Evaluation of different planting techniques on paddy yield under agro-ecological zone of Sheikhupura-Pakistan

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ABSTRACT

A field experiment was carried out under agro-ecological conditions of Sheikhupura to evaluate different planting techniques for rice cultivation during Kharif-2014 and 2015 at Adaptive Research Farm, Sheikhupura. The experiment was laid out in randomized complete block design (RCBD) with five treatments, each replicated thrice during both the years. The treatments comprised, transplanting of nursery (Conventional method of sowing), direct seeding (Broadcasting of sprouted seed in puddled soil), direct seeding (Broadcasting of sprouted seed in standing water without pudded soil), direct seeding (Drilling of soaked seed after land preparation in wattar condition) and direct seeding (Broadcasting of soaked seed in dry soil). All other agronomic and plant protection practices were kept uniform throughout the growing season during both the years. Data related to plant height at maturity, number of productive tillers, number of grains per spike, 1000-grain weight and paddy yield was recorded by using appropriate procedures. The results revealed that transplanted rice in puddled soil was better than direct seeded rice sown by all different methods. However, net economic return was lowest in transplanted rice and higher net returns were gained when rice was sown using DSR under agro-ecological conditions of Sheikhupura-Pakistan. It could be concluded that even transplanted rice is better than DSR in terms of reaping higher paddy yield, but DSR could also not be neglected as its economic returns are higher than transplanted rice and is not labour dependent for its timely and proper execution.

Key words: Rice, drilling, transplantation**,** paddy yield.

Rice is considered among the most important cereals and staple food crop for the 50 percent of the global population in the world (FAO, 2004 and Liu et al 2011). In Pakistan, it was grown on an area of 2891 thousand hectare in 2016 and its production was 7005 thousand metric tonne (Anonymous-2015). The reasons for low rice yield include water shortage, weed infestation, insect pests and diseases and inappropriate sowing method leading to low plant population. Low plant population can be optimized by using a proper sowing method.

In addition to it, many socioeconomic and climatic factors are still threatening the current sustainable production of rice in the world. These factors include energy crisis, inefficient use of inputs, changing climate, increased fuel prices and urbanization etc. (Ladha *et al.*, 2009). Generally rice is grown through transplanting in Asia that has multiple benefits like weed control, proper establishment of seedling and reduced percolation losses but unfortunately, in developing countries like Pakistan, the major threat to optimum rice production on sustainable basis through transplanting is the scarcity of labour for rice nursery transplanting. Moreover the puddling also creates certain problems with soil physical health like destruction of soil aggregates, reduced subsurface permeability of water and creation of a shallow hard-pan (Sharma et al., 2005). It is also reported that the transplanted rice has higher water requirements. Ali et al 2007 reported that the reason for low paddy yield in Pakistan is due to water scarcity, delay plantings, shortage of skilled labour and low plant population, weeds and pest infestation.

Weerakoon *et al.,* 2011 also reported that due to water and labor scarcity and problems associated with soil health in transplanted rice, the growers are shifting towards direct seeded rice (DSR) as an economically sound alternative. Awan et al., 2007 also reported that direct seeded rice is at par with transplanted rice in terms of paddy yield. Agronomic factors like seed rate, sowing method, sowing time, and fertilizer and irrigation management are key factors for getting higher yield of any crop. It is the need of time to reduce the consumption of the factors by adopting suitable planting techniques for rice production. Keeping in view, all these aspects a study was carried out at Adaptive Research Farm Sheikhupura to evaluate different planting techniques for growth and yield of paddy.

MATERIALS AND METHODS

Site description: The experiment was conducted consecutively for Kharif 2014 and 2015 at Adaptive Research Farm, Sheikhupura on a clay loam soil. This area is prominent for the production of paddy crop and is called the rice tract of Pakistan. The climatic conditions are moist sub-humid with an annual rain fall of 250 –500 mm having rice-wheat cropping system.

Crop husbandry: During both the season, the crop was sown during 1st week of June. Direct seeding and nursery sowing for conventional method of transplanting were carried out at the same date during both the season. The seed rate for direct seeding was 30 kg ha^{-1} and thirty days old nursery was transplanted in the puddle field having 3 cm standing water depth. Balanced NPK fertilizers @ 100-67-62 kg ha^{-1} were applied. All P and K and ½ of the Nitrogenous fertilizers were used at sowing time as basal dose while remaining nitrogenous fertilizer was applied in two splits during both the years to the crop. For effective weed control the herbicide bispyribac sodium (Clover) @ 300 g ha^{-1} was used on all the treatments except the treatment where nursery was transplanted. In the nursery transplanted treatment butachlor @ 2000 ml ha^{-1} a pre-emergence weed control herbicide was applied during both the years. All other agronomic practices like irrigation and plant protection measures were kept uniform for all the experimental units for both the years. Each year, the crop was harvested manually at maturity and threshed, data related to paddy yield and yield components were recorded.

Experimental Design and Treatments: The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications at the same site. The experiment comprised of five treatments those were different sowing methods viz:

T_1= Transplanting of nursery (Conventional method of sowing)

T_2= Direct seeding (Broadcasting of sprouted seed in puddled soil)

T_3= Direct seeding (Broadcasting of sprouted seed in standing water without pudded soil)

T_4= Direct seeding (Drilling of soaked seed after land preparation in wattar condition)

T_5= Direct seeding (Broadcasting of soaked seed in dry soil)

The net plot size was 3.78 m × 3.12 m for each experimental unit during both years at both experimental sites.

Economic and Statistical Analysis: Economic analysis was carried out by calculating the gross income considering the price of paddy and market rates of straw. Cost of collaborate production was calculated by adding the varying cost of all the sowing methods. Net income was calculated by the formula as a difference of gross income and variable cost. Benefit cost ratio was calculated by dividing gross income by total cost of production. The collected data was analyzed statistically by employing the Fisher's analysis of variance technique and means were tested by least significance difference (LSD) test at 5% probability level (Steel et al., 1997).

RESULTS AND DISCUSSION

Number of Productive tillers (m^2): Productive tillers directly contribute to paddy yield. Data presented in table 1 revealed that numbers of productive tillers in all the treatments were statistically at par. Maximum number of productive tillers *i.e.* 325 m^{-2} were recorded from the treatment where transplanting of nursery was done followed by 300 m^{-2} and 305 m^{-2} were obtained from the direct seeded sowing, where sprouted seed was broadcasted in puddle soil during the year 2014 and 2015 respectively. These results are in line with those of Oyewole and Whiteman 2007 who reported that broadcasting generally decreases germination of seed because of less contact of roots to soil. Our findings are also in accordance with the results of Ehsanullah *et al.,* 2007 who reported that more productive tillers were

observed in transplanting techniques than direct seeded due to low availability of moisture and nutrients and lacking proper plant to plant distance in direct seeding.

Number of grains per spike: Data presented in table 1 showed that the number of grains per panicle remained statistically at par during both the years. The maximum (120 and 116) grains per panicle were noted from the treatment where transplanting of nursery was accomplished while minimum (109 and 107) grains per panicle was observed in the treatment of direct seeding where seed was broad casted in dry soil. The treatment where seed was drilled in wattar condition remained at par with the transplanting of nursery during year 2014 and 2015 respectively. These results are in agreement with the findings of Parsad et al 2001 and Aslam et al 2008 who reported that all the growth and yield attributes of rice increase in transplanting over direct seeding.

1000-grain weight (g): No significant effect regarding 1000 grains weight was observed in all the treatments however data revealed that 23.28 and 22.61g weight was observed in the transplanting of rice nursery followed by 22.06 and 19.90 g obtained from the direct seeding rice, where drill sowing was adopted during both the years. The findings of Tahir et al 2007 who pointed out that 1000 grain weight was higher in transplanted rice than direct seeding which is in agreement with our results. These findings are also agreed with those of Qazi *et al.,* 2013 who reported that higher grain weight was obtained in transplanted rice.

Paddy yield (kg ha^{-1}): Data presented in table 1 showed that significant effect on yield was observed in all the sowing techniques during both years. Among all the treatments, maximum paddy yield (3850 and 3506.7 kg ha^{-1}) was recorded from the transplanting followed by 3700 and 3166.7 kg ha^{-1} which was obtained from direct seeded rice where drill sowing was done in wattar condition during the 2014 and 2015 respectively. Minimum (3551.7 and 3103.3 kg ha^{-1}) paddy yield was recorded from the plot where soaked seed was broad casted in dry soil. Our results are in agreement with the findings of Mehmood *et al.,* 2013 and Maqsood, 1998 who reported that transplanting produced higher paddy yield than direct seeding. Awan et al 2007 also reported that maximum paddy yield was resulted from transplanting rice. Our findings are also in agreement with the findings of Ehsanullah et al 2007 who reported that transplanting produced higher paddy yield than direct seeding.

Economic Analyses: It is predicted from the data presented in table 2 that the maximum net income Rs. 64000 and 55379 was obtained from the treatment, where seed was drilled in wattar condition after proper land preparation during the year 2014 and 2015 respectively followed by 61400 that was obtained from Direct seeding (Broadcasting of sprouted seed in standing water without pudded soil) during 2014 and from conventional method during 2014 which was Rs. 54279. Regarding cost benefit ratio it increased in direct seeding line sowing (1: 1.84) whereas the lowest benefit (1:1.71 and 1:1.69) was recorded in transplantation.

Table 1. Evaluation of different planting techniques on yield & yield attributes of paddy (Kharif 2014 & 2015)

Treatments	Number of productive tillers (m^2)		No. of grains per panicle		1000-grain weight (g)		Grain yield (kg ha^{-1})	
	2014	2015	2014	2015	2014	2015	2014	2015
Adaptive Research Farm, Sheikhupura								
T_1=Transplanting of Nursery (conventional method of sowing)	325a	325a	120.0a	116.0a	23.28 a	22.61 a	3850.0 a	3506.7 a
T_2 =Direct Seeding (Broadcasting of sprouted seed in puddled soil)	300b	305b	114.0b	110.0b	21.41 b	20.28 b	3653.3 bc	3223.3 b
T_3=Direct Seeding (Broadcasting of sprouted seed in standing water without puddled soil)	291c	295c	112.0 bc	108 b	21.12 b	19.54 bc	3600.0 cd	2993.3 e
T_4 =Direct seeding (Drilling of soaked seed in wattar condition)	295bc	300b	113.0 bc	111.0 b	22.06 ab	19.90 bc	3700.0 b	3166.7 c
T_5 =Direct seeding (Broadcasting of soaked seed in dry soil)	290c	302b	109.0 c	107.0 b	21.80 ab	18.71 c	3551.7 d	3103.3 d
LSD ($p \leq 0.05$)	5.22	5.41	4.65	4.30	1.71	1.34	96.86	54.57

Table 2. Economic analyses and cost benefit ratio of different planting techniques during the year 2014 & 2015

Treatments	Grain yield (t ha^{-1})		Cost of production (ha^{-1})		Gross income		Net Income		Cost of benefit ratio	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Adaptive Research Farm, Sheikhupura										
T_1=Transplanting of Nursery (conventional method of sowing)	3.85	3.50	85750	78431	146750	132710	61000	54279	1:1.71	1:1.69
T_2 =Direct Seeding (Broadcasting of sprouted seed in puddled soil)	3.65	3.22	77890	69044	137840	123305	60000	54261	1:1.77	1:1.78
T_3=Direct Seeding (Broadcasting of sprouted seed in standing water without puddled soil)	3.60	2.99	74600	63535	136000	116755	61400	53220	1:1.82	1:1.83
T_4 =Direct seeding (Drilling of soaked seed in wattar condition)	3.70	3.16	75500	65431	139500	120810	64000	55379	1:1.84	1:1.84
T_5 =Direct seeding (Broadcasting of soaked seed in dry soil)	3.55	3.10	74400	65044	134285	118605	59885	53561	1:1.80	1:1.82

CONCLUSION

The present study suggests that under agro-ecological conditions of Sheikhupura-Pakistan, even transplanting of rice nursery is better than direct seeding for rice cultivation, however its net return is low due to high cost of transplanting. So, under labour shortage conditions, the direct seeded rice could be opted as an economically sound alternative.

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