

Effect of tillage and fertilizer on productivity of wheat (*Triticum aestivum*) under dry-seeded and transplanted rice conditions

S.C. TRIPATHI AND D.S. CHAUHAN

Directorate of Wheat Research, Karnal, Haryana 132 001.

Received : May 2000

ABSTRACT

An experiment was conducted during winter seasons of 1993–94 and 1994–95 to study the effect of tillage and NPK level on productivity of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) under dry-seeded and transplanted rice conditions. Combined analysis showed that wheat yield under dry-seeded rice plot (45.0 q/ha) was significantly higher (8.2%) than transplanted rice (41.3 q/ha). Zero tillage (46.2 q/ha) recorded significantly higher yield (13.2%) and its attributing parameters as compared with yield and its component characters recorded under conventional tillage (40.1 q/ha). Application of 150:75:50 kg/ha (N:P:K) resulted in significantly higher grain yield (44.7 q/ha), 1,000-grain weight and spikes/m² than recommended dose of N:P:K (120:60:40 kg/ha) application (38.3 q/ha).

Interactions among rice seeding/transplanting methods, tillage practices and NPK level on wheat yield were significant. Under zero tillage, 25 and 50% higher dose of NPK application exhibited 7.5 and 6.3 q/ha more grain yield, respectively, than yield recorded with same level of NPK application under conventional tillage condition. Zero tillage resulted in 3 and 9 q more grain yield/ha, which was significantly higher compared to yield recorded with conventional tillage under dry seeded and transplanted rice respectively. In transplanted rice condition, under zero tillage, application of 25 and 50% higher dose of NPK recorded significantly higher grain yield (10–12 q/ha more) than conventional tillage. Under dry-seeded rice, conventional tillage with 25 to 50% higher dose of NPK application exhibited significantly higher yield than yields obtained under transplanted rice.

Key words : Zero tillage, Wheat, Nutrient and Rice seeding methods

Rice-wheat is a dominant cropping system in India and it contributes 74% of the total foodgrain production of the country. Generally, rice is cultivated on puddled soil, which reduces the aeration,

and on the other hand wheat is cultivated on a well-ploughed land. Puddled soils produce large clods and require more energy and time to bring soil to fine tilth for wheat sowing. Nutrient uptake is also

slowed down due to extensive removal of mineralized nitrogen by rice and microbial immobilization of applied nitrogen to subsequent wheat crop (Dear *et al.*, 1979, Meelu *et al.*, 1979). Generally, farmers do repeated tillage operations for wheat cultivation after rice, which delay wheat sowing and ultimately limit the productivity of wheat. Delayed sowing of wheat beyond November reduces grain yield by 30–50 kg/ha/day (Randhawa *et al.*, 1976). Soil type, moisture content, tillage and time of seeding influence productivity of wheat. Problems of repeated tillage operations for wheat sowing after rice, less turn around period and low nutrient response are main constraints for this production system. To overcome these problems, an experiment was carried out under transplanted and dry-seeded rice conditions by application of different tillage practices and NPK levels in wheat.

MATERIALS AND METHODS

The experiment was conducted during winter seasons of 1993–94 and 1994–95 at the experimental farm of Directorate of Wheat Research, Karnal, in a strip split-plot design, replicated 4 times in a plot size of 8 m × 2.3 m on a clay-loam soil. In both the years, the rainy season, vertical strips consisted of 2 rice seeding/transplanting methods, viz. transplanted rice (puddled) and dry-seeded rice (unpuddled). In winter season, 2 tillage practices, viz. zero (direct sown by Pantnagar seed drill) and conventional tillage (3 disking, 3 cultivator and 2 planking), were kept as horizontal strips and subplots were 3 levels of N, P₂O₅ and K₂O (120:60:40, 150:75:50 and

180:90:60 kg/ha). Rice variety 'Basmati 370' and wheat variety 'PBW 343' were used during both the years. Recommended production and protection systems for rice cultivation was adopted. In winter season, wheat sowing was done with 125 kg seed/ha and irrigation was applied at all physiological stages of crop. Half dose of nitrogen, full amount of phosphorus and potash were applied basal through urea, DAP and MOP respectively. Remaining nitrogen was top-dressed after first irrigation. The experimental soil was low in nitrogen, medium in phosphorus and potash. Weeds were controlled with the application of isoguard plus (a chemical blend of isoproturon and 2,4-D (@ 0.5 + 0.125 kg a.i./ha) in 500 litres of water at 30 days after sowing. Before sowing of wheat in non-tilled conditions, 1 spray of Paraquat @ 0.4 kg a.i./ha was applied to control weeds left and emerged after harvest of rice. Sowing was advanced by 4–5 days in zero tillage compared with conventional tillage due to higher moisture requirement in the former method. Fertilizer-cum-seed drill, specially designed for zero tillage conditions, was used for sowing. Observations were recorded on yield and its component characters. Standard statistical methods of analysis were followed for yield data (Gomez and Gomez, 1984)

RESULTS AND DISCUSSION

From pooled analysis, wheat yield under dry-seeded rice plot was significantly higher (8.2%) than grain yield (41.3 q/ha) recorded in transplanted rice plot. This was achieved due to significantly higher 1,000-grain weight and grains-spike in former

production method than latter, whereas spikes/m² were at par under both conditions (Table 1). This confirms report of Tripathi *et al.* (1999) that puddling of soils for rice cultivation adversely affects wheat productivity.

Zero tillage, direct wheat sowing after rice, exhibited significantly higher yield and attributing parameters than those recorded under conventional tillage in pooled analysis (Table 1). This increase in yield under zero tillage, partially contributed by 4–5 days advanced sowing, was more than 13% than conventional tillage. These findings confirm those of Dhiman *et al.* (1983). However, Singh and Brar (1994) reported that zero, reduced and conventional tillage recorded statistically similar grain yield.

Combined analysis over the years revealed that application of 150:75:50 kg/ha (N:P:K) resulted in significantly higher

grain yield, 1,000-grain weight and spikes/m² than recommended dose of N:P:K (120:60:40 kg/ha) application. However, 50% higher dose of N:P:K (180:90:60 kg/ha) application gave maximum grain yield (46.5 q/ha), which was statistically at par with yield obtained at 25% higher dose of NPK application (Table 1).

Various combinations of interactions were significant (Tables 2 and 3) on a pooled analysis basis. There was no significant year effect. Under zero tillage, application of 150:75:50 kg/ha (N:P:K) resulted in significantly higher grain yield than yield obtained at recommended level (120:60:40) of N:P:K application. Response on grain yield was up to 180:90:60 kg/ha (N:P:K) application, which was at par with 25% higher dose of NPK application. On the other hand, under conventional tillage, application of 50% higher dose of NPK resulted in significantly

Table 1. Effect of rice seeding methods, tillage and NPK level on wheat yield and its attributing characters in a combined analysis of 2 years

Treatment	Grain yield (q/ha)	Straw yield (q/ha)	1,000-grain weight (g)	Grains/spike	Spikes/m ²
<i>Rice seeding method</i>					
Dry seeding	45.0	69.1	45.1	53	366
Transplanting	41.3	68.6	43.3	50	349
CD (P=0.05)	0.9	NS	1.4	2	NS
<i>Tillage practice</i>					
Conventional tillage	40.1	63.7	43.9	49	355
Zero tillage	46.2	74.1	45.9	55	385
CD (P = 0.05)	1.9	5.1	1.1	4	13
<i>NPK level (kg/ha)</i>					
120 : 60 : 40	38.3	56.8	42.1	51	346
150 : 75 : 50	44.7	65.9	45.2	52	369
180 : 90 : 60	46.5	74.9	45.6	55	386
CD (P = 0.05)	3.8	6.3	2.4	3	20

higher yield than recommended level of NPK but found at par with 25% higher dose of NPK. Under zero tillage, 25 and 50% higher dose of NPK application showed 7.5 and 6.3 q/ha more grain yield, respectively, than yield recorded with same level of NPK application under conventional tillage condition. Verma *et al.* (1988) observed that yield of wheat in non-tilled condition at lower level of nitrogen application is adversely affected but this

was not the case with conventionally tilled crop. However, our finding did not corroborate with the findings of these authors because we have not tested below the recommended dose of NPK application.

From pooled analysis, zero tillage resulted in 3 and 9 q more grain yield/ha which was significantly higher than the yield recorded with conventional tillage under dry seeded and transplanted rice respectively. Application of 25 and 50% higher dose of NPK gave significantly higher yield than recommended level of NPK under dry seeded rice, whereas at par yields were obtained in transplanted rice plots. In transplanted rice condition under zero tillage, application of 25 and 50% higher dose of NPK recorded significantly higher grain yield (10–12 q/ha more) than conventional tillage. However, in dry-seeded rice plot, zero tillage gave the maximum wheat yield with 25 (49.0 q/ha) and 50% (51.1 q/ha) higher dose of NPK application but at par yield obtained with

Table 2. Response of NPK level on productivity of wheat (q/ha) under zero and conventional tillage conditions (pooled analysis of 2 years)

Fertilizer	Tillage practices	
	ZT	CT
<i>NPK (kg/ha)</i>		
120 : 60 : 40	40.6	36.0
150 : 75 : 50	48.5	41.0
180 : 90 : 60	49.6	43.3
<i>CD (P=0.05)</i>		
Interaction		5.3

ZT, Zero tillage; CT, conventional tillage

Table 3. Wheat grain yield (q/ha) as affected by tillage and NPK level under transplanted and dry-seeded rice in a pooled analysis (1993–94 and 1994–95)

Rice seeding methods (A) Tillage in wheat (B)	Transplanted rice			Dry-seeded rice		
	ZT	CT	Mean	ZT	CT	Mean
<i>N : P : K (kg/ha) (C)</i>						
120 : 60 : 40	41.7	34.9	38.3	39.6	37.1	38.3
150 : 75 : 50	48.0	36.8	42.4	49.0	45.3	47.1
180 : 90 : 60	48.2	38.5	43.4	51.1	48.1	49.6
Mean	45.9	36.7		46.5	43.5	
<i>CD (P=0.05)</i>						
A × B			2.7			
A × C			5.3			
A × B × C			7.5			

ZT, Zero tillage; CT, conventional transplanting

same level of NPK application in conventional tillage. Under dry-seeded rice, conventional tillage with 25 and 50% higher dose of NPK application showed significantly higher yield than yields obtained with same tillage practices under transplanted rice. However, application of recommended N:P:K dose (120:60:40 kg/ha) recorded at par grain yield in zero and conventional tillage systems when rice was dry seeded or transplanted (Table 3). This showed that response of higher dose of NPK level was more conspicuous under zero tillage with transplanted rice and at the same time better with dry seeded rice as compared to conventional tillage.

REFERENCES

- Dear, B.S., Mc. Donald, D.F. and Falconer, G. 1979. Nitrogen and phosphorus requirements of wheat sown by minimum tillage in to rice stubble and the effect of rice stubble treatment. *Australian Journal of Experimental Agriculture and Animal Husbandry* **19** : 488-494.
- Dhiman, S.D., Sharma, D.N., Singh, D. and Sharma, S. 1983. Possibility of zero tillage in wheat in heavy soil. Paper presented at the 22nd All-India Co-ordinated Wheat Improvement Project Workshop, held during 25-29 August 1983 at Tamil Nadu Agricultural University, Coimbatore.
- Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research*, pp. 97-107. John Wiley & Sons, New York.
- Meelu, O.P., Beri V., Sharma, K.N., Jalota, S.K. and Sandhu, B.S. 1979. Influence of paddy and corn in different rotations on wheat yield, nutrient removal and soil properties. *Plant and Soil* **51**: 51-57.
- Randhawa, A.S., Gill, K.S. and Dhillon, S.S. 1976. Time of sowing and productivity of wheat varieties. *Progressive Farming* **13** : 210-222.
- Singh, Goriqbal and Brar, S.S. 1994. Tillage and nitrogen requirement of wheat (*Triticum aestivum* L.) sown after rice (*Oryza sativa* L.). *Indian Journal of Agronomy* **39** (1) : 162-163.
- Tripathi, S.C., Nagarajan, S. and Chauhan, D.S. 1999. Evaluation of zero tillage in wheat (*Triticum aestivum*) under different methods of rice (*Oryza sativa*) transplanting. *Indian Journal of Agronomy* **44** (2) : 219-222.
- Verma, U.N., Srivastava, V.C. and Verma, U.K. 1988. Nitrogen management in wheat under conventional and no tillage conditions in rice-wheat sequence. *Indian Journal of Agronomy* **33** : 37-43