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Effect of Pre Plant Incorporation of Herbicidal Mixture on Weed Dynamics in Soybean under Black Soil of Jabalpur Region

Shani Gulaiya[1], K.K. Jain[2], Abhinav Rathi[3], Priya Kochale[1*], Pinki Mehra[1], Rajkumar Prajapati[4] and Abhishek Sharma[1]

[1]Research Scholar, Agronomy, College of Agriculture, JNKVV, Jabalpur (M.P.), India.
[2]Professor, Agronomy, College of Agriculture, JNKVV, Jabalpur (M.P.), India.
[3]Ph.D. Research Scholar, Department of Soil Science and Water Management, Dr. Y. S. Parmar University of Horticulture and Forestry, Solan (H.P.), India.
[4] Research Scholar, Agroforestry, Bundelkhand University, Jhansi (U.P.), India.

(Corresponding author: Priya Kochale)*
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ABSTRACT: A field experiment was conducted at Breeder Seed Production Farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during *Kharif* season 2019. The weed associated with crop in experimental field were classified as monocot weeds like *Echinochloa colona, Cyperus iria* and dicot weeds like *Mollugo pentaphylla, Phyllanthus urinaria, Alternenthera philoxeroides*. These five species were most dominant, contributing about 100 percent of the total weed flora of monocot and dicot weeds. In weedy check plots the dicot weeds were predominance among the dicot weeds *Mollugo pentaphylla was the most dominant weed with maximum relative density (23.14%) followed by Alternenthera philoxeroides (14.89%),* whereas monocot weeds contributed (49.99%) to relative density of weeds, However, among the monocot weeds *Echinochloa colona* marked its presence in more value (26.16%) as compared to *Cyperus iria* (23.83%). The dry weight of weeds reduction was more pronounced when Diclosulam 0.9% + Pendimethalin 35% SE ready mixture was applied at higher rate *i.e.* from 20.25 + 787.5 to 45 + 1750 g ha^{-1}. The density and dry weight of weeds were reduced under hand weeding to the maximum extent over herbicidal treatments. The highest weed control efficiency (81.00%) was recorded under application of Diclosulam 0.9% + Pendimethalin 35% SE 45 + 1750 g ha^{-1} followed by application of Diclosulam 0.9% + Pendimethalin 35% SE at 22.5 + 875 g ha^{-1} (77.69%). However, the maximum weed control efficiency (95.69%) were observed under hand weeding at 20 and 40 DAS in soybean over herbicidal treatments.

Keywords: Weed flora, soybean, *relative density*, *Echinochloa colona*, dicot and monocot weeds, hand weeding, weed control efficiency.

INTRODUCTION

Soybean (*Glycine max* (L.) merrill) is an important leguminous oilseed crop accounting for more than 50 per cent of oilseeds and about 30 per cent of the total supply of all vegetable oils (Tiwari, 2006). It is extremely resilient and performs even under severe water stress conditions, it has capacity to give profitable returns under minimum agricultural inputs and management practices. It is usually grown as *kharif* season crop under rainfed situation. The crop has a distinct behavior of improving soil fertility in a cropping system by the biological nitrogen fixation. Soybean is considered as a "Wonder Crop" or "Golden Bean" of the 21st century. Its seed contains 20 per cent oil, 40 per cent protein, 30 per cent carbohydrates, 4 per cent saponins, 5 per cent fibre and contains no cholesterol. First 30 days after sowing of soybean is critical with respect to weed competition. Being a rainy season crop it is heavily infested with grasses and broad leaf weeds. Weed infestation is considered as a complex constraint in soybean, as it influences growth and development as it complete for nutrients, water, light and space (Vollmann *et al.*, 2010). However, losses caused by weeds are depending on intensity and weed species involved. Kewat and Pandey (2001) reported that weeds species *Digitaria sangunalis*, *Echinochloa crusgalli*, *Dactyloctenium aegyptium* and *Cyperus rotundus* dominating weed species which affect the yield of soybean. A similar study was also conducted by Panda *et al*. (2015) at Jabalpur, clarified

that grassy weeds were predominant (76.25%) in the experimental field as compared to broad- leaved weeds (23.75%) recorded in soybean ecosystem. Weed interference during initial stages of crop establishment and significantly decreased crop up to 84 percent (Kachroo *et al.*, 2003 and Lal *et al*. (2017).

MATERIAL AND METHODS

Keeping the above facts in view the present experiment was conducted with an object to study the weed floral diversity field experiment was conducted at Breeder Seed Production farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during *Kharif* season 2019. A total 11 weed control treatments were laid out in Randomized Block Design with three replications. The soil of the experimental field was clay loam in texture. Sowing of soybean variety JS 20-69 was done manually at the rate of 80 kg/ha using normal package of practices for The data on various parameters related to weeds flora and density.

A. Weed flora of soybean

The dominant weed flora associated with soybean crop were *Echinochloa colona* and *Cyperus iria* among monocot weeds and *Alternenthera philoxer oides*, *Mollugo pentaphylla* and *Phyllanthus urinary* among dicot weeds. The most dominant weeds was soybean. Recommended dose of fertilizers (20 kg N + 60 kg P_2O_5 + 20 kg K_2O/ha) was applied through urea, single super phosphate and muriate of potash, respectively. The observations were made species-by-species at 30 DAS, the most crucial time for crops weed competition. The weed-infested plots were measured using a quadrate of 0.25 square meters (0.5 m × 0.5 m) in order to count the weeds by species. The formulas were used to convert the recorded data. From the weedy check plot, the percentage composition of weed flora was estimated. The relative density of individual weed was worked out as per formula suggested by Misra (1968).

$$\text{Density/m}^2 = \frac{\text{Total number of individuals of species}}{\text{Total number of quadrates plotted}}$$

$$\text{Relative Density (\%)} = \frac{\text{Number of individuals of the same species}}{\text{Number of individuals of all species}} \times 100$$

RESULTS AND DISCUSSION

Mollugo pentaphylla with maximum relative density (23.14%) followed by *Alternenthera philoxeroides* (14.89%), whereas monocot weeds contributed (49.99%) to relative density of weeds. However among the monocot *Echinochloa colona* marked its presence in more value i.e. 26.16% as compared to *Cyperus iria* (23.83%).

Table 1: Weed flora and relative density m^{-2} of weeds in weedy check plot at different stages.

Weed flora		Density (DAA)						
		15	30	45	60	At harvest	Mean	Relative Density (%)
Monocot weeds								
1	*Echinochloa colona*	8.67	21.50	36.58	63.00	49.00	35.75	26.16
2	*Cyperus iria*	8.59	17.25	33.67	56.30	47.00	32.56	23.83
Sub total							**68.31**	**49.99**
Dicot weeds								
3	*Alternentha philoxeroids*	5.87	12.63	25.25	32.00	26.00	20.35	14.89
4	*Mollugo pentaphylla*	9.75	25.25	37.75	44.70	40.67	31.62	23.14
5	*Phyllanthus urinaria*	7.03	13.33	20.83	22.67	18.00	16.37	11.98
Sub total							**68.34**	**50.01**
						Total	**136.65**	**100.00**

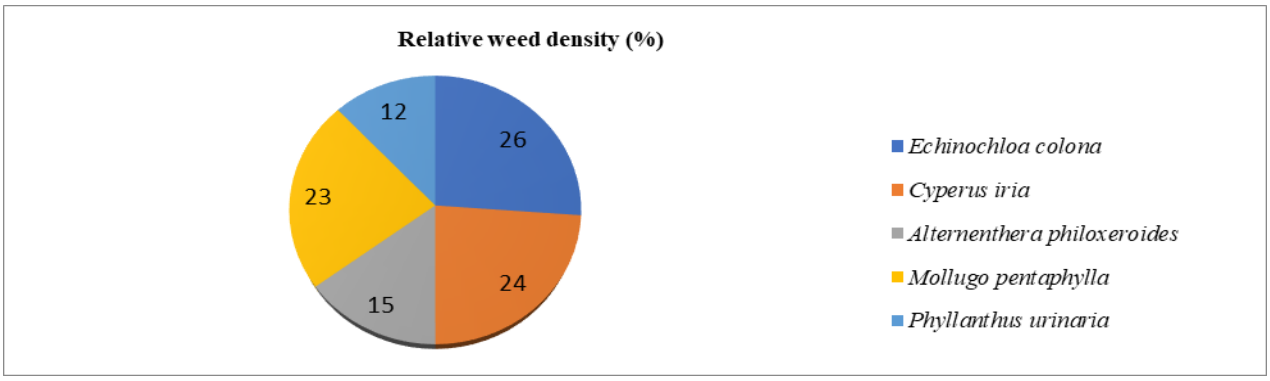

Fig. 1. Relative density of weed in the experiment field in control plots.

B. Weed density and weed dry weight

Weed density and dry weight of weeds at 30 DAA significantly affected due to different weed control treatments show in Table 2 & 3 and it is depicted graphically in Fig. 2 & 3. The density and dry weight of all these weeds were higher under control plot due to continue growth of weeds whereas no weed control practices were adopted in weed control plots. However, identical reduction in density and dry weight of weeds were recorded when weeds were controlled either chemically or mechanically. The application of Diclosulam 0.9% + Pendimethalin 35% SE ready mixture at the lowest dose 18 + 700 g ha^{-1} as pre plant incorporation at 30 DAA caused appreciable reduction in density (4.26 m^2) and dry weight (5.66 g/m^2).

Table 2: Influence of different weed control treatments on the density of weeds at 30 DAA.

Weed Density (g m^{-2})							
Treatments		**Dose (g/ha)**	***Echinochloa colona***	***Cyperus Iria***	***Alternanthera philoxeroides***	***Mollugo pentaphylla***	***Phyllanthus urinaria***
T_1	Diclosulam 0.9% + Pendimethalin 35% SE	18 + 700	4.01 (15.58)	3.01 (8.58)	2.55 (6.00)	2.74 (7.03)	2.90 (7.92)
T_2	Diclosulam 0.9% + Pendimethalin 35% SE	20.25 + 787.5	3.91 (14.75)	2.74 (7.00)	2.39 (5.23)	2.68(6.70)	2.78(7.25)
T_3	Diclosulam 0.9% + Pendimethalin 35% SE	22.5 + 875	3.66 (12.92)	2.68 (6.70)	2.22 (4.42)	2.45(5.50)	2.65(6.53)
T_4	Diclosulam 0.9% + Pendimethalin 35% SE	45 + 1750	3.57 (12.23)	2.51 (5.80)	2.04 (3.67)	2.34(5.00)	2.50(5.75)
T_5	Diclosulam 84 % WG	20.25	4.12 (16.45)	3.24 (9.97)	2.93 (8.08)	2.70(6.80)	2.91(8.00)
T_6	Diclosulam 84 % WG	22.50	3.92 (14.83)	3.23 (9.93)	2.91(8.00)	2.82(7.43)	2.93(8.07)
T_7	Pendimethalin 30 % EC	787.5	3.93 (14.92)	3.21 (9.80)	2.96(8.25)	2.93(8.07)	2.94(8.17)
T_8	Pendimethalin 30 % EC	875	3.98 (15.33)	3.17 (9.53)	2.92(8.03)	2.93(8.08)	2.97(8.30)
T_9	Pendimethalin 30 % EC +Imazethapyr 2 % EC	900 + 60	4.15 (16.75)	3.30 (10.8)	3.09 (9.03)	3.20(9.77)	2.99(8.47)
T_{10}	Hand weeding	20 & 40 DAS	1.22 (1.00)	1.35 (1.33)	1.22(0.98)	1.25(1.07)	1.22(1.00)
T_{11}	Weedy check (control)	-	4.69 (21.50)	4.21(17.25)	3.62(12.63)	5.07(25.25)	3.72(13.3)
		SEm±	**0.04**	**0.04**	**0.05**	**0.34**	**0.27**
		CD (p= 0.05)	**0.11**	**0.10**	**0.13**	**1.04**	**0.79**

* = The figures in the parenthesis are the original value and out of parenthesis are in the transformed value (√x+0.5)
DAA = Days after application

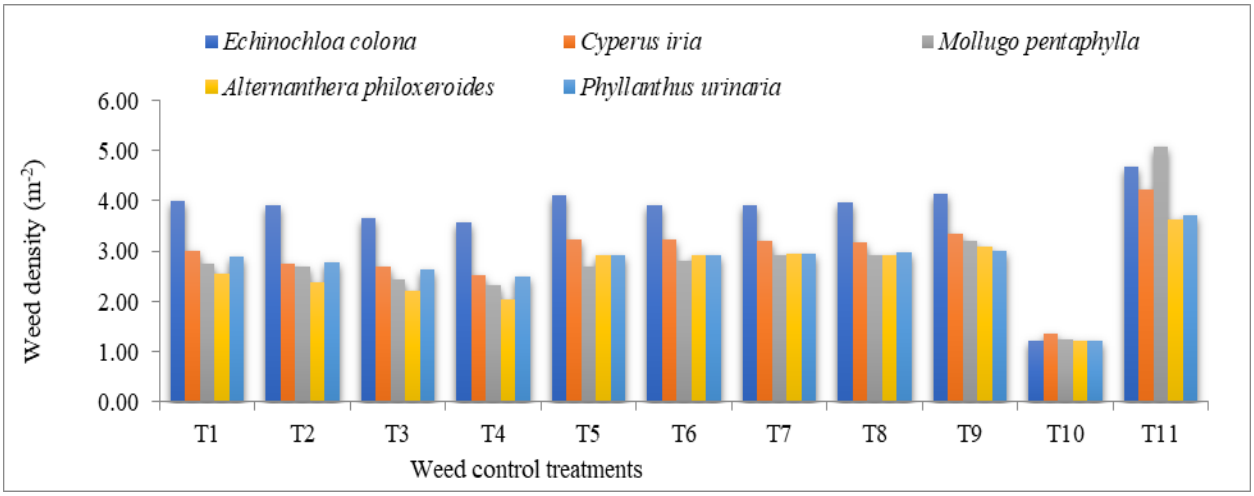

Fig. 2. Influence of different weed control treatments on weed density at 30 DAA.

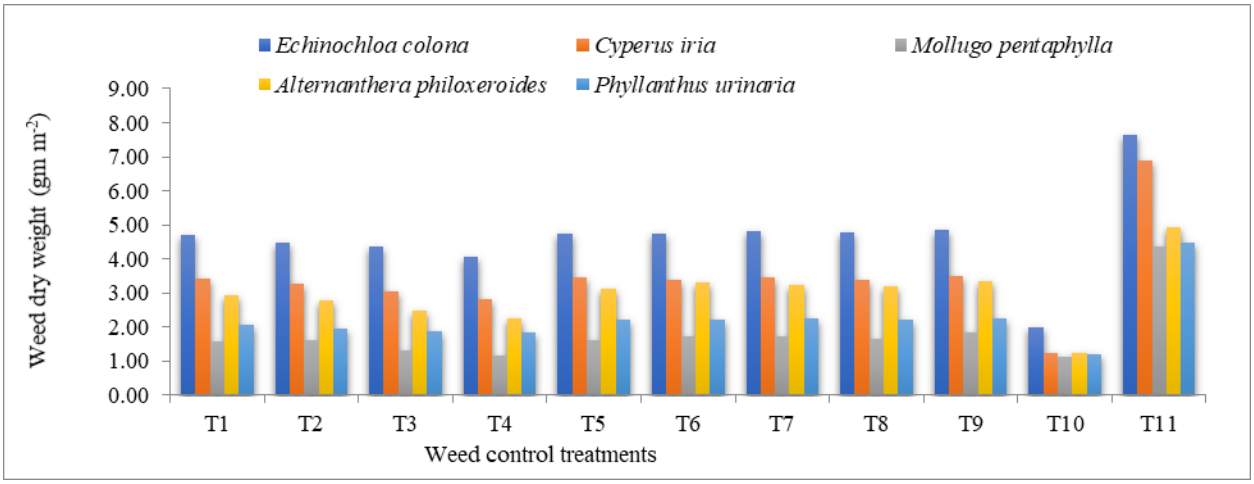

Fig. 3. Influence of different weed control treatments on weed dry weight at 30 DAA.

Table 3: Influence of different weed control treatments on the dry weight of weeds at 30 DAA.

Weed Dry weight (g m^{-2})							
Treatments		**Dose (g/ha)**	***Echinochloa colona***	***Cyperus Iria***	***Alternenthera philoxeroides***	***Mollugo pentaphylla***	***Phyllanthus urinaria***
T_1	Diclosulam 0.9% + Pendimethalin 35% SE	18 + 700	4.72 (21.77)	3.43 (11.27)	2.94 (8.16)	1.58 (2.01)	2.06(3.78)
T_2	Diclosulam 0.9% + Pendimethalin 35% SE	20.25 + 787.5	4.46 (19.38)	3.27 (10.18)	2.77 (7.19)	1.59 (2.04)	1.95(3.29)
T_3	Diclosulam 0.9% + Pendimethalin 35% SE	22.5 + 875	4.37 (18.62)	3.03 (8.67)	2.49 (5.68)	1.32 (1.25)	1.88(3.04)
T_4	Diclosulam 0.9% + Pendimethalin 35% SE	45 + 1750	4.06 (16.00)	2.80 (7.33)	2.25 (4.60)	1.18 (0.88)	1.84(2.90)
T_5	Diclosulam 84 % WG	20.25	4.73 (21.88)	3.46 (11.51)	3.13 (9.33)	1.62 (2.13)	2.21(4.37)
T_6	Diclosulam 84 % WG	22.50	4.73 (21.91)	3.39 (11.01)	3.30 (10.40)	1.74 (2.53)	2.22(4.43)
T_7	Pendimethalin 30 % EC	787.5	4.82 (22.75)	3.47 (11.53)	3.23 (10.02)	1.70 (2.41)	2.23(4.48)
T_8	Pendimethalin 30 % EC	875	4.76 (22.17)	3.38 (10.92)	3.20 (9.79)	1.65 (2.25)	2.21(4.40)
T_9	Pendimethalin 30 % EC +Imazethapyr 2 % EC	900 + 60	4.84 (22.91)	3.49 (11.67)	3.34 (10.69)	1.82 (2.83)	2.24(4.50)
T_{10}	Hand weeding	20 & 40 DAS	1.97 (3.43)	1.22 (0.99)	1.24 (1.03)	1.13 (0.78)	1.21(0.97)
T_{11}	Weedy check (control)	-	7.65 (58.08)	6.89 (47.00)	4.92 (23.66)	4.35 (18.50)	4.49(19.6)
		SEm±	**0.06**	**0.08**	**0.09**	**0.08**	**0.06**
		CD (p=0.05)	**0.17**	**0.22**	**0.26**	**0.24**	**0.17**

* = The figures in the parenthesis are the original value and out of parenthesis are in the transformed value (√x+0.5)
DAA = Days after application

Amongst all the herbicidal treatments the lowest weed density (2.59 m^2) and dry weight (2.42 g/m^2) was recorded under Diclosulam 0.9% + Pendimethalin 35% SE 45 + 1750 g ha^{-1} followed by Diclosulam 0.9% + Pendimethalin 35% SE 22.5 + 875 g/ha (2.73 $m^2$and 2.81 g/m^2) respectively. It is also reported by Patil *et al.* (2018). The density and dry weight of weeds were reduced (1.25 m^2 and 1.35 g/m^2) respectively over herbicidal treatments under hand weeding at 20 and 40 DAS due to elimination of all sorts of weeds.

Hand weeding twice at 20 and 40 DAS reduced the density and dry weight of weeds to the maximum extent over herbicidal treatments due to elimination of all sort of weeds in hand weeding. Similar views were also

endorsed by Patil *et al.* (2018) and Patidar *et al.* (2019). That reason might be due to have minimal density and dry weight of weeds under hand weeding due to elimination of all short of weeds in hand weeding. Similar findings were also reported by Patil *et al.* (2018) and Patidar *et al.* (2019).

C. Weed Control Efficiency (%)

Weed control efficiency (WCE %) of all the treatments have strong and negative association with weed dry weight. Among all the herbicidal treatments the highest weed control efficiency (81.00%) was recorded with the application of Diclosulam 0.9% + Pendimethalin 35% SE 45 + 1750 g ha^{-1} followed by Diclosulam 0.9% + Pendimethalin 35% SE at 22.5 + 875 g ha^{-1} (77.69%). However, the maximum (95.69%) WCE was observed under hand weeding.

The data on weed control efficiency (%) of weeds are presented in Table 4 and depicted graphically in Fig. 4. The reason might be due to the presence of Diclosulam 0.9% + Pendimethalin 35% SE ready mixture in non-lethal concentration at the site of action could be the reason for poor activity of Diclosulam 0.9% + Pendimethalin 35% SE ready mixture when applied at the lowest dose 18 + 700 g ha^{-1} but the reverse was true when it was applied at higher rates. It is also reported by Patil *et al.* (2018). These results were also recorded by Singh *et al.* (2009), Jha and Soni (2013) and Raskar and Bhoi (2002).

Table 4: Influence of different weed control treatments on weed control efficiency.

Treatments		Dose (g/ha)	Weed control efficiency (%)
T_1	Diclosulam 0.9% + Pendimethalin 35% SE	18 + 700	71.85
T_2	Diclosulam 0.9% + Pendimethalin 35% SE	20.25 +787.5	74.79
T_3	Diclosulam 0.9% + Pendimethalin 35% SE	22.5 + 875	77.69
T_4	Diclosulam 0.9% + Pendimethalin 35% SE	45 + 1750	81.00
T_5	Diclosulam 84 % WG	20.25	70.51
T_6	Diclosulam 84 % WG	22.50	69.87
T_7	Pendimethalin 30 % EC	787.5	69.33
T_8	Pendimethalin 30 % EC	875	70.26
T_9	Pendimethalin 30 % EC +Imazethapyr 2 % EC	900 + 60	68.48
T_{10}	Hand weeding	20 & 40 DAS	95.69
T_{11}	Weedy check (control)	-	0.00

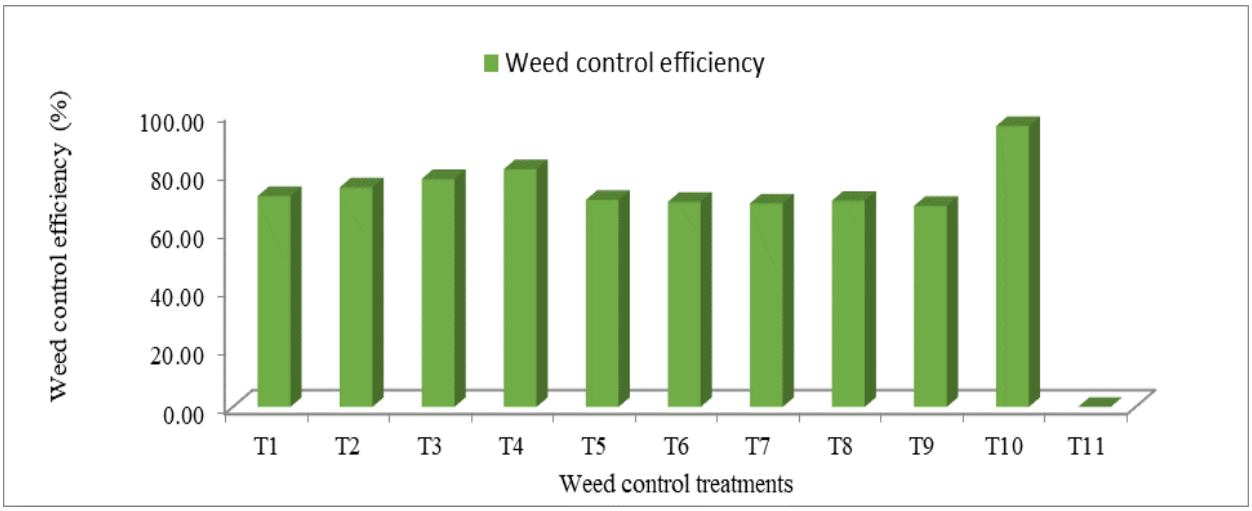

Fig. 4. Influence of different weed control treatments on weed control efficiency.

CONCLUSIONS

Based on the foregoing discussion it can be concluded that the dominant weed flora in the experiment field *Echinochloa colona* and *Mollugo pentaphylla* was predominant weed flora in experimental field during experiment. However, other monocots like *Cyperus iria* and dicots like *Alternenthera philoxeroides* and *Phyllanthus urinaria* were also found. Density and dry weight of weeds reduction was more pronounced when Diclosulam 0.9% + Pendimethalin 35% SE ready mixture was applied at higher rate *i.e*. from 20.25 + 787.5 to 45 + 1750 g ha^{-1} among all the herbicidal treatments. Thus, farmers can adopt the pre plant ncorporation application of Diclosulam 0.9% + Pendimethalin 35% SE ready mixture as a wise alternative for weed management in soybean crop.

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Conflict of interest. None.

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