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Research Paper

Evaluation of weed control implement in soybean (*Glycine max* L.)

S.U. PAWAR, A.S. JADHAV AND A.K. GORE

See end of the paper for authors' affiliations

Correspondence to :
S.U. PAWAR
Weed Science Rresearch Centre, Marathwada Agriculture University, PARBHANI (M.S.) INDIA
Email :pawarsu7@rediffmail.com

ABSTRACT

Field studies were conducted at Weed Science Research centre Marathawada Agril University, Parbhani during *Kharif* season of 2008, 2009 and 2010to evaluate performance of different mechanical weed control implements for weed control in soybean. Soybean grain yield (kg/ha) was significantly influenced due to various weed control treatments. The mechanical weeding (2 HW and 2H) recorded highest grain yield during 2008-09, 2009-10, 2010-11 and Mean (Table 1) which was found significantly superior over TW_2 *i.e.* Grubber, TW_1 *i.e.,* Twin wheel hoe TW_4 *i.e.,* Hand hoe and TW_6 *i.e.* weedy check and was found at par with the use of cycle hoe (TW_3). The use of cycle hoe, hand hoe, twin wheel hoe and grubber were found to be significantly superior over the unwedded control in terms of grain yield kg/ha. The unwedded control (TW_6) recorded significantly lowest grain yield than rest of the treatments. The highest weed control efficiency for grassy as well as broad leaved weeds at 30 and 60 days was observed in 2 HW and 2H weed control treatment followed by the use of cycle hoe and hand hoe for weeding in soybean (*Glycine max* L.) crop.

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KEY WORDS : Soybean, Weed control, Implements

Awareness of environmental sustainability has increased efforts to reduce agrochemical use for plant protection which also include herbicide use. On the other hand, exponential increase in demand for organic foods due to substanciated health benefits and new emerging markets for them are positive reasons for transforming some soybean area to organic production. The biggest obstacle in organic soybean production is weed management. Today's organic soybean production system, for weed control rely on mechanical cultivation, flame weeding, crop rotations, companion crops and other cultural, mechanical and biological methods. The research on mechanical weed control effectiveness is limited. In light of above, this study was conducted to evaluate performance of different weeding implements for weed control in soybean (*Glycine max* L.).

RESEARCH PROCEDURE

A field experiment was conducted during *Kharif* season of 2008-09, 2009-10 and 2010-11 in Randomized Block Design with four replications. The gross and net plot size were 6.0 x 6.0 m and 5.4 x 4.8 m, respectively. The crop was sown at 45 x 5 cm spacing. The recommended dose of NPK and plant protection schedule was followed.

The weeders like cycle hoe, twin wheel hoe, grubber and hand hoe were used for weeding in soybean crop and they were compared with hand weeding and hoeing. The working width of each weeder including hand hoe was measured and tabulated in Table 7 and 8. The speed of operation as km/hr was also recorded for every weeder by running that weeder for 5 m distance in the experimental area. The time required for weeding by every weeder for weeding the given plot size or area (36 m^2) was also calculated by using stopwatch. Considering the speed of operation and working width, the theoretical field capacity of each weeder was calculated with the formula:

$$\frac{SW}{10}$$

where, S = Speed of operation km/hr
W = Width of the weeder (m)

The actual field capacity was also drawn with the help of time required for weeding the given plot or area and thus after getting actual field capacity, with the following formula the field efficiency of each weeder was calculated.

$$\text{Field efficiency (\%)} = \frac{\text{Actual field capacity}}{\text{Theoretical field capacity}} \times 100$$

Thus considering the working width, speed of operation, time required to cover the area, theoretical field capacity, actual field capacity of each weeder used, the field efficiency was calculated and presented in Table 7 and 8 at each weeding.

Treatment details :

The treatments details as follows : T_1- Twin wheel hoe, T_2-Grubber, T_3-Cycle kolpa/hoe, T_4-Hand hoe, T_5- 2 HW and 2 hoeings and T_6 -Weedy check

Weeding interval : 1st 20 DAS
2nd 40 DAS

Crop weed association :

During 2008-09:

The weed flora of experimental site indicated the presence of 34 per cent grassy weeds and 66 per cent broad-leaved weeds. The dominant weed species in grassy weeds were B*rachiaria eruciformis,Cynodon dactylon, Cyperus rotundus* and *Dinebra retraflexa*. Where as the dominant broad leaved weed species were *Acalypha indica, Digera arvensis, Phyllanthus medraspentasis, Abutilon indicum, Corchorus acutangulus, Parthenium hysterophorus* and *Euphorbia genicullata*.

During 2009-10:

The weed flora of the experimental site indicated the presence of 37 per cent grassy weeds and 63 per cent broad-leaved weeds. The dominant weed species in grassy weeds were *Cynodon dactylon, Dinebra retraflexa, Brachiaria eruciformis* and *Eragrostis minor.* Whereas the dominant broad leaved weed species were *Euphorbia genicullata, Phyllanthus medraspentasis, Abutilon indicum, Parthenium hysterophorus, Acalypha indica* and *Alternanthera sessilis*.

During 2010-11:

The weed flora of experimental site indicated the presence of 32 per cent grassy weeds and 68 per cent broad-leaved weeds. The dominant weed species in grassy weeds were *Cynodon dactylon, Dinebra retraflexa, Brachiaria eruciformis* and *Eragrostis minor*. While the dominant broad leaved weed species were *Euphorbia genicullata, Phyllenthus medrapentasis, Abutulon indicum, Merremia emergenata, Argemone mexicana, Alternanthera sessilis. Acalypha indica* and *Alternethra sessilis.*

RESEARCH ANALYSIS AND REASONING

The grain yield of soybean (*Glycine max* L.), dry weed weight, weed index and weed control efficiency were significantly influenced due to various treatments.

Effect of treatments on grain yield:

Soybean (*Glycine max* L.) grain yield (kg/ha) was significantly influenced due to various weed control treatments. The mechanical weeding (2 HW and 2H) recorded highest grain yield during 2008-09, 2009-10, 2010-11 and Mean (Table 1) which was found significantly superior over T_2 *i.e.* grubber T_1 *i.e.* twin wheel hoe T_4 *i.e.* hand hoe and T_6 *i.e.* weedy check and was found at par with the use of cycle hoe (T_3). The use of cycle hoe, hand hoe, twin wheel hoe and grubber were found to be significantly superior over the unwedded control in terms of grain yield kg/ha. The unwedded control (TW_6) recorded significantly lowest grain yield than rest of the treatments.

Effect of treatments on dry weed weight of weeds :

The significantly lowest dry weed weight of grassy weeds and broad leaved weeds at 30 DAS was recorded in TW_5 *i.e.* 2 HW and H which was found significantly lowest than rest of all the treatments during 2008-09, 2009-10, 2010-11 and mean (Table 2).

Table 1: Soybean grain yield (kg/ha) as influenced by different treatments

Sr. No.	Treatments	Grain yield (kg/ha)			
		2008-09	2009-10	2010-11	Mean
1.	T_1 = Twin wheel hoe	2173	1825	1735	1921
2.	T_2 = Grubber	2130	1618	1683	1814
3.	T_3 = Cycle kolpa/ hoe	2382	2452	2167	2334
4.	T_4 = Hand hoe	2304	2129	1793	2082
5.	T_5 = 2 HW and 2 hoeings	2493	2610	2233	2448
6.	T_6 = Weedy check	1712	1478	1590	1605
7.	S.E. $\pm$	99	200	148	156
8.	C.D. (P=0.05)	299	629	455	472

Table 2 : Dry weed weight g/m^2 in soybean as influenced by different treatments

Sr. No.	Treatments	Dry weed weight g/m^{2}at 30 DAS							
		2008-09		2009-10		2010-11		Mean	
		BL	Grassy	BL	Grassy	BL	Grassy	BL	Grassy
1.	T_1 = Twin wheel hoe	6.90	4.80	8.25	7.60	13.35	6.90	9.50	6.43
2.	T_2 = Grubber	9.40	5.10	9.95	9.42	10.32	6.96	9.89	7.16
3.	T_3 = Cycle kolpa/ hoe	5.20	3.00	5.08	4.33	6.35	3.96	5.54	3.76
4.	T_4 = Hand hoe	6.48	3.90	6.58	6.00	8.75	6.70	7.27	5.53
5.	T_5 = 2 HW and 2 hoeings	2.90	1.80	2.54	2.10	3.16	2.86	2.86	2.25
6.	T_6 = Weedy check	11.20	6.25	11.42	14.35	28.16	11.00	16.96	9.95
7.	S.E. $\pm$	0.36	0.53	0.65	1.81	1.02	0.44	0.78	0.95
8.	C.D. (P=0.05)	1.11	1.59	2.06	5.71	3.22	1.52	2.27	2.91

Table 3 : Dry weed weight g/m^2 in soybean as influenced by different treatments

Sr. No.	Treatments	Dry weed weight g/m^{2}at 60 DAS							
		2008-09		2009-10		2010-11		Mean	
		BL	Grassy	BL	Grassy	BL	Grassy	BL	Grassy
1.	T_1 = Twin wheel hoe	6.20	5.90	9.74	9.48	14.75	9.31	10.23	8.23
2.	T_2 = Grubber	8.28	7.82	11.06	11.08	11.22	9.68	10.18	9.52
3.	T_3 = Cycle kolpa/ hoe	4.48	5.48	5.95	5.77	8.13	6.05	6.18	5.76
4.	T_4 = Hand hoe	5.48	5.65	7.76	7.90	10.35	8.63	7.86	7.39
5.	T_5 = 2 HW and 2 hoeings	3.10	2.68	3.70	4.05	5.53	5.06	4.11	3.93
6.	T_6 = Weedy check	13.28	9.78	18.15	15.78	31.98	13.05	21.13	12.87
7.	SE $\pm$	0.51	0.70	1.19	1.61	1.15	1.39	1.01	1.03
8.	C.D. (P=0.05)	1.53	2.10	3.75	5.09	3.64	4.38	2.35	3.32

At 60 days the significantly lowest dry matter of grassy weeds and broad-leaved weeds was observed in 2 HW and 2H treatment, which was found significantly lowest than rest of all the treatments during 2008-09, 2009-10, 2010-11 and mean (Table 3) followed by the cycle hoe and was found significantly lowest than rest of all the treatments. These results are in line with those reported by Renner and Woods(1999) who concluded that when used at an appropriate time, rotary hoe can reduce weed populations by as much as 70 per cent.

Effect of treatments on weed index and weed control efficiency :

The data presented in Table 4 revealed that the highest weed index was recorded in treatments TW_6 *i.e.* unweeded control indicating the yield reduction of 31,43, 29 and 34.33 per cent due to unchecked weeds during 2008-09, 2009-10, 2010-11 and mean followed by grubber (T_2), twin wheel hoe (T_1), hand hoe (T_4) and cycle hoe (T_3), respectively.

The highest weed control efficiency for grassy as well as broad leaved weeds at 30 and 60 days was observed in 2 HW and 2H weed control treatment (Table 5 and 6) followed by the use of cycle hoe and hand hoe for weeding in soybean crop. The results on better weed control efficiency through mechanical weeding by sequential passes of rotary hoe and cultivators in wide rows of soybean were recorded by Kluchinski and Singer (2005).

Field efficiency of different weeders:

The data on field efficiency of different weeders

Table 4 : Weed index (%) as influenced by different treatments

Sr. No.	Treatments	Weed index (%)			
		2008-09	2009-10	2010-11	Mean
1.	T_1 = Twin wheel hoe	13	30	22	21.13
2.	T_2 = Grubber	15	38	25	26.11
3.	T_3 = Cycle kolpa/ hoe	04	06	03	04.33
4.	T_4 = Hand hoe	08	18	20	15.33
5.	T_5 = 2 HW and 2 hoeings	-	-	-	-
6.	T_6 = Weedy check	31	43	29	34.33

Table 5 : Weed control efficiency (%) as influenced by different treatments at 30 DAS

Sr. No.	Treatments	Weed control efficiency (%) at 30 DAS							
		2008-09		2009-10		2010-11		Mean	
		BL	Grassy	BL	Grassy	BL	Grassy	BL	Grassy
1.	T_1 = Twin wheel hoe	38	23	27	47	53	37	39.33	35.66
2.	T_2 = Grubber	16	18	13	34	64	37	31.00	29.66
3.	T_3 = Cycle kolpa/ hoe	53	52	44	69	78	64	58.33	61.66
4.	T_4 = Hand hoe	42	38	42	58	70	39	57.33	45.00
5.	T_5 = 2 HW and 2 hoeings	74	71	77	85	88	74	79.68	76.66
6.	T_6 = Weedy check	-	-	-	-	-	-	-	-

Table 6 : Weed control efficiency (%) as influenced by different treatments at 60 DAS

Sr. No.	Treatments	Weed control efficiency (%) at 60 DAS							
		2008-09		2009-10		2010-11		Mean	
		BL	Grassy	BL	Grassy	BL	Grassy	BL	Grassy
1.	T_1 = Twin wheel hoe	53	40	46	39	54	35	51.00	38.00
2.	T_2 = Grubber	38	20	39	30	65	26	47.33	25.33
3.	T_3 = Cycle kolpa/ hoe	66	44	67	63	74	54	69.00	53.66
4.	T_4 = Hand hoe	59	42	57	49	67	34	61.00	41.66
5.	T_5 = 2 HW and 2 hoeings	77	72	79	74	32	61	79.33	69.00
6.	T_6 = Weedy check	-	-	-	-	-	-	-	-

revealed that, the highest field efficiency was observed with cycle hoe at 20 DAS and 40 DAS weedings for control of grassy as well as broad leaved weeds which was followed by twin wheel hoe, grubber and hand hoe.

The highest weeding efficiency at both the weedings *i.e.* at 20 and 40 DAS was observed with cycle hoe closely followed by hand hoe and twin wheel hoe. Economics of different weed control treatments in soybean Based on the male, female, bullock pair and their charges to undertake the various weed control treatments the economics of various weed control treatment was calculated (Table 9).

Table 7 : The field efficiency of different weeders at 20 DAS in soybean

Sr. No.	Particulars	Twin wheel hoe			Grubber			Cycle kolpa			Hand hoe		
		2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
1.	W- Working width (m)	0.21	0.21	0.21	0.22	0.22	0.22	0.15	0.15	0.15	0.20	0.20	0.20
2.	S- Speed of operation (km/hr)	1.74	1.80	1.80	1.45	1.52	1.48	1.65	1.69	1.68	1.20	1.22	1.16
3.	Time required to cover area (min)	7.00	7.30	8.10	9.10	10.0	8.50	10.20	10.40	12.10	15.00	16.0	18.0
4.	Theoretical fields capacity (SW/10) (ha/hr)	0.036	0.037	0.034	0.031	0.033	0.032	0.024	0.025	0.022	0.024	0.024	0.012
5.	Actual field capacity (ha/hr)	0.030	0.029	0.030	0.024	0.021	0.026	0.021	0.020	0.020	0.014	0.013	0.002
6.	Field efficiency (%)	83.33	78.37	80.35	77.41	63.63	66.63	87.50	80.00	85.79	60.00	54.16	58.20
7.	BL weeds/m^2 before weeding (20 DAS)	9.50	11.50	8.25	12.0	17.50	11.50	14.25	19.25	13.55	9.25	9.75	10.10
8.	BL weeds/m^2 after weeding (20 DAS)	2.00	3.50	2.00	4.25	7.25	3.80	2.00	3.50	3.00	1.75	2.25	10.75
9.	Weeding efficiency for BL weeds (20 DAS)	78.94	69.56	75.75	64.58	58.57	66.95	85.96	81.81	76.01	81.08	76.92	80.19
10.	Grassy weeds/ m^2 before weeding (20 DAS)	12.50	9.75	9.10	13.75	16.50	9.00	9.50	12.50	8.85	11.00	12.25	7.2
11.	Grassy weeds weeds/ m^2 after weeding (20 DAS)	3.25	4.0	3.20	5.25	7.25	2.60	1.75	3.50	1.85	2.25	4.25	2.0
12.	Weeding efficiency for grassy weeds (20 DAS)	74.00	58.97	64.18	61.81	56.06	62.8	81.57	72.00	72.99	79.54	65.30	72.22

Table 8 : The field efficiency of different weeders at 40 DAS in soybean

Sr. No.	Particulars	Twin wheel hoe			Grubber			Cycle kolpa			Hand hoe		
		2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
1.	W- Working width (m)	0.21	0.21	0.21	0.22	0.22	0.22	0.15	0.15	0.15	0.20	0.20	0.20
2.	S- Speed of operation (km/h)	1.60	1.70	1.63	1.20	1.45	1.25	1.50	1.45	1.52	1.10	1.00	1.11
3.	Time required to cover area (min)	9.00	7.00	5.06	12.10	9.10	6.75	11.40	10.30	6.41	16.00	15.20	9.00
4.	Theoretical fields capacity (SW/10) (ha/hr)	0.033	0.035	0.034	0.026	0.031	0.027	0.022	0.021	0.022	0.022	0.020	0.022
5.	Actual field capacity (ha/hr)	0.023	0.031	0.020	0.017	0.023	0.018	0.018	0.020	0.018	0.013	0.014	0.013
6.	Field efficiency (%)	69.69	88.57	70.11	65.38	74.19	65.45	81.81	95.23	83.10	59.09	70.00	60.81
7.	BL weeds/m^2 before weeding (20 DAS)	7.5	16.50	6.50	8.25	18.75	9.65	6.0	20.00	8.00	7.00	12.25	8.60
8.	BL weeds/m^2 after weeding (40 DAS)	1.5	4.75	1.55	2.5	6.75	2.80	0.75	3.00	1.80	1.25	2.75	1.50
9.	Weeding efficiency for BL weeds (40 DAS)	80.0	71.21	76.15	69.69	64.00	70.96	87.50	85.00	77.50	82.14	77.35	62.55
10.	Grassy weeds/ m^2 before weeding (40 DAS)	9	12.25	5.25	9.5	14.50	8.65	7.25	9.75	10.95	8.00	10.25	6.15
11.	Grassy weeds weeds/ m^2 after weeding (40 DAS)	2.75	5.00	2.00	3.50	6.00	3.20	1.75	2.50	2.15	2.00	3.25	11.85
12.	Weeding efficiency for Grassy weeds (40 DAS)	69.44	59.18	61.90	63.15	58.62	63.0	76.00	74.35	80.36	75.00	68.29	47.69

Table 9 : Economics of different weed control treatments in soybean

Treatments	Expenditure (Rs.)			
	Labour required per weeding			Total labour charges per weeding
	Male	Female	Bullock pair	Rs./ha
T_1 = Twin wheel hoe	4.5	-	-	540
T_2 = Grubber	6.0	-	-	720
T_3 = Cycle kolpa/ hoe	6.0	-	-	720
T_4 = Hand hoe	9.5	-	-	1140
T_5 = 2 HW and 2 hoeings	1.0	20	1	2920
Ts_6 = Weedy check	-	-		-

Rate/day Male = Rs. 120/day and Female = Rs. 120/day Bullock pair = Rs.400/day

The highest cost of inter culture operation was observed in 2 HW and 2 hoeing treatment followed by hand hoe, cycle hoe, grubber and was lowest with twin wheel hoe.

Authors' affiliations:

A.S. JADHAV, Weed Science Research Centre, Marathwada Agriculture University, PARBHANI (M.S.) INDIA

A.K. GORE, Department of Agronomy, Marathwada Agriculture University, PARBHANI (M.S.) INDIA

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