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Productivity of direct seeded rice in relation to different dates of sowing and varieties in Central Punjab

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ABSTRACT

Field experiments were conducted during kharif season of 2007 and 2008 at Research Farm of the Department of Agronomy, Punjab Agricultural University, Ludhiana and University Seed Farm (USF), Ladhowal to find out suitable varieties and most favorable sowing time for direct seeded rice under Punjab conditions. Experimental results revealed that grain yield of PR 115 variety was equivalent to PR 116 at PAU research Farm and to PAU 201 variety of rice at USF, Ladhowal. Maximum grain yield (60.53 q/ha) was obtained with recommended practice of puddling and transplanting 28 days old seedlings which was statistically at par with direct sowing of rice on the day of nursery sowing (55.01 q/ha) and direct sowing 7 days after nursery sowing (47.40 q/ha) at Research Farm, PAU, Ludhiana. At USF, Ladhowal highest grain yield was recorded with recommended puddled transplanting treatment (54.58 q/ha), which remained statistically at par with direct sowing of rice on the day of nursery sowing (53.45 q/ha) but was significantly superior to the yields obtained with other treatments.

Key words: Rice varieties, direct sowing, transplanting, dates of sowing, productivity

To tackle the problem of labour shortage and high production cost, there is increased interest in cultivation of direct seeded rice in many parts of India. In Punjab rice cultivation is mainly practiced through transplanting which is cumbersome and labour intensive. This technique requires puddling and continuous ponding of water for first 15 days for establishment of the seedlings. It leads to nutrient losses through leaching besides causing high evapotranspirational losses during hot summer. To meet the water need of transplanted paddy, underground water is being over exploited by excessive pumping resulting into decline in water table. It is estimated that ground water in the major rice growing areas of the state is declining at the rate of 0.23 meter per year (Gupta *et al.,* 1995), causing serious concern and raising doubt about the future sustainability of the rice-based system.

In this context, direct Seeding of rice under unpuddled conditions as appears to be the most credible option and efficient irrigation water technology apart from its cost and labour effectiveness. Expansion in the irrigated area, introduction of early maturing rice cultivars, availability of selective herbicides for weed management together with increasing transplanting cost and declining profitability of transplanted rice production system have encouraged rice farmers to shift from transplanting to direct seeding (Subbaiah *et al*., 1999). To make paddy cultivation cost effective and eco-friendly, direct-seeded rice provides an option which saves not only labour required for transplanting but also helps to preserve natural resources especially underground water. One of the critical aspects of direct seeding of rice is time of sowing. Planting time is the major factor that determines the productivity of a crop. Optimum planting time for a crop is location specific. Optimum planting time worked out June 1-10 in Punjab (Gill *et al.,* 2006), June 15 at New Delhi (Narayanaswamy *et al.,* 1982), June 5-15 at Cuttack (Chandra *et al.,* 1991) and May 215 at Pusa, Bihar. Early or delay in sowing leads to lower production of direct seeded rice. Optimum sowing time thus needs to be standized for every ago-ecological situation for success of direct seeded rice. Gravois and Helms (1998) also showed that rice grain yields declined as seeding date was delayed. 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 (Reddy and Narayana, 1984). Rice varieties exhibit wide variation in the production of high density grains which showed maximum potential for grain filling and test weight (Murty *et al.,* 1992). Rice varieties vary in their seedling vigour, weed competitiveness, submergence and drought tolerance, maturity duration, lodging resistance, affecting the resource utilization and productivity. Quick growing genotypes with higher tillering potential (Roy and Mishra, 1999) showed promise for weed control in direct seeded rice. A short duration and early maturing rice variety (PR 115) was superior for direct seeded rice (Gill *et al.,* 2006). However, Gravois and helms (1998) showed that very short duration cultivar did not always produce high grain yield than mid-season cultivars especially under late sown conditions.

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The saving of water in direct seeded rice will depend on the sowing time. In direct seeded rice, Most of the research work has been done on weed management and method of establishment. But there is lack of knowledge on right time of sowing of direct seeded rice. Keeping these points in view, present investigation was undertaken to study the effect of time of sowing and rice varieties on performance of direct seeded rice.

MATERIALS AND METHODS

During 2007, experiment was conducted at Research Farm of Department of Agronomy, Punjab Agricultural University, Ludhiana (30^0 56' N latitude with 75^0 52' E longitude, 247 m mean sea level) to work out right time of sowing for direct seeded rice. The soil of the experimental field was loamy sand in texture containing 76.3 % sand, 10.0 % silt and 13.6 % clay. It was low in available nitrogen (245 kg/ha), medium in available P (13.1 kg/ha) and available K (147.5 $kg.ha^{-1}$). The soil pH (7.83) and electrical conductivity (0.256 dS m^{-1}) were within normal range. The experiment was laid out in split plot design with three replications. Two cultivars *i.e.* PR 115 and PR 116 were kept in main plots where as five sowing dates (direct seeding on 0, 7, 14 and 21 days after nursery sowing; and transplanting 28 days after nursery sowing) were kept in sub plots.

During 2008, experiment was conducted on heavy textured soils at University Seed Farm (USF) Ladhowal. The soil of the experimental field was sandy loam in texture containing 72.7 % sand, 11.1 % silt and 15.0 % clay. It was medium in available nitrogen (311 kg/ha), available P (13.1 kg/ha) and available K (147.5 kg/ha). The soil pH (7.41) and electrical conductivity (0.242 dS m^{-1}) were within normal range. The design and treatments were same as was in first year (Except one treatment of sowing 28 days after nursery sowing was more in second year Rice varieties were PAU 201 and PR 115. The crop was sown on 8^{th} and 10^{th} June during 2007 and 2008 respectively) Seed rate of 50 kg ha^{-1} was used for direct sowing of both the varieties was done on different dates as per treatments. For transplanting treatment seed rate of 20 kg ha^{-1} was used. Sowing was done manually with a single row drill by keeping row to row spacing of 20 cm. Pre-emergence application of pendimethalin at 0.75 kg ha^{-1} was done within two days of sowing through sprays. The follow-up application of bispyribac 25 $g.ha^{-1}$ was done 25-30 days after sowing to check weed growth. Direct sowing treatments were compared with transplanting which was done with 28 days old nursery seedlings at 20 x 15 cm spacing. The net plot size harvested was 26.0 square meters. PR 115 is short duration variety which requires 125 days from seed to seed. PAU 201 and PR 116 are medium duration variety requiring 144 days to mature. The experimental crop was raised by adopting all recommended agronomic and plant protection measures. 330 kg urea, 70 kg DAP and 20 kg MOP was applied to direct sown crop, whereas to transplanted crop 275 kg urea and same quantity of DAP and MOP were applied. Full dose of DAP and MOP was applied at sowing where as Urea was applied in four splits for direct crop and three splits for transplanted crop. Irrigation of 5 cm was applied at required intervals when the water was completely drained and irrigation was withheld 10 days before the harvest. Data was subjected to analysis as detailed by Cheema and Singh (1991) in statistical package CPCS-1.

RESULTS AND DISCUSSION

In the first year at PAU, there was no significant difference between rice varieties (PR 115 and PR 116) in respect of grain yield, although PR 115 yielded 5 per cent higher than PR 116. Similarly, differences in Plant height and effective tillers of PR 115 and PR 116 were found to be non-significant (Table 1). Panicle length was found to be significantly higher in PR 115 variety as compared to PR 116.

Among sub plot treatments, differences in plant height and panicle length among different dates of sowing treatments were found to be non-significant. The recommended treatment i.e. transplanting 28 days old seedlings in puddled field recorded significantly higher effective tillers (60.08) as compared to direct seeded crop sown 7,14 and 21 days after nursery sowing (DANS), but remained statistically at par with direct sowing on the day of nursery sowing. Goel and Verma (2000) also recorded more tillers under direct seeding method due to more plants per unit area. Transplanted crop produced the highest grain yield (60.53q/ha) and was at par with direct seeding on the day of nursery sowing (57.01 q/ha) and seven days after nursery sowing (47.40 q/ha), but significantly higher than direct seeding 7, 14 and 21 DANS (Table 1). Transplanted crop yielded 9.0, 21.7, 28.7 and 51.9 per cent higher as compared to direct sowing on 0, 7, 14 and 21 DANS, respectively. Manjunatha et al (2009) observed the significant variation in grain yield of rice in respect of age of seedling for transplanting. Gill *et al.* (2006) also reported that direct sowing on 10 June gave maximum yield. Padhi (1995) also reported highest grain yield from rice directly sown on 1^{st} June

Table 1: Growth and yield of rice as influenced by varieties and dates of sowing (PAU, Ludhiana-1st Year)

Treatments	Plant height (cm)	Effective tillers.m^{-1} row length	Panicle length (cm)	Grain yield (q.ha^{-1})
Variety				
PR-115	64.96	56.83	22.43	48.18
PR-116	64.69	54.33	20.79	45.91
LSD (0.05)	**NS**	**NS**	**1.00**	**NS**
Date of sowing				
Direct sowing, 0 DANS	66.13	57.08	22.43	55.01
Direct sowing, 7 ,,	65.27	54.92	21.60	47.40
Direct sowing, 14 ,,	64.00	52.92	20.83	43.18
Direct sowing, 21 ,,	63.53	52.92	21.00	29.09
Transplanting (25 days old nursery)	65.20	60.08	22.93	60.53
LSD (0.05)	**NS**	**5.11**	**NS**	**15.33**

DANS – Days after nursery sowing, LSD for Interaction-NS

and there was reduction in yield with every 15 days delay in sowing to the extent of 12.3 and 17.7 per cent, respectively. Lower nutrient uptake, higher weeds pressure, resulted in short panicles, less number of grains and light grains which reduced the grain yield under late sowings. Low temperature started during last week of September coincides with reproduction phase of late planted crop leading to increased spikelet sterility and poor grain filling.

During second year at USF, Ladhowal, the two varieties i.e. PAU 201 and PR 115 were statistically at par with respect to all yield attributes expect panicle length (Table 2). PAU 201 yielded slightly higher than PR 115.

A perusal of data reveal that plant height, effective tillers, panicle length and grain yield were higher in rice directly sown on the same day of nursery sowing (sowing on 0 day after nursery sowing) than rest of the

Table 2: Growth and seed yield of rice as influenced by varieties and dates of sowing (USF Ladhowal, 2nd year)

Treatments	Plant height (cm)	Effective tillers.m^{-1} row length	Panicle length (cm)	Seed yield (q.ha^{-1})
Varieties				
PAU 201	49.57	37.88	19.17	45.54
PR 115	50.39	40.28	20.12	43.26
LSD (0.05)	**NS**	**NS**	**0.54**	**NS**
Date of sowing				
Direct sowing, 0 DANS	56.70	54.67	21.93	53.45
Direct sowing, 7 DANS	54.53	51.40	21.59	40.28
Direct sowing, 14 DANS	52.83	50.50	21.33	39.95
Direct sowing, 21 DANS	50.13	37.33	17.87	23.64
Direct sowing, 28 DANS	40.80	24.83	17.44	14.07
Transplanting (28 days old nursery)	44.90	53.75	17.71	54.58
LSD (0.05)	**10.35**	**8.87**	**0.99**	**10.9**

DANS – Days after nursery sowing, LSD for Interaction-NS

direct sowing treatments (Table 2). Highest grain yield was recorded in transplanted treatment (54.58 q/ha) and it was statistically at par with direct sowing 0 day after nursery sowing treatment (53.45 q/ha) but significantly superior to direct sowing on 7, 14, 21 and 28 days after nursery sowing. There was 2.1, 26.2, 26.8, 56.7 and 74.2 per cent reduction in seed yield of direct seeded crop sown at 0, 7, 14, 21 and 28 days after nursery sowing as compared to transplanted crop. The reduction in grain yield of direct sown rice with delayed sowing was due to shortening of overall growth period of crop. As the sowing of direct seeded rice is delayed to end June, the grain yield will decline. Gill *et al.* (2006) also reported that direct sowing on June 1-10 produced the higher rice grain yield resulted from more effective tillers filled grain, panicles, 1000-grain weight and lesser spikelet sterility as compared to crop was on 20 June at Ludhiana. Singh *et al.* (2010) revealed similar DSR grain yield seeded on the day of nursery raising to PTR. Slaton *et al.* (2003) opined that rice sown during the optimum period had a longer vegetative growth phase than later sown rice. Mishra and Singh (2008) conduct field experiment at Jabalpur, (MP) and reported that dry seeding after receipt of first flush of monsoon produced significantly higher grain yield as compared to seeding before monsoon. All the interactions were non significant.

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