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Bioefficacy of Diclosulam in soybean

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ABSTRACT

A farmer's participatory field experiment was conducted during two consecutive *kharif* seasons of 2019–20 and 2020-21 at farmer's fields in Bichhia village of Sehore district of Madhya Pradesh to assess the effect of pre emergence herbicide diclosulam on weeds and growth and yield of soybean. The application of pre-emergence diclosulam@26 g/ha gave 22.95 per cent higher seed yield as compared to farmer's practice. Further, application of pre-emergence diclosulam @ 26 g /ha treatment gave significantly higher pods per plant, plant height and straw yield of soybean and significantly reduced the weed count and weed dry matter as compared to all other treatments tested.

Key Words: Diclosulam, Herbicides, Seed yield, Soybean.

INTRODUCTION

Soybean, a vehicle of socioeconomic transformation for millions of small and marginal farmers of central India (Dupare *et al,* 2009; Sharma *et al,* 2016), is being commercially cultivated by the farmers since last 5 decades. The average productivity of soybean in India although, improved from 426 kg/ha during early 1970 to 1,219 kg/ha in 2016-17 (Anonymous, 2017), is stagnated at around 1,000 kg/ha since last few years and is a matter of concern. The ecological condition of Madhya Pradesh is congenial for soybean production, but the productivity is very low in Madhya Pradesh as compared to national productivity of soybean. Dhakad *et al* (2022) reported that the broad bed furrow sowing was significantly better in term of growth, seed index, yield and harvest index when compare with normal flatbed sowing of soybean crop. Soybean is a rainy season crop and it suffers severely due to excessive weed infestation. 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. Pendimethalin provide effective control of grass weeds, but are less effective on broad leaf weeds and sedges. Therefore, Malik *et al* (2006) suggested that application of herbicides may provide consisted weed control than single application of herbicide. Therefore, an on farm trial was conducted to assess the possibility of pre-emergence herbicides with management practices for effective weed control in soybean under Sehore District of Madhya Pradesh

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Table1. Weed species associated with soybean in On Farm Trials

Sr. No.	Hindiname	Englishname	Botanical name	Family
A	**Monocot weeds**			
1	JanglliSawan	Barnyardgrass	Echinochloa crus-galli	Gramineae
2	JanglliSawan	Wild rice	Echinochloa colonum	Gramineae
3	Samel	Indian Crowfoot Grass	Dinebra arebica	Poaceae
4	Chipkani	Foxtail	Setaria glauca	Poaceae
5	Diwalia	Cynotis	Cynotisaxillaris	Commelinaceae
6	Bokhana	Day flower	Commelina benghalensis	Commelinaceae
7	Motha	Prplenut sedge	Cyperus rotundus	Cyperaceae
8	Toli	Crab grass	Digitariarestroflexa	Poaceae
B	**Dicot weeds**			
1	Lehsua	Digera	Digerarvensis	Amaranthaceae
2	Bhangra	Mukand	Eclipta alba	Asteraceae
3	Jngli jute	Wild jute	Corchorus acutangulus	Tilliaceae
4	-	-	Tridax procumbens	Asteraceae
5	Badi dudhi	Badi dudhi	Euphorbia hirta	Euphorbiaceae
6	Gajarghas	Congress grass	Parthemium hysterophorus	Asteraceae
7	Jangli Choulai	Prickly chafflower	Achyranthes aspera	Amaranthaceae

Table 2. Effect of weed management treatments on weeds in soybean.

Treatment	Weed density (No/m^2)			Weed dry matter (g/m^2)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1- Post Emergence herbicide	9.07	8.4	8.74	16.92	16.67	16.79
T_2- Pendimethalin 30 EC@ 3.25.l / ha (PE)	13.54	12.65	13.10	40.14	47.23	43.68
T_3- Diclosulam 84 % WDG @ 26 g/ha(PE)	4.34	3.43	3.89	11.03	13.14	12.08
CD (P=0.05)	0.79	1.00	0.89	2.79	2.52	2.65

MATERIALS AND METHODS

The present trial was conducted at 10 farmer's fields with soybean variety JS 9560 and JS-2034. Each treatment was laid out in 4000 sqm area having fairly uniform topography. The village characterized by black vertisols mostly medium in depth, 60% area comes under medium black soil (30 to 60 cm depth) and about 20% deep black (more than 60 cm depth) and approximately 20% shallow black soil (30 cm depth). The soils were low in nitrogen (N), medium in phosphorus (P_2O_5) and medium in potash (K_2O). About 40 % soils of have been reported deficient in micro nutrient especially Zink (Zn), Sulpher (S) and Boron (B), soil pH rage in the scale of 7.3 to 7.8 making the soil fit for cultivation of wide range of crops.

The selected field was naturally infested with location specific weeds. Sehore is situated in sub-tropical zone of Vindhyan Plateau of Madhya Pradesh.The average annual rainfall varies from 1000 to 1200 mm, concentrated mostly from June to September. The mean annual maximum and minimum temperatures are 42.1^{0}Cand 21.2^{0}C, respectively. The weekly meteorological data *viz*., rainfall, temperature, relative humidity and number of rainy days during crop season were recorded in

Table 3. Effect of weed management treatments on no. of pods/ plant and seeds/pod in soybean.

Treatment	No. of pods plant^{-1}			No. of seeds pod $^{-1}$		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1- Apply Post Emergence herbicide	12.06	10.67	11.37	2.00	1.63	1.82
T_2- Pendimethalin 30 EC@ 3.25.liter / ha (PE)	9.12	10.14	9.63	1.98	1.55	1.77
T_3- Diclosulam 84 % WDG @ 26 g/ha(PE)	13.95	11.68	12.82	2.15	1.82	1.99
CD (P=0.05)	1.89	0.99	1.44	0.15	0.19	0.17

meteorological observatory of R.A.K. College of Agriculture, Sehore. The crop was line sown with row to row spacing of 35 cm. The treatmets were farmer's practice (post emergence herbicide twice) viz., Fenoxaprop-p-ethyl 1000 ml+ Chlorimuron ethyl 37g/ha at 15-20 DAS and Quizalofpo ethyl @ 1000 ml/ha at 35-40 days after sowing, pendimethalin@ 1000.ml/ha at pre-emergenceand diclosulam@ 26 g/haat pre-emergence. All the herbicides were applied manually by knapsack sprayer fitted with flat fan nozzle using spray volume of 500 litres/ha. Soybean was sown in the last week of June and harvested in last week of September. Recommended package of practices were followed to raise the crop. The observation on weed dry matter and weed count were recorded using quadrate (0.5 m X 0.5 m) at 40 DAS. Quadrate was randomly placed at two places in each plot for record weed intensity and plant population of soybean

RESULTS AND DISCUSSION

Weed density (Number/m^2) and Weed dry matter (g/m^2)

Different weeds species found during the crop season were identified and were listed (Table 1). Application of diclosulam @ 26 g/ ha at pre-emergence treatment found significantly superior with respect to lowest weed density and dry weight (Table 2). Further, apply post emergence herbicide twice under also significantly reduced the weed count and weed dry matter as compared to Application of Pendimethalin 30 EC@ 3.25.l/ha (Singh *et al*, 2009). The pre-emergence application of Diclosulam 84 % WDG @ 26 g/ ha was responsible for control of target weeds by inhibiting the plant enzyme, Aceto Lactate Synthase (ALS). Inhibition of ALS stops synthesis of 3 amino acids which are generally active in meristematic tissue (root/shoot tip). It is absorbed by roots and to a lesser extent shoots of germinating seedlings of weeds which prevents them from emerging.This affects protein synthesis and cell division ultimately leading to death of target weeds. Similar results were reported by Yadav *et al* (2017), Shaktawat *et al* (2017)and Singh *et al* (2009)

Yield attributes

All weed control treatments significantly affect the growth and yield attributes of soybean. It was revealed (Table 3) that all weed control treatments significantly increased the number of pods per plant, Number of seeds per pod as compared to farmer practice. Application of Diclosulam @ 26 g/ ha was

Table 4. Effect of weed management treatments on test weight (g) soybean.

Treatment	Test Weight (g)		
	2019-20	2020-21	Pooled
T_1 -Post Emergence herbicide	103.73	90.69	97.21
T_2- Pendimethalin 30 EC@ 3.25.l / ha (PE)	101.40	90.46	95.93
T_3- Diclosulam 84 % WDG @ 26 g/ha(PE)	104.20	91.34	97.77
CD (P=0.05)	1.73	0.65	1.19

Table 5. Effect of weed management treatments on Grain yield q ha^{-1}in soybean.

Treatments	Grain yield (q/ ha)			Straw yield (q/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1- Apply Post Emergence herbicide	10.42	6.47	8.45	19.79	12.29	16.05
T_2- Pendimethalin 30 EC@ 3.25.liter / ha (PE)	7.55	5.79	6.67	13.96	11.00	12.48
T_3- Diclosulam 84 % WDG @ 26 g/ha(PE)	12.79	7.99	10.39	26.85	15.18	21.02
CD (P=0.05)	2.37	1.52	1.94	7.06	2.89	4.97

superior over rest of the weed control treatments as regards all yield attributing traits namely number of pods plant^{-1} (12.82), number of seed/pod (1.99), and 1000 seed weight (97.7g) revealing the beneficial effect of weed free environment resulting in no competition between weed and crop plant at initial stage and vegetative stage of soybean. Similar results were reported by Similar results were reported by Thakare *et al (*2015).

Yield

The results of the study indicated that maximum seed yield (10.39 q/ ha) and straw yield (21.02 q/ ha) were obtained with application of Diclosulam 84 % WDG @ 26 g/ ha as compared to other. Seed yield was increased underapply twice spray of post emergence herbicide by 18.06 % over the treatment of Pendimethalin 30 EC@ 3.25.l/ ha average of the both year. The increase in soybean seed yield with applicatin of pre emergence herbicide Diclosulam 84 % WDG @ 26 g/ ha can be attributed to the fact that the crop was kept free of competition at the early critical stages of growth resulting in the crop using the land and climatic resources more efficiently. Similar results were reported by Natrajan *et al* (1997) and Nainwal *et al (*2010)

Economics

Among the weed control treatments, Diclosulam 84 % WDG @ 26 g/ ha pre emergence fetches the significantly highest net return and B: C ratio (Rs. 15978/ ha and1.68) followed by Pendimethalin 30 EC@ 3.25.l /ha pre emergence treatment. The lowest B:C ratio was observed under farmers practice as compared to all other treatments tested. Application of Diclosulam 84 % WDG @ 26 g/ha pre emergencetreatment good economic return of yield might be reason for highest net return and B:C ratio. Similar findings were also reported by Singh *et al* (2016) and Thakare *et al (*2015)

CONCLUSION

On the basis of two years resultsobtained from the present on farm assessment it was concluded that application of Diclosulam 84 % WDG @ 26 g/ha as pre emergence gave significantly higher grain yield as compare to Pendimethalin 30 EC@ 3.25.l/ ha and apply post emergence herbicide twice (farmer's practice). To gain feedback of farmers are application of Diclosulam 84 % WDG @ 26 g/ha as pre emergence is economically as compare to apply post emergence herbicide twice (farmer's practice) because increase cost.

Table 6. Effect of weed management treatments on Economics.

Treatments	Net return (Rs/ha)			B : C Ratio		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1- Post Emergence herbicide	7731	923	4327	1.37	1.04	1.21
T_2- Pendimethalin 30 EC@ 3.25.liter / ha (PE)	17159	2150	9655	1.77	1.10	1.44
T_3- Diclosulam 84 % WDG @ 26 g/ha(PE)	25104	6851	15978	2.07	1.29	1.68

Prepration of stock solution of Diclosulam

Spray of Diclosulam (PE)

Weed count with Qudrate method

Pod filling stage of Soybean

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