

Production potential of rice (*Oryza sativa*)-wheat (*Triticum aestivum*) cropping system under different methods of crop establishment

J. S. SAMRA AND S. S. DHILLON

Wheat Section, Punjab Agricultural University, Ludhiana 141 004

Received : February 1999

ABSTRACT

Field experiments were conducted to improve the production potential of rice (*Oryza sativa* L.)-wheat (*Triticum aestivum* L. emend. Fiori & Paol.) system under different methods of crop establishment during rainy (*kharif*) and (*rabi*) seasons of 1995-96 and 1996-97 at Ludhiana. The rice transplanted after puddling (M_1 method) gave significantly higher mean grain yield over puddling and broadcasting of sprouted seed (M_2); and line sowing of sprouted seed without puddling (M_3). The conventional tillage and drill sowing (T_5) recorded the highest mean grain yield, followed by minimum tillage and drill sowing (T_3) in wheat. The sowing of wheat by drill proved better than that by broadcasting.

Key words : Rice, Wheat, Production potential, Crop establishment

Rice-wheat is one of the major cropping systems in Punjab. The wider adoption of this system by the farmers is due to its better economic returns. For rice the soil is puddled, which results in the formation of a hard pan. This needs more labour, energy and tillage operations for the sowing of succeeding wheat crop (Singh *et al.*, 1998). The direct seeding of rice would reduce significantly the labour input for undertaking various operations like seed-bed preparation, seedling care, lifting seedlings from the nursery and their transplanting in the field. To find out a suitable and economical method of rice and wheat planting for improving their

production potential in the prevalent rice-wheat system, different methods of crop establishment were compared under field conditions.

MATERIALS AND METHODS

A field experiment was conducted during rainy (*kharif*) and winter (*rabi*) seasons of 1995-96 and 1996-97 at the Wheat Research Farm of Punjab Agricultural University, Ludhiana. The soil of the experimental field was loamy sand, testing low in organic carbon (0.19%) and nitrogen (176 kg/ha) and medium in phosphorus (18.3 kg/ha) and potassium (153 kg/ha) availability. The experiment

was conducted in split-plot design with four replications. Three methods of rice planting, viz. puddling and transplanting (M_1), puddling and broadcasting sprouted seed (M_2) and line sowing of sprouted seed without puddling (M_3), were kept as the main plots; and six methods of wheat sowing (details in Table 2) as subplots. In M_1 method, seedlings of rice cv 'PR 106' at 35 days were transplanted in rows spaced at 20×15 cm. In M_2 method the puddling was done and sprouted seeds were sown by broadcasting. In M_3 method the sprouted seeds of rice were sown in line maintained 20 cm apart under proper moisture (water) conditions. In M_2 and M_3 methods the sowing was done in the third week of May, and nursery for M_1 method was also sown on the same day, and 35 days old seedlings were transplanted keeping two seedlings per hill.

In direct-seeded rice (M_2 and M_3 methods) a seed rate of 75 kg/ha was used and sowing was done behind the plough in M_1 method. The wheat cv 'HD 2329' was mechanically sown with the help of a striptill drill without seed-bed preparation under

zero tillage. The reduced tillage comprised one discing and one tilling followed by planking. Under the conventional tillage, two discings and two tillings were followed by planking. The fertilizer (NPK) was applied to both rice and wheat crops as per local recommendation (Anon., 1996).

RESULTS AND DISCUSSION

Rice establishment

The methods of planting were found to significantly affect the pooled grain yield of rice (Table 1). The rice transplanted after puddling (M_1) recorded significantly higher mean grain yield of 59.7 q/ha over puddling and broadcasting of sprouted seed (M_2) and line sowing of sprouted seed (M_3). The M_2 and M_3 methods produced a mean grain yield of 45.2 and 43.3 q/ha respectively. The M_1 (puddling and transplanting) registered an increase of 32.1 and 37.9% in grain yield over M_2 (puddling and broadcasting of sprouted seed) and M_3 (line sowing of sprouted seed) methods respectively. However, the difference in grain yield between puddling and broadcasting sprouted seed (M_2) and line sowing of sprouted seed

Table 1. Grain yield (q/ha) and ancillary charaters of rice as affected by different methods of crop establishment in rice-wheat system (pooled data of 1995-96 and 1996-97)

Method of establishment	Grain yield (q/ha)	Panicles/m ²	Grains/panicle	Grain wt/panicle (g)	1,000-grain wt (g)
M_1 Puddling and transplanting	59.7	424.7	188.0	4.0	25.5
M_2 Puddling and broadcast of sprouted seed	45.2	403.2	174.7	3.7	24.2
M_3 Line sowing of sprouted seed without puddling	43.3	391.5	159.4	3.6	23.5
CD (P = 0.05)	4.97	N.S.	N.S.	0.21	N.S.

(M₃) was not significant. The higher yield in M₁ method (puddling and transplanting) may be due to no lodging and the beneficial effect on ancillary characters such as number of panicles/m², test weight and grain weight/panicle (Table 1). The reduction in grain yield in M₂ (puddling and broadcasting sprouted seed) and M₃ (line sowing of sprouted seed) methods may be attributed to severe lodging, which affected the yield components adversely. Dhiman *et al.* (1998) also reported similar findings.

Wheat establishment

The perusal of the pooled data of 1995-96 and 1996-97 (Table 2) indicated that the

grain yield was not influenced significantly by different methods of crop-establishment studied. Conventional tillage and drill sowing (T₅) recorded the highest mean grain yield of 50.3 q/ha, closely followed by that (50.0 q/ha) in case of treatment comprising minimum tillage and drill sowing (T₃). The mean grain was reduced to 48.6 q/ha in minimum tillage and strip-till drill sowing (T₂) and was 3.0 and 3.6% less compared with the methods of minimum tillage and drill sowing (T₃) and conventional tillage and broadcast (T₅) respectively. The increase in yield with conventional tillage over zero tillage was also reported by Singh *et al.* (1998). The

Table 2. Grain and straw yields (q/ha) and ancillary characters of wheat as affected by different methods of crop establishment in rice-wheat system (pooled data of 1995-96 and 1996-97)

Method of establishment	Grain yield (q/ha)	Straw yield (q/ha)	Tiller/ m ²	Ears/ m ²	Grains/ ear	1,000-grain wt (g)	Plant height (cm)
T ₁ Zero tillage and sowing by strip till drill	47.6	69.5	457.8	416.6	48.4	37.4	81.4
T ₂ Minimum tillage and sowing with strip-till drill	48.6	68.9	453.0	412.7	49.3	37.5	81.2
T ₃ Minimum tillage and sowing with seed-cum-fertilizer-drill	50.0	71.6	448.7	410.8	47.8	37.5	82.1
T ₄ Minimum tillage and sowing by broadcasting	47.6	73.7	438.7	389.0	48.3	36.2	81.5
T ₅ Conventional tillage and sowing by seed-cum-fertilizer drill	50.3	72.4	458.5	412.5	48.1	37.8	82.4
T ₆ Conventional tillage and sowing by broadcasting	47.3	71.7	437.5	384.1	47.8	37.1	80.6
CD (P = 0.05)	NS	NS	NS	16.05	NS	NS	NS

sowing of wheat by drill (seed-cum-fertilizer/strip-till-drill) gave higher grain yield over broadcast both under minimum and conventional tillage, but the differences were not significant. The ancillary characters such as tillers/m², grains/ear and test weight were also improved when the crop was sown by drill compared with broadcast method. These results are in line with those of Gogoi and Kalita (1995), who also studied different seeding methods in relation to wheat yield. It is interesting to note that zero tillage produced statistically similar grain yield to that of minimum and conventional tillage. The results confirm the findings of Sharma *et al.* (1984) and Singh and Brar (1994).

REFERENCES

- Anonymous. 1996. *Package of Practices for Crops of Punjab: Rabi*. Punjab Agricultural University, Ludhiana, pp. 10.
- Dhiman, S.D., Sharma, H.C., Nandal, D.P., M.H. and Singh, D. 1998. Effect of irrigation methods of crop establishment and fertilizer management on soil properties and productivity in rice (*Oryza sativa*)-wheat (*Triticum aestivum*) sequence. *Indian Journal of Agronomy* 43 (2) : 208-212.
- Gogoi, A.K. and Kalita, H. 1995. Effect of seeding method and herbicide on weeds, and growth and yield of wheat (*Triticum aestivum*). *Indian Journal of Agronomy* 40 (2) : 209-211.
- Sharma, D.N., Jain, M.L. and Sharma, S. 1984. Evaluation of no tillage and conventional tillage systems. *Agricultural Mechanization in Asia, Africa and Latin America* 15 : 14-18.
- Singh, G. and Brar, S.S. 1994. Tillage and nitrogen requirement of wheat (*Triticum aestivum*) sown after rice (*Oryza sativa*). *Indian Journal of Agronomy* 39 (1) : 162-163.
- Singh, P., Aipe, K.C., Prasad, S.N. and Singh, S. 1998. Relative effect of zero and conventional tillage on the growth and yield of wheat (*Triticum aestivum*) and soil fertility under rice (*Oryza sativa*)-wheat cropping system. *Indian Journal of Agronomy* 43 (2) : 204-207.