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Research Article

Influence of FYM, brown manuring and levels of nitrogen on yield, net water expense and quality parameters of direct seeded and transplanted rice (*Oryza sativa* L.)

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Abstract : The influences of FYM, brown manuring and nitrogen levels on yield, net water expense and quality parameters of rice was assessed in a field experiment carried out on a loamy sand soil at Punjab Agricultural University, Ludhiana, during *Kharif* 2008. Field experiment comprised of 20 treatment combinations *viz.*, five main plot treatments (Direct seeded rice with and without FYM, Direct seeded with brown manuring, Transplanted rice with and without FYM and 4 nitrogen levels as sub-plot treatments (90, 120 and 150 kg N ha^{-1} and LCC treatment). Rice growth and yield were statistically similar under direct seeded and transplanted conditions. The direct seeded puddle rice gave yield comparable to that of traditional practice of transplanting of seedlings with the added advantage of earlier maturity of the crop by 12 days. Compared with transplanted rice, direct seeded rice reduced the net water expense during crop growth period by 21 per cent. Both transplanted and direct seeded rice responded to the application of 120 kg N ha^{-1}. Quality parameters *i.e.* hulled, milled and head rice recovery and protein content was not influenced by different planting methods. These findings thus clearly illucidate the scope of direct seeded rice under puddle irrigated conditions on Punjab.

Key Words : Brown manuring, Direct seeded rice, FYM, Leaf colour chart, Nitrogen

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INTRODUCTION

In Punjab, the rice is cultivated on an area of about 2.6 million hectares with total production of 10.5 million tones of milled rice (Anonymous, 2009a). Traditionally, rice is cultivated as puddle transplanted, which is cumbersome and labour intensive. Moreover, this technique requires continuous ponding of water for establishment of the seedlings and for full effectiveness of applied herbicides. This in turn leads to nutrient losses through leaching besides causing high evapo-transpiration (ET) losses during the hot summer months. In addition, it has been realized that at cultivar's fields plant population varies from 16-21 hills/m^2 as against the recommended 33 hills/m^2, which acts as a yield limiting factor. Presently, the farmers in Punjab transplant paddy in the first week of June when the daily evaporation rate is very high (8-10 mm/day). This practice of staggered planting has led not only to higher water consumption but also posed a serious threat to timely planted paddy crop (15-30 June) due to sizeable build-up of pests and disease and over exploitation of resources. Moreover, in the Indo-Gangetic Plains (IGP) in general and in Punjab which lies in the Trans-Gangetic region of IGP, in particular, the underground water is being over exploited by excessive pumping to meet the water need of transplanted paddy. As a consequence, it has been causing a sharp decline in ground water table. Therefore, of late, need has acutely

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been felt to develop technically viable and economically feasible alternate technique for growing paddy in this area. To make paddy cultivation cost, effective, direct-seeded rice provides an option which saves labour expenses and water, besides maintaining optimum plant population. This method of rice cultivation is now fast replacing traditional transplanted rice in areas with good drainage and weed control (Balasubramanian and Hill, 2002). Direct-seeding cultivation of rice could also help to ensure the timely sowing in a stipulated time. Fertilizers have contributed substantially to the spectacular increase in crop production. However, application of inorganic fertilizers alone in large quantities over a longer period of time results in imbalance in the supply of other nutrients. The combined use of organic manures and inorganic fertilizers help in maintaining yield stability through correction of marginal deficiencies of secondary and micronutrients, enhancing efficiency of applied nutrients and providing favourable soil physical conditions. Application of farm yard manure (FYM) to soil improves the physical, chemical and biological properties thereby improving the nutrient availability in soils. It occupies an important position amongst bulky organic manures. The fertilizer N-use efficiency varies from 18-40 per cent in transplanted rice, because applied inorganic N is rapidly lost from the soil by leaching, ammonia volatilization and denitrification. Urea is the principal nitrogenous fertilizer in rice-growing Asian countries which is prone to various losses. Application of urea in combination with organic material (FYM) minimizes N losses and increase N-use efficiency. Information on efficient management of fertilizer N in wet-direct seeded rice in northwestern India is meager. Therefore, a field experiment was conducted in rice to optimize the rate of N application in combination with organic material (FYM) and its effect on soil properties.

EXPERIMENTAL METHODS

Field experiment was conducted at the Punjab Agricultural University, Ludhiana, during *Kharif* 2008. The soil was loamy sand, slightly alkaline in reaction, low in organic carbon (0.32%) and available N (252.7 kg ha^{-1}) and medium in available (12.8 kg ha^{-1}) and K (146 kg ha^{-1}). The field experiment comprised of 20 treatment combination *viz*., five main plot treatments (Direct seeded rice with 10 t/ha FYM, Direct seeded rice without FYM, Direct seeded rice with 'brown manuring', Transplanted rice with FYM 10 t/ha and transplanted rice without FYM) and 4 nitrogen levels as sub plot treatments (90, 120 and 150 kg N ha^{-1} and LCC treatment). The experiment was laid out in split plot design with four replications. The sowing of direct-seeded rice was done by broadcasting of pre-sprouted seeds after puddling on 4 June, 2008 (50 kg ha^{-1}). Transplanting was done on 2 July, 2008 with 28 days old seedling keeping row to row spacing of 20 cm and plant to plant spacing of 15 cm (20 ha^{-1}). Uniform application of butachlor (3 l ha^{-1} after mixing in 150 kg sand) was done within 3 days of sowing/transplanting and later on uniform application of pretilachlor 30.5 EC (1.25 l ha^{-1}) was made 7 days after sowing/transplanting to control weeds. Nitrogen was applied through urea in three equal doses as 1/3 applied as basal+1/3 after three weeks + 1/3 after six weeks of sowing/ transplanting of crop. In case of leaf control chart (LCC) 28.75 kg N ha^{-1} was applied as basal dose at time of puddling. The first set of LCC reading was taken 21 days after seedling of direct seeded rice and 21 days after transplanting of transplanted rice. The readings were taken at the same time of the day (8-10 am) with the sun at back to shade the leaf being measured. Ten disease-free rice hills were selected randomly from a plot with uniform plant population. Placing the middle part of the youngest fully expanded leaf on the top of the colour strips in the chart, the colour of the leaf of the 10 selected plants was compared. When six or more leaves read below a set critical value, 28.75 kg N ha^{-1} as urea was applied (Anonymous, 2009b). The process was repeated after every 7 days in order to cover early tillering, active tillering, panicle initiation and first flowering stage, and N was applied as needed. The last set of readings was taken when the first flower appeared. In leaf colour chart (LCC) 115 kg N ha^{-1} was applied in 4 split applications. Last dose of N was applied eight weeks after sowing/transplanting of direct seeded and transplanted rice. The each of P_2O_5 and K_2O was applied at the time of field preparation (30 kg ha^{-1}). To overcome Zn deficiency, $ZnSO_4$ was applied @ 62.5 kg ha^{-1}. To resolve the problem of Fe deficiency, 1 per cent solution of $FeSO_4$ was sprayed twice at weekly intervals. The direct-seeded rice was kept moist during the first week to ensure its proper germination and water was not allowed to accumulate for avoiding seed rotting. Thereafter, the irrigations were applied at 3-days interval throughout up to 15 days before harvesting. In transplanted rice, continuous ponding of water was kept for the first 15 days and the subsequent irrigations were given, 2 days after the disappearance of ponded water. The last irrigation to transplanted rice too was applied 15 days before harvesting. The irrigation depth of 5 cm was applied in direct-seeded plots and in transplanted plots it was 7.5 cm. Depth of each irrigation was measured with Parshall flume. The rainfall received during crop growth period of transplanted rice was more (88.8 cm) as compared to 86.8 cm during crop growth period of direct seeded rice as transplanted rice matured 12 days later and there was 1.98 cm of rainfall during that period. The irrigation intervals were extended according to the intensity and frequency of rainfall. The harvested produce from the net plot of 15 m^2 was threshed manually and grain yield was converted to q ha^{-1} after adjusting to 14 per cent grain moisture content. Net water expense was calculated by the formula :

NEW = IW + RF – WL

where,

NEW=Net water expense of the crop (cm)

IW = Amount of water required (cm) for puddling, crop establishment and during the period after crop establishment (cm)

RF = Rainfall during crop growth period (cm)

WL = Amount of water left in the soil profile at the time of harvesting (cm)

Grain quality was measured as under :

Hulled / Brown rice recovery (Shelling) :

The clean paddy samples (125 g; 13.5-14.5 per cent moisture content) were shelled in laboratory sheller (Satake Rice Sheller, Satake Engg. Co., Japan) equipped with rubber rolls. The distance between the rolls was adjusted depending upon the thickness of grains to get minimum breakage. Shelled (brown) rice was weighed and expressed as percentage of hulled / brown rice.

Milled rice recovery (Milling) :

Brown rice samples were milled (polished) in Mc Gill, Miller No. 2 (U.S.A.) to remove the polish (bran). The time of polishing was adjusted to achieve 6-8 per cent degree of milling.

Head rice recovery :

Rice sizing device was used to separate broken kernel from milled rice after milling. The kernel with more than two-third length was considered as head rice and expressed as percentage.

Protein :

Protein content in grain was calculated by multiplying the N percentage in grain by factor 5.95.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Yield and yield contributing characters:

Effective tillers:

There was no effect of FYM and brown manuring on the effective tiller density in direct seeded as well as transplanted rice (Table 1). Among nitrogen levels, 120 kg N ha^{-1} significantly increased the tiller density compared with 90 kg N ha^{-1} and there was no further increase in the tiller density by increasing the N rate to 150 kg ha^{-1} (Table 1). The maximum number of effective tillers was obtained with 120 kg N ha^{-1} which was similar to that with the application of 150 kg N ha^{-1} and LCC treatment but it was significantly more than 90 kg N ha^{-1}.

Spikelets / panicle :

The spikelets/panicle was influenced by planting

Table 1 : Influences of FYM, brown manuring and nitrogen levels on effective tillers, spikelets per panicle and 1000 grain, weight, grain yield, straw yield and maturity of direct seeded and transplanted rice

Treatments	Effective tillers (m^{-2})	Spikelets/ panicle	1000 grain weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Maturity (days)
Main plot						
Direct seeded rice with FYM	446.6	89.4	21.2	60.9	116.9	114.5
Direct seeded rice without FYM	433.6	85.2	20.8	58.2	109.3	113.9
Direct seeded rice with brown manuring	438.3	86.5	20.7	59.7	110.5	114.3
Transplanted rice with FYM	467.7	93.7	21.4	63.9	111.8	126.5
Transplanted rice without FYM	452.9	91.9	21.3	61.1	105.8	126.0
C.D. (P=0.05)	NS	6.1	NS	NS	NS	0.6
Sub plot (nitrogen levels kg ha^{-1})						
90	411.0	87.4	20.7	57.3	104.6	118.9
120	466.1	90.4	21.3	63.8	111.8	119.1
150	454.7	90.2	21.1	60.3	116.1	119.3
LCC	459.4	89.3	21.2	61.6	111.0	118.9
C.D. (P=0.05)	30.6	NS	NS	4.59	7.6	NS
Interaction	NS	NS	NS	NS	NS	NS

NS=Non-significant

methods and FYM (Table 1). Transplanted rice with FYM produced 93.7 spikelets/panicle, which was significantly higher than direct seeded rice with brown manuring (86.5) and direct seeded rice without FYM (85.2), but it was at par with transplanted rice without FYM (91.9) and direct seeded rice with FYM (89.4). Higher number of spikelets/panicle recorded in conventional transplanted method due to better growth and development. Perusal of data further revealed that spikelets/panicle did not differ significantly with increasing levels of nitrogen.

1000-grain weight :

There was no significant effect of FYM and fertilizer N application on the 1000- grain weight of rice, irrespective of methods of planting (Table 1).

Yield :

The grain and straw yield of rice (Table 1) were not influenced by the different planting techniques and FYM treatments indicating that direct seeding did not resulting any yield reduction. Similar observations were also reported by Singh *et al.* (2007). Different nitrogen levels significantly affected the grain yield of rice (Table 1). Maximum grain yield (63.8 q ha^{-1}) was obtained with 120 kg N ha^{-1} which was significantly superior to 90 kg N ha^{-1} (57.3 q ha^{-1}), but statistically was at par with 150 kg N ha^{-1} was 11.3 per cent higher than 90 kg N ha^{-1}. The interaction effect of different methods of seeding and levels of nitrogen was non-significant.

Maturity :

The present study (Table 1) showed significant effect of methods of crop establishment and nitrogen levels on days to maturity. The transplanted crop took 12 days more to mature as compared to direct seeded rice. The reduction in maturity period of direct seeded rice was due to elimination of the transplanting shock. Dingkuhn *et al.* (1990) also reported reduction in crop duration by 8-12 days, regardless of the nitrogen levels, due to the absence of transplanting shock in direct seeded rice. Many workers (Peng *et al.*, 1996, Santhi *et al.,* 1998; Saikia *et al.*, 1992) also found similar trernds.

There was no significant effect of increased level of N application to 150 kg ha^{-1} on days to maturity.

Net water expense :

Total irrigation water applied included the irrigation water applied from puddling to crop harvest (Table 2). Total irrigation water applied to transplanted rice was 196 cm which was 31 per cent more as compared to direct seeded rice (150cm). This might be due to the fact that direct-seeded rice was kept moist the first week to ensure its proper germination and water was not allowed to accumulate for avoiding seed rotting. Thereafter, the irrigations were applied at 3-dyas interval throughout up to 15 days before harvesting. However, in transplanted rice, continuous ponding of water was kept for the first 15 days and the subsequent irrigations were given, 2 days after the disappearance of ponded water and also direct seeded rice matured 12 days earlier than transplanted rice as direct seeding of rice was done along with nursery raising of transplanted rice. The rainfall received during crop growth period of transplanted rice was more *i.e.* 88.8 cm as compared to 86.8 cm during crop growth period direct seeded rice as transplanted rice matured 12 days later and there was 1.98 cm of rainfall during that period. The total water expense was more in transplanted rice (284.8 cm) as compared to direct seeded rice, which was 236.8 cm. Water left at harvest in soil profile was more in transplanted rice as compared to direct seeded rice. This might be due to two days early suspension of irrigation water in direct seeded rice. Therefore, net water expense was more in transplanted rice *i.e.* 267.9 cm that was 21 per cent more than direct seeded rice (221.2 cm).

Grain quality:

Hulled / Brown rice recovery :

The data on hulled/brown rice recovery presented in Table 3 indicated that recovery of brown rice was unaffected by seeding techniques and FYM. 120 kg N ha^{-1} performed better and gave significantly higher brown rice recovery (76.85 %) as compared to 90 kg N ha^{-1} (72.55 %) and 150 kg N ha^{-1} (73.23 %), which was, however, at par with LCC

Table 2 : Net water expense in direct seeded and transplanted rice

Treatments	Irrigation water applied during initial 30 days to DSR and nursery of TPR (0-30 DAS) (cm)	Irrigation were applied for pudding (cm)	Irrigation water applied during crop establishment (30-45 DAS) (cm)	Irrigation water applied after crop establishment (45 DAS-Harvest) (cm)	Total irrigation water applied from puddling to harvest (cm)	Rainfall during crop growth period (cm)	Total water expense (cm)	Water left at harvest (cm)	New water expenses of crop (cm)
Direct seeded rice	36	14	20	80	150	86.8	236.8	15.6	221.2
Transplanted rice	2	14	60	120	196	88.8	284.8	16.9	267.9

Table 3 : Influence of FYM, brown manuring and nitrogen levels on quality parameters of direct seeded and transplanted rice

Treatments	Hulled rice recovery (%)	Milled rice recovery (%)	Head rice recovery (%)	Protein (%)
Main plot				
Direct seeded rice with FYM	75.1	68.8	55.5	6.94
Direct seeded rice without FYM	73.7	67.3	54.2	6.85
Direct seeded rice with brown manuring	74.2	67.8	55.2	6.72
Transplanted rice with FYM	75.7	69.5	56.2	6.97
Transplanted rice without FYM	74.3	67.8	55.3	6.93
C.D. (P=0.05)	NS	NS	NS	NS
Sub plot (nitrogen levels kg ha^{-1})				
90	72.6	66.8	53.6	6.67
120	76.9	70.1	56.8	7.02
150	73.2	67.1	54.5	7.08
LCC	75.7	68.9	56.0	6.78
C.D. (P=0.05)	1.2	2.1	1.8	0.24
Interaction	NS	NS	NS	NS

NS=Non-significant

(75.73%). Although transplanted rice with FYM gave highest brown rice recovery but did not differ significantly than other treatments. Interaction between treatments was non-significant.

Milled rice recovery :

There was non-significant difference in milled rice recovery with respect to seeding techniques and FYM as presented in Table 3. 120 kg N ha^{-1} performed better and gave significantly higher milled rice recovery (70.13 %) as compared to 90 kg N ha^{-1} (66.78 %) and 150 kg N ha^{-1} 67.12 %), which was, however, at par with LCC (68.89%). Interaction between treatments was non-significant.

Head rice recovery :

The data on head rice recovery presented in Table 3 indicated that head rice recovery was unaffected by seeding techniques and FYM. 120 kg N ha^{-1} gave maximum head rice recovery (56.78 %) which was statistically at par with LCC (56.02 %) but significant more than 90 kg N ha^{-1} (53.63 %) and 150 kg ha^{-1} (54.51 %). However, interaction among different planting methods with levels of nitrogen was non-significant.

Protein :

Protein content in grains is one of the important characters to judge the quality of rice. The data presented in Table 3 indicated that methods of planting and FYM had non-significant effect on protein content. Levels of nitrogen increased the protein content in grains and the highest protein content was recorded with 150 kg N ha^{-1}, which was, however, at par with 120 kg ha^{-1} but it gave significantly more protein content as compared to LCC treatment and 90 kg N ha^{-1}. International effect was found to be non-significant.

Conclusion :

On the basis of research investigation, it may be concluded that rice growth and yield were statistically similar under direct seeded and transplanted conditions. The direct seeded rice irrespective of FYM (with or without FYM) gave comparable yield as that of recommended practice of transplanting of seedlings in puddle field with the added advantage of 46.6 cm (21 %) saving of irrigation water during crop season and earlier maturity of the crop by 12 days. Among levels of nitrogen, 120 kg N ha^{-1} recorded all yield attributes, yield and quality parameters higher than 90 kg ha^{-1} but it produced similar with 150 kg N ha^{-1} and LCC treatment (115 kg ha^{-1}).

REFERENCES

Anonymous (2009a). Area and production of rice in India. http:/ www.indiastat.com.

Anonymous (2009b). *Package and practices for Kharif crops*. Punjab Agricultural University, LDUHIANA, PUNJAB, (India).

Balasubramanian, V. and Hill, J. (2002). Direct wet seeding of rice in Asia : Emerging issues and strategic research needs for the 21st century, paper presented at the Annual Workshop of the Directorate of rice Research, Hyderabad, India, 7th April, 2002.

Dingkuhn, M., Schnier, H.F., De Datta, S.K., Dorffling, K. and Javellana, C. (1990). Relationships between ripening phase productivity and crop duration, canopy photosynthesis and senescence in transplanted and direct seeded lowland rice. *Field Crops Res.*, **26** : 327-345.

Peng, S., Garcia, F.V., Laza, R.C., Gines, H.C., Samron, M.I., Sanico, A.L., Visperas, R.M. and Cassman, K.G. (1996). Nitrogen use efficiency of irrigated tropical rice established by broadcast wet seeding and transplanting. *Fert. Res.*, **45** : 123-134.

Saikia, L., Bhattarcharya, S.C. and Pathak, A.K. (1992). Seeding and transplanting practices of rice (*Oryza sativa* L.) with and without nitrogen, phosphorus and potash. *Indian J. Agron.*, **37** : 155-157.

Santhi, P.K., Ponnuswamy and Kempuchety (1998). A labour saving technique in direct sown and transplanted rice. *Internat. Rice Res. Newsl.*, **23** : 35.

Singh, Yadvinder, Gupta, R.K., Singh, Bijay and Gupta, S. (2007). Efficient management of fertilizer nitrogen in wet direct-seeded rice (*Oryza sativa* L.) in North West India, *Indian J. Agric. Sci.*, **77** : 561-564.

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