

Performance of potato (*Solanum tuberosum*) + wheat (*Triticum aestivum*) relay cropping system

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ABSTRACT

A field experiment was conducted for 2 years at New Delhi, to study agronomic aspects of potato (*Solanum tuberosum* L.) + wheat (*Triticum aestivum* L. emend. Fiori & Paol.) relay cropping system. Row spacing of 50 cm as well as seed rate of 80 kg/ha of wheat was found the optimum practice for this cropping system. Nitrogen application to wheat not only increased the grain and straw yields and gross and net income of wheat but also the tuber yield of potato crop. The response of wheat to P was associated with available P content of soil.

Several workers (Bains *et al.*, 1968; Chatterjee *et al.*, 1978; Sharma *et al.*, 1989; Sharma *et al.*, 1991) suggested potato (*Solanum tuberosum* L.) + wheat (*Triticum aestivum* L. emend. Fiori & Paol.) relay cropping for higher productivity. Sharma *et al.* (1989) reported that the disadvantage of fewer wheat rows in potato + wheat relay cropping as reported by Chatterjee *et al.* (1978) can be overcome by using higher seed rate (80 kg/ha) in reduced number of wheat rows. They reported that wheat yield obtained from reduced number of rows with 80 kg seed rate in potato + wheat relay cropping was similar to that obtained from normal row spacing (23 cm) with 100 kg/ha seed rate in potato–wheat sequential cropping. The advantage of relay cropping over sequential cropping was production of 4–11 tonnes/ha more potato tubers. This was mainly because the former provided full period required by potato for bulking of tubers, as it is harvested in February but in the latter, potato has to be harvested early (I or II week of December) to permit wheat sow-

ing. Besides these developments, potato + wheat relay cropping requires a number of other agronomic recommendations. Hence a field experiment was taken up to find out the optimum row spacing, seed rate of wheat and rate of nitrogen and phosphorus application to wheat in potato + wheat relay cropping system.

MATERIALS AND METHODS

A field experiment was conducted on a deep alluvial sandy-loam soil during 1989–90 and 1990–91 at New Delhi. The experimental field was low in total N (0.04–0.05%), medium to high in 0.5 M NaHCO₃-extractable P (14 kg/ha in 1989–90 and 22 kg/ha in 1990–91) and medium in CH₃COONH₄-extractable K (140–145 kg/ha), having pH 7.9 (1 : 2.5 soil: water ratio).

The experiment was laid out in split-plot design with 3 replications. The treatments consisted of 8 combinations of 2 row spacings (50 and 75 cm), 2 seed rates (80 and 100 kg/ha) of wheat and 2 levels (0 and 40

kg P_2O_5 /ha) of phosphorus to wheat as main plots and 3 levels (0, 60, and 120 kg N/ha) of nitrogen to wheat as subplots. There were 24 treatment combinations.

'Kufri Badshah' potato was planted on ridges 50 or 75 cm apart as per treatment in the second week of October in both the years. Potato received 120 kg N/ha as urea, 26 kg P/ha as single superphosphate and 66 kg K/ha as muriate of potash. Half the dose of N and full dose of P and K were broadcast on soil surface before making the ridges. The remaining half dose of N was applied before earthing-up in the second week of

November in both the years.

'HD 2329' wheat was sown in furrows between potato ridges after earthing-up in the third week of November in both the years. In 50 cm row spacing 1 row of wheat was sown in between 2 rows of potato, whereas in 75 cm row spacing 2 rows of wheat were sown in between 2 rows of potato. However, a same seed rate (80 or 100 kg/ha as per treatment) of wheat was used in both 50 and 75 cm row spacings. The wheat was sown with a hand plough and the seed was covered manually. Potato continued to grow along with wheat till its maturity and

Table 1. Effect of row spacing, seed rate of wheat and nitrogen and phosphorus application to wheat on the productivity (tonne/ha) of potato + wheat cropping system

Treatment	1989-90				1990-91			
	Potato	Wheat		Total wheat equivalent*	Potato	Wheat		Total wheat equivalent*
		Grain	Straw			Grain	Straw	
<i>Row spacing (cm)</i>								
50	22.7	3.4	5.6	10.6	26.8	3.1	5.4	11.5
75	21.1	4.0	6.5	11.0	20.0	3.6	6.5	10.3
CD (P = 0.05)	1.03	0.22	0.35	NS	3.00	0.38	0.52	1.03
<i>Seed rate of wheat (kg/ha)</i>								
80	21.7	3.7	5.9	10.7	23.9	3.3	5.8	10.9
100	22.1	3.7	6.3	10.9	22.9	3.4	6.1	10.8
CD (P = 0.05)	NS	NS	0.35	NS	NS	NS	NS	NS
<i>N (kg/ha) applied to wheat</i>								
0	21.0	3.2	5.3	9.9	23.7	2.7	4.9	10.2
60	21.8	3.8	6.1	10.9	22.8	3.4	6.1	10.8
120	22.8	4.1	6.8	11.6	23.7	4.0	6.9	11.7
CD (P = 0.05)	0.85	0.11	0.03	0.29	NS	0.34	0.46	0.33
<i>P₂O₅ (kg/ha) applied to wheat</i>								
0	20.9	3.5	5.9	10.4	23.7	3.3	5.8	14.9
40	22.9	3.8	6.2	11.3	23.1	3.5	6.1	14.6
CD (P = 0.05)	1.03	0.22	NS	0.34	NS	NS	NS	NS

*Calculated on the basis of price of potato Rs 1,000, wheat grain Rs 3,500 and wheat straw Rs 500/tonne

tubers were dug in the first week of February in both the years of study. Wheat was harvested in the second week of April.

RESULTS AND DISCUSSION

Effect of row spacing

Row spacing had a significant effect on the yield of both potato and wheat in both the years (Table 1). The tuber yield of potato significantly decreased, whereas grain and straw yields of wheat significantly increased when row spacing increased from 50 to 75 cm. The total productivity of the system was not affected significantly by row spacing in 1989–90, whereas in 1990–91, it was significantly more with 50 cm row spacing as compared with 75 cm row spacing.

Row spacing of 50 cm gave more gross and net income than that of 75 cm (Table 2). Wheat crop with 75 cm row spacing gave Rs 2,300/ha more net income than that with 50 cm row spacing, whereas potato with 50 cm row spacing gave Rs 3,900/ha more net income than that with 75 cm row spacing, resulting a net grain of Rs 1,600/ha with 50 cm row spacing when compared with 75 row spacing.

Effect of seed rate of wheat

The increase in seed rate of wheat from 80 to 100 kg/ha had no significant effect on the yield of any crop in any year (Table 1). This confirms the findings of Sharma *et al.* (1989), who reported that 80 kg/ha is the optimum seed rate of wheat in potato + wheat relay cropping system.

The gross and net income of potato + wheat relay cropping system was also not affected by the increase in seed rate of wheat from 80 to 100 kg/ha (Table 2).

Effect of nitrogen

Nitrogen application to wheat significantly increased the tuber yield of potato

only in 1989–90 and grain and straw yields of wheat in both the years (Table 1). In 1989–90 the first increment of 60 kg N/ha gave an increase of 0.8 tonne/ha in potato and 0.6 tonne/ha in wheat, while second increment of 60 kg N/ha gave an increase of 1 tonne/ha in potato and 0.3 tonne/ha in wheat. In 1990–91 the potato yield was not affected by nitrogen application to wheat, while grain yield of wheat increased by 0.7 tonne/ha with first increment and by 0.6 tonne/ha with second increment of 60 kg N/ha. The total productivity increased linearly with increasing level of nitrogen to wheat in both the years.

Nitrogen application to wheat also increased gross and net income of the cropping system linearly (Table 2). The first increment of 60 kg N/ha increased the gross income by Rs 2,725/ha and net income by Rs 2,292/ha, whereas second increment of 60 kg N/ha increased the gross income by Rs 2,900/ha and net income by Rs 2,467/ha.

Effect of phosphorus

Phosphorus application to wheat significantly increased the tuber yield of potato and grain yield of wheat in 1989–90, while it had no significant effect on any crop of the system in 1990–91. This year-wise difference in response to P was due to the difference in available P content of soil in 2 years. It was 14 kg/ha in 1989–90 and 22 kg/ha in 1990–91. Thus it may be concluded that response to P is associated with the available P content of the soil.

Economics of phosphate fertilization (Table 2) indicated that application of 40 kg P_2O_5 /ha to wheat increased the gross income of the system by Rs 1,725/ha and net income by Rs 1,125/ha; about half of these increases obtained from potato and half from wheat crop.

Table 2. Effect of row spacing, seed rate of wheat and nitrogen and phosphorus application to wheat on gross income, cost of cultivation and net income (Rs/ha) from potato + wheat relay cropping system (pooled data of 1989–90 and 1991–91)

Treatment	Gross income			Cost of cultivation			Net income		
	Potato	Wheat	Total	Potato	Wheat	Total	Potato	Wheat	Total
<i>Row spacing (cm)</i>									
50	24,750	14,125	38,875	13,066	5,437	18,503	11,684	8,688	20,372
75	20,550	16,550	37,100	12,795	5,520	18,315	7,755	11,030	18,785
<i>Seed rate of wheat (kg/ha)</i>									
80	22,800	15,175	37,975	12,930	5,427	18,357	9,870	9,748	19,618
100	22,500	15,525	38,025	12,930	5,529	18,459	9,570	9,996	19,566
<i>N (kg/ha) applied to wheat</i>									
0	22,350	12,875	35,225	12,930	5,045	17,975	9,420	7,830	17,250
60	22,300	15,650	37,950	12,930	5,478	18,408	9,370	10,172	19,542
120	23,250	17,600	40,850	12,930	5,911	18,841	10,320	11,689	22,009
<i>P₂O₅ (kg/ha) applied to wheat</i>									
0	22,300	14,825	37,125	12,930	5,178	18,108	9,370	9,647	19,017
40	23,000	15,850	38,850	12,930	5,778	18,708	10,070	10,072	20,142

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