Indian Journal of Weed Science (2025) **57**(3): 366–368
http://dx.doi.org/10.5958/0974-8164.2025.00062.3

RESEARCH NOTE

Saflufenacil to manage weeds in soybean

Ashok Walikar, Rajesh Kumar Singh, Nihal Chandra Mahajan and N. Anthony Baite*

Received: 21 September 2024 | Revised: 9 March 2025 | Accepted: 12 March 2025

ABSTRACT

This study was conducted at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh (U.P.) during the *Kharif* season of 2023-24. The aim was to evaluate the efficacy of saflufenacil against weeds in soybean (*Glycine max* L.). A randomized block design (RBD) was used with seven treatments, *viz.* four dosage rates of saflufenacil at 16, 22, 25, and 50 g/ha, diclosulam 26 g/ha, hand weeding twice at 20 and 40 days after sowing (DAS), and unweeded check, replicated thrice. Hand weeding at 20 and 40 DAS resulted in maximum weed control, growth of soybean and highest seed yield, amongst the tested treatments. Saflufenacil 50 g/ha caused the lowest weed density, weed biomass, and highest weed control efficiency which improved soybean growth parameters, yield-related characteristics and increased yield of soybean amongst saflufenacil dosage rates tested.

Keywords: Diclosulam, Herbicides, Soybean, Saflufenacil, Weed management

Effective weed management is crucial to minimize weed competition and optimize soybean growth and production. Despite advanced technologies, producers often report high losses due to weeds. The estimated potential soybean yield loss was 50-76% due to weed infestation (Gharde *et al.* 2018). In order to reduce yield losses due to weeds in soybean production, efficient and strategic weed management practices are the fundamental need.

Saflufenacil, a pre-emergent herbicide with protoporphyrinogen oxidase (PPO) mode of action, has demonstrated broad-spectrum efficacy against both annual and perennial weeds, including species resistant to conventional herbicides (Grossmann *et al*. 2010). It is absorbed by both the roots and foliage of plants, primarily transported through the xylem, with limited movement in the phloem (Soltani *et al.* 2012). Its quick action, broad weed control spectrum, and favorable environmental profile make it a promising option for soybean growers struggling with diverse weed populations (Liebl *et al*. 2008). It can be applied as both pre- and post-emergence and is also found to be effective in controlling glyphosate resistance horseweed (*Conyza* sp.) (Mellendorf *et al.* 2013). However, limited studies have been conducted to evaluate its efficacy in controlling specific weed species such as *Cynodon dactylon*, *Cyperus rotundus*, and *Parthenium hysterophorus* which are dominant in soybean field under Indian agro-climatic conditions. Hence, an experiment was conducted to assess the efficacy of saflufenacil to manage weeds in soybean.

Department of Agronomy, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

* Corresponding author email: baiteanthony@gmail.com

The study was conducted at the Agricultural Research Farm of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. A randomized block design (RBD) was used with seven treatments replicated thrice. The treatments include: saflufenacil at four dosage rates, *viz.* 16, 22, 25 and 50 g/ha, diclosulam 26 g/ha, hand weeding twice at 20 and 40 days after sowing (DAS) and unweeded check. Soybean variety RVSM 2011-35 was sown on 23rd June 2023 in a 7×3 m sized plot each. Herbicides were applied as pre-emergence application (PE) at 3 days after sowing (DAS) by using knapsack sprayer fitted with flat fan nozzle. The weed density was recorded at 30, and 60 days after treatment application (DAT) by placing 1 × 1m quadrat at three random places per plot. Additionally, weed biomass was recorded at 30, and 60 DAT by uprooting weeds, followed by hot air drying at 70^{o}C and weighing. Weed control efficiency (WCE), herbicide efficiency index (HEI) and weed management index (WMI) was computed using the equation suggested by Mani *et al.* (1973) and Mishra and Misra (1997).

Crop and weed data were subjected to analysis of variance (ANOVA) for RBD as given by Gomez and Gomez (1984). Weed density and weed biomass data was square root transformed ($\sqrt{x+0.5}$). Post-hoc analysis using Duncan's multiple range test (DMRT) was performed using Statistical Tool for Agricultural Research (STAR), IRRI, version 2.0.1. The same software was used for correlation analysis.

Weed flora

Weed flora in the experimental area consisted of grasses: *Cynodon dactylon* L., *Echinochloa colona* L.

and *Paspalum conjugatum* P.J. Bergius; sedges: *Cyperus rotundus* L. and *Cyperus esculents* L.; broad-leaved weeds: *Parthenium hysterophorus* L., *Phyllanthus niruri* L., *Eclipta alba* L., *Ludwigia parviflora* and *Lindernia procumbens*. The predominant weed flora in experimental field were *Cyperus rotundus* accounting (58%), *C. esculentus* (8%), *C. dactylon* (7%), *P. hysterophorus* (9%) and *Phyllanthus niruri* (5% of the total weeds).

Effect on weeds

Saflufenacil at all dosage rates significantly reduced the weed density of different weed *species* compared to the weedy check (**Table 1**). The lowest weed density, biomass and highest weed control efficiency (WCE) among herbicidal treatments tested was recorded with saflufenacil 50 g/ha. The hand weeding recorded the lowest weed biomass of grasses, sedges and broad-leaved weeds (**Table 2**). Although the highest WCE (84.97%) was under hand weeding twice at 20 and 40 DAS, the application of saflufenacil recorded equally higher WCE (**Table 2**). This might be due to the efficacy of saflufenacil as a pre-emergence herbicide and its ability to control a broad spectrum of broad-leaved weeds (Mueller *et al.* 2014). Moreover, saflufenacil has residual activity (half-life of 59 days under saturated condition and 33 days under field capacity) that provides extended control of weed species over time (Camargo *et al.* 2013). This residual effect helped in maintaining lower weed densities throughout the critical periods (15-45 DAS) of soybean growth (Kumar *et al.* 2022; Liebl *et al.* 2008).

Interestingly, diclosulam 26 g/ha exhibited the highest HEI (1.26), indicating its effectiveness in enhancing soybean yield per unit of weed biomass reduction. This finding aligns with findings of Gulaiya *et al.* (2023) who reported that diclosulam provides excellent residual control of broad-leaved weeds and is particularly effective in soybean. Saflufenacil 25 and 50 g/ha both recorded the highest values (0.74) of weed management index. The high WMI values for saflufenacil treatments indicate that these doses effectively balanced weed control with crop productivity.

Table 1. Weed density as influenced by weed control treatments in soybean

Treatment	Weed density (no./m^2)					
	Total sedges		Total grasses		Total broad-leaved weeds	
	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT
Saflufenacil 16 g/ha	17.45(304.3)	20.83(434.0)	7.31(53.3)	9.80(96.0)	2.01(4.0)	6.91(47.7)
Saflufenacil 22 g/ha	14.88(221.3)	17.07(291.3)	6.98(48.7)	9.11(83.0)	1.55(2.3)	6.29(39.6)
Saflufenacil 25 g/ha	12.32(151.7)	14.90(222.0)	6.61(43.6)	8.27(68.3)	0.22(0)	5.27(27.7)
Saflufenacil 50 g/ha	11.46(131.3)	13.93(194.0)	6.28(39.3)	8.09(65.3)	0.22(0)	4.81(23.0)
Diclosulam 26 g/ha	16.27(264.7)	19.43(377.3)	7.22(52.0)	9.47(89.7)	2.01(4.0)	6.63(43.9)
Hand weeding twice at 20 and 40 DAS	4.03(16.2)	13.84(191.6)	3.47(12.0)	5.18(26.8)	0.22(0)	3.08(9.4)
unweeded check	21.16(447.7)	23.83(567.6)	8.15(66.3)	10.39(108.0)	8.27(68.3)	11.31(127.9)
LSD (p=0.05)	1.53	2.01	1.02	1.28	0.72	1.45

Original figures in parentheses were subjected to square-root transformation ($\sqrt{x+0.5}$) before statistical analysis. DAS- days after seeding; DAT-days after treatment application

Table 2. Weed biomass and weed indices (60 DAT) as influenced by weed control treatments in soybean

Treatment	Weed biomass (g/m^2)*								WCE (%)	HEI	WMI
	Sedges		Grasses		Broad-leaved		Total				
	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT			
Saflufenacil 16 g/ha	8.93 (79.3)	9.58 (91.30)	3.97 (15.27)	5.89 (34.20)	0.90 (0.31)	2.57 (6.09)	9.77 (94.88)	11.49 (131.59)	58.25	0.53	0.49
Saflufenacil 22 g/ha	7.55 (56.5)	9.29 (85.90)	3.66 (12.91)	5.23 (26.90)	0.83 (0.19)	2.39 (5.23)	8.37 (69.0)	10.88 (118.03)	62.56	0.76	0.64
Saflufenacil 25 g/ha	6.68 (44.14)	8.85 (77.97)	3.48 (11.64)	4.52 (19.98)	0.80 (0.14)	2.10 (3.93)	7.51 (55.92)	10.11 (101.88)	67.68	0.81	0.74
Saflufenacil 50 g/ha	6.23 (38.35)	8.15 (65.98)	3.30 (10.38)	4.27 (17.75)	0.79 (0.12)	2.01 (3.55)	7.02 (48.85)	9.36 (87.28)	72.31	1.04	0.74
Diclosulam 26 g/ha	7.96 (62.93)	9.45 (88.98)	3.85 (14.32)	5.56 (30.36)	0.88 (0.28)	2.49 (5.72)	8.83 (77.53)	11.20 (125.06)	60.33	1.26	0.58
Hand weeding twice at 20 and 40 DAS	1.97 (3.4)	6.37 (40.12)	1.65 (2.3)	2.52 (5.9)	0.71 (0)	1.36 (1.35)	2.48 (5.7)	6.91 (47.37)	84.97	-	0.71
Unweeded check	10.28 (105.19)	13.90 (192.59)	4.39 (18.81)	9.29 (85.94)	2.27 (4.66)	6.09 (36.75)	11.36 (128.66)	17.76 (315.22)	-	-	-
LSD (p=0.05)	0.56	0.80	0.27	0.39	0.08	0.20	0.45	0.54			

*Original figures in parentheses were subjected to square-root transformation ($\sqrt{x+0.5}$) before statistical analysis; WCE- Weed control efficiency; HEI – Herbicide efficiency index; WMI – Weed management index; DAS- days after seeding; DAT-days after treatment application

Table 3. Soybean growth and yield attributes as influenced by weed control treatments

Treatment	Crop biomass (g/m^2)		Pods/ plant	100-seed weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
	30 DAT	60 DAT					
Saflufenacil 16 g/ha	85.03	217.68	32.67	9.7	1283	2181	37.04
Saflufenacil 22 g/ha	89.38	229.71	34.33	9.9	1401	2288	37.98
Saflufenacil 25 g/ha	95.49	246.36	36.33	10.3	1504	2356	38.96
Saflufenacil 50 g/ha	95.87	247.44	36.87	10.5	1538	2384	39.21
Diclosulam 26 g/ha	87.12	223.03	33.00	9.8	1353	2216	37.91
Hand weeding twice at 20 and 40 DAS	98.89	253.16	37.33	10.8	1605	2487	39.22
Unweeded check	64.72	165.68	27.67	8.9	998	1894	34.51
LSD (p=0.05)	3.61	7.01	1.40	0.51	70.5	115	1.17

*DAS- days after seeding; DAT-days after treatment application

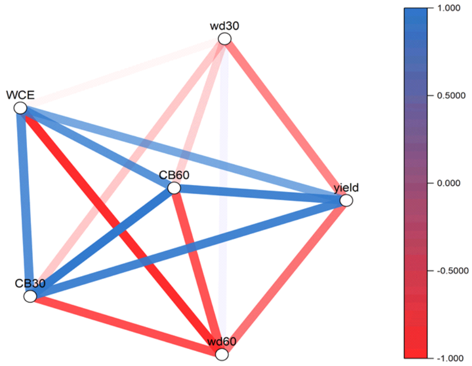

Figure 1. Correlation between various parameters under study. Wd30- weed density at 30 DAT; wd60- weed density at 60 DAT; CB30- crop biomass at 30 DAT; CB60- crop biomass at 60 DAT; WCE- weed control efficiency

Soybean growth and yield attributes

Hand weeding twice at 20 and 40 DAS resulted in the highest crop biomass, pod count, and seed yield (**Table 3**), signifying the effectiveness of manual weed control, though it may be labor-intensive (Richard *et* al. 2023). Among the tested herbicides, saflufenacil 50 g/ha produced the highest crop biomass at 30 DAT and 60 DAT, seed yield, stover yield and harvest index. Similar observations were made by Walsh *et al.* (2015).

Correlation analysis

Higher weed biomass at 30 and 60 DAT are strongly negatively correlated with WCE, crop biomass at 30 and 60 DAT and seed yield (**Figure 1**), indicating greater weed competition for resources, which lead to lower soybean growth and yield. Additionally, there is strong positive correlation in WCE with crop biomass at 30 and 60 DAT and soybean seed yield.

Conclusion

Saflufenacil 50 g/ha effectively managed weeds in soybean resulting in substantial increases in soybean biomass and yield. Hence, saflufenacil 50 g/ ha is recommended for adequate weed management and soybean productivity.

REFERENCES

Camargo ER, Senseman SA, Haney RL, Guice JB and McCauley GN. 2013. Soil residue analysis and degradation of saflufenacil as affected by moisture content and soil characteristics. *Pest Management Science* **69**(12): 1291–1297.

Gharde Y, Singh PK, Dubey RP and Gupta PK. 2018. Assessment of yield and economic losses in agriculture due to weeds in India. *Crop Protection* **107**: 12–18.

Gomez KA and Gomez AA. 1984. *Statistical Procedures for Agricultural Research*. John wiley & sons.

Grossmann K, Niggeweg R, Christiansen N, Looser R and Ehrhardt T. 2010. The herbicide saflufenacil (Kixor™) is a new inhibitor of protoporphyrinogen IX oxidase activity. *Weed Science* **58**(1): 1–9.

Gulaiya S, Jain KK, Jamre PS, Ahirwal A, Sharma A, Kochale P, Prajapati R and Kumar A. 2023. Effect of Different Herbicides on Weed Management, Crop Growth and Yield of Soybean. *International Journal of Plant & Soil Science* **35**(22): 435–440.

Kumar S, Rana SS and Ramesh. 2022. Weed management strategies in soybean (Glycine max)—A review. *The Indian Journal of Agricultural Sciences* **92**(4): 438–444.

Liebl RA, Walter H, Bowe SJ, Holt TJ and Westberg DE. 2008. BAS 800H: a new herbicide for preplant burndown and preemergence dicot weed control. *Weed Science Society of America* **48**: 120.

Mani VS, Malla ML, Gautam KC and Das B. 1973. Weed killing chemical in potato cultivation. *Indian Farming* **23**(8): 17–18.

Mellendorf TG, Young JM, Matthews JL and Young BG. 2013. Influence of plant height and glyphosate on saflufenacil efficacy on glyphosate-resistant horseweed (Conyza canadensis). *Weed Technology* **27**(3): 463-467.

Mishra M and Misra A. 1997. Estimation of IPM index in Jute: a new approach. *Indian Journal of Weed Science* **29**(1&2): 39–42.

Mueller TC, Boswell BW, Mueller SS and Steckel LE. 2014. Dissipation of fomesafen, saflufenacil, sulfentrazone, and flumioxazin from a Tennessee soil under field conditions. *Weed Science* **62**(4): 664–671.

Richard D, Leimbrock-Rosch L, Keßler S, Stoll E and Zimmer S. 2023. Soybean yield response to different mechanical weed control methods in organic agriculture in Luxembourg. *European Journal of Agronomy* **147**: 126842.

Soltani N, Shropshire C and Sikkema PH. 2012. Weed control and sensitivity of oats (*Avena sativa*) with various doses of saflufenacil. *Crop Protection* **31**(1): 45–49.

Walsh KD, Soltani N, Shropshire C and Sikkema PH. 2015. Weed control in soybean with imazethapyr applied alone or in tank mix with saflufenacil/dimethenamid-P. *Weed Science* **63**(1): 329–335.