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EFFECT OF TRANSPLANTING METHOD ON YIELD CONTRIBUTING CHARACTERS, SEED RECOVERY AND QUALITY IN RICE (*ORYZA SATIVA* L.)

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Abstract

The present investigation were conducted during *Kharif* 2015 and 2016 with objective of the study for yield contributing traits and seed quality parameters *i.e.* no of tillers per plant, productive tillers per hill, Plant height (cm), panicle length, harvest index, seed recovery, seed yield (q/ha), 1000 seed weight (g), germination (%), vigour index and electrical conductivity. The field experiment was laid out with three replications keeping two methods of transplanting *viz*. C_1 (Normal method) and C_2 (SRI method) were also applied with three genotype *viz.* NDR 97, NDR359 and BPT 5204. The result revealed that inoculation of SRI transplanting method significantly improved no. of tillers per plant, productive tillers per hill, Plant height (cm), panicle length, harvest index, seed recovery, seed yield (q/ha), 1000 seed weight (g), germination (%), vigour index and reduce electrical conductivity. Overall the treatment of findings revealed that rice crop should be transplanted under SRI method for obtaining high seed yield potential of the variety producing good quality seeds with maximum seed recovery.

Key words: SRI method, Transplanting method, seed recovery, Rice seed.

Introduction

Rice (*Oryza sativa* L.) is a semi-aquatic annual grass plant belongs to the genus *Oryza*, tribe Oryzeae and family Poaceae. It is the second largest principal food crop in the world after wheat and is one of the main staple food crop in India. Besides being the staple food crop, it has been the cornerstone of food and culture for our people. Among four billion people on the earth, more than half of them depend on this crop for principal source of energy in their daily diet. Rice is distributed over a wider range of latitude from 50 ^{0}N to 40 ^{0}S and is being grown up to an altitude of 2500 meters. It evolved in humid tropics as a semi aquatic plant and it has got unique adaptive nature to hot humid environment, which is not seen in any other major cereal crop.

Seed quality plays a crucial role in realizing the full genetic potential of varieties as well as benefits of other agricultural inputs (Seshu and Dadlani 1993). The use of quality seeds alone increases the productivity to the extent of 15-20 per cent (Dahiya *et al.* 1993). Only seeds with assured genetic and physical purity can be expected to response to the other inputs in agriculture. Among the inputs used by the farmers for agriculture production seed is the cheapest one and it forms only part of the cultivation expenses. All the efforts and investment would be unremunerative if farmer does not get good quality seeds. Only seed with good germination and vigour can give a good stand of the crop, otherwise there will be inadequate plant population and low yields. A mere increase in the seed rate may compensate for poor germination, but it cannot ensure vigourous and uniform growth of the crop. Thus, quality seed is a crucial factor to enhance grain production in rice.

In the case of rice production seedling stage and method of transplanting also performance of individual hills was significantly improved with wider spacing compared with closer-spaced hills in terms of root growth and xylem exudation rates, leaf number and leaf sizes, canopy angle, tiller and panicle number, panicle length and grain number per panicle, grain filling and 1000 grain weight and straw weight. By the practices of seedling stage and method of transplanting enhanced percentage of effective tillers and showed substantial and positive impacts on grain yield increase 17 % extra.

Material and Methods

The field experiments was conducted on three varieties of rice (*Oryza sativa*) *viz*. NDR-97, NDR-359 and BPT-5204 to study the Effect of transplanting method on yield contributing characters, seed recovery and quality in rice (*Oryza sativa* L.) during *kharif* season 2015 and 2016 at Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad. It is situated at 26.47^0 N latitude and 82.12^0 E longitude and at an altitude of 113 m above mean sea level. The soil is silty loam in texture with moderate salinity. It has a semi-arid and sub-tropical climate characterized by extreme hot and cool winters. The nursery beds of 8 m (length) X 1.5 m (width) and 4 inches height were prepared and seeds of all the varieties were line sown in month of June. The seeds were then covered with soil and sprinkled with water. Fertilizer application, plant protection measures and regular watering were done as per recommendations.

SRI Method- Twelve day old seedlings of all the varieties were transplanted at single seedling per hill with the spacings of 25 cm × 25 cm.

Normal Method- Twenty one day old seedlings of all the varieties were transplanted at single seedling per hill with the spacings of 20 cm × 15 cm.

Before transplanting, 50 percent of the recommended nitrogen as ammonium sulphate entire dose of phosphorus as single super phosphate and potassium as Muriate of potash were applied to the experimental plot as basal dose. Nitrogen was applied in 2 equal splits, 10 and 50 days after transplanting. The observations were recorded at no. of tillers per plant, productive tillers per hill, Plant height (cm), panicle length, harvest index, seed recovery, seed yield (q/ha), 1000 seed weight (g), germination (%), vigour index and electrical conductivity. .

Total number of tillers were observed and recorded manually on ten randomly selected plants in the field from each plot of different rice varieties. Among the total number of tillers recorded on ten randomly selected plants in each plot, the tillers which were bearing panicles were counted and recorded as productive tillers. Plant height was recorded on ten randomly selected plants in each plot at the time of maturity from the base of the stem at ground level to the base of main panicle. The mean length of panicle was obtained by measuring from the base to the tip of panicle on ten randomly selected panicles in each plot.

Harvest index was calculated by using following formula,

$$\text{Harvest index (\%)} = \frac{\text{Economical yield (kg)}}{\text{Biological yield (kg)}} \times 100$$

Total amount of pure seed was obtained by separating under sized and light seeds after processing of raw seed. The amount was recorded in the kilogram and it was recorded in percentage by computing with suitable conversion factor. The seeds obtained from the corresponding plots were sun dried, weighed and recorded. The seed yield per hectare was computed with appropriate conversion factor. Test weight (g) was determined by counting manually one hundred seeds of eight replicates from each genotype and weighed up to four significant figures on top pan precision balance. Coefficient of variation was calculated, replication showing C.V. less than 6.0 were selected and mean was calculated. The mean was multiplied by 10 to get the final 1000 seed weight. The weight was expressed in grams.

Germination test was conducted by using 'between paper' method as per (ISTA, 2008). Four replicates of one hundred seeds from each treated genotype were placed equidistantly on moist germination paper. The rolled towels were incubated at 25±1^{0}C for fourteen days. The first and final counts were recorded on fifth and fourteenth day, respectively. The germination percentage was recorded on the basis of normal seedling only at the final count and expressed in percentage. Ten seedlings from each replication were taken at random after fourteenth day of incubation to determine the seedling length. The seedling length was measured from the tip of the primary root to the tip of the primary leaf and mean of ten seedlings was calculated and expressed in centimetres. The seedlings used to measure seedling length were dried in a hot air oven maintained at 80 ± 2^{0}C for 24 hours. Later they were cooled over silica gel and weighed. The mean dry weight of seedlings was computed and expressed in milligram. Seedling vigour index was calculated by using seedling growth parameters and expressed as a whole number as suggested by Abdul-Baki and Anderson (1973) and it is given below.

Vigour index I = Germination (%) x Mean seedling length (cm)

Vigour index II = Germination (%) x Mean seedling dry weight (mg)

Four replicates of fifty seeds each for each treated genotype were soaked in 50 ml distilled water for 24h at 20 1^{0}C. At the end of soaking, the steeped water (seed leachate) was decanted and electrical conductivity of the seed leachate was measured with the help of Conductivity Bridge and expressed in dS/m/gm(ISTA, 2008).

Results and Discussion

The data recorded on various characters were analysed statistically to authenticate the effects of transplanting methods on different variety of rice seed production and its quality. The conspicuous findings of the present investigation entitled **"**Effect of transplanting method on yield contributing characters, seed recovery and quality in rice (*Oryza sativa* L.)**"** have been elaborated under following heads and presented in corresponding tables.

No. of tillers per plant and Productive tillers per hill: Number of tillers per plant and number of productive tillers per hill was also significantly influenced with the transplanting method in both the years of present investigation. Higher number of tillers per plant (20.76 and 22.76) was recorded with transplanting SRI method than normal transplanting (13.92 and 15.92), whereas also Higher number of productive tillers per hill (18.76 and 18.93) was recorded with transplanting SRI method than normal transplanting (11.90 and 11.88) in 2015 and 2016, respectively (Table 1). And also Number of tillers per plant and number of productive tillers per hill was significantly influenced under transplanting SRI method with all investigated varieties. Similar results had been observed by Saina (2001); Garcia *et al.* (1995) and Akbar (2004).

Plant height (cm): The methods of transplanting had also significant effect on this character in both the years of study. Significantly higher plant height (91.22 cm and 92.59 cm) was recorded with SRI method of transplanting as compared to normal method of transplanting in 2015 and 2016, respectively (Table 1) And also plant height was significantly influenced under transplanting SRI method which was found superior to normal method of transplanting with all investigated varieties. The present findings are in accordance with the results obtained by Hossain *et al.* (2003) and Husain *et al.* (2003).

Panicle length (cm): The transplanting methods showed significant influence on the length of panicle in both the years of present investigation. The maximum panicle length of 23.67 cm and 24.71 cm were recorded under transplanting SRI method, which was significantly superior to normal method of transplanting during first and second year, respectively (Table 1). And also panicle length was significantly influenced under transplanting SRI method which was found superior to normal method of transplanting with all investigated varieties. Similar results had been observed by Salahuddin *et al.* (2009).

Harvest Index (%): The transplanting method had significant effect on harvest index during both the years. Higher harvest index (32.24% and 33.26%) was recorded under transplanting SRI method than normal transplanting method (24.78% and 25.55%) in 2015 and 2016, respectively (Table 2). And also harvest index was significantly influenced under transplanting SRI method which was found superior to normal transplanting method with all investigated varieties. Similar results had been observed by Longxing *et al*. (2002) and Hamid *et al.* (2011).

Seed recovery (%): The transplanting method had significant effect on seed recovery during both the years. Higher seed recovery (85.44% and 87.84%) was recorded under transplanting SRI method than normal transplanting method (78.51% and 80.82%) in 2015 and 2016, respectively (Table 2). And also seed recovery was significantly influenced under transplanting SRI method which was found superior to normal transplanting method with all investigated varieties.

Seed Yield: The transplanting method had significant effect on seed yield during both the years. Higher seed yield (41.47q/ha and 42.29q/ha) was recorded under transplanting SRI method than normal transplanting method (39.63q/ha and 40.45q/ha) in 2015 and 2016, respectively (Table 2). And also seed yield was significantly influenced under transplanting SRI method which was found superior to normal transplanting method with all investigated varieties. The present findings are in accordance with the results obtained by Zheng *et al.* (2004) and Devarajan (2005).

1000 seed weight (gm): The transplanting method had significant effect on 1000 seed weight during both the years. Maximum 1000 seed weight (23.30g and 23.41g) was recorded under transplanting SRI method than normal transplanting method (21.86g and 21.97g) in 2015 and 2016, respectively (Table 2). And also 1000 seed weight was significantly influenced under transplanting SRI method which was found superior to normal transplanting method with all investigated varieties. Similar results had been observed by Aziz and Hasan (2000).

Germination test (%): The transplanting method had sowing better effect on germination during both the years. Maximum germination (87.32% and 88.66%) was recorded under transplanting SRI method that sowing better than normal transplanting method (86.17% and 87.50%) in 2015 and 2016, respectively (Table 3). And also seed germination was better influenced under transplanting SRI method which was found superior to normal transplanting method with all investigated varieties.

Seedling vigour index: The transplanting method had significant effect on seedling vigour index during both the years. Maximum seedling vigour index I and II (2123.62 and 2188.61) and (1343.25 and 1381.84) ware recorded under transplanting SRI method than normal transplanting method (1991.59 and 2054.50) and (1279.37 and 1317.00) in 2015 and 2016, respectively (Table 3). And also seedling vigour index was significantly influenced under transplanting SRI method which was found superior to normal transplanting method with all investigated varieties.

Electrical conductivity (dS/m/gm): The transplanting method had negatively significant effect on electrical conductivity during both the years. Minimum electrical conductivity (1.11 dS/m/gm and 1.00 dS/m/gm) was recorded under transplanting SRI method than normal transplanting method (1.25 dS/m/gm and 1.14 dS/m/gm) in 2015 and 2016, respectively (Table 3). And also significant decrease in electrical conductivity was noticed under transplanting SRI method which was found superior to normal transplanting method with all investigated varieties.

The above findings germination test, seedling vigour index and electrical conductivity are in accordance with the results obtained by Hammes (1969) found positive relationship between seed quality parameters and size of seeds. There was an increase in shoot length, root length and dry matter with increase in seed weight. According to Cicero and Orsie (1978) vigour was greater in the heavy seeds than in the light seeds. Amral and Dos (1979) observed that rice seeds of higher weight and size had better physiological quality as shown by higher longevity, germination capacity and higher vigour, than lighter seeds. Gasper and Bus (1981) reported that, in seeds of higher 1000 seed weight were superior both in germination capacity and seedling vigour. Mathur *et al.* (1982) observed a significant positive association between 1000 seed weight (g), dry matter (mg/10 seedlings), germination per cent, germination index, root length and shoot length. Vannagamudi and Ramaswamy (1984) reported that co-efficient of variation in seed weight and vigour parameters like root, shoot and coleoptiles lengths of the seedlings varied significantly within and between size grades of seed. Tomar and Prasad (1993) reported that germination percentage decreased as specific gravity of seed decreased.

Conclusion

In the light of results obtained in above investigation may be safely concluded that among transplanting method, SRI method may be utilized in rice for seed production as it produced higher seed yield, maintained the seed recovery and other yield contributing quality of seeds. By the practices of seedling stage and method of transplanting enhanced percentage of effective tillers and showed substantial and positive impacts on grain yield increase 17% extra.

Table 1: Effect of transplanting method, on tillers per plant, productive tillers per hill, plant height and panicle length in rice varieties during 2015 and 2016

Treatment	Tillers/Plant (No.)		Pro. Tillers/hill (No.)		Plant Height (cm)		Panicle length (cm)	
	2015	2016	2015	2016	2015	2016	2015	2016
NDR 97 (V_1)	15.48	17.48	13.48	13.38	80.37	81.38	20.72	21.98
NDR 359 (V_2)	19.54	21.54	17.54	17.54	94.93	97.14	24.27	25.37
BPT 5204 (V_3)	16.98	18.98	14.98	15.29	93.46	94.35	23.52	24.27
SEm ±	0.16	0.16	0.16	0.21	1.02	0.97	0.24	0.29
CD 5%	0.47	0.47	0.47	0.63	3.00	2.84	0.70	0.86
Normal transplanting (C_1)	13.90	15.90	11.90	11.88	87.95	89.32	22.00	23.04
SRI transplanting (C_2)	20.76	22.76	18.76	18.93	91.22	92.59	23.67	24.71
SEm ±	0.13	0.13	0.13	0.17	0.83	0.79	0.20	0.24
CD 5%	0.39	0.39	0.39	0.51	2.45	2.32	0.58	0.70
$V_1 \times C_1$	12.04	14.04	10.04	10.04	78.77	79.78	20.05	21.31
$V_1 \times C_2$	18.92	20.92	16.92	16.71	81.97	82.98	21.39	22.65
$V2 \times C_1$	15.75	17.75	13.75	13.54	93.19	95.40	23.14	24.24
$V_2 \times C_2$	23.33	25.33	21.33	21.54	96.68	98.89	25.40	26.50
$V_3 \times C_1$	13.92	15.92	11.92	12.04	91.89	92.78	22.82	23.57
$V_3 \times C_2$	20.04	22.04	18.04	18.54	95.02	95.91	24.23	24.98
SEm ±	0.228	0.228	0.228	0.303	1.444	1.370	0.340	0.415
CD 5%	0.669	0.669	0.669	0.889	4.236	4.019	0.997	1.217

Table 2: Effect of transplanting method on harvest Index, Seed recovery, Seed yield and 1000 seed weight in rice varieties during 2015 and 2016

Treatment	Harvest Index (%)		Seed Recovery (%)		Seed Yield(q/ha)		1000 Seed weight (g)	
	2015	2016	2015	2016	2015	2016	2015	2016
NDR 97 (V_1)	27.65	28.78	81.27	22.29	22.29	27.63	22.29	22.40
NDR 359 (V_2)	30.16	30.86	80.04	26.40	26.40	45.70	26.40	26.52
BPT 5204 (V_3)	27.72	28.57	84.60	19.05	19.05	50.79	19.05	19.16
SEm ±	0.31	0.38	0.93	0.24	0.24	0.52	0.24	0.28
CD 5%	0.91	1.11	2.74	0.68	0.68	1.51	0.68	0.80
Normal transplanting (C_1)	24.78	25.55	78.51	21.86	21.86	40.45	21.86	21.97
SRI transplanting (C_2)	32.24	33.26	85.44	23.30	23.30	42.29	23.30	23.41
SEm ±	0.25	0.31	0.76	0.20	0.20	0.42	0.20	0.23
CD 5%	0.74	0.91	2.24	0.55	0.55	1.23	0.55	0.65
$V_1 \times C_1$	24.82	25.87	77.81	21.39	21.39	26.71	21.39	21.49
$V_1 \times C_2$	30.47	31.70	84.74	23.20	23.20	28.55	23.20	23.30
$V2 \times C_1$	25.37	25.96	76.58	25.53	25.53	44.78	25.53	25.66
$V_2 \times C_2$	34.95	35.77	83.51	27.26	27.26	46.62	27.26	27.38
$V_3 \times C_1$	24.14	24.83	81.14	18.65	18.65	49.87	18.65	18.76
$V_3 \times C_2$	31.30	32.31	88.07	19.45	19.45	51.71	19.45	19.55
SEm ±	0.44	0.54	1.32	0.34	0.34	0.73	0.34	0.40
CD 5%	1.28	1.57	3.88	0.95	0.95	2.14	0.95	1.13

Table 3: Effect of transplanting method on germination test, seedling vigour index and electrical conductivity in rice varieties during 2015 and 2016

Treatment	Germination (%)		Seedling vigour index I		Seedling vigour index II		E.C. (dS/m/gm)	
	2015	2016	2015	2016	2015	2016	2015	2016
NDR 97 (V_1)	85.08	87.08	2176.64	2253.85	1449.10	1497.07	1.36	1.25
NDR 359 (V_2)	88.08	89.08	2011.79	2067.56	1771.96	1809.88	1.20	1.09
BPT 5204 (V_3)	87.08	88.08	1984.37	2043.25	712.87	741.31	0.98	0.87
SEm ±	0.52	0.50	13.12	14.38	13.93	8.75	0.01	0.01
CD 5%	1.46	1.41	36.72	40.27	39.00	24.50	0.04	0.03
Normal transplanting (C_1)	86.17	87.50	1991.59	2054.50	1279.37	1317.00	1.25	1.14
SRI transplanting (C_2)	87.32	88.66	2123.62	2188.61	1343.25	1381.84	1.11	1.00
SEm ±	0.43	0.41	10.71	11.74	11.37	7.14	0.01	0.01
CD 5%	1.19	1.15	29.99	32.88	31.84	20.01	0.03	0.02
$V_1 \times C_1$	84.50	86.50	2100.40	2176.02	1411.80	1459.03	1.41	1.30
$V_1 \times C_2$	85.66	87.66	2252.88	2331.68	1486.40	1535.11	1.32	1.20
$V2 \times C_1$	87.50	88.50	1943.41	1998.35	1736.83	1774.37	1.29	1.18
$V_2 \times C_2$	88.66	89.66	2080.18	2136.78	1807.09	1845.39	1.11	0.99
$V_3 \times C_1$	86.50	87.50	1930.96	1989.14	689.50	717.59	1.04	0.93
$V_3 \times C_2$	87.66	88.66	2037.78	2097.35	736.24	765.02	0.92	0.80
SEm ±	0.74	0.71	18.55	20.34	19.70	12.37	0.02	0.01
CD 5%	2.07	1.99	51.94	56.96	55.15	34.65	0.06	0.04

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