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Response of wheat (*Triticum aestivum*) to crop geometry and weed management

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ABSTRACT

A field experiment was conducted during the winter season of 1992–93 and 1993–94 on moderately acidic sandy-loam soil to study response of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) to crop geometry and weed management. Weedy dry weight was minimum in closer sowing at 15 cm. Intergrated weed management was 97% efficient in reducing weed dry weight. Criss-cross sowing at 22.5 cm x 22.5 cm and unidirectional sowing at 15 cm increased grain yield by 22.7 and 13.6% compared with wider sowing at 22.5 cm. Similarly, straw yield increase was recorded up to 27.3 and 18.2% over wider sowing at 22.5 cm. Criss-cross sowing with integrated weed-management practice found to be the best combination and gave the maximum yield of 3.1 tonnes/ha.

Farmers manage weeds by hoeing and hand-pulling which are not compatible to close sown or bidirectionally sown crop and the practice is costly, cumbersome and time-consuming. Hundal and Sandhu (1988) reported higher yield with criss-cross sowing at 22.5 cm x 22.5 cm and unidirectional sowing at 15 cm compared with unidirectional sowing at 22.5 cm. Johri and Singh (1991) reported has some significant influence of crop geometry on weed management. A judicious combination of crop geometry and weed management may act synergistically to control weeds and ultimately increase grain yield. Keeping this in view the present experiment was conducted to study the effect of different treatments on the control of weeds, growth and nutrient uptake by weeds and crop and yield of wheat.

MATERIAL AND METHODS

The experiment was conducted during the winter season of 1992–93 and 1993–94 at Bhubaneshwar. The soil was moderately acidic sandy loam (Arenic haplustalfs)) with pH 5.4, organic carbon 0.53%, total nitrogen 0.057%, available P_2O_5 26.3 kg/ha and available K_2O 152.8 kg/ha. The treatments comprising 3 crop geometries (C_1, unidirectional sowing at 15 cm; C_2, unidirectional sowing at 22.5 cm;C3, criss-cross sowing or bidirectional sowing at 22.5 cm x 22.5 cm) and 4 weed-management practices (W_1, pre-emergence application of pendimethalin @ 1.0 kg/ha; W_2, W_1 + manual weeding at crown-root initiation (CRI); W_3, manual weeding at CRI; and W_4, weedy check) were arranged in split-plot design with 3 replications. 'Sonalika' wheat was sown on 27 and 29 November and harvested on 4 and 8

March in both the years respectively.

Altogether 15 weeds belonging to 15 genera and 7 families infested the crop. The weed flora comprised grasses, viz. bermuda grass [*Cynodon dactylon* (L.) Pers.], crowfoot grass [*Dactyloctenium aegypticum* (L.) Willd.], crabgrass [*Digitaria ciliaris* (Retz.) Koel.], jungle rice [*Echinochloa colonum* (L.) Link], goose grass [*Eleusine indica* (L.) Gaertn] and kodomillet (*Paspalum scrobiculatum* L.); sedges, viz. purplenut-sedge (*Cyperus rotundus* L.) and fimbristylis (*Fimbristylis miliacea* L.); and broad-leaf weeds, viz. bristly starbur (*Acanthospermum hyspidum* L.), goat-weed (*Ageratum conyzoides* L.), wild mustard (*Cleome viscosa* L.), day-flower (*Commelina bengalensis* L.), croton (*Croton sparsiflorus* L.), ground cherry (*Physalis minima* L.) and niruri (*Phyllanthus niruri* L.).

RESULTS AND DISCUSSION

Unidirectional sowing at 22.5 cm recorded the maximum dry weight of weeds at harvest (Table 1). Bidirectional sowing at 22.5 cm x 22.5 cm and unidirectional sowing at 15 cm reduced dry weight of weeds to 11.1 and 19.6% compared with unidirectional sowing at 22.5 cm respectively. The maximum dry weight was recorded in weedy check. Weed dry weight declined by 10.3, 94.4 and 97.0% in manual weeding, Pendimethalin 1.0 kg/ha and pendimethalin 1.0 kg/ha + manual weeding respectively.

Table 1. Effect of crop geometry and weed management on total weed population, weed dry weight, weed-control efficiency and nutrient uptake by weeds at harvest of wheat (pooled data of 2 years)

Treatment	Weed population/ 0.5 m^2 (pooled)	Dry weight of weeds (g/ 0.5 m^2) (pooled)	Weed-control efficiency (%) (pooled)	Nutrient uptake by weed (kg/ha)		
				N	P	K
Crop geometry						
C_1	5.58 (30.19)	4.00 (14.98)		7.26	1.14	7.22
C_2	6.45 (40.62)	4.43 (18.63)		8.11	1.27	7.56
C_3	5.73 (31.85)	4.19 (16.56)		7.52	1.01	6.75
CD (P = 0.05)	0.37	0.24				
Weed management						
W_1	3.89 (14.15)	1.63 (1.66)	97	0.56	0.09	0.47
W_2	2.81 (6.92)	1.55 (1.39)	98	0.54	0.07	0.46
W_3	7.98 (62.70)	6.55 (41.85)	11	9.82	1.68	13.00
W_4	8.95 (29.02)	6.91 (46.69)	0	11.88	2.67	14.44
CD (P = 0.05)	0.57	0.22				

Figures in parentheses are original values which were subjected to square-root transformation $\sqrt{x+1}$ before analysis; Details of treatments are given under Materials and Methods

Interaction effect of crop geometry and weed management was found significant for dry-matter production of weeds. Weedy check under spacing allowed the weeds to attain maximum dry weight. Integrated weed management in different crop geometries except C_3 geometry recorded significantly lower dry weight of weeds (Table 1).

Absence of weed-management practices permitted the weeds to remove 11.8, 2.67 and 14.44 N, P and K/ha respectively. Manual weeding reduced uptake of N, P and K by 17.3, 37.1 and 10.07% respectively. The corresponding values were 95.3, 96.6 and 96.7% for pendimethalin alone and 98.5, 97.4 and 96.8 for integrated practice.

Unidirectional sowing at 15 cm and bi-directional sowing at 22.5 cm x 22.5 cm recorded higher panicles/m^2, panicle length and test weight than unidirectional sowing at 22.5 cm, whereas bi-directional sowing at 22.5 cm x 22.5 cm recorded maximum number of filled grains/panicle, followed by unidirectional sowing at 22.5 cm.

Unrestricted weed growth reduced the yield attributes like panicles/m^2, panicle length, filled grains/panicle and test weight to minimum, whereas weed management produced longer and more panicles/m^2, with heavier grains.

Crop geometry influenced the grain and straw yields significantly (Table 2). Wider spacing at 22.5 cm resulted in minimum yield, whereas closer spacing increased these by 13.6 and 18.2% respectively. The respective values for criss-cross sowing were 22.7 and 27.3%. Similar findings were reported by Grewal and Kler (1987). Criss-cross sowing caused marginal increase in yield compared to closer spacing.

Weedy check registered the minimum yield. Grain and straw yields increased by 26.3 and 31.6% in manual weeding respec-

Table 2. Effect of crop geometry and weed management on yield-attributing characters and yield of wheat

Treatment	Panicles/ m^2*	Length of panicle (cm)*	Filled grains/ panicle*	1,000-grain weight (g)*	Grain yield (tonnes/ha)			Straw yield (tonnes/ha)		
					1992–93	1993–94	Pooled	1992–93	1993–94	Pooled
Crop geometry										
C_1	189	11.1	32.9	44.05	2.4	2.6	2.5	2.5	2.7	2.6
C_2	179	10.0	33.6	43.13	2.1	2.3	2.2	2.1	2.3	2.2
C_3	192	11.3	33.9	43.92	2.5	2.8	2.7	2.6	3.0	2.8
CD (P = 0.05)	NS	0.3	0.4	0.03	0.2	0.3	0.3	0.3	0.3	0.3
Weed management										
W_1	191	11.2	34.6	44.10	2.5	2.6	2.6	2.5	2.7	2.6
W_2	205	11.6	35.2	44.84	2.8	2.9	2.9	2.8	3.1	3.0
W_3	187	10.1	34.55	43.91	2.3	2.5	2.4	2.4	2.5	2.5
W_4	161	9.8	30.7	42.07	1.8	1.9	1.9	1.8	1.9	1.9
CD (P = 0.05)			0.4	0.08	0.2	0.3	0.3	0.2	0.3	0.3

*Pooled; details of treatments are given under Materials and Methods

tively, 36.8% each in pendimethalin at 1.0 kg/ha and 52.6 and 57.9% in integrated weed-management practice respectively. Similar findings were reported by Pandey and Mishra (1993).

Interaction effect of crop geometry and weed management was found significant in respect of yield (Table 3). Integrated weed management in bidirectionally-sown crop registered the maximum yield. Criss-cross sowing increased the yield by 22.7%, integrated weed management by 57.8%. But the combination of the two acted synergestically and increased grain yield by 83.3% over

Table 3. Interaction effect of crop geometry and weed management on dry weight of weeds and grain and straw yields of wheat

Weed management	Crop geometry											
	W_1			W_2			W_3			W_4		
	1992	1993	Pooled	1992	1993	Pooled	1992	1993	Pooled	1992	1993	Pooled
Dry weight of weeds/0.5 m² (g)												
C_1	1.55 (1.42)	1.57 (1.47)	1.56 (1.45)	1.38 (0.92)	1.40 (0.95)	1.39 (0.94)	6.33 (39.11)	6.57 (42.13)	6.45 (40.62)	0.59 (42.47)	6.81 (45.32)	6.70 (43.90
C_2	1.87 (2.49)	1.90 (2.61)	1.88 (2.55)	1.58 (1.50)	1.60 (1.57)	1.59 (1.54)	6.54 (41.81)	6.76 (44.65)	6.65 (43.23)	7.44 (54.34)	7.64 (57.37)	7.54 (55.86)
C_3	1.43 (1.06)	1.45 (1.09)	1.44 (1.08)	1.65 (1.73)	1.68 (1.81)	1.66 (1.77)	6.55 (41.94)	6.77 (44.87)	6.66 (43.41)	6.85 (46.01)	7.09 (49.23)	6.97 (47.62)
CD (P = 0.05)	*1992* C x W* = 0.45 W x C** = 0.41						*1993* C x W* = 0.48 W x C** = 0.43					
Grain yield (tonnes/ha)												
C_1	2.6	2.8	2.7	3.0	3.3	3.2	2.5	2.7	2.6	1.8	1.9	1.9
C_2	2.0	2.1	2.1	2.4	2.6	2.5	2.2	2.3	2.3	1.7	1.8	1.8
C_3	2.8	2.9	2.9	3.1	3.5	3.3	2.3	2.6	2.5	1.8	1.9	1.9
CD (P = 0.05)	*1992* C x W = 0.5 W x C = 0.2						*1993* C x W = 0 6 W x C = 0.3					
Straw yield (tonnes/ha)												
C_1	2.6	2.9	2.8	3.0	3.3	3.2	2.5	2.8	2.7	1.8	1.9	1.9
C_2	2.0	2.2	2.1	2.4	2.6	2.5	2.2	2.4	2.3	1.6	1.9	1.9
C_3	2.9	3.1	3.0	3.1	3.3	3.2	2.4	2.7	2.6	1.9	2.1	2.0
CD (P 0.05)	*1992* C x W = 0.4 W x C = 0.3						*1993* C x W = 0.5 W x C = 0.4					

Figures in parentheses indicate original values

* Weed management at same crop geometry

** Crop geometry at same or different weed management

recommended spacing and weedy check. Similarly, straw yield increased by 22.7% and 50.0% due to criss-cross sowing and integrated weed management respectively and the synergestic action of the two enhanced the straw yield by 68.4%.

It was concluded that integrated weed management consisting of pre-emergence application of pendimethalin @ 1.0 kg/ha and manual weeding at crown-root initiation might be recommended in bi-directionally-sown wheat for maximum weed-control efficiency and yield.

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