INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2003/05–1–4–6
http://www.ijab.org

Reducing Herbicide Rate in Combination with Allelopathic Sorgaab for Weed Control in Cotton

ZAHID ATA CHEEMA, ABDUL KHALIQ AND RIAZ HUSSAIN
Department of Agronomy, University of Agriculture Faisalabad–38040, Pakistan

ABSTRACT

A field trial to determine suitable combination of concentrated sorgaab with reduced rates of two pre-emergence herbicides for weed control in cotton was carried out. Concentrated sorgaab @ 10 L ha^{-1} was combined with pre-emergence herbicides pendimethalin and S-metolachlor at reduced rates as 333, 500, 667; 667, 1000 and 1330 g a.i. ha^{-1}, respectively and were compared with pendimethalin @ 1 kg a.i. ha^{-1} and S-metolachlor @ 2 kg a.i. ha^{-1} at sowing and two hand weedings at 20 and 45 DAS. A weedy check was maintained as control. Results of the study showed that $1/3^{rd}$ of the recommended dose of S-metolachlor @ 667 g a.i. ha^{-1} combined with concentrated sorgaab @ 10 L ha^{-1} at sowing reduced total weed dry weight by 58-71% and 1/3 dose of pendimethalin @ 333 g a.i. ha^{-1} ($1/3^{rd}$ of the recommended dose) combined with concentrated sorgaab @ 10 L ha^{-1} reduced total weed dry weight by 50-74%. The increase in seed cotton yield with the later treatment was maximum (25.4%) and it was the only economical treatment.

Key Words: Reducing herbicide dose; Sorgaab; Weed control; Cotton

INTRODUCTION

The allelopathic sorghum water extract (sorgaab) has been used in many recent studies to suppress weeds in different crops as wheat, maize, mung, canola, rice and cotton. Weed inhibition with foliar sprays (1-3) of sorgaab in these crops generally ranges between 20-50%. Cheema *et al*. (2000) in a field study revealed that two foliar spays of sorgaab at 20 and 40 days after sowing (DAS) reduced total weed dry weight by 35% and increased seed cotton yield by 59% over control. Though the use of allelopathic water extracts is economical and environment friendly yet the reduction in weed biomass is less than herbicides and manual weeding. Moreover for achieving this much weed control two to three sprays are needed which is neither practicable nor desirable. However, it may be possible to use these allelopathic water extracts with reduced rates of herbicides to increase their efficacy.

In a recent trial, Cheema *et al.* (2002) investigated the possibility of reducing herbicidal dose in combination with concentrated sorgaab. He reported that half dose of pendimethalin @ 0.5 kg a.i. ha^{-1} with concentrated sorgaab @ 12 L ha^{-1} applied at sowing reduced the density and biomass of *Trianthema portulacastrum* by 72% and 76%, respectively and increased seed cotton yield by 72% over control which provided clue to further investigate in this direction. Therefore present studies were carried out to determine a suitable dose of two pre-emergence herbicides in combination with sorgaab for weed control in cotton under Faisalabad conditions.

MATERIALS AND METHODS

A field trial was carried out at Agronomic Research Farms, University of Agriculture, Faisalabad. The experiment was laid out in randomized complete block design (RCBD) with four replications in 5 x 2.25 m plots. Mature, dried and chaffed sorghum herbage was soaked in water in a ratio of 1:10 (w/v) for 24 h and passed through sieves number 10 and 60 to collect sorgaab. The filtrate was concentrated to 20 times by boiling at 100 ºC on a gas burner in Weed Science-Allelopathy Laboratory, Department of Agronomy, University of Agriculture, Faisalabad. The volume of the spray was 300 L ha^{-1} and spraying was done with the help of knapsack hand sprayer fitted with flat fan nozzle just after sowing as pre-emergence. Concentrated sorgaab (1:10 w/v) was combined with pre-emergence herbicides namely pendimethalin and S-metolachlor at 333, 500, 667, 667, 1000 and 1330 g a.i. ha^{-1}, respectively. Pendimethalin @ 1 kg a.i. ha^{-1} and S-metolachlor @ 2 kg a.i. ha^{-1} and two hand weedings at 20 and 45 DAS were compared and a weedy check was maintained as control.

Cotton variety FH-900 was sown using seed rate of 20 kg ha^{-1} on 27^{th} of May 2001, in 75 cm spaced rows with single row hand drill. A basal fertilizer dose as nitrogen and phosphorus was applied @ 145 kg ha^{-1} and 58 kg ha^{-1}, respectively in the form of urea and diammonium phosphate. Thinning was done manually to maintain 30 cm plant to plant distance at 15 cm plant height. The data regarding weed density were recorded from two quadrates

of 50x50 cm at 15 and 30 DAS. Weeds were harvested at ground level at 30 and 60 DAS and their fresh weigh were recorded. Dry weight of the same was recorded after drying in an oven at 80 ºC for 48 h. Seed cotton yield (kg ha^{-1}) was recorded using standard sampling procedure.

The data so collected for different parameters was analyzed statistically using Fisher's analysis of variance technique and differences among the treatment means were compared by using the least significant difference (LSD) test at 0.05 probability level (Steel & Torrie, 1984).

The treatments were compared by employing economic and marginal analyses Buyerlee (1988) to determine economical treatment. Marginal rate of return MRR (%) was calculated as dividing the change in the benefits by change in cost and expressed as percentage.

RESULTS AND DISCUSSION

In the experimental area, main weeds were purple nutsedge, horse purslance and few plants of field bind weed

Table I. Effect of concentrated sorgaab in combination with pre-emergence herbicides on density and dry weight of weeds

Treatments	Purple nutsedge		Horse purslane		Total weeds	
	Density	Dry weight (g)	Density	Dry weight (g)	Density	Dry weight (g)
Control (Weedy check)	11.50 a[1]	12.75 a	13.00 a	98.43 a	30.50 a (-)[2]	112.8 a (-)
Pendimethalin (Stomp 330E) @ 1 kg a.i. ha^{-1} pre. em	7.50 bc	6.25 bcd	5.00 c	29.45 d	14.50 d (52.45%)	36.16 f (67.94%)
S-metolachlor (Dual Gold 960 EC) @ 2 Kg a.i. ha^{-1} pre. em	5.50 c	4.92 cd	6.00 bc	42.41 bc	15.00 cd (50.81%)	49.57 cd (56.05%)
Sorgaab conc. @ 10 L ha^{-1} +Pendimethalin @ 667g a.i. ha^{-1} pre. em	5.75 c	5.04 cd	6.25 bc	30.98 d	17.75 bc (41.80%)	36.26 f (67.85%)
Sorgaab conc. @ 10 L ha^{-1} +Pendimethalin @ 500 g a.i. ha^{-1} pre. em	7.00 bc	8.24 b	6.25 bc	48.91 b	16.50 bcd (45.90%)	57.15 b (49.34%)
Sorgaab conc. @ 10 L ha^{-1}+ Pendimethalin @ 333 g a.i. ha^{-1} pre. Em	7.50 bc	7.01 bc	6.50 bc	30.21 d	17.25 bcd (43.44%)	57.07 b (49.40%)
Sorgaab conc. @ 10 L ha^{-1} + S-metolachlor @ 1330 g a.i. ha^{-1} pre. em	7.00 bc	4.75 d	5.75 bc	43.97 bc	16.00 cd (45.54%)	52.47 bc (53.48%)
Sorgaab conc. @ 10 L ha^{-1} + S-metolachlor @ 1000 g a.i. ha^{-1} pre. em	5.75 c	4.86 cd	6.25 bc	36.47 cd	17.50 bcd (42.62%)	41.69 e (63.04%)
Sorgaab conc. @ 10 L ha^{-1} + S-metolachlor @ 667 g a.i. ha^{-1} pre. em	6.00 c	4.74 d	6.00 bc	42.71 bc	16.75 bcd (45.08%)	47.64 cd (57.77%)
Two hand weedings at 20 and 45 DAS	9.00 b	6.66 bcd	7.50 b	39.29 bcd	19.25 b (36.88%)	45.70 de (59.48%)
LSD (5%)	2.12	2.18	2.16	11.20	3.20	5.40

[1]Any two means not sharing a letter in common differ significantly at 5% level of probability; [2]Figures given in parenthesis show % decrease over control

Table II. Economic analysis of different weed control methods in cotton

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	Remarks
Seed cotton yield	857.14	1028.56	1012.67	1038.88	925.38	1149.20	880.94	887.29	1007.92	933.33	kg ha^{-1}
Gross income	17357.14	20828.47	20506.72	21037.50	18738.90	23271.30	17838.90	17967.60	20410.65	18900.0	@ Rs. 22.5 kg^{-1}
Cost of herbicides ha^{-1}	-	1111.5	1125.0	741.0	555.75	370.5	750.0	562.5	375.0	-	Stomp @ Rs. 450 L^{-1}, Dual gold @ Rs. 450/800 ml
Cost of hand weedings	-	-	-	-	-	-	-	-	-	2000	Rs. 100 man^{-1} day^{-1} 10 men day^{-1} ha^{-1}
Cost of conc. sorgaab	-	-	-	30	30	30	30	30	30	-	Rs.10/40 kg sorghum + conc. sorgaab preparation
Cost of spraying	-	100	100	100	100	100	100	100	100	-	Rs. 100 man^{-1} ha^{-1}
Sprayer rent	-	50	50	50	50	50	50	50	50	-	Rs. 50 /spray
Cost that vary	-	1261.5	1275.0	921.0	735.75	550.5	930.0	742.50	555.0	2000	Rs.
Net profit	17357.17	19566.97	19231.72	20116.50	18003.15	22720.80	16908.90	17225.10	19855.65	16900.0	Rs. Ha^{-1}

T1=control (weedy check); T2=pendimethalin (Stomp 330E) @ 1 kg a.i. ha^{-1} pre. em; T3= S-metolachlor (Dual Gold 960 EC) @ 2 kg a.i. ha^{-1} pre. em; T4= sorgaab conc. @ 10 L ha^{-1} +Pendimethalin @ 667g a.i. ha^{-1} pre. em ; T5=sorgaab conc. @ 10 L ha^{-1} +Pendimethalin @ 500 g a.i. ha^{-1} pre. em; T6=sorgaab conc. @ 10 L ha^{-1}+Pendimethalin @ 333 g a.i. ha^{-1} pre. em; T7=sorgaab conc. @ 10 L ha^{-1} + S-metolachlor @ 1330 g a.i. ha^{-1} pre. em; T8=sorgaab conc. @ 10 L ha^{-1} + S-metolachlor @ 1000 g a.i. ha^{-1} pre. em; T9=sorgaab conc. @ 10 L ha^{-1} + S-metolachlor @ 667 g a.i. ha^{-1} pre. em; T10=two hand weedings at 20 and 45 DAS

Table III. Dominance and marginal analysis of different weed management methods in cotton

Treatments	Cost that vary (Rs ha^{-1})	Net Benefit (Rs ha^{-1})	MRR (%)
Control (Weedy check)	-	17357.17	-
Sorgaab conc. @ 10 L ha^{-1}+Pendimethalin @ 333 g a.i. ha^{-1} pre. em	550.5	22720.80	974.31
Sorgaab conc. @ 10 L ha^{-1}+S-metolachlor @ 667 g a.i. ha^{-1} pre. em	555.0	19855.65	D*
Sorgaab conc. @ 10 L ha^{-1}+Pendimethalin @ 500 g a.i. ha^{-1} pre. em	735.75	18003.15	D
Sorgaab conc. @ 10 L ha^{-1}+S-metolachlor @ 1000 g a.i. ha^{-1} pre. em	742.50	17225.10	D
Sorgaab conc. @ 10 L ha^{-1}+Pendimethalin @ 667g a.i. ha^{-1} pre. em	921.0	20116.50	D
Sorgaab conc. @ 10 L ha^{-1}+S-metolachlor @ 1330 g a.i. ha^{-1} pre. em	930.0	16908.90	D
Pendimethalin (Stomp 330E) @ 1 kg a.i. ha^{-1} pre. em	1261.5	19566.97	D
S-metolachlor (Dual Gold 960 EC) @ 2 kg a.i. ha^{-1} pre. Em	1275.0	19231.72	D
Two hand weedings at 20 and 45 DAS	2000.0	16900.0	D

*Dominated

and amaranth were also present. All the treatments significantly inhibited the density and dry weight of weeds (Table I). Concentrated sorgaab @10 L ha^{-1} combined with of pendimethalin @333 g a.i. ha^{-1} (1/3rd of the recommended dose) as pre-emergence spray was as effective as full dose of pendimethalin (1 kg a.i. ha^{-1}) in reducing the individual and total weed density and dry weight. Concentrated sorgaab @ 10 L ha^{-1} with 1/3 dose of S-metolachlor @ 667 g a.i. ha^{-1} ^{1} (1/3rd of the recommended dose) was also effective against purple nutsedge and horse purslane. These results indicated that herbicidal dose could be reduced considerably i.e. (67%). These findings are in line with previous work reported by Cheema *et al.* (2002). Concentrated sorgaab @ 10 L ha^{-1} with 1/3 dose of pendimethalin @ 333 g a.i. ha^{-1} was the best treatment with highest seed cotton yield (1149 kg ha^{-1}) and net benefit (Rs. 22721 ha^{-1}) as presented in (Table II) and was the only economical treatment with highest marginal rate of return (974%) while other treatments were dominated due to higher cost that vary and less benefits (Table III). Based on these findings of this study, it is suggested that herbicidal dose could be reduced up to 67% in combination with concentrated sorgaab. Concentrated sorgaab @ 10 L ha^{-1} could be combined with 1/3 dose of pendimethalin and S-metolachlor to control cotton weeds. However, studies of similar nature may be continued.

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(Received 21 August 2002; Accepted 11 November 2002)