



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2020; 8(1): 2029-2032

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Received: 22-11-2019

Accepted: 24-12-2019

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Effect of delayed dates of planting on yield attributes and yield of different rice varieties (*Oryza sativa* L.)

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i1ad.8565>

Abstract

Rice is one of the principle staple food crop of the world and major energy source, especially in Asia. Therefore, its productivity should be promoted by optimizing the sowing dates which vary with varieties and region. For this purpose, the influence of delayed planting on rice productivity in different varieties was studied through a field experiment under the irrigated condition of Kharif season 2018 at Varanasi. Split plot design was opted with three replication allocating four rice varieties (Gargi, DRR 42, Sadabahar and NDR 97) in the main plot and three transplanting dates (5th August, 13th August and 21st August) in sub-plot. The results of the experiment revealed that the Gargi performed best (*w.r.t* yield attributes and yield) over other varieties planted on all the three dates of planting. However, Sadabahar produced the least yield at last date of planting. Therefore, the first date of planting (5th August) was found to be best for all the varieties in this region.

Keywords: Delayed planting, rice varieties, yield attributes, yield

Introduction

Rice (*Oryza sativa* L.) is the most important cereal crop after wheat which is produced in nearly 95 countries across the globe and it is an indispensable staple food for more than half of the world's current population^[20,14]. Asian countries are the largest producer (75% of the total global rice production) and consumer of rice^[15]. Rice is the principal staple food for more than 70% of Indians and is grown in 427.53 lakh hectares with a production of about 105.24 million tonnes^[22]. West Bengal leads in terms of rice production with 14.71 million tonnes followed by Uttar Pradesh with 12.22 million tonnes and Andhra Pradesh with 11.57 million tonnes^[1]. It is estimated that rice demands in India will be raised by 2025 to about 140 million tons^[23]. With the burgeoning population, the demand for rice in the world has estimated to increase by 2000 million metric tons by 2030^[8]. The increase in production has necessarily to come from increased productivity under depleting and diminishing resources, climate change as well as dwindling land availability. Productivity should also meet the demands of sustainability and preservation of environmental quality^[24]. Timely planting is a very important factor ensuring proper vegetative growth (i.e., taller plants, more no. of tillers and leaves etc.) grain yield and quality^[12]. And delayed planting has resulted in tremendous yield reduction (Dhiman et al., 1997). Too early and too late planting also has resulted in yield reduction which cannot be compensated by any other input or practice^[9]. Late planting also limits the growth duration which further leads to a reduction in leaf area, filled spikelets per panicle and productive tillers ultimately reducing grain weight^[5]. Optimum planting time is of great significance due to variation in the growth duration, photo sensitiveness, thermosensitivity and vegetative lag period of different varieties. The extent of yield loss under late transplanting condition varies with variety and their duration^[19].

Material and Methods

The present study was carried out at the Agricultural Research Farm of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, under irrigated condition during the *Kharif* season of 2018.

Varanasi falls under a sub-tropical zone of Indo-Gangetic plains and the farm is located at 25°15'17.92'' N latitude, 82°59'20.73'' E longitude and altitude of 75.7 meters above mean sea level. Varanasi falls in the belt of semi-arid to sub-humid climate receiving a mean annual rainfall of 1100 mm and 1525 mm of potential evapotranspiration, causing a moisture deficit of 425 mm. The Average time of the onset of monsoon in this region is the late third week of June and it lasts up to the end of September or sometimes extends to the first week of October. The meteorological data used in the study were recorded from the meteorological observatory (AICRP on Dryland Agriculture), I.A.Sc., B.H.U, Varanasi.

The experiment studies the effect of delayed dates of planting on yield attributes and yield of different rice varieties. It was laid out in split-plot design replicated thrice, comprising four rice varieties (Gargi, DRR 42, Sadabahar and NDR 97) in the main plot and three transplanting dates (5th August, 13th August and 21st August) in sub-plot. Four weeks-old seedlings were transplanted on the well-puddled soil at a hill spacing of 20 × 15 cm with 3-4 seedlings per hill. A recommended dose of nutrients i.e., 120 kg N, 60 kg P₂O₅, 60 kg K₂O per hectare were applied through broadcasting. One-third dose of nitrogen and a full dose of P and K were applied as basal and the remaining dose of nitrogen was top-dressed in two equal splits. Water management and weed control measures were adopted as per the recommendation and crop need. The crop was harvested at maturity and threshed as per schedule. The data on yield attributes viz. a number of effective tillers/m², test weight and yield of rice varieties were recorded and analysed.

Result and Discussion

The results obtained for various attributes of the present investigation are been given below.

Varieties

The number of effective tillers/m², test weight, grain yield, straw yield and harvest index vary significantly with different varieties. In yield attributing characters, Gargi (V1) produced maximum number of tillers/m² (273.50) and test weight (24.54 g) followed by DRR 42 (V2), NDR 97 (V4) and Sadabahar (V3) which produced (224.68, 187.50, 164.92) number of effective tillers/m² and (24.13, 20.95 and 19.56 g) test weight respectively.

All the varieties were significantly different from each other in terms of grain yield. However, the straw yield does not vary significantly among different varieties. The highest grain yield (21.74 q/ha) was observed in Gargi (V1) followed by DRR 42 (V2), NDR 97 (V4) and Sadabahar (V3) having (19.59, 16.85 and 15.60 q/ha) respectively. However, the highest straw yield (41.20 q/ha) was recorded in DRR 42 (V2) followed by Gargi (V1), NDR 97 (V4) and Sadabahar (V3). Among the different rice varieties highest harvest index (34.95%) was recorded in Gargi (V1) followed by DRR 42 (V2), NDR 97 (V4) and Sadabahar (V3) with (33.07, 31.24 and 29.60 %) respectively.

Date of planting

The number of effective tillers/m² and test weight was found to be significantly influenced by different dates of planting. It exhibited decreasing trend due to delayed planting i.e., the number of effective tillers/m² and test weight was maximum at 5th August (259.66 and 25.76 g) followed by 13th August (195.26 and 21.67 g) and 21st August (183.03 and 19.47 g) respectively.

The data in the study revealed that the grain yield, straw yield, and harvest index decreased significantly due to delay in planting. The maximum grain yield was recorded with the first date of planting i.e., 5th August (24.24 q/ha and 44.62 q/ha) followed by 13th August (17.86 q/ha and 38.30 q/ha) and 21st August (13.24 q/ha and 30.36 q/ha) respectively. And the harvest index at 5th August (35.39%) was observed to be significantly superior to rice planted on 13th August (31.72%) and 21st August (29.53%).

The differences in the productive tillers/m² and test weight are in general due to management practices. The superiority of Gargi planted on 5th August in number of effective tillers/m² and test weight over other varieties planted late seemed to be due to efficient formation of photosynthates (due to greater number of tillers, green leaves, fresh weight and height etc.) and translocation of assimilates towards grain development or for building sink capacity. This increase might also be explained by the fact that the earliest planted crop was exposed to favourable weather conditions during the entire crop period which facilitated the completion of different phenological stages at the appropriate time. These results are comparable with the findings of [4, 16, 21].

The grain yield is a function of various important yield attributes such as the number of filled spikelets/panicle, productive tillers/m² and 1000 grain weight. The grain yield in this study varied significantly among varieties and with dates of planting. The maximum grain yield was produced by NDR 97 when planted on 5th August (25.83 q/ha) while Sadabahar recorded the minimum grain yield when planted on 21st August (7.12 q/ha). The maximum yield of NDR 97 might be attributed to its maximum biomass production at the early date of planting (5th August) with the higher number of tillers, leaves and proper partitioning of photosynthates which was evident from higher yield attributes like panicle weight, test weight and the number of fertile spikelets. The findings were similar to that of [3, 13, 10]. The lowest yield in Sadabahar when planted on 21st August was due to positive correlation between the mean daily temperature, solar radiation and yield. Hence due to reduced conversion of solar energy to photosynthates, there was the poor expression of vegetative as well as reproductive characters which ultimately led to lower grain yield [6, 11, 2, 7, 16]. Another reason for reduced Sadabahar yield on 21st August planting was lesser sunshine hours available for photosynthetic and respiratory activities [17]. The grain yield of Sadabahar planted on 21st August was reduced drastically because both pre- and post-anthesis dry weight per hill were reduced by delayed planting. Therefore, increased biological yield played a key role in the higher grain yield of the early planted crop [18].

Table 1: Yield and yield attributing parameters of rice as affected by different dates of transplanting and varieties

Treatments	Effective tillers/m ²	Test weight (gm)	Yield (q/ha)		Harvest index (%)
			Grain	Straw	
Varieties					
Gargi (V ₁)	273.50	24.54	21.74	40.65	34.95
DRR 42 (V ₂)	224.68	24.13	19.59	41.31	33.07
Sadabahar (V ₃)	164.92	19.56	15.60	34.16	29.60
NDR 97 (V ₄)	187.50	20.95	16.85	35.03	31.24
Sem±	7.11	1.03	0.85	1.70	0.87
C.D.(p=0.05)	24.59	3.56	2.93	5.87	3.00
Date of Planting					
5 th August (D ₁)	259.66	25.76	24.24	44.70	35.39
13 th August (D ₂)	195.26	21.67	17.86	38.30	31.72
21 st August (D ₃)	183.03	19.47	13.24	30.36	29.53
Sem±	6.11	0.56	0.69	0.95	0.58
C.D.(p=0.05)	18.33	1.69	2.06	2.83	1.73
Sem±	12.23	1.13	1.38	1.89	1.15
V×D C.D. (p=0.05)	36.66	NS	4.12	5.67	3.45

Table 2: Interaction effect of varieties and dates of planting on grain yield (q/ha) of rice

Treatment	V1	V2	V3	V4	Mean
D1	25.40	21.73	23.99	25.83	24.24
D2	21.23	19.46	15.69	15.06	17.86
D3	18.59	17.57	7.12	9.67	13.24
Mean	21.74	19.59	15.60	16.85	
				Sem±	C.D. (p=0.05)
Subplot at same/different mainplot				1.38	4.12
Mainplot at same/different subplot				1.99	4.45

*V1- Gargi, V2- DRR 42, V3- Sadabahar, V4- NDR 97, D1- 5th August, D2- 13th August, D3- 21st August

Conclusion

Based on the above findings following conclusion can be drawn. There was a significant effect of delayed date of planting on yield attributes and yield of potential rice varieties. Among the four varieties studied, Gargi produced maximum grain yield followed by DRR 42, NDR 97 and Sadabahar under irrigated condition. But, under delayed planting condition in this region variety NDR 97, when planted on 5th August outyielded other varieties. And as the planting gets delayed beyond the first week of August the yield of rice decreases progressively.

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