COMPARISON OF PARACHUTE, LINE AND TRADITIONAL RICE TRANSPLANTING METHODS AT FARMER'S FIELD IN RICE GROWING AREA

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Parachute transplanting method of rice as compared to line transplanting and farmer's method of random transplanting was studied at 10 different locations viz., Kamonki, Wazirabad, Daska, Pasroor, Gujranwala, Sialkot, Lahore, Hafizabad and Sheikhupura during 2003 and 2004. Super Basmati was used as test variety. Yield and yield components of three transplanting techniques, averaged across 10 locations, were found significantly different from each other. The line transplanting gave the highest yield of 4.34 t/ha followed by the parachute transplanting method. The conventional transplanting method practiced by farmers gave the minimum yield of 3.79 t/ha. The line transplanting also produced maximum value for number of tillers /plant (25.30), number of grains/ panicle (65.50). In parachute transplanting method the plant population (213530) was maximum followed by line transplanting and farmer's practice of random transplanting.
Keywords: Rice, parachute transplanting, method, form field

INTRODUCTION

Rice and wheat are the most important staple food crops grown in sequence in south Asia (Latha *et al.*, 2000; Timsina *et al.*, 2001). Inadequate Planting density and delayed transplanting are the major yield-limiting factors causing approximately 20% yield reduction (Ashraf *et al.*, 1986; Chaudhary, 1986). The non-availability of skilled labour at the planting season delays rice transplanting and ultimately results in poor yield. Mechanical transplanting was tested but failed under local condition due to high requirement for trained labour and high rate of missing hills (Chaudhary and Iqbal, 1986). In Pakistan, rice being one of the leading cereal crops of the country occupies second position after wheat, as the staple food of the people and supplies more calories than any other cereal. In addition to this, rice crop plays a vital role in the economy of Pakistan as it contributed about US $ 1.132 billion to the total national foreign earning during 2005-06 (Anonymous, 2006). In Pakistan, rice is grown on an area of 2.5 million hactares, with annual production of 4.95 million tones and an average yield of 1970 Kg/ha (Anonymous, 2004) which is much lower than many other rice growing countries of the world like Australia, Japan, U.S.A and Mexico where yields are 10269, 6997, 6219, 6059, 5283, 5650 and 4738 Kg /ha, respectively. Traditionally, rice has been transplanted in puddled soil containing a plow pan developed due to the long–term puddling (wet-tillage operation) (Mann and Ashraf, 2001). There exists a great scope of increasing rice production as present yield level is much lower than the potential of our existing varieties. There might be a number of factors contributing to the low yield of this crop. The main cause of low density of rice plant is scarcity of labour during the peak period of rice transplantation. Therefore, the lack of labour along with the increased labour cost during the scorching heat of June and July has compelled the scientists and farmers to think about the substitution of conventional ways of rice transplanting.

Although manual transplanting is the common method of rice cultivation but it is too much laborious, cumbersome, time consuming and entails a lot of expenditure on raising, uprooting and transplanting of nursery. Careless transplanting by hired labour results in low planting densities in the farmer's field. The scarcity and high cost of farm labour invariably delays transplanting and often leads to the use of aged seedlings (Santhi *et al.*, 1998) which causes low yield (OM *et al.*, 1993). Hence manual transplanting results in yield reductions due to low plant population. In many parts of the world alternative methods of seedling transplanting are being practiced. One of these methods is parachute technology. Because of rising labour cost and shorter turn around time in rice-wheat cropping system, the so-called "light rice cultivation" such as parachute technology for rice plant establishment, has been adopted in some rice growing regions in China. Parachute technology has developed rapidly in recent years because of its significant advantages, as well as the use of low-cost soft polyvinyl chloride (PVC) trays for growing seedlings (MOA, 1997, Cheng, 2000).

Although rice cultivation by manual transplanting is generally considered superior than other methods of sowing but some researchers reported that parachute planting of rice is an easy method of planting with high yield per hectare than the conventional method of transplanting (Akhter and Sabir, 2002). ha^{-1}

The parachute planting method developed in China has potential to overcome labour shortage and to achieve optimum plant population. Parachute planting of rice has been introduced in the country a few years ago. This technique requires plastic bubble sheets to raise seedlings. Specially raised seedlings can be broadcasted manually or with the help of a blower. There are two distinct advantages of this. First, there is no transplanting shock or seedling mortality at the early stage and secondly optimum plant density can be achieved (Mann and Meisner, 2002; Akhter and Sabir, 2002). Optimum plant population and higher paddy yield than conventional transplanting methods can be obtained by this technology. Conventionally planted KS282 and Super Basmati had shorter and lesser number of roots than parachute method. Parachute seedlings attained greater shoot length and number of tillers than manual planting (Nabi *et al.,* 2003). The objective of this study was to know whether parachute method achieve optimum plant population and ultimately the paddy yield.

The present study was therefore, designed to compare the parachute planting method with line transplanting and farmer's method of random transplanting to determine the feasibility of parachute planting at farmer's field .

MATERIALS AND METHODS

In this study, a new rice planting techniques imported from China i.e. parachute planting was compared with the farmer's conventional and recommended line transplanting methods. To check the feasibility of parachute planting at farmer field this study was carried out at ten (10) different locations viz., Kamonki, Wazirabad, Daska, Passroor, Narowal, Shakargarh, Lahore, Hafizabad, Sheikhupura and Ferozwala lying in traditional rice growing districts i.e. Gujranwala, Sialkot, Narowal, Lahore , Hafizabad and Sheikhupura.

Super Basmati was used as test variety. Experiment was laid out in randomized complete block design (RCBD) and replicated thrice having a net plot size of 30 m x 40 m. The studies were carried out for two years during kharif season 2003 and 2004. Nursery for line and conventional transplanting was sown at farmer's fields near transplanting location but for parachute planting nursery was sown at Rice Research Institute, Kala Shah Kaku because parachute nursery required more care than conventional nursery, which could only be possible at Rice Research Institute at one place instead of ten locations. For line transplanting and conventional planting, rice nursery was sown by broadcasting the sprouted seed in puddled soil where as in parachute planting, the nursery was sown in special plastic trays each comprising 400 cavities with a hole at the bottom. The trays were placed together on leveled raised beds in compact manner. Two third of the each cavity was filled with fine soil and the sprouted seed was broadcasted on the trays ensuring 2 to 3 seeds per cavity. The seeds were covered with soil upto the brim and irrigated. Seed sproutening was accomplished by soaking seeds for 24 hour and incubating it for 24 hours.

Parachute nursery was transported from Rice Research Institute, Kala Shah Kaku to the 10 destinations by truck on the day of planting. For line & conventional transplanting nursery was uprooted and transplanted manually at the same location. At the time of land preparation 45 Kg N/ha, 84 Kg P/ha and 62 Kg K/ha were applied in the form of urea, diammonium phosphate and potassium sulfate, respectively and land was well prepared during puddling. Transplanting was done manually. For line and conventional transplanting, 30-days old seedlings were transplanted at 22.5 x 22.5 cm plant to plant and row to row spacing during both the years. Plant population was kept 1,69,000 to 1,76,000 per hectare for conventional planting, 2,00,000 per hectare for line transplanting and 1,80,000 to 2,50,000 per hectare for parachute transplanting. For parachute transplanting, 22-days old seedlings were thrown from a meter above the soil surface in the puddled field. The seedlings settled in upright position by the free fall due to the weight of seedling clumps. Seven hundred trays were used per hectare. In line transplanting treatment, plant to plant and row to row spacing 9 inches (22.5 cm) was maintained to establish 2,00.000 hills per hectare. In parachute transplanting it was tried best to maintain equal spacing in the field @ 2,00,000 hills per hectare. In conventional transplanting labour was asked to plant the nursery seedlings approximately at 9 inches so that required plant population per hectare can be achieved.

Nursery sowing and transplanting dates at ten locations during 2003 and 2004 for each planting method are given in the Table 1.

Recommended herbicide i.e. Butachlor and Sunstar was applied 3-5 days after transplanting to all treatments for weed control. Other agronomic and cultural practices were kept standard and uniform for all treatments. Every location was visited fortnightly to check crop growth and applying the required input to the crop. Precautionary fungicides were applied to control Bacterial Leaf Blight and Brown Leaf Spot Data on paddy yield and yield components were recorded as following:

Plant population and Productive tillers meter^{-2} were recorded by counting the average of three samples (one meter^2) taken randomly from each repeat, plant height, grains per panicle, sterility % age, 1000 grain weight were recorded by taking three samples (five plants/sample) taken randomly from each repeat. Data on paddy yield was recorded by harvesting three samples taken randomly from each repeat, each sample

Table 1. Nursery sowing and transplanting dates at ten (10) locations during both the years

Tensile/ Location	For the year 2003				For the year 2004			
	Line and conventional transplanting		Parachute planting		Line and conventional transplanting		Parachute planting	
	Nursery sowing date	Transplant -ing date	Nursery sowing date	Parachute planting date	Nursery sowing date	Transplant -ing date	Nursery sowing date	Parachute planting date
Kamonki	20.5.03	15.6.03	14.6.03	10.7.03	8.6.04	12.7.04	18.6.04	13.7.04
Wazirabad	29.5.03	4.7.03	15.6.03	8.7.03	28.5.04	3.7.04	10.6.04	4.7.04
Daska	30.5.03	6.7.03	10.6,03	6.7.03	2.6.04	6.7.04	10.6.04	6.7.04
Passroor	25.5.03	26.6.03	15.6.03	7.7.03	30.5.04	5.7.04	10.6.04	6.7.04
Narowal	26.5.03	1.7.03	10.6.03	2.7.03	23.5.04	25.6.04	2.6.04	26.6.04
Shakargarh	30.5.03	7.7.03	20.6.03	14.7.03	20.5.04	23.6.04	2.6.04	24.6.04
Hafizabad	29.5.03	1.7.03	15.6.03	10.7.03	5.6.04	10.7.04	18.6.04	11.7.04
Sheikhupura	3.6.03	8.7.03	15.6.03	9.7.03	29.5.04	1.7.04	10.6.04	2.7.04
Ferozwala	5.6.03	9.7.03	20.6.03	15.7.03	25.5.04	30.6.04	2.6.04	30.6.04
Lahore	30.5.03	3.7.03	10.6.03	4.7.03	30.5.04	5.7.04	10.6.04	6.7.04

Table 2. Mean squares of yield and yield components

S.O.V	D.F.	Plant population ha^{-1}	Tillers $plant^{-1}$	Tillers m^{-2}	Grain $panicle^{-1}$	Steritity %age	1000 Grain Wt (gm)	Yield (t/ha)
CV (%)		0.19	9.25	9.30	5.39	11.08	5.00	3.92
Error-1	20	218052.833	6.10	2447.78	28.51	0.57	1.01	0.027
Error-2	40	129650.33	4.4	1635.74	12.061	0.715	1.113	0.025
Location	9	1219294412..8**	161.33**	47851.71**	647.81**	32.41**	7.28**	4.84**
Location x Treatment	18	871429156.2**	63.7**	32676.87**	121.82**	3.80**	5.93**	0.46**
Treatment	2	14723095468.9**	156.7**	149741.05**	106.74**	21.42**	3.50 ns	2.38**

having size of one marla (25 m^2) Data collected were statistically analyzed using Fisher's analysis of variance technique and treatment means were compared by LSD at 0.05 probability (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

The result presented in Table 4 revealed that yield and yield components were significantly different during both the years for locations and planting methods as well as their interaction. The line transplanting gave the highest yield of 4.34 ton ha^{-2} followed by parachute method of planting. The lowest yield of 3.79 ton ha^{-2} was achieved by the farmer's practice. Similarly line transplanting produced maximum values for tillers per plant (25.30), grains per panicle (65.50) and 1000 grains weight (21.49 g). However the sterility percentage was the lowest (6.75 %) in line transplanting. After line transplanting, second highest paddy yield, number of tillers per plant, grains per panicle and 1000 grains weight were achieved in parachute method of planting. On the other hand, farmer's practice of random transplanting gave lowest paddy yield, number of tillers $plant^{-1}$, number of grains $plant^{-1}$and 1000 grain weight. Plant population was highest in parachute planting followed by line transplanting and farmers practice.

Plant population

Data presented in Table 3 showed that maximum plant population per hectare (237120) was recorded in parachute transplanting at Ferozewala tehsil which was statistically higher than that observed in all the other treatments. The second highest values of this parameter were noted in the same treatment where nursery was transplanted by parachute technology at Pasroor (233825 plants ha^{-1}) and Shakargarh (233825 plants ha^{-1}), whereas, lowest plant population of 128440 plants/ha was noted in farmer's practice of random transplanting at tehsil Wazirabad. The averaged data of ten locations given in Table 4 which showed that maximum plant population of 213530.0 plants/ha was given by parachute transplanting treatment significantly different from line transplanting (195409.3 plants/ha) and farmer's practice of random transplanting (169454.8 plants ha^{-1}).

Table 3. Location x treatment interaction means of yield and yield components using the averages across years

Location	Treatments	Plant population ha^{-1}	Tillers $plant^{-1}$	Tillers m^{-2}	Grains $panicle^{-1}$	Sterility %age	1000 Grain Wt (gm)	Yield (t/ha)
Sheikhupura	Line transplanting	197600 i	34.00 ab	671.8 a	76.00 bcd	4.613 o	19.97 ghijkl	4.80 cde
	Parachute planting	205010 f	19.00 jklm	389.5 ghi	93.00 a	4.9 mno	19.7 ijkl	3.400 mn
	Farmer's practice	167960 q	26.00 efg	436.7 efgh	76.00 bcd	5.333 lmno	20.40 efghijkl	4.10 jk
Hafizabad	Line transplanting	197600 i	36.00 a	711.4 a	56.00 lmnop	7.733 ghij	19.17 klm	3.40 mn
	Parachute planting	187840 o	20.00 ijklm	375.8 hi	68.00 efgh	9.333 cdef	20.30 fghijkl	3.20 n
	Farmer's practice	151460 t	23.00 ghij	348.4 ij	62.00 hijkl	10.47 bcd	21.73 abcdefghi	3.20 n
Kamonki	Line transplanting	194677 n	21.00 hijkl	402.7 fghi	64.00 ghijk	12.47 a	19.50 jklm	2.50 o
	Parachute planting	195130 k	23.00 ghij	448.8 efgh	59.33 ijklmn	11.77 ab	20.97 cdefghijkl	2.40 op
	Farmer's practice	148200 u	22.00 ghijk	326.0 ijk	63.00 hijk	10.43 bcd	21.13 cdefghijk	2.20 p
Shakargarh	Line transplanting	194305 l	25.00 fgh	485.8 cde	59.00 jklmn	7.600 ghij	21.27 bcdefghij	5.00 bc
	Parachute planting	233825 b	24.00 ghi	561.2 b	51.00 pq	7.167 hijk	20.97 cdefghijkl	4.30 hij
	Farmer's practice	177840 p	30.00 cd	533.5 bcd	52.00 opq	8.367 fgh	22.03 abcdefg	4.50 fgh
Narowal	Line transplanting	194305 l	20.00 ijklm	388.6 ghi	64.00 ghijk	6.400 ijklm	19.87 hijkl	4.00 kl
	Parachute planting	214065 d	18.00 klm	385.0 ghi	66.00 fghi	7.400 ghij	20.00 ghijkl	3.50 m
	Farmer's practice	207480 e	11.00 o	228.2 l	54.00 nopq	5.767 klmno	20.17 ghijkl	3.40 mn
Daska	Line transplanting	195130 k	20.00 ijklm	390.3 ghi	68.00 efgh	6.100 jklmno	23.27 ab	4.20 ijk
	Parachute planting	200892 h	23.00 ghij	462.0 defg	55.00 mnopq	8.000 fghi	22.40 abcde	4.50 fgh
	Farmer's practice	193648 m	25.00 fgh	483.1 cde	49.00 q	8.933 defg	17.63 m	4.60 efg
Lahore	Line transplanting	194305 l	28.00 def	544.1 bc	77.00 bc	6.733 hijkl	21.87 abcdefgh	4.80 cde
	Parachute planting	204305 g	17.00 lm	347.3 ij	80.00 b	8.800 efg	21.47 bcdefghij	4.40 ghi
	Farmer's practice	154785 s	18.00 klm	278.6 jkl	72.00 cdef	10.13 cde	20.70 defghijkl	3.80 l
Ferozwala	Line transplanting	195130 k	18.00 klm	351.2 ij	74.00 bcde	4.767 no	23.33 ab	4.90 bcd
	Parachute planting	237120 a	16.00 mn	379.3 hi	59.00 jklmn	7.467 ghij	18.97 lm	4.20 ijk
	Farmer's practice	160550 r	21.00 ijkl	337.1 ijk	65.00 ghij	8.000 fghi	21.33 bcdefghij	4.30 hij
Passroor	Line transplanting	197600 i	22.00 ghijk	434.7 efgh	59.00 jklmn	6.300 jklmn	23.70 a	5.10 b
	Parachute planting	233825 b	20.00 ijklm	467.6 def	62.00 hijkl	6.800 hijkl	22.30 abcdef	4.30 hij
	Farmer's practice	204185 g	13.00 no	265.4 kl	70.00 defg	10.73 bc	22.63 abcd	4.00 kl
Wazirabad	Line transplanting	196365 j	29.00 cde	569.5 b	58.00 klmno	4.767 no	22.93 abc	4.70 def
	Parachute planting	223288 c	32.00 bc	714.5 a	61.00 ijklm	5.667 klmno	22.30 abcdef	5.40 a
	Farmer's practice	128440 v	26.00 efg	334.0 ijk	59.00 jklmn	6.133 jklmno	20.80 defghijkl	3.80 l
LSD Value		**594.2**	**3.461**	**66.74**	**5.731**	**1.395**	**1.741**	**0.2609**

Tillers plant^{-1}

Maximum value of 36 tillers plant^{-1} was shown by standard line transplanting method at tehsil Hafizabad which was statistically at par with that recorded in the same treatment at Sheikhupura tehsil counted as 34 tillers plant^{-1} (Table 2). Parachute transplanted crop produced the second highest value of 32 tillers plant^{-1} whereas the lowest number of tillers plant^{-1} (11 tillers) was observed in farmer's practice of random transplanting. The averages of ten locations given in Table 4 revealed that standard line transplanting gave the highest of 25.3 tillers plant^{-1} significantly higher than observed in both the other treatments viz; farmer's practice of random transplanting (21.5 tillers plant^{-1}) and parachute transplanting (21.2 tillers plant^{-1}).

Table 4. Averages of 10 locations for three treatments

Treatments	Plant population ha^{-1}	Tillers plant^{-1}	Tillers m^{-2}	Grains panicle^{-1}	Sterility % age	1000 Grain Wt (g)	Yield (t/ha)
Line transplanting	195409.300 b	25.30 a	466.3a	65.50 a	6.748 c	21.49 a	4.34 a
Parachute	213530.000 a	21.50 b	421.0b	65.43 a	7.730 b	20.94 ab	3.96 b
Farmer's practice	169454.800 c	21.20 b	312.5c	62.20 b	8.430 a	20.86 b	3.79 c
LSD values	187.9	1.095	14.30	1.812	0.4413	0.5505	0.08251

Tillers m^{-2}

Highest number of tillers/m^2 (714.5) was shown by parachute transplanted crop at Wazirabad tehsil which remained non-significantly different from that produced by the line transplanting treatment at Hafizabad (711.4 tillers m^{-2}) and Sheikhupura (671.8 tillers m^{-2}) sites (Table 3). The lowest value of this parameter (228.21 tillers m^{-2}) was noted in the farmer's randomly transplanted treatment. Average of 10 locations given in Table 4 revealed that standard line transplanting produced a highest number of 466.3 tillers m^{-2} which were significantly different from that recorded in parachute (421.0 tillers m^{-2}) as well as farmer's practice of random transplanting (312.5 tillers m^{-2}) which are contradicted to the results of Nabi *et al.* (2002), who stated that tillers in parachute transplanted rice was significantly higher than in conventional transplanting

Number of grains panicle^{-1}

Data given in Table 3 revealed that maximum number of grains per panicle (93.00) was produced by parachute transplanted crop at Sheikhupura site which remained statistically different from that noted in all the other treatments whereas the lowest number of grains per panicle (49.00) was recorded in farmer's practice of random transplanting. However the average of 10 locations (Table 4) showed that highest number of grains per panicle (65.50) was produced by standard line transplanting method which was statistically at par with that noted in parachute transplanting (65.43 grains panicle^{-1}) whereas lowest number of grains panicle^{-1} (62.20) was shown by farmer's practice of random transplanting. Hussain *et al.* (2005) also reported that maximum number of grains panicle^{-1} was produced by line transplanted method whereas Akhtar and Sabir (2002) found that number of grains panicle^{-1} was higher in the parachute method than other two methods.

Sterility %age

Minimum value of sterility %age (4.61%) was recorded in standard line transplanting technique at Sheikhupura which was non significantly different from that observed in the same treatment at Ferozewala, Wazirabad and Daska sites, as well as, parachute and farmer's transplanting at Shiekhupura and Wazirabad tehsils and farmer's practice of random transplanting at Narowal tehsil. However, maximum percentage of sterile grains (12.47%) and (11.77%) was observed in line transplanting and parachute planting at tehsil Kamoki (Table 3). Data averaged across 10 locations and 2 years presented in Table 4 showed that sterility percentage was minimum (6.75%) in line transplanting which was significantly different from parachute transplanting (7.73%) and farmer's practice of random transplanting (8.43%). Awan *et al.* (2006) reported a non-significant difference between sterility percentage values recorded in parachute transplanting and standard line transplanting.

1000 grain weight

Data regarding 1000 grain weight are given in Table 3 which showed that highest value of this parameter (23.70 g) was achieved in line transplanting technique which was statistically non-significant from that recorded in the same treatment at Ferozewala (23.33 g), Daska (23.27 g) and Wazirabad (22.93 g) sites, as well as, in farmer's practice of random transplanting at Pasroor (22.63 g), Shakargarh (22.03 g) and Hafizabad (21.73 g) parachute transplanting technique at Daska (22.40 g), Pasroor (22.30 g) and Wazirabad (22.30 g). However, minimum weight of 1000 grains

(17.63 g) was recorded in farmer's practice of random transplanting at tehsil Daska. Table 4 containing average data of 10 locations showed that higher value of 1000 grain weight (21.49 g) was obtained in line transplanted crop which was statistically similar with that recorded in parachute transplanting (20..94 g) as well as farmer's practice of random transplanting (20.86 g).These findings are similar to those reported by Akhtar and Sabir (2002).

Paddy yield

Data relating to paddy yield are presented in Table 3 which revealed that highest paddy yield (5.40 ton ha^{-1}) was produced by parachute transplanting technique at Wazirabad which was statistically different from that recorded in all the other two treatments at all sites. Standard line transplanting technique gave second highest value of 5.1 ton ha^{-1}, 5.0 t/ha and 4.9 ton ha^{-1} paddy yield at Pasroor, Shakargarh and Ferozewala sites, respectively. However, lowest paddy yield (2.2 ton ha^{-1}) was recorded in the treatment where nursery was randomly transplanted by the farmer at Kamoki Tehsil. Data averaged across locations and years (Table 3) showed the highest paddy yield of 4.34 ton $ha^{-1}$by the standard line transplanting technique statistically higher than the other treatments. The second highest value for paddy yield (3.96 ton ha^{-1}) was produced by parachute transplanting treatment whereas farmer's practice of random transplanting showed lowest paddy yield of 3.79 t/ha. These results are in line with those reported by Awan *et al.* (2006) who also noted that highest paddy yield was produced in standard line transplanting whereas parachute transplanting was ranked at second position. However, Baloach (2005) reported that parachute transplanting technology although a cumbersome job but produced higher paddy yield and returns per unit area.

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