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EFFECT OF DIFFERENT TRANSPLANTING METHODS ON PADDY YIELD AND ITS COMPONENTS AT FARMER'S FIELD IN RICE ZONE OF PUNJAB

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ABSTRACT

The present study was designed to study the effect of different transplanting methods in comparison with the farmer's conventional transplanting methods at farmer's field. Experiments were 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 consecutively for three years during kharif season 2003, 2004 and 2005. For this study fifteen(15) locations viz; Sheikhupura (Mallian Kalan), Nankana Sahib (Warburten), Lahore (Burki), Wazirabad (Manzoorbad), Wazirabad (Rakh Bharokae), Kamonke (Ramey Farm), Noshehra Virkan, Daska, Pindi Bhattian (Sokhakea), Hafizabad (Ahmadpur Chatha), Pasroor (Poorib Klair), Gujranwala (Batala farm), Norowal (Burj). Shakar Garh (Tittarpur) and Ferozwala (Khori) were selected. The highest paddy yield (6.02 t ha^{-1}) was produced by standard line transplanting at Nankana sahib which was statistically at par with that recorded in the same treatment at Sheikhupura and Gujranwala sites. The lowest paddy yield (3.3 t ha^{-1}) was recorded in the treatment where nursery was randomly transplanted by the farmer in Kamoke tehsil. Data averaged across locations and years showed the highest paddy yield of 5.07 t ha^{-1}were produced by the standard line transplanting which remained significantly different from both the other treatments (open & framer's transplanting). The second highest value of paddy yield (4.33 t/ha) was produced by open transplanting treatment whereas farmer's practice of random transplanting showed lowest paddy yield of 3.97 t/ha.

Key words: Demonstrations, dissemination of rice production technology.

INTRODUCTION

In Pakistan, the rice is grown on an area of 2.5 million hectare, with annual production of 5.6 million tones and an average paddy yield of 3192 Kg/ha which is much lower than many other rice growing countries of the world like, U.S.A., Japan, China, Philippine and India where yields are 8054, 6538, 6341, 3765 and 3208 Kg ha^{-1} (Anonymous, 2007). There exists a great scope of increasing rice production, as present yield level is much lower than the potential of the existing cultivars. Among the yield limiting factors, the most important are less number of plants per unit area, transplanting of aged rice nursery, imbalanced use of fertilizer etc. The main cause of low density of rice plant is scarcity of labour during the peak period of rice transplantation. Careless transplanting by hired labour results in low plant 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 which cause low yield. (Santhi *et al*., 1998). Production of Basmati rice in Pakistan can only be increased by increasing per acre yield as there is a big room for improvement as demonstrated yield in core rice districts of the Punjab is 4750 kg/ha as compared with 2850 kg $ha^{-1}$of Punjab Province and yield gap of 1900 kg ha^{-1}can be filled by implementing production technology in farmers fields. At present there is a vide gap between productivity of the Agricultural Research Institutes and national average yields. Reasons for low yield are less acceptance of production technology by growers along with use of imbalance inputs at improper time. It is dire need of the time to demonstrate the production technology in core area of Punjab.

The main focus in demonstration of modern rice production technology comprised on raising healthy nursery through seed rate of 0.5Kg/25m^2, timely transplanting at the appropriate age of seedling and maintaining of recommended plant population with standard geometry.

MATERIALS AND METHODS

Super Basmati was used as a test variety because most of the farmers of the rice growing tract are using it as a commercial variety. Experiments were 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 consecutively for three years during kharif season 2003, 2004 and 2005. For this study fifteen(15) locations viz; Sheikhupura (Mallian Kalan), Nankana Sahib (Warburten), Lahore (Burki), Wazirabad (Manzoorbad), Wazirabad (Rakh Bharokae), Kamonke (Ramey Farm), Noshehra Virkan, Daska, Pindi Bhattian (Sokhakea), Hafizabad (Ahmadpur Chatha), Pasroor

Table-1: Physical and Chemical Properties of Soil of selected sites of six Districts under Study

Locations	Soil Sample of depth 0-6 inches						Soil Sample of depth 6-12 inches					
	EC dS/m	pH	O.M %	P ppm	K ppm	Satu % ag	EC dS/m	pH	O.M%	P ppm	K ppm	Sat%
Sheikhupura (Mallian Kalan)	1.1	8.0	1.56	21.6	216	46	0.7	8.0	1.03	16.8	241	42
Nankana Sahib (Warburten)	0.8	8.0	0.83	20.9	176	46	0.7	8.1	1.07	14.0	202	44
Lahore (Burki)	0.6	8.3	1.03	24.1	212	40	0.6	8.3	0.90	15.2	126	36
Wazirabad (Manzorrbad)	0.8	8.1	1.03	9.1	140	46	0.7	8.2	0.83	5.1	119	40
Wazirabad (Bharokae)	0.7	8.1	1.03	10.9	162	40	1.1	8.4	0.76	8.2	126	38
Kamonke (Ramey Farm)	0.8	8.2	0.90	19.9	119	40	0.7	8.2	0.69	12.9	101	36
Noshehra Virkan	0.8	8.0	0.48	10.3	104	38	0.6	7.9	0.69	12.2	233	38
Daska	0.5	7.9	0.97	8.71	130	33	0.7	8.0	0.69	8.9	122	38
Pindi Bhattian (Sokhakea)	0.6	7.9	1.38	19.4	187	40	0.6	8.0	0.62	10.9	209	42
Hafizabad	0.8	8.0	0.69	8.6	76	40	0.6	8.0	0.69	9.7	169	42
Pasroor (Poorib Klair)	0.8	8.0	1.38	5.5	194	46	0.5	8.1	0.55	16.3	169	46
Gujranwala (Batala farm)	0.5	8.0	0.97	8.9	79	42	0.4	7.5	0.69	13.9	140	42
Norowal (Burj)	0.7	7.5	1.17	10.9	133	42	0.9	7.4	0.55	17.5	115	44
Shakar Garh	0.8	8.0	0.90	19.1	115	44	0.9	7.9	0.76	8.7	90	42
Ferozwala (Khori)	0.8	8.2	1.03	23.8	144	42	0.9	8.1	0.62	6.2	58	40

EC=Electrical conductivity, its unit dS/m= decisimen per meter, ppm= Parts per million

(Poorib Klair), Gujranwala (Batala farm), Norowal (Burj). Shakar Garh (Tittarpur) and Ferozwala (Khori) were selected with the cooperation of local extension staff. Soil analysis report of the selected sites is given in Table-1 .

Nursery for line & conventional transplanting was sown at farmer field at the spot of transplanting location. To control the weeds from nursery field recommended herbicide according to the kind of weeds were applied in the prepared field after final land preparation. It is necessary to develop the healthy & weeds free nursery, which is essential to get maximum yield. Land was well prepared during puddling. At the time of land preparation 45 Kg N ha^{-1}, 84 Kg P ha^{-1} and 62 Kg K ha^{-1}were applied in the form of urea, diammonium phosphate and potassium sulfate, respectively.

Following three treatments were applied for three years

T_1 = Line transplanting with recommended inputs at proper time

T_2 = Open transplanting with recommended inputs at proper time

T_3 = Farmer practice of open transplanting without recommended inputs at improper time

Thirty to thirty five days old seedlings were transplanted in all three years. Transplanting was done manually in lines at 22.5 x 22.5 cm plant - to – plant and row-to- row spacing on rope to maintain 80000 plant population. In case of open transplanting i.e. conventional transplanting labour was asked to plant nursery plant at approximately 9 inches so that required plant population per hectare can be achieved.

Recommended herbicide i.e. Mechaete (Butachlor) / Sunstar was applied 3-5 days after transplanting in all treatments according to the kind of weeds for their control. $ZnSO_4$ was applied ten to twelve days after transplanting without observing the deficiency symptoms to the crop for healthy growth. Other agronomic and cultural practices were kept standard and uniform for all treatments.

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 having size of one marla (25 m^2). Data collected were statistically analyzed using Fisher's analysis of variance techniques and DMRT compared treatment means at 0.05 probability (Mstatc)

RESULTS AND DISCUSSION

i) **Plant population:** Data presented in Table 2 showed that maximum plant population per hectare (197600) was recorded in recommended line transplanting at Sheikhupura, Noshera, Nankana and Pasrur tehisls which were statistically at par with the same treatment at all the other tehsils except Kamoke, Narowal and Daska. The lowest number of plants per hectare (132559) was recorded in farmer's practice of random transplanting at Wazirabad (Manzoorabad) tehsil.

The data averaged across locations and years are given in Table-3 which revealed that the highest plant population of 194665 plants/ha was given by recommended line transplanting which significantly differed from open transplanting (180755 plants / ha) and farmer's practice of random transplanting (161975 plants

/ ha).The result indicated that proper plant population per acre play major role in increasing paddy yield

ii) **Tillers plant^{-1}:** Highest values of 38.33 and 35.67 tillers plant^{-1} were observed in open transplanting at Pindi Bhattian and Sheikhupura tehsils, respectively and were significantly different from all the other treatments. However, the lowest number of tillers per plant (15.1) was recorded in the farmer practice of random transplanting at Narowal (Table 2). Data given in Table-3 revealed that open transplanting gave the highest (24.92) tillers plant^{-1}and was significantly better than the other treatments viz; line transplanting (23.7 tillers plant^{-1}) and farmer's practice of random transplanting (18.31 tillers plant^{-1}). Sharma (1995) while studying the effect of direct seeding and transplanted crop reported similar results. In another study similar findings were reported by Naklange *et al*. (1996). Although tillers per plant were more in open transplanting which was due to more space between plant to plant. But more space produced more tertiary tillers which contributed little toward increasing grain yield.

iii) **No. of grains panicle^{-1}:** Data given in Table 2 revealed that maximum number of grains per panicle (78.31) was produced by recommended line transplanting at Sheikhupura which remained statistically non significant in the same treatment at Gujranwala, Noshera, Pindi Bhattian, Narowal, Daska, Nankana, Lahore (Burki) and Wazirabad (Rakh Bharoke) as well as in farmer's practice of random transplanting at Sheikhupura and Hafizabad and in open transplanting at Lahore (Burki) and Wazirabad (Rakh Bharoke). However, the lowest number of grains per panicle (41.33) was shown by open transplanting at tehsil Kamoke. The average of 15 locations (Table 3) showed the highest number of grains panicle^{-1} (72.04) which was produced by recommended line transplanting which was statistically different from farmer's practice of random transplanting (63.43) as well as open transplanting (62.57). The results indicated that recommended plant population per acre produced more grains panicle^{-1} which was due to proper space between plant to plant and row to row. These results are inconformity with Awan *et al* (2007), Chang and Liu-Dj (1992) and Zhou-Han-Liang, (2001) who reported that first five tillers increase grains per spike by 5.4 percent.

iv) **Sterility %age:** Highest %age (22.96) of sterile grains was recorded in farmer's practice of random transplanting at tehsil Hafizabad which was statistically at par with the same treatment at Kamoke, Daska, Nankana, Ferozewala and Pasrur sites as well as in open transplanting at Kamoke site. However, the minimum value of this parameter (4.93%) was observed in open transplanting method at tehsil Sheikhupura (Table 2). Data averaged across 15 locations (3 years) presented in Table-3 showed that sterility %age was maximum (16.46) in farmer's practice of random transplanting and was significantly different from line transplanting (10.34) and open transplanting (10.09).

v) **1000 grain weight (g) :** Data regarding 1000 grain weight presented in Table-2 showed that highest value of this parameter (23.23 g) was achieved in recommended line transplanting at Nanakna and was statistically at par with the same treatment at Gujranwala, Noshera, Pindi Bhattian, Shakargarh, Daska, Lahore (Burki), Ferozewala, Wazirabad (Manzoorabad) and Wazirabad (Rakh Bharoke) sites and in open transplanting at Noshera, Lahroe (Burki), Wazirabad (Manzoorabad) and Rakh Bharoke as well as in farmer's method of random transplanting at Noshera, Pindi Bhattian, Shakargarh, Lahore (Burki), Pasrur and Wazirabad (Manzoorabad) sites. However, minimum weight of 1000 grains (19.14 g) was obtained in open transplanting at tehsil Hafizabad. Data averaged of 15 locations (Table-3) showed that the highest value of 1000 grain weight (21.77 g) was obtained in line transplanting and was statistically different from open transplanting (21.06 g) and farmer's practice of random translpating (21.32 g). The results are in conformity with Maqsood (1998) and Thakur (1993) studied the effect of performance of high yielding varieties of rice under different transplanting methods. The results revealed that proper plant population increased the 1000-grain weight where as in case of farmers practice of transplanting. There were less plants per acre with more space which produced more unproductive tillers resulting decreased in grain weight.

vi) **Paddy yield** : Data pertaining to paddy yield presented in Table 2 revealed that the highest paddy yield (6.02 t/ha) was produced in recommended line transplanting at Nankana Sahib which was statistically at par with the same treatment at Sheikhupura and Gujranwala sites. The lowest paddy yield (3.3 t/ha) was recorded in the treatment randomly transplanted by the farmer at Kamoke tehsil. Three year data averaged across 15 locations (Table-3) showed the highest paddy yield of 5.07 t/ha which was produced by the standard line transplanting and remained significantly different from both the other treatments. The second highest value of paddy yield (4.33 t/ha) was produced by open transplanting whereas farmer's practice of random transplanting showed the lowest paddy yield (3.97 t/ha).Paddy yield increase was due to recommended plant population per acre as in this case the plants utilized the soil nutrients more effectively. Thus, the line transplanting with proper plants and space is the best method. Similar findings were reported by Counce. (1996), Khan and Tiwari (2000), and Krishnan and Nayak (2000), Zhou-Hand Liang (2001), Kon *et al.* (2003).

Table-2:-Yield and yield components as affected by different locations and treatment s (average of three years 2003, 04 and 05)

Location	Treatment	Plant Population	Tillers/ Plant	Grains/ Panicle	Sterility %age	1000 grain weight	Yield t/ha
Shiekhupura	Line Transplanting	197600 a	26.47 bcde	78.31 a	11.16 ijklmnop	20.56 Hijklm	5.623 ab
	Open transplanting	177840 klm	35.67 a	68.50 defg	4.933 t	20.76 fghijkl	4.530 hijklm
	Farmer transplanting	158640 rs	19.07 lmnopqr	71.80 abcde	15.28 efgh	20.91 efghijkl	4.153 mnopqr
Hafizabad	Line Transplanting	195637 ab	26.52 bcde	69.47 cdef	12.25 hijklm	20.71 Ghijklm	4.267 klmnopq
	Open transplanting	177877 klm	25.29 cdefg	67.33 efghi	9.213 klmnopqrs	19.14 M	4.000 pqrs
	Farmer transplanting	150533 u	19.80 lmnopq	72.93 abcde	22.96 a	21.14 Defghijk	3.500 tu
Gujranwala	Line Transplanting	195953 ab	26.80 bcde	71.63 abcde	8.220 nopqrst	21.88 Abcdefghi	5.610 b
	Open transplanting	183199 ghijk	17.57 opqrst	67.91 defgh	6.127 rst	20.66 ghijklm	4.367 jklmnop
	Farmer transplanting	170595 no	16.07 rst	60.22 jklm	11.14 ijklmnop	19.45 Lm	4.063 opqrs
Noshera	Line Transplanting	197600 a	18.93 lmnopqr	72.51 abcde	8.433 mnopqrst	21.84 Abcdefghij	4.933 defgh
	Open transplanting	186983 efgh	21.67 hijklmn	67.33 efghi	7.233 qrst	23.16 Ab	4.570 ghijkl
	Farmer transplanting	172768 mn	16.87 qrst	60.95 ijklm	12.24 hijklm	22. 63Abcd	3.833 rst
Pindi Bhattian	Line Transplanting	195067 abc	27.13 bcde	72.37 abcde	7.500 pqrst	21.69 Abcdefghijk	5.510 bc
	Open transplanting	182400 hijkl	38.33 a	62.26 ghijkl	17.06 cdef	20.53 hijklm	5.000 def
	Farmer transplanting	157789 st	15.33 st	60.60 jklm	10.35 jklmnopq	21.66 abcdefghijk	4.230 lmnopqr
Kamoke	Line Transplanting	189784 cdef	20.27 klmnopq	64.39 fghijk	18.59 bcde	20.21 Jklm	4.100 nopqr
	Open transplanting	169667 nop	24.20 defghij	41.33 o	19.48 abcd	20.60 hijklm	3.667 stu
	Farmer transplanting	151406 u	20.63 ijklmnop	60.77 ijklm	20.40 abc	21.56 bcdefghijk	3.300 u
Shakargarh	Line Transplanting	190635 bcde	21.27 hijklmno	68.31 defg	11.73 hijklmno	21.88 Abcdefghi	5.273 bcd
	Open transplanting	196318 a	20.94 hijklmnop	55.01 mn	12.50 hijkl	21.35 Cdefghijk	4.500 ijklmn
	Farmer transplanting	179540 ijkl	20.73 hijklmnop	60.44 jklm	16.66 defg	22.18 Abcdefghi	4.297 klmnop
Narowal	Line Transplanting	190635 bcde	20.53 jklmnopq	72.69 abcde	11.93 hijklmn	21.20 defghijk	4.947 defg
	Open transplanting	176888 lm	22.61 fghijkl	61.38 hijklm	12.82 hijk	20.73 fghijklm	4.133 mnopqr
	Farmer transplanting	180199 ijkl	15.10 t	56.81 lmn	14.46 fghi	20.56 hijklm	3.883 qrst
Daska	Line Transplanting	188275 defg	20.56 jklmnopq	75.39 abc	11.45 ijklmno	22.31 Abcdefg	4.737 efghij
	Open transplanting	164532 pq	22.05 ghijklm	58.95 klmn	9.953 jklmnopqr	21.04 defghijkl	4.133 mnopqr
	Farmer transplanting	163073 qr	19.46 lmnopqr	61.86 ghijkl	20.57 abc	20.13 Klm	4.033 opqrs
Nankana	Line Transplanting	197600 a	28.24 bc	77.48 ab	6.977 qrst	23.23 A	6.017 a
	Open transplanting	177540 klm	24.27 defghi	67.90 defgh	8.413 mnopqrst	20.86 Efghijkl	4.267 klmnopq
	Farmer transplanting	143220 v	18.26 nopqrst	71.03 bcdef	21.37 ab	21.47 Cdefghijk	3.687 stu
Lahore Barki	Line Transplanting	196502 a	23.67 efghijk	74.67 abcd	7.957 opqrst	22.38 Abcdef	4.633 fghijkl
	Open transplanting	188781 defg	19.97 klmnopq	71.73 abcde	9.447 klmnopqrs	21.59 abcdefghijk	4.133 mnopqr
	Farmer transplanting	164432 pq	17.37 pqrst	66.17 efghij	12.31 hijklm	21.82 Abcdefghij	3.833 rst
Ferozwala	Line Transplanting	193396 abcd	20.50 klmnopq	70.43 cdef	8.900 lmnopqrs	22.92 Abc	5.233 bcd
	Open transplanting	180669 ijkl	18.66 mnopqrst	64.23 fghijk	9.923 jklmnopqr	21.27 Defghijk	4.667 fghijk
	Farmer transplanting	152938 tu	18.74 mnopqrs	69.50 cdef	21.92 ab	21.36 Cdefghijk	4.400 jklmnop
Pasroor	Line Transplanting	197600 a	22.27 ghijklm	69.71 cdef	13.39 ghij	21.52 Bcdefghijk	5.100 de
	Open transplanting	186617 efgh	25.94 bcdef	53.33 n	11.14 ijklmnop	20.52 Ijklm	4.333 jklmnop
	Farmer transplanting	184728 fghi	15.14 st	60.87 ijklm	21.58 ab	22.19 Abcdefgh	4.337 jklmnop
Wazirabad (Manzoorabad)	Line Transplanting	197189 a	28.00 bc	70.22 cdef	10.36 jklmnopq	22.49 Abcde	5.167 cd
	Open transplanting	178213 jklm	29.17 b	58.73 klmn	7.237 qrst	21.67 Abcdefghijk	4.433 jklmno
	Farmer transplanting	132559 w	22.00 ghijklmn	60.10 jklm	16.94 cdefg	21.63 Abcdefghijk	4.100 nopqr
Wazirabad (Rakh Baroki)	Line Transplanting	196502 a	24.33 defgh	73.00 abcde	6.310 rst	21.75 Abcdefghijk	4.900 defghi
	Open transplanting	183799 ghij	27.50 bcd	72.61 abcde	5.867 st	21.94 Abcdefghi	4.233 lmnopqr
	Farmer transplanting	167200 opq	20.05 klmnopq	57.43 lmn	8.747 lmnopqrst	21.07 Defghijk	3.883 qrst

Table-3:- Average data of yield and yield components of 15 locations/ treatments across three years

Treatment	Plant Population	Tillers/ Plant	Grains/ panicle	Sterility % age	1000 grain Weight	Yield
Line Transplanting	194665 A	23.70 B	72.04 A	10.34 B	21.77 A	5.070 A
Open Transplanting	180755 B	24.92 A	62.57 B	10.09 B	21.06 B	4.331 B
Farmer Practice	161975 C	18.31 C	63.43 B	16.46 A	21.32 B	3.969 C

Table-4:- Means error degree of freedom of yield and yield components (averag of three years 2003-2005)

	DF	Plant Population per ha	Tillers per Panicle	No. Grains per panicle	Sterility % age	1000 grain wt.	Yield
Location	14	827179097**	196.667**	448.981**	31.715**	11.439**	4.252**
Error	30	940756	2.733	32.711	0.530	1.307	0.030
Factor-a	2	9499923865**	484.467**	332.867**	44.859**	9.027**	9.593**
LA	28	467613365**	63.752**	113.224**	4.427**	3.829**	0.781**
Error	60	942434	5.500	9.78	0.607	0.957	0.023
Total	134						

** = significant (P<0.0)

The planting density influenced 1000-grain weight and grain yield. The yield differed in various planting geometries in rice (Zheng *et al*., 2004). These results are also in line with those of Ali, *et al*. (2005) who reported that the yield of rice is largly dependent on plant population. Farmers could get higher income by adopting the plant density of 197600 hills ha^{-1} (22.25x22.25 cm) which has higher cost benefit ratio and paddy yield.

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