

Productivity and profitability of wheat (*Triticum aestivum*) as influenced by cultural and chemical weed control

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ABSTRACT

A field experiment was conducted during the winter season of 1995–96 and 1996–97 to study the effect of weed-management practices on productivity and profitability of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) grown under limited irrigation. The pooled data revealed that 2 hand-weedings resulted in maximum grain yield (28.6 q/ha) and net returns (Rs 8,796/ha). Combined application of butachlor and 2, 4-D each at 1.0 kg/ha proved as effective as 2 hand-weeding (1.10) in respect of benefit : cost ratio.

Key words : Limited irrigation condition, Weed flora, Nutrient uptake, Weed, Nutrient uptake, Wheat

The farmers of Chotanagpur plateau region grow wheat under assured or limited irrigated condition, but under both the conditions, the production is below the mark. Among many factors responsible for low production, weed occupies a dominant position. As availability of labourers during peak period is meagre and a costly affair, a need was felt to seek out some other measures which will suit both productivity and profitability of wheat production in the region. Hence a field experiment was conducted during the winter season of 1995–96 and 1996–97 to study the effect of cultural and chemical method of weed control on productivity and profitability of wheat grown under limited irrigation condition.

MATERIALS AND METHODS

The soil was sandy clay loam of low fertility status, having organic carbon 0.25% and available N, P_2O_5 and K_2O 184, 9 and 127 kg/ha, respectively, with pH 6.4. Thirteen treatments (Tables 1 and 2) were laid out in randomized block design and replicated thrice. 'Sonalika' wheat fertilized at 120, 60 and 40kg and N, P and K/ha was sown at 120 kg/ha on 10 and 11 November 1995 and 1996 respectively. Entire P_2O_5 and K_2O and half N were applied basal and the remaining N as urea was top-dressed in 2 equal splits, one fourth applied basal and one-fourth at tillering and at flag-leaf initiation stage check.. Each year the crop was irrigated thrice at crown root initiation

flag leaf and milking stages during 1995–96 and at sowing, crown-root initiation and flowering stages during 1996–97. Irrigation schedule during the next year was changed due to prolonged moisture-stress condition. The crop was harvested on 1 and 4 April 1995–96 and 1996–97 respectively. The total rainfall in 1995–96 was 191.1 mm and in 1996–97 was 45.2 mm.

RESULTS AND DISCUSSION

Weed flora

The experimental sites were dominated by *Cynodon dactylon* (L.) Pers., *Brachiaria mutica* Stapf, and *Echinochloa crus-galli* Beauv. among grasses; and *Phalaris minor* (L.) and *Chenopodium album* L. among non-grasses and *Cyperus rotundus* L. among sedges.

Weed biomass

All the treatments significantly reduced weed biomass than weedy check (Table 1). Among the measures, minimum biomass was noted with 2 hand-weedings which was followed in increasing order by hand-weeding + hoeing and butachlor + 2,4-D. Two hand-weedings, hand-weeding + hoeing and butachlor + 2,4-D could suppress biomass 74.3, 69.3 and 67.7% respectively. Combination of pendimethalin + 2,4-D could suppress only 66.8%. However, of all the measures, single hoeing could be able to suppress weeds up to 38.5% and thus found to be the least effective in reducing the weed biomass.

Nutrient uptake by weeds

Weeds under all the treatments took up less nutrients than that with weedy check

(Table 1). Among the measures, weeds in 2 hand-weedings registered least N, P and K uptake, which was followed in increasing order by hand-weeding + hoeing and butachlor + 2,4-D. Weeds associated with 2 hand-weedings, hand-weeding + hoeing and butachlor + 2, 4-D took up 84.5, 82.8 and 73.6%; 78.6, 78.1 and 68.0; and 72.8, 75.2 and 70.0% less NPK with compared weedy check. However, the lowest NPK uptake by weeds 57.4, 60.9, 56.8%), respectively, was recorded in case of pre-emergence application of pendimethalin as compared with weedy check.

Growth and yield attributes

All the treatments caused taller plants, greater no. of effective tillers and fertile spikelets/spike and decreased number of unfertile spikelets/spike compared with weedy check. However, when the measures were compared among themselves, 2 hand-weedings proved the most effective which was followed in decreasing order by hand-weeding and hoeing. However, in increasing fertile spikelets, hand-weeding + hoeing and chemical combination of butachlor + 2, 4-D each at 1 kg/ha were found comparable, although in reducing unfertile spikelets, hand-weeding + hoeing showed superiority to butachlor + 2, 4-D.

Nutrient uptake by the wheat

All the measures caused higher nutrient uptake than weedy check (Table 2). Of all the measures, wheat crop with 2 hand-weedings showed maximum quantity of N, P and K uptake, was followed in decreasing order by hand-weeding + hoeing. The latter treatment with respect to uptake of N and P

Table 1. Effect of weed-control measures on dry weight and nutrient uptake by weeds and on yield components of wheat (pooled data of 2 years)

Treatment (kg/ha)	Weed biomass at 60 days* (g/m ²)	Weed-control efficiency	Weed index (%)	Nutrient uptake by weeds (kg/ha)			Plant height (cm)	Effective tiller/m ²	Unfertile spikelets/spikelets/m ²	Fertile spikelets/spike
				N	P	K				
Pendimethalin @ 1.0 as pre-em.	16.3	51.0	34.9	6.9	4.1	8.5	85.5	266.6	12.6	25.0
Butachlor @ 1.5 as pre-em.	15.4	51.5	38.3	6.7	4.0	8.3	86.2	275.7	11.6	25.5
Isoproturon @ 1.5 as post-em.	16.6	47.6	39.0	6.1	3.8	7.8	86.4	259.3	12.3	25.1
2,4-D @ 1.5 as post-em.	15.0	51.4	29.1	5.7	3.8	7.8	86.7	322.1	11.7	25.4
Pendimethalin @ 0.5 as pre-em. + isoproturon @ 1.0 as post-em.	14.3	55.6	40.3	5.6	3.2	7.2	85.6	326.9	11.6	24.8
Pendimethalin @ 0.5 as pre-em. + 2,4-D @ 1.0	10.6	66.6	21.2	5.3	3.1	6.8	87.2	337.6	11.5	28.8
Butachlor @ 1.0 as pre-em. + 2,4-D @ 1.0 as pre-em.	12.8	59.2	23.4	5.2	2.9	6.8	85.8	320.0	12.2	27.3
Butachlor @ 1.0 as pre-em. + 2,4-D @ 1.0 as pre-em.	10.3	67.4	18.9	4.4	2.6	5.9	87.2	339.8	11.2	29.4
Hoeing at 20 days*	19.6	38.2	32.1	6.0	3.1	7.6	85.8	319.6	13.3	26.8
Hand-weeding at 20 days*	16.8	47.1	20.9	4.5	2.6	7.1	86.6	327.5	11.7	27.8
HW (20 days) + hoeing (20 days*)	9.8	69.0	14.5	3.5	2.3	6.3	87.8	350.6	11.1	29.9
HW (20 and 40 days*)	8.2	74.2		2.5	1.8	5.2	89.3	276.7	10.3	33.8
Weedy check	31.9		50.5	16.2	10.5	19.7	80.8	231.6	14.5	17.0
CD (P=0.05)	0.4			0.3	0.2	0.3	0.3	5.0	0.2	0.6

Pre-em., pre-emergence; Post-em., post-emergence; days* days after sowing; HW, hand-weeding

Table 2. Effect of weed-control measures on nutrient uptake by the crop, grain yield of wheat, net return and benefit : cost ratio (pooled data of 2-years)

Treatments (kg/ha)	Nutrient uptake by crop (kg/ha)			Grain yield (q/ha)			Net return (Rs/ha)			Grain yield (q/ha)		
	N	P	K	1995-96	1996-97	Pooled	1995-96	1996-97	Pooled	1995-96	1996-97	Pooled
Pendimethalin @ 1.0 as pre-em.	53.1	17.9	71.1	15.7	19.6	17.6	3,128	5,938	4,533	0.51	0.88	0.70
Butachlor @ 1.5 as pre-em.	55.4	18.8	71.3	16.3	21.0	18.6	3,356	5,996	4,676	0.65	0.90	0.77
Isoproturon @ 1.5 as post-em.	55.5	18.3	72.8	16.5	21.4	18.9	4,216	6,046	5,131	0.60	0.91	0.80
2,4-D @ 1.5 as post-em.	57.0	20.0	74.6	18.3	22.3	19.9	4,477	6,475	5,476	0.77	1.03	0.90
Pendimethalin @ 0.5 as pre-em. + isoproturon @ 1.0 as post-em.	61.2	21.8	76.0	18.7	21.2	20.3	5,040	7,301	6,170	0.82	1.10	0.96
Pendimethalin @ 0.5 as pre-em. + 2,4-D @ 1.0 as post-em.	62.9	23.0	77.1	20.4	24.7	22.5	5,358	7,931	6,644	0.82	1.18	1.00
Butachlor @ 1.0 as pre-em. + as pre-em. + Isoproturon @ 1.0 as post-em.	63.6	22.7	75.5	20.0	23.8	21.9	5,296	8,068	6,682	0.85	1.21	1.03
Butachlor @ 1.0 as pre-em. + 2,4-D @ 1.0 as pre-em.	67.2	25.3	76.8	21.4	25.0	23.1	5,940	8,181	7,060	0.96	1.31	1.13
Hoeing at 20 days*	65.3	23.7	70.0	17.4	21.5	19.4	2,731	5,050	3,870	0.13	0.77	0.60
Hand-weeding (HW) at 20 days*	65.7	24.5	74.9	19.5	26.0	22.7	3,065	5,503	4,284	0.45	0.78	0.61
HW (20 days) + hoeing (20 days*)	69.1	25.7	80.8	22.2	26.0	24.4	6,063	8,671	7,367	0.92	0.96	0.73
HW (20 and 40 days*)	73.0	26.7	82.3	25.7	31.6	28.6	7,108	10,485	8,796	0.21	1.28	1.10
Weedy check	24.5	12.7	68.8	12.4	16.0	14.2	1,640	3,581	2,580	0.15	0.55	0.38
CD (P=0.05)	2.2	0.9	1.2	1.3	0.8	0.4	978	515	442		0.08	0.07

was as effective as butachlor + 2,4-D but for K, the crop with hand-weeding + hoeing registered higher K uptake than that with butachlor + 2,4-D. The plants with 2 hand-weedings + hoeing and butachlor + 2,4-D took up N 197.9, 182.0 and 174.3%; P 110.2, 102.4 and 99.25; and K 19.6, 17.4 and 11.6% more than that with weedy check. However, of all the treatments, minimum nutrient uptake (116.7, 40.9, 3.3% NPK respectively) compared with the weedy check was recorded in case of pre-em. application of pendimethalin.

Grain yield

The pooled yield revealed that all the measures proved superior to weedy check (Table 2). Among the treatments, maximum seed yield was recorded in case of 2 hand-weedings. Plants hereunder produced 50.3, 14.7 and 19.2% higher grain yield than weedy check, hand-weedings + hoeing and butachlor + 2,4-D respectively. Higher grain yield with 2 hand-weedings were attributed due to least crop-weed competition. The highest weed-control efficiency and minimum weed-index value evince the result. The minimum nutrient uptake by weed and maximum by plants were reflected as increased plant height and yield attributes and finally as grain yield. This finding is in agreement with the findings of Sharma *et al.* (1987), Gogoi and Kalita (1995), Joshi and Billore (1998) and Singh and Singh (1998). Negative correlation between weed dry weight and unfertile spikelets vs fertile spikelets ($r=0.63$ and 0.73 respectively) and negative correlation between number of tillers and fertile spikelets vs grain yield ($r=0.69$ and 0.73

respectively) and negative correlations between unfertile spikelets vs grain yield ($r=-0.81$) further confirmed the result.

Economics

Of all the measures, 2 hand-weedings registered the maximum net return, by hand-weeding + hoeing but the latter failed to show its superiority to butachlor + 2,4-D. However, benefit : cost ratio showed a differential results. Combination of butachlor with 2,4-D (1.13) and 2 hand-weedings (1.10) gave similar ratios. Butachlor + Isoproturon (1.03) and pendimethalin + 2,4-D (1.00) gave similar ratios but less than the first 2 measures. The remaining treatments gave ratio less than 1.00.

Thus productivity and for 2 hand-weedings showed superiority economics combined application of butachlor+2, 4-D each at 1 kg/ha was found more remunerative.

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