Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 600-603
Received: 10-03-2019
Accepted: 12-04-2019

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# Response of rice (*Oryza sativa* L.) varieties to different planting dates

**Sandeep Singh, Balwinder Singh Dhillon and Sham Singh Dhillon**

**Abstract**
A field experiment entitled "Response of rice (*Oryza sativa* L.) varieties to different planting dates" was conducted at Research Farm, Guru Kashi University, Talwandi Sabo during *Kharif* season 2017. The experiment comprised of different transplanting dates (27$^{th}$ June, 11$^{th}$ July, 26$^{th}$ July) and three cultivars (PR 126, PR 124, PR 114) making three replications in split plot design with nine treatments. The soil of the experimental field was loamy sand, with neutral in reaction, low in organic carbon and available nitrogen, medium in available phosphorous and high in available potassium. Among the varieties (viz., PR 126, PR 124, PR 114), the variety PR 124 resulted in maximum growth parameters, yield attributes and grain yield (83.13 q/ha) and minimum (78.71 q/ha) from PR 126. The first date of planting (27$^{th}$ June) gave maximum growth parameters, yield attributes and grain yield (89.97 q/ha) and minimum growth parameters, yield attributes and grain yield (70.06 q/ha) were recorded in third date of sowing (26$^{th}$ July). Thus, variety PR 124 of rice grown on 27$^{th}$ June was suitable to obtain the better grain yield.

**Keywords:** Grain yield, growth, rice and sowing dates.

## Introduction

Rice (*Oryza sativa* L.) belonging to the family Gramineae, is the principle cereal crop grown across the globe especially in Asia. Globally, production of rice is estimated at a new record of 110.2 million tonnes harvested from 43.2 million hectares and productivity was 25.5 q/ha. It was grown in area of 43.5 million hectares with production of 104.41 million tonnes and productivity was 24.0 q/ha in India (Anonymous 2018).

The crop needs continuous standing of water for about 15 days, which comes huge losses of water through evaporation, during the hot summer of June. Canal water being limited, the underground water is being excessively used, rather over exploited. This has created serious problem of declining of underground water, the declining rate being 0.23 meter per annum (Gupta *et al.*, 1995) [8]. Therefore, there is an immediate and urgent need to reduce the water consumption especially during the early establishment of the crop after transplanting. So there is a serious need to test the delaying of transplanting of the crop by at least 10-15 days late transplanting (from 15$^{th}$ June to 25$^{th}$ June), which is quite dry, hot and highly evaporating period. Second important consideration should be to identify the suitable genotypes suitable for late transplanting after the present recommended date (15$^{th}$ June) for Punjab State. This will save huge quantity of precious natural resource the life line of diversity of organism, plant and animals.

## Material and Methods

The experiment was carried out during *kharif* season 2017 at Research Farm, Guru Kashi University, Talwandi Sabo (Bathinda). Talwandi Sabo is located at 29$^0$57'N latitude and 75$^0$7'E longitude and altitude of 213 meters above the sea level. This tract is characterized by semi arid climate, where both winters and summers are extreme. Maximum temperature in summer (July) is 27 °C and minimum temperature in winter (November) falls below 10°C. The soil of the experimental field was loamy sand texture with pH 7.9, organic carbon 0.30, available N 234.25 kg ha$^{-1}$, available P 15.06 kg ha$^{-1}$ and available K 217.56 kg ha$^{-1}$. Observations were taken at flowering and at harvesting stage. Three different cultivars was sown with the spacing of 15*15 cm. Relatively higher seed rate (20 kg ha$^{-1}$) was applied with the fertilizer application of 105 kg N, 30 Kg P and 30 Kg K ha$^{-1}$. Split plot design was selected for experimentation having nine treatments with three replications. Varieties were kept as main plot (PR 126, PR 124 and PR 114) and transplanting dates were kept as sub plots (27$^{th}$ June, 11$^{th}$ July and 26$^{th}$ July). The net plot size was 4 m × 3 m (12 m$^2$) and gross plot size was 4.5 m × 3.5 m (15.75 m$^2$).

Plant height randomly selected five plants were measured in each plot at the time of maturity from the base of the stem at ground level to the base of main panicle of rice. Total number of tillers of five randomly selected plants was recorded from the each plot at the time of maturity. The number of effective tillers from randomly selected five plants in each plot was counted. The length of the panicle was measured from the base of panicle to the tip of panicle from the five randomly selected plants in each plot. The no. of grains per panicle was counted from five randomly selected panicles. The mean number of grains per panicle was calculated. The number of plants at maturity was recorded on alternate days from every plot. The data on which about more than 70% of plants got maturity was taken as the date of maturity. The samples of 1000-grains were drawn from each plot after cleaning mean value was worked out after recording their weight. The weight of total production from the net plot was recorded after harvest with help of electronic balance. The weight of the grain per net plot was record in kilogram after threshing of the produce. Later on it was converted into grain yield (q/ha).The straw yield was worked out from the weight of total biomass and expressed q/ha. The biological yield was calculated by the addition of grain yield and straw yield. The harvest index was calculated with the help of following formula

$$\text{HI (\%)} = \frac{\text{Grain yield (q/ha)}}{\text{Biological yield (q/ha)}} \times 100$$

The collected data were statistically analyzed by using Fisher's ANOVA technique and least significant difference (LSD) test at 5% probability level was used to compare differences among treatment means.

## Result and Discussion

### Growth parameters of rice

**Plant height:** The dates of transplanting showed the significant effect on plant height (Table 1). Accordingly, out of different sowing dates the earliest June 27 recorded the highest plant height (130.31 cm), being significantly higher than July 11 and July 26 transplanting dates. The shortest plant height (104.11 cm) was recorded in July 26 transplanting date. The reduction in plant height is probably due to decreasing temperature and day length was also reported by Khade *et al*., (1997) [12]. The decreased plant height with delay in sowing was also reported by (Safdar *et al*., (2013); Akram *et al*., (2007) [19, 1,]. These studies are in agreement with present investigation. The varieties also differed significantly in plant height. Amongst the varieties, PR 124 ($V_2$) attained tallest plant height (121.08 cm), which was significantly higher than PR 126 ($V_1$) and PR 114 ($V_3$). The shortest plant height (115.75 cm) was attained from PR 126 ($V_1$). Taller height in early sowing than late sowing was also reported by Ramachandra *et al*., (2015) [18] and Safdar *et al*., (2008) [20].

**Number of tillers/plant:** The result pertaining to the number of total tillers/plant shows the significant effect of date of transplanting (Table 1). Out of different sowing dates the earliest June 27 recorded the higher number of total tillers (16.13) per plant, being significantly higher than July 11 and July 26 transplanting dates. The minimum number of total tillers (13.28) per plant was recorded in July 26 transplanting date. The number of total tillers significantly less with delayed planting was also reported by Rai and Kushwaha 2008 [17], which corresponds with the present study. The varieties differed significantly for number of total tillers per plant. Amongst the varieties, PR 124 ($V_2$) attained highest number of total tillers (15.88) per plant, which was significantly higher than PR 126 ($V_1$) and PR 114 ($V_3$). The lowest number of total tillers (14) per plant was recorded in PR 126 ($V_1$). The number of tillers influenced by delay in transplanting was also reported by Akram *et al*., 2007 [1], which is similar to these genotypes.

**Table 1:** Effect of transplanting date and varieties on the growth attributes of rice

| Treatment | Plant height (cm) | Number of tillers/plant |
|---|---|---|
| Varieties | | |
| PR 126 | 115.75 | 14.00 |
| PR 124 | 121.08 | 15.88 |
| PR 114 | 117.77 | 14.57 |
| LSD (P=0.05) | 0.78 | 0.59 |
| Date of transplanting | | |
| June 27 | 130.31 | 16.13 |
| July 11 | 120.20 | 15.04 |
| July 26 | 104.11 | 13.25 |
| LSD (P=0.05) | 0.41 | 0.19 |

### Phenology of rice

**No. of days taken to maturity:** The 27th June ($D_1$) took more number of days (100.44) to maturity which was significantly higher than 11th July ($D_2$) and 26th July ($D_3$) transplanting dates (Table 2). This might be due to the reason that the maturity is affected by the temperature and day length which go on decreasing towards maturity. This trend has also been reported by Rai and Kushwaha (2008) [17] and Khalifa and El-Rewainy (2012) [10] which support the present results. The variety PR 114 ($V_3$) took more number of days (105.11) to maturity while PR 126 ($V_1$) took lesser number of days (89.44) to maturity. The different varieties took different days to 100% maturity and more days than the late sowing (Brar *et al*., 2011) [5].

### Yield attributes of rice

**Number of effective tillers/plant:** The results indicate that dates of transplanting showed the significant effect on number of effective tillers per plant (Table 2). Out of different sowing dates the earliest 27th June ($D_1$) was recorded the highest number of effective tillers (15.42) per plant, being significantly higher than 11th July ($D_2$) and 26th July ($D_3$) transplanting dates. The lowest number of effective tillers (12.53) per plant was recorded in 26th July ($D_3$) transplanting. This shows the decreasing trend for this character with the delay in transplanting. This also augments the present study. The varieties showed the significant effect on number of effective tillers per plant. Amongst the varieties, PR 124 ($V_2$) was recorded highest number of effective tillers (14.93) per plant, which was significantly higher than PR 126 ($V_1$) and PR 114 ($V_3$). The minimum number of effective tillers (13.24) per plant was recorded in PR 126 ($V_1$). Thus the trend emerges that early sowing produces more number of effective tillers, which was also suggested by Safdar *et al*., 2008 [20].

**Panicle length:** The first date of sowing (27th June) attained the maximum panicle length (28.78 cm), which was significantly higher than 11th July ($D_2$) and 26th July ($D_3$) transplanting dates (Table 2). The early transplanting is good for panicle length than the late transplanting (Mohapatra *et* *al*., 1997; Balaswamy and Kulkarni 2001; Khalifa 2009) [15, 3, 11]. This was due to the fact that more favorable environment was available to the early sowing. The variety PR 124 ($V_2$) attained longest panicle length (27.61 cm), which was significantly higher than PR 126 ($V_1$) and PR 114 ($V_3$). The significant varietal differences for this trait may be due to the difference in their genetic makeup. The effect of interaction between the varieties and transplanting dates was significant. The maximum panicle length (29.63) was recorded in interaction $V_2D_1$ (PR 124 and 27th June) and minimum in $V_1D_3$ (PR 126 and 26th July).

**Number of grains/panicle:** Out of different sowing dates the earliest 27th June ($D_1$) recorded the higher number of grains per panicle (252.24), being significantly higher than 11th July ($D_2$) and 26th July ($D_3$) transplanting date (Table 2). The delayed sowing in rice adversely affected the yield attribute like number of grains per panicle (Mohapatra *et al*., 1997; Bashir *et al*., 2010) [15, 4]. The present study has also the similar trend for this character. Amongst the varieties, PR 124 ($V_2$) attained highest number of grains/panicle (239.64), which was significantly higher than PR 126 ($V_1$) and PR 114 ($V_3$). The more number of grains obtained from cultivars with early sowing than the late sowing has also reported by Balaswamy and Kulkarni (2001) [3] and Akram *et al*., (2007) [1].

**1000-grain weight:** The dates of transplanting showed the significant effect on test weight of 1000-grains (Table 2). Out of different sowing dates the earliest 27th June ($D_1$) recorded maximum weight of 1000-grains (29.82 g), being significantly higher than 11th July ($D_2$) and 26th July ($D_3$) transplanting dates. The minimum 1000-grain weight (26.58 g) was recorded in 26th July ($D_3$) transplanting. The early sowing was reported to be the appropriate time for the expression of characters (Khalifa 2009) [11]. Heavier 1000-grain weight under early sowing than the late sowing has also been reported by Mohapatra *et al*., (1997) [15] and Bashir *et al*., (2010) [4]. These reports are in agreement with our results. The differences due to varieties for these traits were non-significant.

**Table 2:** Effect of transplanting date and varieties on the yield attributes of rice

| Treatment | No. of effective tillers/plant | Panicle length (cm) | No. of grains/panicle | Test weight (g) | No. of days taken to maturity |
|---|---|---|---|---|---|
| Varieties | | | | | |
| PR 126 | 13.24 | 26.20 | 228.91 | 27.98 | 89.44 |
| PR 124 | 14.93 | 27.61 | 239.64 | 28.72 | 99.88 |
| PR 114 | 13.84 | 26.84 | 233.82 | 28.14 | 105.11 |
| LSD (P=0.05) | 0.49 | 0.37 | 0.45 | NS | 0.66 |
| Date of transplanting | | | | | |
| June 27 | 15.42 | 28.78 | 252.24 | 29.82 | 100.44 |
| July 11 | 14.06 | 26.90 | 237.64 | 28.44 | 97.77 |
| July 26 | 12.53 | 24.96 | 212.48 | 26.58 | 126.22 |
| LSD (P=0.05) | 0.17 | 0.28 | 1.97 | 0.34 | 1.08 |

**Productivity of rice**

**Grain yield:** The dates of transplanting show the significant effect on grain yield (Table 3). The earliest 27th June ($D_1$) recorded the highest grain yield (89.97 q/ha), being significantly higher to 11th July ($D_2$) and 26th July ($D_3$) transplanting dates. There was loss in grain yield with further delay in sowing (Manjappa and Kumar 2002) [13]. The 25th June showed significantly higher yield than the late planting (Dixit *et al*., 2004; Mukesh *et al*., 2013) [14]. These reports are in agreement with present results.

Amongst the varieties, PR 124 ($V_2$) was recorded highest grain yield (83.13 q/ha), which was significantly higher than PR 126 ($V_1$) and PR 114 ($V_3$).The grain yield decreased ofall varieties with delay in sowing (Singh *et al*., 1993; Dhiman *et al*., 1997; Nayak *et al*., 2003) [21, 6, 16]. The significant interaction of varieties and transplanting dates was observed on grain yield.

**Straw yield:** Accordingly, out of sowing dates the earliest 27th June ($D_1$) attained the highest straw yield (193.42 q/ha) being significantly higher to 11th July ($D_2$) and 26th July ($D_3$) transplanting dates (Table 3). Early sowing dates produced higher straw yield than delayed planting (Hussain *et al*., 2009) [9]. This can be expected the early sown crop gets suitable environment in terms of temperature and photoperiod. Amongst the varieties, PR 124 ($V_2$) attained highest straw yield (186.02 q/ha), which was significantly higher than PR 126 ($V_1$) and PR 114 ($V_3$). These differences between varieties can be assigned to the different genotypes of varieties used.

**Table 3:** Productivity of rice as influenced by transplanting date and varieties

| Treatment | Grain yield (q/ha) | Straw yield (q/ha) | Biological yield (q/ha) | Harvest index (%) |
|---|---|---|---|---|
| Varieties | | | | |
| PR-126 | 78.71 | 170.51 | 249.22 | 31.51 |
| PR-124 | 83.13 | 186.02 | 269.15 | 30.84 |
| PR-114 | 80.97 | 179.95 | 260.93 | 30.89 |
| LSD (P=0.05) | 1.05 | 2.54 | 3.47 | 0.31 |
| Date of transplanting | | | | |
| June 27 | 89.87 | 193.42 | 283.4 | 31.75 |
| July 11 | 82.77 | 181.68 | 264.46 | 31.23 |
| July 26 | 70.06 | 161.37 | 231.44 | 30.26 |
| LSD (P=0.05) | 0.56 | 1.43 | 1.97 | 0.17 |

**Biological yield:** Accordingly, out of planting dates the earliest 27th June ($D_1$) was recorded the maximum biological yield (283.4 q/ha), being significantly highest than 11th July ($D_2$) and 26th July ($D_3$) transplanting dates (Table 3). The trend of decreasing yield under the delayed transplanting can be due to the availability of suitable temperature and photoperiod under the early transplanting. Amongst the varieties, PR 124 ($V_2$) was recorded highest biological yield (269.15 q/ha), which was significantly higher than PR 126 ($V_1$) and PR 114 ($V_3$).

**Harvest index:** The dates of transplanting show the significant effect on harvest index (Table 3). Accordingly, out of sowing dates the earliest 27$^{th}$ June ($D_1$) calculated higher harvest index (31.75%), being significantly highest than 11$^{th}$ July ($D_2$) and 26$^{th}$ July ($D_3$) transplanting dates. The early sowing dates produced higher harvest index than delayed planting (Hussain *et al*., 2009) [9]. Out of the varieties, PR 126 ($V_1$) was recorded highest harvest index (31.51%), which was significantly higher than PR 124 ($V_2$) and PR 114 ($V_3$). This could be due to the production of more yield attributes like tillers and hence more straw yield along with the grain yield. Since the harvest index is the proportion of grain yield to total biomass expressed as percent.

## Conclusion

The PR 124 variety of rice resulted in maximum growth parameters, yield attributes and grain yield on earlier (June 27) transplanting. This was significantly higher than the PR 114 and PR 126 cultivars and late transplanting i.e., July 11 and July 26.

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