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Weed management by sowing methods and herbicides in soybean

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ABSTRACT

A field experiment was conducted at Jabalpur to evaluate the different sowing methods and weed control practices for higher grain yield of soybean. The dominated weed species among monocot weeds were *Cyperus iria*, *Ehinochloa colona* and *Cynodon dactylon*, however among dictot weed species *Eclipta alba*, *Commelina diffusa*, *Alternenthera sessilis* and *Phylanthus niruri* were observed during the growing season.The results revealed that the weed density of monocot (25.1/m^2) and dicot (18.7/m^2) weed was lowest in broad bed furrow (BBF) sowing method and application of pendimethalin (0.75 kg/ha) *fb* imazethapyr (0.75 g/ha. Maximum weed control efficiency (80.0%) was observed with the application of pendimethalin (0.75 kg/ha) *fb* imazethapyr (0.75 kg/ha). BBF sowing method also recorded highest yield attributes and grain and straw yield (1.47 and 1.51 t/ha). The BBF sowing method of soybean gave maximum net monetary returns and B:C ratio (` 16,584 /ha and 1.87, respectively).

Key words: Herbicides, Soybean, Sowing methods

Soybean is one of the important oil seed crops among all the seed crops. It has been termed as miracle bean because of higher protein (40%) and oil (20%) content (Chouhan and Joshi 2005). In India it is cultivated in 106.95 lakh ha with the annual production of 126.7 lakh t. Madhya Pradesh contributes 58.1 lakh ha with production of 66.8 lakh MT with 1.15 t/ha of productivity (Anonymous 2012). Weed infestation is considered as a complex constraint in soybean production. Several herbicides, *viz*. pendimethalin, alachlor, chlorimuon, imazethapyr *etc*. are presently being used for controlling the weeds in soybean but these herbicides were not found much effective to control many broad-leaved weeds in soybean. The broad bed furrow was also found to reduce seed rate and provides favorable environment for the growth and development of the soybean crop under rainfed condition (Ram and Kler 2007). Hence, the present investigation was done to evaluate the suitable sowing method and post-emergence herbicides for controlling the broad spectrum weeds for higher growth and yield of soybean.

MATERIALS AND METHODS

The experiment was conducted at research farm of JNKVV, Jabalpur during 2012 and 2013. The soil of the experimental field was clay loam having 7.7 pH, OC and available N, P, K (258, 14.2, 375 kg/ha), respectively. The treatment was laid out in split plot design with sowing method as main plot and weed control method as sub plot treatments. Three sowing methods (flat bed [FB], broad bed furrow [BBF] and ridge furrow [RF]) and three weed control practices (pendimethalin 1 kg/ha, imazethapyt 1 kg/ha and pendimethalin (0.75 kg/ha) *fb* imazethapyr (0.75 g/ha) were evaluated in three replications. Soybean variety *'JS 97-52'* was sown on 24 June, 2012 and 18 June, 2013 with tractor drawn seed drill machine as per sowing method using 70 kg of seeds/ha . Recommended dose of N (20 kg/ha), P (60 kg/ha) and K (20 kg/ha) were applied through DAP (diammonium phosphate), muriate of potash, respectively. The herbicides were applied with their respective doses as per treatments. Spraying was done with flat fen nozzle with knapsack sprayer 500 liter of water/ha. Weed population and weed dry weight was taken using 0.25 x 0.25 m sized quadrate at 60 DAS. Weed data were subjected to square root transformation before statistical analysis. Grain, straw yield and economics were also recorded.

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RESULTS AND DISCUSSION

Effects on weeds

The experimental field was infested various weed species consisting of different species of monocot and dicot weeds. The dominated weed species among monocot weeds were *Cyperus iria*, *Ehinochloa colona* and *Cynodon dactylon*. However, among dictot weed species, *Eclipta alba*, *Commelina diffusa*, *Alternenthera sessilis* and *Phylanthus niruri* were observed during the growing season. The weed density and weed dry weight was significantly differ with the sowing methods and also with the weed control practices (Table 1). Among the different

sowing methods, the higher density of monocot (43.2/m^2) and dicot (34.4/m^2) weeds were recorded under flat bed method of sowing and lowest weed density of monocot and dicot (25.1 and 18.7/m^2) weed under BBF method of sowing. However, among different weed control practices, application of pendimethain (1 kg/ha) *fb* imazethapyr (100g/ha) recorded lowest density of monocot and dicot weeds (23.1 and 16.1/m^2). The density of monocot (74.4/m^2) and dicot (98.4/m^2) weeds in control plot was higher. Habimana *et al*. (2013a) reported similar observation that pendimethalin (0.75 kg/ha) at 3 DAS *fb* imazethapyr (100 g/ha) at 20 DAS recorded minimum weed density and weed dry weight as compare to alone application of pendimethalin. The weed dry weight of the monocot and dicot weeds was highest in flat bed sowing method (21.2 and 32.2 g/m^2) and control plot (54.1 and 86.1 g/m^2) among different treatment because of higher infestation of different weed species. However, weed dry weight of monocot and dicot was lowest in case of BBF sowing methods (15.0 and 17.5 g/m^2).

Weed control efficiency

Maximum weed control efficiency (80.1%) was observed with the application of pendimethalin (0.75 kg/ha) *fb* imazethapyr (0.75 kg/ha). The higher weed control efficiency with pendimethalin *fb* imazethapyr may be contributed to the lowest weed competition and resulted higher grain yield. However, among different method of sowing BBF method also contributed the higher weed control efficiency 76.9%, followed by ridge furrow method (71.9%). Habimana *et al*. (2013a) also reported that pendimethalin at 0.75 kg/ha at 3 DAS *fb*. imazethapyr at 0.75 g/ha at 20 DAS recorded 81.9% weed control efficiency in soybean crop.

Table 1. Weed density and weed dry weight as influenced by sowing methods and herbicides (mean of 2-011 and 2012)

Treatment	Density of monocot weeds (no./m^2)	Density of dicot weeds (no./m^2)	Dry weight of monocot weeds (g/m^2)	Dry weight of dicot weeds (g/m^2)
Sowing method				
Flat bed	6.6 (43.2)	5.9 (34.4)	4.6 (21.2)	5.7 (32.2)
Broad bed furrow	5.0 (25.1)	4.3 (18.6)	3.9 (15.0)	4.2 (17.5)
Ridge and furrow	6.2 (38.7)	5.1 (25.5)	4.1 (16.4)	4.8 (23.2)
LSD (P=0.05)	0.36	0.66	0.24	0.54
Herbicide				
Pendimethalin (1.0 kg/ha)	7.1 (50.1)	6.6 (43.3)	5.5 (30.4)	6.2 (38.3)
Imazethapyr (1.0 kg/ha)	6.3 (39.3)	5.0 (25.1)	4.9 (23.9)	5.9 (35.2)
Pendimethalin (0.75 kg/ha) *fb* Imazethapyr (0.75 g/ha)	4.8 (23.1)	4.0 (16.0)	3.6 (12.6)	4.0 (15.7)
Control	8.6 (74.4)	9.9 (98.3)	7.3 (54.1)	9.3 (86.1)
LSD (P=0.05)	1.32	0.99	0.45	0.20

Table 2. Weed control efficiency and economics of soybean as influenced by sowing methods and herbicides

Treatment	Weed control efficiency (%)		Mean	Net monetary returns (x10^3/ha)		Mean	B:C ratio		Mean
	2012	2013		2012	2013		2012	2013	
Sowing method									
Flat-bed	60.6	63.4	62.0	6.47	7.98	7.23	1.36	1.44	1.40
Broad-bed furrow	74.7	79.1	76.9	15.93	17.23	16.58	1.84	1.91	1.87
Ridge furrow	69.0	74.8	71.9	13.78	14.81	14.30	1.75	1.80	1.77
Herbicide									
Pendimethalin (1.00 kg/ha)	48.5	53.9	51.2	10.51	11.41	10.96	1.55	1.60	1.58
Imazethapyr (1.00 kg/ha)	54.8	61.2	58.0	11.27	12.33	11.80	1.59	1.65	1.62
Pendimethalin (0.75 kg/ha) *fb* Imazethapyr (0.75 g/ha)	75.9	84.1	80.0	13.29	14.09	13.69	1.66	1.70	1.68
Control	0.0	0.0	0.0	2.56	3.52	3.04	1.14	1.20	1.17

Table 3. Yield attributes and yield of soybean crop as influenced by sowing methods and herbicides

Treatment	Plant height (cm)	Branches/ plant	Pods/ plant	Seed index (g)	Grain yield (t/ha)		Mean	Straw yield (t/ha)		Mean
					2012	2013		2012	2013	
Sowing method										
Flat-bed	65.6	3.45	60.3	9.76	1.01	1.07	1.04	1.21	1.28	1.24
Broad-bed furrow	84.1	5.73	90.4	10.40	1.44	1.49	1.47	1.48	1.54	1.51
Ridge furrow	77.1	5.12	83.4	10.10	1.33	1.37	1.35	1.45	1.45	1.45
LSD (P=0.05)	5.42	0.46	5.83	0.25	0.05	0.06	0.05	0.02	0.03	0.33
Herbicide										
Pendimethalin (1.00 kg/ha)	68.8	4.57	71.0	10.10	1.22	1.25	1.24	1.26	1.30	1.28
Imazethapyr (1.00 kg/ha)	70.0	4.77	76.8	10.12	1.25	1.29	1.27	1.31	1.37	1.34
Pendimethalin (0.75 kg/ha) *fb* imazethapyr (0.75 g/ha)	78.1	5.34	87.1	10.34	1.37	1.41	1.39	1.37	1.46	1.41
Control	58.8	3.81	55.1	9.57	0.84	0.88	0.86	1.16	1.24	1.20
LSD (P=0.05)	1.37	0.18	4.32	0.17	0.08	0.03	0.04	0.04	0.44	0.05

Yield attributes and yield

Soybean grown in BBF recorded higher plant height (84.12 cm), number of branches (5.7), number of pods (90.4) and seed index (10.40 g) *fb* ridge and furrow sowing method. The plant of flat bed sowing recorded lowest plant height (65.6 cm), number of branches (3.4) number of pods (60.3) and seed index (9.76 g). The grain (1.47 t/ha) and straw (1.51 t/ha) yields of soybean crop was also highest in BBF sowing method and lowest in flat bed sowing method (1.04 and 1.24 t/ha). Similar findings also reported by Kang *et al.* (2012). Among different weed control practices, application of pendimethalin *fb* imazethapyr recorded highest plant height (78.1 cm), number of branches (5.34), number of pods (87.1) and seed index (10.34 g). The grain and straw yield was also higher with the application of pendimethalin *fb* imazethapyr (1.39 and 1.41 t/ha), whereas control plot recorded lowest yield attributes, grain (0.86 t/ha) and straw yield (1.20 t/ha) of soybean due to higher weed density. Habimana *et al.* (2013a) similarly reported that pendimethalin *fb* imazethapyr recorded highest grain and straw yields in soybean.

Economics

Net monetary returns and B:C ratio were higher with the BBF sowing method (` 16,584/ha and 1.87, respectively) than other sowing method of soybean. Ram *et al.* (2011) also reported that NMR and B:C ratio were highest in raised bed sowing (2.12) method which were significantly higher than ridge furrow (1.99) and flat-bed method of sowing (2.00). Application of pendimethalin *fb* imazethapyr recorded higher NMR (` 13,696/ha) and B:C ratio (1.68) among the weed control practices (Habimana *et al.* 2013b). The control plot recorded lowest NMR (` 3,045/ha) and B:C (1.17) ratio among all the treatments because of lowest yield of soybean crop.

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