

## Efficacy of diclosulam on weeds and yield of soybean

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### ABSTRACT

The experiment was conducted during *kharif* 2007 and 2008 to evaluate the bio-efficacy of diclosulam at different doses in soybean crop at G.B. Pant University of Agriculture & Technology, Pantnagar. Eight treatments comprising diclosulam (84 WDG) at 18, 22 and 26 g/ha, pendimethalin (30 EC) and fluchloralin (45 EC) 1000 g/ha, two hand weeding (30 and 45 DAS), weed free and weedy treatments were used in the experimental plots. Diclosulam at higher doses (22 and 26 g/ha) were found effective against grassy and broad leaf weeds at different evaluation timings as it recorded lower weed population followed by weed free, hand weeding and application of diclosulam 18 g/ha and rest of the herbicides. Diclosulam applied at 22 and 26 g/ha showed higher weed control efficiency as compared to other herbicidal treatments at all the stages of crop growth, due to broad spectrum weed control and hence higher value for all the characters of yield attributes and grain yield. Weedy plots recorded 57% lower grain yield as compared to weed-free treatments. Application of diclosulam at 22 and 26 g/ha produced maximum grain yield which was similar to yield found in weed free treatment during both the years.

**Key words :** Chemical control, Diclosulam, Soybean

Soybean (*Glycine max* L.) is a source of oil (20%) and protein (40%). Being a leguminous crop, it can fix 50 to 200 kg/ha atmospheric nitrogen per season (Roughley 1980). The shortage and consequently huge imports of edible oils make it indispensable to concentrate on increasing soybean acreage and production in the country. However, yield losses due to weed competition in soybean production are greater than losses from all other pests combined (McWhorter and Patterson 1979).

Weeds are known to compete with cultivated crops for water, light, nutrients, space and quality of the crop produce (Muzik 1970). For soybeans, Rao (1987) reported 76% losses in yield due to weed infestation in India. Similarly, Chandler *et al.* (1984) reported 90 to 100% yield losses in soybean due to weed competition in Canada and United States, respectively. Weeds compete directly with soybean for light, nutrients and moisture, and may exhibit allelopathy to reduce crop growth (Lolas and Coble 1982). Anderson and McWhorter (1976) reported increased seed moisture content, seed contamination and seed splits when soybean were grown in high density of weeds.

To overcome the deleterious effects of weeds in soybean, it is imperative that weeds population be kept below the economic threshold level. For this purpose, several pre-emergence and pre-plant incorporated herbicides have been recommended to control the weeds in soybean crop. Fluchloralin and pendimethalin provide effective control of grass weeds, but are less effective on broad leaf weeds and sedges.

### MATERIALS AND METHODS

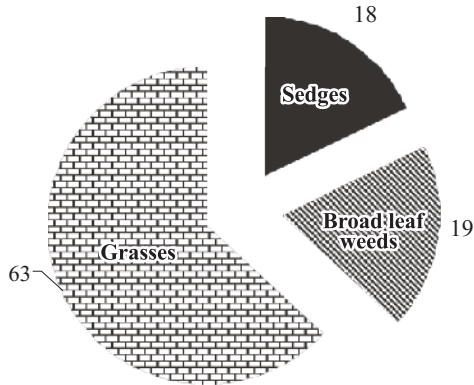
The experiment was conducted during the rainy season of 2007 and 2008 at Crop Research Centre of G.B. Pant University of Agriculture & Technology, Pantnagar. The experiment was planned in a randomized block design with three replications of 8 treatments; which included diclosulam (84 WDG) at 18, 22 and 26 g/ha, pendimethalin (30 EC) and fluchloralin (45 EC) each at 1.0 kg/ha, two hand weeding (at 30 and 45 DAS), weedy and weed free. Soybean crop (variety *PS 1241*) was sown on 8<sup>th</sup> July, 2007 for the first season and 2<sup>nd</sup> July, 2008 for the second season. All the herbicide treatments except fluchloralin were applied the day after sowing of soybean seed, whereas, fluchloralin was applied as pre plant incorporated treatment one day before sowing. Herbicides were applied using a Knap sack sprayer fitted with flat fan nozzle calibrated to deliver 750 litres of water per hectare. Cultural practices recommended for soybean were adopted during the crop growth period. Weed count (species wise) and weed density were counted at 30, 45 and 60 days after sowing (DAS). Yield and yield attributes were recorded at harvest of crop. Crop was harvested on 13<sup>th</sup> November, 2007 and 10<sup>th</sup> November, 2008.

### RESULTS AND DISCUSSION

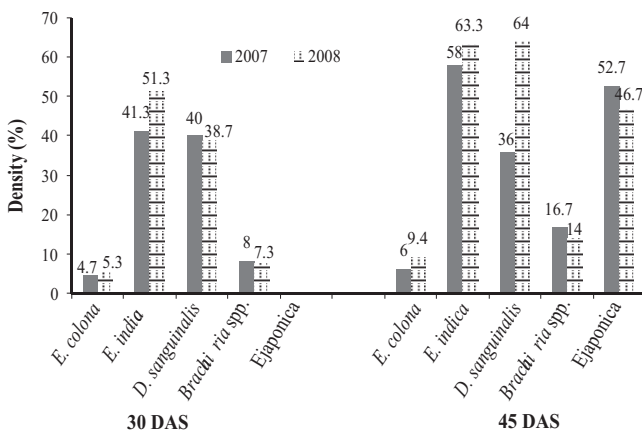
#### Effect on weeds

The experimental plot area was mainly infested with *Eleusine indica*, *Brachiaria ramosa*, *Digitaria sanguinalis*, *Eragrostis japonica*, *Echinochloa colona* among the grasses; *Lindernia ciliata*, *Eclipta alba* and

*Trianthema monogyna* among the broad leaf weeds and *Cyperus rotundus* among the sedges. Grasses, broad leaf weeds and sedges accounted about 63, 19 and 18% of the total weeds in weedy plot at 60 days after sowing (Fig. 1). *Eragrostis japonica* was not observed at the first evaluation (30 DAS), however, at later stages (45 and 60 DAS) it occupied the major population of grasses (Fig. 2).



**Fig 1:** Percentage of grasses, broad leaf weeds and sedges in total density at 60 days after sowing



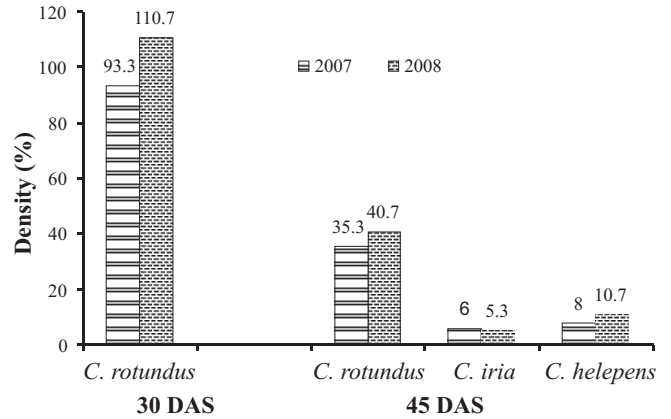
**Fig. 2.** Grasses (%) at 30 and 45 days after sowing

**Weed density and dry weight**

Diclosulam effectively controlled broad leaf weeds and sedges resulting in lower density of these weeds as compared to pendimethalin and fluchloralin treated plots. The higher doses (20 and 26 g/ha) of diclosulam (84WDG) were found effective against different weed species as compared to its lowest dose (18 g/ha). Diclosulam (84 WDG) 26 g/ha was found most effective to control all type of weeds (grassy and non grassy). The lowest density and dry weight of all weed species was observed at the highest dose (26 g/ha) of diclosulam, followed by diclosulam at 22 g/ha (Table 1).

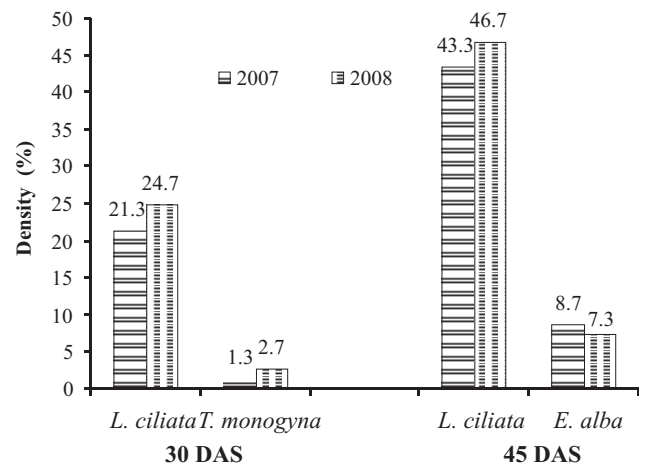
Amongst the sedges, *Cyperus rotundus* was dominant at initial stage (30 DAS), however, at later stages (45 and

60 DAS) *Cyperus iria* and *Cyperus helepens* were also seen (Fig. 3). Diclosulam was found effective to suppress the sedges at all evaluation times, as it resulted in lower weed density followed by weed free and hand weeding twice (30 and 45 DAS) (Table 2).



**Fig 3:** Sedges density at 30 and 45 days after sowing

Amongst broadleaf weeds, the lowest density of *Trianthema monogyna* was recorded at 30 days after sowing. At 45 days after sowing, *Lindernia ciliata* was the dominant weed species (Fig. 4) and *Cyperus rotundus* was the dominant sedge species. Both the species were effectively controlled by the highest dose of diclosulam at 26 g/ha. Diclosulam at 22 and 26 g/ha provided good control of these broadleaf weeds at all evaluation times as compared to the standard check i.e. pendimethalin and fluchloralin (Table 2).



**Fig 4:** Broad leaf weeds at 30 and 45 days after sowing

**Weed control efficiency (WCE)**

The highest weed control efficiencies (WCE) (80.6 and 83.1% in 2007 and 2008, respectively) were found in the treatment of diclosulam at 26 g/ha followed by its lower rate i.e. 22 and 18 g/ha. The weed control efficiency of diclosulam was higher than pendimethalin and

**Table 1: Effect of weed control treatments on weed density and dry weight of grasses and weed control efficiency at 45 DAS in soybean**

Treatments	Dose (g/ha)	Species wise grassy weed density (no./m <sup>2</sup> )												Grassy weed density (no./m <sup>2</sup> )		Grassy weed dry wt. (g/m <sup>2</sup> )		Total weeds dry weight (g/m <sup>2</sup> )		WCE (%)			
		<i>E. colona</i>			<i>Eleusine indica</i>			<i>E. japonica</i>			<i>Brachiaria</i> Spp.			<i>D. sanguinalis</i>		2007	2008	2007	2008	2007	2008	2007	2008
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008										
Diclosulam (84 WDG)	18	1.4 (3.3)	1.7 (15.5)	3.9 (48.7)	3.7 (42.0)	3.1 (21.3)	2.9 (17.3)	1.8 (5.3)	1.4 (3.3)	3.0 (18.7)	3.1 (21.3)	4.6 (97.3)	4.5 (99.4)	56.7	49.3	66.7	57.0	74.5	77.3				
Diclosulam (84 WDG)	22	1.3 (2.7)	1.4 (12.5)	3.7 (38.0)	3.6 (34.7)	2.6 (12.7)	2.8 (15.3)	1.7 (4.7)	1.3 (2.7)	2.8 (16.0)	2.9 (17.3)	4.3 (82.5)	4.3 (82.5)	45.9	41.7	53.9	47.4	79.4	81.1				
Diclosulam (84 WDG)	26	1.3 (2.7)	1.3 (10.9)	3.5 (31.3)	3.4 (28.7)	2.5 (10.7)	2.7 (13.3)	1.7 (4.7)	0.7 (1.3)	2.7 (14.0)	2.7 (13.3)	4.2 (67.5)	4.1 (67.5)	43.8	37.1	50.9	42.4	80.6	83.1				
Pendimethalin (30 EC)	1000	0.5 (1.3)	0.5 (24.9)	3.7 (40.7)	3.6 (34.0)	3.4 (30.7)	3.4 (8.7)	1.1 (3.3)	0.7 (1.3)	2.0 (6.7)	3.5 (32.7)	4.4 (82.7)	4.3 (101.6)	49.7	45.1	86.1	71.0	67.1	71.8				
Fluchloralin (45 EC)	1000	0.4 (0.7)	0.4 (29.4)	3.4 (30.7)	3.3 (27.3)	3.4 (28.7)	2.3 (9.3)	1.8 (5.3)	1.9 (6.0)	1.8 (5.3)	3.4 (29.3)	4.2 (70.7)	4.3 (101.3)	61.8	53.3	88.7	71.1	66.1	71.7				
Hand weeding at 30 & 45 DAS	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0	0.0	0.0	0.0	100	100				
Untreated	-	1.9 (6.0)	1.9 (9.4)	4.1 (58.0)	4.2 (63.3)	4.0 (52.7)	3.9 (46.7)	2.8 (16.7)	2.7 (14.0)	3.6 (36.0)	4.2 (64.0)	5.2 (169.4)	5.3 (282.0)	236.8	224.6	262.0	251.4	0.0	-				
Weed free	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0	0.0	0.0	0.0	100	100				
LSD (P=0.05)	-	0.7	0.7	0.2	0.1	0.4	0.2	1.1	0.7	0.3	0.2	0.1	0.6	20.0	11.1	-	10.7	-	-				

Figure in parenthesis are original values and transformed to log (X+1) for analysis, WCE- Weed control efficiency, DAS - Days after sowing

**Table 2: Effect of weed control treatments on weed density and dry weight of broad leaf weeds and sedges at 45 DAS in soybean**

Treatments	Dose (g/ha)	Species wise broad leaf weeds (no./m <sup>2</sup> )												Broad leaf weeds density (no./m <sup>2</sup> )		Broad leaf weeds dry wt. (g/m <sup>2</sup> )		Sedges density (no./m <sup>2</sup> )		Sedges dry wt. (g/m <sup>2</sup> )	
		<i>Lindernia</i> Spp.			<i>Eclipta alba</i>			<i>C. rotundus</i>			<i>Cyperus iria</i>			<i>Cyperus helpens</i>		2007	2008	2007	2008	2007	2008
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008								
Diclosulam (84 WDG)	18	3.3 (26.0)	2.9 (17.3)	0.5 (1.3)	0.4 (0.7)	3.3 (26.7)	3.1 (20.7)	1.3 (4.7)	1.4 (3.3)	0.5 (1.3)	0.9 (2.0)	3.3 (27.3)	2.9 (18.0)	2.7	1.8	3.5 (32.7)	3.3 (26.0)	7.3	6.0		
Diclosulam (84 WDG)	22	3.1 (20.7)	2.6 (12.7)	0.0 (0.0)	0.0 (0.0)	3.2 (23.3)	2.9 (17.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.1 (20.7)	2.6 (12.7)	2.2	1.3	3.2 (23.3)	2.9 (17.3)	5.8	4.4		
Diclosulam (84 WDG)	26	2.8 (15.3)	2.5 (10.7)	0.0 (0.0)	0.0 (0.0)	3.2 (22.7)	2.9 (16.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	2.8 (15.3)	2.5 (10.7)	1.7	1.0	3.2 (22.7)	2.9 (16.7)	5.4	4.2		
Pendimeth (30 EC)	1000	3.7 (44.0)	3.7 (41.3)	2.2 (8.7)	2.0 (6.7)	4.5 (88.7)	4.2 (67.3)	2.2 (8.7)	2.1 (7.3)	2.8 (16.0)	2.5 (11.3)	3.9 (52.7)	3.9 (48.0)	5.2	4.7	4.7 (113.3)	4.5 (86.0)	31.2	21.2		
Fluchloralin (45 EC)	1000	3.8 (46.7)	3.6 (37.3)	1.6 (4.0)	1.7 (4.7)	4.0 (56.7)	3.6 (35.3)	2.5 (12.0)	2.3 (9.3)	2.1 (7.3)	3.9 (52.0)	3.8 (42.0)	5.1	4.3	4.3 (77.3)	4.0 (52.0)	21.8	13.5			
Two hand weeding at 30 and 45 DAS	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0	0.0	0.0	0.0	0.0	0.0		
Untreated	-	3.8 (43.3)	3.9 (46.7)	2.3 (8.7)	2.1 (7.3)	3.6 (35.3)	3.7 (40.7)	1.9 (6.0)	1.8 (5.3)	2.1 (8.0)	2.5 (10.7)	4.0 (54.0)	4.0 (54.0)	4.6	4.7	3.9 (49.3)	4.1 (56.7)	20.1	22.1		
Weed free	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0	0.0	0.0	0.0	0.0	0.0		
LSD (P=0.05)	-	0.4	0.2	0.6	0.4	0.3	0.2	0.8	0.3	0.6	0.5	0.4	0.2	1.3	0.2	0.2	0.2	0.2	6.2		

Figure in parenthesis are original values and transformed to log (X+1) for analysis, WCE- Weed control efficiency, DAS - Days after sowing

**Table 3: Effect of weed control treatment on yield and yield attributes of soybean**

Treatments	Dose (g/ha)	Pods per plant		Grains per pod		1000 grain wt. (g)		Grain yield (kg/ha)	
		2007	2008	2007	2008	2007	2008	2007	2008
Diclosulam (84 WDG)	18	112.5	115	2.3	2.3	110	111.0	1782	1979
Diclosulam (84 WDG)	22	128.6	131	2.4	2.5	116	114.0	2187	2234
Diclosulam (84 WDG)	26	131.5	133	2.5	2.5	113	114.0	2112	2373
Pendimethlin (30 EC)	1000	118.1	120	2.5	2.5	114	114.7	1898	1956
Fluchoralin (45 EC)	1000	104.7	109	2.7	2.6	112	112.7	1586	1707
Two hand weeding at 30 and 45 DAS	-	114.3	119	2.4	2.5	106	109.3	2210	2118
Untreated	-	91.7	89	2.4	2.2	99	102.0	1001	1042
Weed free	-	134.5	137	2.3	2.5	115	116.0	2326	2442
LSD (P=0.05)		20.9	11	NS	0.3	NS	5.8	359	217

fluchloralin used as standard check. These results show that diclosulam equally suppresses all type of weed i.e. grasses, broad leaves and sedges (Table 1).

#### Yield and yield attributes

Amongst all the yield attributes, significant differences were obtained with number of pods per plant and grain yield during both the years. Weedy plots recorded about 57% lower grain yield as compared to weed-free treatments. Application of diclosulam at the higher doses (22 and 26 g/ha) resulted in soybeans yields which were significantly equal to the weed free treatments during both the years. This might be due to more number of pods per plant. Two hand weeding were found to be as effective as diclosulam at higher doses (22 and 26 g/ha). Application of diclosulam at 18 g/ha resulted in soybean yields similar to plots treated with pendimethalin and fluchloralin (Table 3).

The highest number of pods per plant were obtained with the highest dose of diclosulam (26g/ha). This treatment resulted in 43 and 49% higher soybean yields than the untreated plots in 2007 and 2008, respectively, and 11% more than the standard check i.e. pendimethalin (30 EC) in both the years. The number of pods per plant obtained in plots treated with the higher doses (22 and 26g) of diclosulam was statistically equal with the pods per plant found in weed free plot of soybean in both the years.

Among the yield attributes, grains per pod and 1000 grain weight was not significantly affected in first year, however, in second year these yield attributes were higher

with diclosulam i.e. at 22 and 26 g/ha and found at par with weed free plots. Soybean yields obtained with diclosulam at 22 g/ha were 118 and 114% higher than the untreated plot, while yields with diclosulam at 26 g/ha were 114 and 128% higher than the untreated plot during 2007 and 2008, respectively.

#### ACKNOWLEDGMENT

The authors acknowledge Dow Agro Sciences India Pvt. Ltd., Mumbai (India) for funding the project.

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