	1,03,292	20,259	66,324	43,292	1.34	2.11	1.72
D3V3	5951	7273	6612	1,08,011	1,32,005	1,20,008	48,011	72,005	60,008	1.80	2.20	2.00
D3V4	4846	7814	6330	87,955	1,41,824	1,14,890	27,955	81,824	54,890	1.47	2.36	1.91

3.3 Interaction Effect

The interaction effect among the different sowing dates and genotypes for grain yield found to be significant in the pooled mean of the data (Table 3).The short duration medium slender genotype KNM-1638 sown during 5th July recorded higher grain yield (7456 kg ha^{-1}) and followed by 20 th June. Similarly Chaudhary et al. [20] reported that the higher grain yield was produced due to the early sowing in the month of June by most of the varieties.

3.4 Harvest Index (%)

The harvest index was not significantly influenced by different dates of sowing and among the varieties; the genotype KNM 733 registered highest harvest index value (48.1) and was on par with the genotypes of KNM 1638 and KNM 118 significantly superior over to the RNR 15048 check genotype respectively. Similar findings was observed by Hossain et al. [21] and Salahuddin et al. [22] concluded that high harvest index was mainly due to higher grain yield which was achieved through better performance in most of the yield, attributing traits.

3.5 Economic Analysis

The higher net returns (Rs. 64, 846 ha^{-1} and Rs. 62, 719 ha^{-1}) and B:C ratio (2.08 and 2.05) was recorded in 5th July sown crop, which was however, comparable with 20th June sown crop and significantly superior to 20th July (Table 2). Among the genotypes, the genotype KNM 1638 recorded significantly higher net returns (Rs.69, 662 ha^{-1} and Rs.63, 268 ha^{-1}) and B:C ratio (1.55 and 1.41) though it comparable with the genotype KNM 733 and significantly superior to rest of the genotypes. Among the treatment combinations tested (Table 4), it was observed that the highest net returns (Rs.75,326 ha^{-1}) and B:C (2.26) ratio were obtained when rice crop was sown during 5th July with the genotype KNM 1638 and followed by sown on 20th June with the genotype KNM 1638. From the above results it was affirmed that, 5th July and 20th June sown crop produced higher net returns and more benefit-cost ratio. The short duration genotypes KNM 1638 and KNM 733 were found on par and produced significantly higher net returns with more benefit-cost ratio as compared to other genotypes. So, it would be better to choose short duration pre released genotypes KNM 1638 and KNM 733 and follow optimum sowing dates from second forthright of June to first week of July under irrigated conditions of Northern Telangana zone. These results are close conformity with the Balaji naik et al. [17].

4. CONCLUSION

In Northern Telangana zone, rice genotypes be sown during 20 th June to 5th July for obtaining higher grain and straw yield with higher net returns and B:C ratio than late sown on 20th July. The rice genotype KNM 1638 be grown for obtaining higher grain and straw yield. Thus it would be concluded that the genotype KNM 1638 sown during 5th July recorded higher grain yield (7456 kg ha^{-1}) and followed by 20 th June under irrigated conditions of Northern Telangana zone.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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