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Efficacy of Different Weed Management Strategies in Mungbean (*Vigna Radiata* L.)

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ABSTRACT

Selective allelopathic character of sorghum water extract alone and in combination with two herbicides was explored for controlling weeds in mungbean. Two hand weedings reduced dry weight of all weeds by 79% (maximum) which was at par with combined pre-em sprays of s. metolachlor @ 1.15 kg a.i. ha^{-1}+sorgaab (conc.) @ 10 L ha^{-1} (78%) and Pendimethalin @ 165 g a.i. ha^{-1}+sorgaab (conc.) @ 10 L ha^{-1} with 78 and 75% weed dry weight reduction, respectively, over control. Maximum plant height and number of grains per pod were recorded in plots with two hand hoeings at 15 and 30 days after sowing (DAS) and were at par with s. metolachlor @ 2.3 kg a.i. ha^{-1} and Pendimethalin @ 330 g a.i. ha^{-1} alone and with combination of both of these herbicides @ 1.15 kg and 165 g a.i. ha^{-1}, respectively with sorgaab. Hand hoeing also resulted in highest 1000-grain weight and was followed by Pendimethalin @ 165 g a.i. ha^{-1}+sorgaab (conc.) @ 10 L ha^{-1} that was at par with s. metolachlor alone @ 2.3 kg a.i. ha^{-1} and @ 1.15 kg a.i. ha^{-1} in combination with sorgaab. The economic analysis of weed management strategies revealed that two hand weedings at 15 and 30 DAS gave the maximum net benefits (Rs. 20404.13 ha^{-1}) and was followed by s. metolachlor @ 1.15 kg a.i. ha^{-1}+sorgaab (conc.) @ 10 L ha^{-1} and Pendimethalin @ 165 g a.i. ha^{-1}+sorgaab (conc.) @ 10 L ha^{-1} with net benefit of Rs.19111.42 and 18460.57 ha^{-1}, respectively. However, the marginal analysis showed that pre-em spray of sorgaab (conc.) @ 10 L ha^{-1} with Pendimethalin @ 165 g a.i. ha^{-1} and s. metolachlor @ 1.15 kg a.i. ha^{-1} gave 6891 and 149% marginal rate of returns, respectively. Other treatments gave either lower marginal rates of return or were dominated due to higher costs involved.

Key Words: Weed management; Allelopathy; Economics; Mungbean

INTRODUCTION

Mungbean (*Vigna radiata* L.) is an important legume crop grown in Pakistan both in rainfed and irrigated conditions. Weed infestation is, however, one of the major factors limiting its growth. Uncontrolled weeds may reduce mungbean yield as much as 50-90% compared with weed free conditions (Poehlman, 1991). Weeds can be controlled chemically but this practice is highly uneconomical due to higher costs involved. Moreover, indiscriminate use of herbicides is posing environmental threats. Allelopathic interaction between plants and other organisms have been recognized by scientists world wide because they offer alternative remedies in agriculture such as decreasing reliance on synthetic herbicides, insecticides and fungicides for weed, insect and disease control (Waller, 1987). Allelopathy is a natural and environment friendly technique, which may prove to be a unique approach for weed control and thereby increase crop yields (Purvis *et al.,* 1985). Sorghum (*Sorghum bicolor* L. Moench) is well-recognized allelopathic crop. Mature sorghum herbage possesses a number (nine) of water-soluble allelochemicals. Present studies were aimed at comparing the efficacy of sorgaab (sorghum water extract) alone and in combination with herbicides for controlling weeds in mungbean and further evaluating the economics of the same for its viability.

MATERIALS AND METHODS

Studies to check the efficacy of different weed management strategies in mungbean (*Vigna radiata* L.) were carried out at the Students Farm, Department of Agronomy, University of Agriculture, Faisalabad, during spring 2001. Sorghum plant herbage was harvested at maturity, dried and chaffed. This chaffed material was soaked in water in a ratio of 1:10 (w/v) for 24 h. The filtrate was used as sorgaab (sorghum water extract). Experiment comprised of (T_1) control, (T_2) two sprays of sorgaab (conc.) @ 10 L ha^{-1} (15 and 30 DAS), (T_3) s. metolachlor (Dual gold 960 EC) @ 2.3 kg a.i. ha^{-1} (Pre-em), (T_4) Pendimethalin (Stomp 330 E) @ 330 g a.i. ha^{-1} (Pre-em), (T_5) s. metolachlor @ 1.15 kg a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em), (T_6) Pendimethalin @ 165 g a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em) and (T_7) two hand hoeings (15 and 30 DAS).

S. Metolachlor and Pendimethalin alone and in combination with sorgaab were sprayed just after the sowing of mungbean crop. Sorgaab @ 10 L ha^{-1} was sprayed after 15 and 30 days after sowing. The sprays were done with the help of knap-sack hand sprayer fitted with T-jet nozzle. Volume of spray was determined by calibration. Hand hoeing was done with hand hoe (*kasola*). The experiment was laid out in randomized complete block design (RCBD)

with four replications and a net plot size of 1.8 x 7m. Seedbed was prepared by cross cultivations followed by double planking. Mungbean variety NM-92 was sown on 26th February 2001 in 45 cm apart rows using single row hand drill. Seed rate was 20 kg ha^{-1}. Plant to plant distance of 10 cm was maintained by thinning out the surplus plants 10 days after emergence. Nitrogen and phosphorus were applied @ 25 and 50 kg ha^{-1} in the form of diammonium phosphate (DAP) and urea, respectively. Half nitrogen and full phosphorus were applied at the time of sowing and remaining half nitrogen were applied with first irrigation.

Observations on dry weight of weeds, plant height at maturity (cm), number of grains per pod, 1000-grain weight (g), seed yield (kg ha^{-1}) and harvest index (%), were recorded. Data so collected were analyzed statistically using Fisher's analysis of variance technique and treatment means were compared using least significant difference test at 5% probability level (Steel & Torrie, 1984). Economic analysis for all weed management strategies was carried out and marginal rate of returns were determined following the procedure of Byerlee (1988).

RESULTS AND DISCUSSION

The allelopathic effect of concentrated sorgaab and pre-em herbicides alone and in combination along with hand weeding on growth and yield of mungbean (*Vigna radiata* L.) and its weeds was studied under field conditions. Data (Table I) revealed that two hand hoeings (15+30 DAS) gave maximum reduction (79%) in the total weed dry weight at 60 DAS and was on par with combined spray of s. metolachlor @ 1.5 kg a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em) and Pendimethalin @ 165 g a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em) that reduced the total weed dry weight by 78 and 75%, respectively over control. Data further revealed that s. metolachlor @ 2.3 kg a.i. ha^{-1} spray was on par with two sprays of conc. sorgaab @ 10 L ha^{-1} and reduced the total dry weight up to 62 and 59% over control, respectively. Minimum reduction in total weed dry weight (40%) was recorded by Pendimethalin @ 330 g a.i. ha^{-1} over control. These findings support the work done by Velu (1998) who stated that hand weeding and Pre-em metolachlor treatments had the highest suppressive effect on weeds in green gram (*Vigna radiata* L.).

Two hand hoeing (15+30 DAS) resulted in maximum plant height. All other treatments except sorgaab conc. @ 10 L ha^{-1} (15+30 DAS) gave statistically similar plant height that was higher than control. Khan *et al.* (1999) also reported increase in plant height due to weed suppression. Two hand weedings produced maximum number of grains per pod (9.71). It was followed by s. metolachlor @ 1.15 kg a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em), s. metolachlor @ 2.3 kg a.i. ha^{-1}, Pendimethalin @ 165 g a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em) and Pendimethalin @ 330 g a.i. ha^{-1}. These findings are in line with those of Pascua (1988) who reported that treatments that gave lower weed weight gave higher number of seeds/pod and longer pods.

Hand weeding also produced maximum 1000-grain weight. Statistically similar 1000-grain weight was recorded for combined spray of sorgaab with both the herbicides and s. metolachlor @ 2.3 kg a.i. ha^{-1}. Ahmad *et al.* (2000) also reported positive effect of hand weeding, sorgaab and herbicide application on 1000-grain weight of maize.

Highest grain yield (1029.4 kg ha^{-1}) was recorded in hand weeded (15 + 30 DAS) plots (Table I). s. metolachlor @ 2.3 kg a.i. ha^{-1} and Pendimethalin @ 165 g a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em) gave statistically similar and 25 and 24% higher grain yield, respectively over control. Two sprays of sorgaab conc. @ 10 L ha^{-1} (15+30 DAS) gave 3.5% higher grain yield than control. Increase in grain yield due to hand weeding in mungbean was also reported by Singh *et al.* (1991). Similarly, Khan *et al.* (1999) reported 8.3% increase in mungbean grain yield with two sprays of sorgaab at 25 and 45 DAS. s. metolachlor @ 1.15 kg a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em) resulted in highest harvest index (24.88%) and harvest indices recorded with s. metolachlor @ 2.3 kg a.i. ha^{-1} alone and two hand weedings were at par with it. Harvest indices were promoted possibly due to increase in more number of grains per pod and more 1000-grain weight in weed control treatments.

Economic analysis of different weed control strategies (Table II) showed that two hand weedings (15+30 DAS) gave maximum net benefits (Rs. 20404.13 ha^{-1}). Combination of sorgaab conc. @ 10 L ha^{-1} with s. metolachlor @ 1.15 kg a.i. ha^{-1} and Pendimethalin @ 2.3 kg a.i. ha^{-1} gave net benefits of Rs. 19111.42 and 18460.57 ha^{-1}, respectively. Marginal analysis (Table III) revealed that pre-em spray of sorgaab conc. @ 10 L ha^{-1} with Pendimethalin @ 165 g a.i. ha^{-1} and s. metolachlor @ 1.15 kg a.i. ha^{-1} gave 6891 and 149% marginal rate of return, respectively that was 170% for two hand weedings. All other treatments were either dominated or had lower marginal rates of return due to higher costs involved.

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Table I. Effect of various weed control practices on dry weight of weeds and growth and yield of mungbean

Treatments	Weed Dry weight ($g\ m^{-2}$)	Plant height (cm)	Number of grains pod^{-1}	1000-grain weight (g)	Seed yield ($kg\ ha^{-1}$)	Harvest index (%)
Control	21.47 a§	41.89 b	5.70 d	49.99 e	707.0 d	22.5 c
Sorgaab (conc.) @ 10L ha^{-1}(15+30 DAS) pre - em	8.67 c	42.29 b	6.35 cd	51.83 d	735.4 d (4.0)*	22.7 c
s. metolachlor (Dualgold 960 EC) @ 2.3 kg a.i. ha^{-1} (pre-em)	8.02 c	46.82 a	7.43 bc	53.76 b	884.9 b (25.0)	24.7 a
Pendimethalin (Stomp 330 E) @ 330 g a.i. ha^{-1} (pre-em)	12.81 b	44.63 ab	7.15 bc	53.11 c	806.2 c (14.0)	24.0 b
s. metolachlor @ 1.15 kg a.i. ha^{-1} + sorgaab (conc.) @ 10L ha^{-1} (Pre-em)	4.44 d	46.76 a	7.85 b	53.87 b	933.3 d (40.3)	24.8 a
Pendimethalin @ 165 g a.i. ha^{-1} + sorgaab (conc.) @ 10L ha^{-1} (Pre-em)	5.26 d	48.03 a	7.36 bc	53.98 b	882.7 b (24.6)	24.0 b
Hand hoeings (15+30 DAS)	4.42 d	48.17 a	9.71 a	55.80 a	1029.4 a (45.3)	24.2 ab
LSD ($\alpha = 0.05$)	0.945	3.731	1.134	0.304	38.56	0.684

§Figures having the same letter in a column are statistically similar; *Figures in parenthesis give % increase over control

Table II. Economic analysis of different weed management strategies in mungbean

	T_1*	T_2	T_3	T_4	T_5	T_6	T_7	Remarks
Total yield ($kg\ ha^{-1}$)	707.99	735.41	884.9	806.20	933.39	882.6	1029.43	$kg\ ha^{-1}$
10 % less	70.79	73.54	88.49	80.62	93.33	88.26	102.94	$kg\ ha^{-1}$ (to bring at farmer's level)
Adjusted Value	637.2	661.87	796.41	725.58	840.06	794.34	926.49	@ Rs. 2375 per 100 kg
Gross Income	15133.5	15719.41	18914.73	17232.52	19951.42	18865.57	22004.13	
Cost of hand weeding	-	-	-	-	-	-	1600	10 men $day^{-1}\ ha^{-1}$ Rs. 80 man^{-1}
Cost of herbicide	-	-	1320	450	660	225	-	Pendimethalin @ Rs. 450 L^{-1} S.metolachlor @ Rs. 550 L^{-1}
Cost of sorgaab	-	100	-	-	50	50	-	Rs. 40/40 kg sorghum+boiling
Spraying cost	-	160	80	80	80	80	-	Rs. 80 man^{-1}, one man $day^{-1}\ ha^{-1}$
Sprayer rent	-	100	50	50	50	50	-	Rs. 50 $spray^{-1}$
Cost that vary	-	360	1450	580	840	405	1600	Rs.
Net benefit	15133.5	15359.41	17464.73	16652.52	19111.42	18460.57	20404.13	Rs.

*T_1=control, T_2=Two sprays of sorgaab (conc.) @ 10 L ha^{-1} (15 and 30 DAS), T_3=s. metolachlor (Dual gold 960 EC) @ 2.3 kg a.i. ha^{-1} (pre-em), T_4=Pendimethalin (Stomp 330 E) @ 330 g a.i. ha^{-1} (pre-em), T_5=s. metolachlor @ 1.15 kg a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (pre-em), T_6=Pendimethalin @ 165 g a.i. ha^{-1} + sorgaab (conc.) @ 10 L ha^{-1} (Pre-em) and T_7=Two hand hoeings (15 and 30 DAS)

Table III. Marginal analysis of different weed management strategies in mungbean

Treatments	Cost that vary Rs. ha^{-1}	Net benefits Rs. ha^{-1}	Marginal rate of return (%age)
Control	0	15133.50	-
Sorgaab (conc.) @ 10L ha^{-1}(15+30 DAS)	360	15359.41	62.75
Pendimethalin @ 165 g a.i. ha^{-1} + sorgaab(conc.) @ 10L ha^{-1} (pre-em)	405	18460.57	6891.44
Pendimethalin (Stomp 330 E)@ 330 g a.i. ha^{-1} (pre-em)	580	16652.52 D	-
s. metolachlor @ 1.15 kg a.i. ha^{-1} + sorgaab(conc.) @ 10L ha^{-1}(pre-em)	840	19111.42	149.62
s. metolachlor (Dualgold 960 EC) @.2.3 kg a.i. ha^{-1} (pre-em)	1450	17464.73 D	-
Two hand hoeings (15 + 30 DAS)	1600	20404.13	170.0

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