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Effect of weed control and sowing methods on production potential of wheat (*Triticum aestivum*)

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ABSTRACT

A field experiment was conducted during winter seasons of 1999–2000 and 2000–2001 to find out effect of weed control and sowing methods on production potential of 'Lok 1' wheat (*Triticum aestivum* L. emend. Fiori & Paol.). Twentyfour treatment combinations consisted of 8 weed-control treatments and 3 methods of sowing. On pooled basis, the monocot and dicot weeds constituted 23.4 and 76.6% weed population respectively. Tank mix application of metsulfuron methyl and isoproturon (4+750 g/ha) recorded the lowest weed dry matter which was at par with other tank mix applications but statistically superior to individual applications. Among individual applications, isoproturon was found statistically superior in reducing weed dry matter. The weed-control treatments recorded significantly higher yield attributes, yield, net returns and benefit : cost ratio compared to weedy check. Application of metsulfuron methyl + isoproturon (4 + 750 g/ha) recorded maximum values of all these parameters which were at par with other tank mix applications but found statistically superior to individual applications. Among individual applications, isoproturon recorded maximum value but found statistically equivalent to other individually applied herbicides. The maximum values of yield attributes, yield, net return and benefit : cost ratio were recorded in cross sowing (22.5 cm x 22.5 cm) compared to normal (22.5 cm) and close (18 cm) line sowing. Cross-sowing methods also recorded lowest weed dry matter.

Key words : Sowing methods, Weed control, Wheat

Irrigated wheat is infested with varying types of weed flora including grassy and broad-leaf weeds. In general, season-long competition from major weeds culminates in yield reduction to an extent of 15–40% and sometimes even higher (Malik *et al.*, 1989). At present, isoproturon is an effective herbicide to control monocot weeds and 2,4-D for broad-leaf weeds. Use of isoproturon in combination with 2,4-D has been generally recommended for the control of mixed weed flora in wheat. Use of 2,4-D for broad-leaf weeds has become restricted because of development of deformities in many high-yielding varieties of wheat and in cotton–wheat system, may cause malformation in succeeding cotton (Gill, 1980). Hence there is need to look for alternate effective herbicides to control broad-leaf weeds in wheat. Weed density and dry matter are supposed to be suppressed substantially through crop geometry (Johri and Singh, 1991). Keeping this in view, metsulfuron methyl was tested alone and as tank mix application with isoproturon to control of wide spectrum of weeds in wheat and economic feasibility of herbicides, their mixtures and manipulation in sowing method of wheat.

MATERIALS AND METHODS

The field experiment was conducted during winters of 1999–2000 and 2000–2001 at the Instructional Farm, Rajasthan College of Agriculture, Udaipur. The soil was clayey loam, with pH 8.05. It contained 269.7, 17.1 and 379.0 kg/ha available N, P_2O_5 and K_2O respectively. The field was uniformly infested with both monocot and dicot weeds during both the seasons. Twentyfour treatment combinations consisting of 8 weed-control treatments (weedy check, 2,4-D 400 g/ha, metsulfuron methyl 3 and 4 g/ha, metsulfuron methyl + isoproturon 3 + 750 g and 4 + 750 g/ha and 2,4-D + isoproturon 400 + 750 g/ha) and 3 methods of sowing (normal line 22.5 cm, cross 22.5 cm x 22.5 cm and close line 18 cm sowing) were replicated 4 times in randomized block design. 'Lok 1' wheat was sown using seed rate of 125 kg/ha.

Recommended dose of fertilizers and irrigation were applied uniformly. Herbicides were sprayed as per treatment 30 days after sowing through knap sack sprayer fitted with flat-fan nozzle using 650 litres water/ha.

RESULTS AND DISCUSSION

Weed dry matter

The experiment field was infested with natural population of both broad-leaf and grassy weeds. The dominant weeds were *Chenopodium album* L., *Chenopodium murale* L., *Anagallis arvensis* L., *Convolvulus arvensis* L., *Coronopus didymus* L. and *Melilotus indica* L. among the broad-leaf; and *Phalaris minor* Retz. among grassy weeds during both the years.

All herbicidal weed-control treatments significantly reduced weed dry matter at harvest compared to weedy check. Amongst individual herbicide applications, isoproturon recorded statistically lower weed dry matter than others, which in turn were at par with each other. The better weed-control efficiency of this herbicide was owing control of both grassy and broad-leaf weeds. Isoproturon is a versatile herbicide for the control of annual grass weeds, particularly *Phalaris minor* and *Avena fatua*, in wheat and barley fields. Besides, it also controls some broad-leaf weeds like *Anagallis, Melilotus, Convolvulus* and *Chenopodium* spp. (Gupta, 2000). These results confirm the findings of Malik *et al.* (1999). The tank mix applications of metsulfuron methyl + isoproturon (4 + 750 g/ha) recorded lowest total weed dry matter (56.92 kg/ha) but was at par with other tank mix applications and reduced weed dry matter by 93.5, 82.3, 55.0, 82.7 and 87.9% compared to weedy check, 2,4-D, isoproturon, metsulfuron methyl (3 g/ha) and metsulfuron methyl (4 g/ha) respectively. The reduction in weed dry matter in tank mix application was superior due to better control of mixed type of weed flora. The superiority of tank mix application of 2, 4-D+ isoproturon to individual applications in reducing weed dry matter was superior also reported by Singh and Singh (1996) and metsulfuron methyl + isoproturon over single applications by Singh *et al.* (1997).

Cross-sowing (22.5 cm × 22.5 cm) recorded significantly lower weed dry matter compared to normal (22.5 cm) and close (18 cm) line sowing. The cross-sowing reduced 14.0 and 5.2% weed dry matter compared to normal and close line sowing, respectively, because the unsown space was reduced to minimum which did not provide enough sunlight and space for all weed seeds to germinate and checked initial growth of germinated weeds (Jadhao and Nalamwar, 1993). Manipulating method of sowing to get dense canopy also helps to control weed dry causing shading effects of weeds.

Yield attributes and yield

Weed–crop competition may pull down wheat yield by suppressing one or more yield attributes. In the present study, the yield attributes (effective tiller/m^2, grains/ear and test weight) increased significantly by all weed-control treatments compared to weedy check, though their efficacy varied depending upon the spectrum of weed control.

The better expression of yield attributes in herbicide-treated plots might be due to poor resurgence frequency

Table 1. Effect of weed control and sowing methods on yield attributes and yield of wheat (pooled data of 2 years)

Treatment	Weed dry matter at harvest (kg/ha)	Effective tillers/m^2	Grains/ ear	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Net returns (Rs/ha)	Benefit : cost ratio
Weed control								
Weedy check	873.00	331.04	32.00	39.80	37.16	56.93	22,477	2.13
2, 4-D (400 g/ha)	321.42	359.51	34.40	41.42	43.06	60.65	26,836	2.46
IPU (750 g/ha)	126.50	368.88	35.48	42.12	44.54	60.97	27,802	2.51
MSM (3 g/ha)	328.75	360.29	34.38	41.29	42.61	60.34	26,512	2.44
MSM (4 g/ha)	314.67	364.73	34.55	41.56	43.56	62.60	27,350	2.50
MSM + IPU (3+750 g/ha)	71.21	387.56	36.17	42.60	47.99	63.98	30,425	2.69
MSP + IPU (4+750 g/ha)	56.92	395.35	36.72	43.20	49.74	64.64	31,713	2.79
2,4-D + IPU (400+750 g/ha)	58.42	391.62	36.62	42.93	48.73	64.49	30,941	2.72
CD (P=0.05)	16.04	13.52	1.31	1.25	2.21	3.47	1,798	0.16
Sowing method								
Normal line sowing	291.50	355.04	33.58	41.26	41.70	59.70	25,765	2.38
Cross-sowing	250.66	379.55	36.35	42.42	47.78	64.62	30,289	2.67
Close line sowing	264.42	374.99	35.18	41.91	44.54	61.85	27,967	2.54
CD (P=0.05)	9.82	8.28	0.80	0.76	1.35	2.12	1,101	0.10

IPU, Isoproturon; MSM, Metsulfuron methyl

and growth of weeds in weed-control treatments and hence weeds were unable to compete with the crop plants for different growth factors. The yield of wheat enhanced significantly by all the herbicides and their mixtures. The increase in yield with herbicides was owing to significant reduction in density and dry matter of weeds which were unable to compete with the crop plants for different growth factors which consequently resulted in the better expression of yield components and thus gave higher yield of wheat.

The yield was significantly improved by 2,4-D, isoproturon and metsulfuron methyl (3 and 4 g/ha) over weedy check. Thakur *et al.* (1998) and Sardana *et al.* (2001) also reported improvements in yield with these herbicides. However, in the present experiment herbicidal mixtures proved superior and increased the yield of wheat by higher magnitude compared to single herbicides like 2,4-D, isoproturon with 2,4-D or metsulfuron methyl (3 and 4 g/ha). Weed control through metsulfuron methyl + isoproturon (4 + 750 g/ha), 2,4-D + isoproturon (400 + 750 g/ha) and metsulfuron methyl+ isoproturon (3+750 g/ha) resulted in 33.8,31.1 and 29.1% increase in grain yield of wheat, and the treatments were found at par. The superiority of these treatments might be owing to better control of both types of weeds. Sidhu *et al.* (2000) also reported superiority of tank mix herbicide to individual ones.

Effective tillers/m^2, grains/ear and test weight improved under cross and close line sowing over normal line sowing. Amongst planting methods, highest values for each yield attribute was recorded under cross-sowing, which gave significantly higher grain and straw yields by 14.6 and 9.5% and 7.3 and 4.5% over normal and close line sowing methods respectively. Marked improvement in yield attributes under cross-sowing appears to be on account of vigorous growth of the plants as reflected by higher accumulation of dry matter by each plant part as well as whole plants/m^2 at successive growth stages along with higher uptake of nutrients. This indicates to view that there was adequate supply of nutrients and metabolites under cross-sowing for growth and development of each reproductive structure of the plants. The higher grain yield in cross-sowing was owing to the lower population and dry weight of weeds and crop canopy developments which resulted in more efficient utilization of solar radiation and nutrients by the crop (Dhaliwal and Kler, 1995).

Since yield formation in cereals is a complex process and governed by complementary interaction between source (photosynthesis and assimilates availability) and sink components (storage organs). Thus a consequence of favourable effects on both these regulative processes as evident from higher accumulation of biomass and nutrients as well as yield components (effective tillers/m^2, grains/ear and test weight), the cross-sown crop gave significantly higher grain yield. Kumawat (1997) ascribed increased yield potential under cross-sown crop on account of efficient utilization of solar radiation by plants towards formation of yield components and yield. The crop planted closely (18 cm) resulted in significant increase (6.8%) ingrain yield of wheat compared to normal (22.5 cm) line sowing, as the dense crop canopy smoothened the weed growth by reducing the dry-matter production and increased crop biomass.

Economics

Amongst the weed-control treatments, tank mix application of metsulfuron methyl+ isoproturon (4+750 g/ha) recorded maximum net returns and benefit : cost ratio, followed by 2,4-D+ isoproturon and metsulfuron methyl+ isoproturon (Table 1). These were at par and statistically superior to individual applications. The cross-sowing (22.5 cm x 22.5 cm) recorded statistically higher net return, benefit : cost ratio compared to normal (22.5 cm) line sowing and close (18 cm) line sowing. The increase in profits with the cross-sowing over the normal and close-line sowing was owing to increase in yield with little cost incurred.

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