Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-10: 543-551

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-10 pp. 543-551**
Journal homepage: http://www.ijcmas.com

Original Research Article

Weed Management in Soybean (*Glycine max* L. Merrill) as Influenced by Imazethapyr 10 % SL Herbicide and its Phytotoxicity Effect on Crop

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A B S T R A C T

A field experiment was conducted in RCBD design at the Main Agricultural Research Station, UAS Dharwad on medium black soil during *kharif* 2016-17, comprising eight treatments *viz*., early post emergent (POE) application of Imazethapyr 10 % SL @ 75, 100, 125 and150 g a.i. ha^{-1}, Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} and pre emergent (PE) application of Pendimethalin 30 % EC @ 1.5 kg ha^{-1}, weed free check and weedy check. At 60 days after sowing early POE of Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} recorded lower total number of weeds m^{-2} (3.59), weed dry weight g m^{-2} (2.28) and good weed control efficiency (83.52 %). However, it was on par with the application of Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE. Application of Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE recorded higher soybean seed yield (18.08 q ha^{-1}), haulm yield (19.10 q ha^{-1}). Application of Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE recorded significantly lower weed count, dry weight and highest weed control efficiency, yielded less due to the phytotoxicity on soybean crop.

Keywords

Soybean, Imazethapyr, Weed count, Weed control effeciency, Soybean seed yield, Haulm yield, Phytotoxicity

Introduction

Soybean (*Glycine max* L. Merrill) is an introduced and commercially exploited crop in India. The crop is also called as "Golden Bean" or "Miracle crop" of the 21st century on account of its multiple uses. It has highest protein 40 %, oil 20 %, rich in lysine and vitamins A, B and D and also rich in mineral salts. One of the major reasons for the poor performance of soybean is inadequate and timely weed control measures. Weed infestation is becoming one of the major constraints in achieving potential yield. The crop is mainly cultivated during *kharif* conditions and is infested with various grassy, sedge and broad leaved weeds which emerge simultaneously with the crop plants and compete for essential nutrients, space and moisture causing substantial loss in yield (20-77 %) depending upon the nature, intensity and duration of infestation of weed flora and weed density (Kuruchania *et al.,* 2001). The crop weed competition lies between 15-45 days after sowing. To avoid competition during the early growth stages, soybean field should be kept free from weeds for the first 30-40 days after sowing. The progressive modernization of agriculture, intensive use of herbicides is gaining popularity in recent years due to lower cost, easy and timely application and effectiveness in controlling weeds. The importance of herbicides for improving crop productivity is not only popular in situations where labour is scarce and expensive. It has been proved beyond

doubt that the chemical weed control is cost effective compared to manual weeding (Bhan and Mishra, 1993).

Manual weeding although effective in reducing weed competition but it is not free from several limitations such as non availability of sufficient manpower during peak periods, high labour cost and time consuming. Hence, it necessitates search for early post emergence herbicides like Imazethapyr 10 % SL like for effective and economical control of weeds (Sangeetha *et al.,* 2012).

Materials and Methods

The field experiment was carried out at Main Agricultural Research Station, Dharwad, during *kharif*-2016 to study the "Weed management in Soybean (*Glycine max* L. Merrill) as influenced by Imazethapyr 10 % SL herbicide and its phytotoxicity effect on crop"

The experiment was replicated thrice in Randomized Complete Block Design. There were eight treatment combinations consisted of Imazethapyr 10 % SL @ 75, 100, 125 and 150 g a.i. ha^{-1} as early POE, Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE, Pendimithalin 30 % EC @ 1.5 kg ha^{-1} as PE, weed free check and weedy check. The soil was medium deep black with pH 7.10. The available N, P_2O_5 and K_2O contents were 252, 32.5 and 292.8 kg ha^{-1}, respectively. The gross plot size was 7.2 m × 5 m and net plot size was 6.6 m × 4.8 m.

Seeds were treated using *Rhizobium* and Phosphorus solubilizing bacteria @ 1250 g per hectare. Two seeds per hill were dibbled 5 cm deep in furrows at a spacing of 30 cm x 10 cm. N, P_2O_5 and K_2O (40: 80: 25 kg ha^{-1}) were applied as per recommendation along with gypsum @ 100 kg ha^{-1}. Pendimithalin 30 % EC @ 1.5 kg ha^{-1} was applied as per treatments on the day of sowing, and after 18 days of sowing early post emergence was applied as per the treatments. Phytotoxicity ratings were taken 7, 14 and 21 days after spraying of herbicide and weed observations were recorded with respect to weed dynamics after at 60 DAS (Rao 1986) (Table 1). The data was statistically analysed as per the procedure given by Gomez and Gomez (1983).

Results and Discussion

Grassy weeds count

At 60 DAS, among different herbicide treatments, Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE recorded the lower grassy weeds m^{-2} area (1.63) as compared to other treatments. However, it was on par with Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE, Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE and Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE (1.82, 1.90 and 1.97, respectively). (Table. 2)

Broad leaved weeds

At 60 DAS, among different herbicide treatments, Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE recorded the lower broad leaved weeds m^{-2} area (1.99) as compared to other treatments. However, it was on par with Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE, Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE and Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE (2.14, 2.30 and 2.44, respectively). (Table. 2)

Sedges

At 60 DAS, among different herbicide treatments, Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE recorded the lower

sedges m^{-2} area (1.90) as compared to other treatments. However, it was on par with Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE (2.31) and followed by Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE, Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE and Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE (2.44, 2.44 and 2.44, respectively). (Table. 2)

The present investigation results are similar with the works of Kundu *et al.,* (2011), Sangeetha *et al.,* (2012) and Gare *et al.,* (2016), revealed that higher the dose of Imazethapyr 10 % SL controlled weeds in soybean field effectively.

Total number of weeds

At 60 DAS, among different herbicide treatments, Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE recorded the lower total number of weeds m^{-2} area (2.89) as compared to other treatments. However, it was on par with Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE (3.36) and followed by Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE and Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE (3.59 and 3.74, respectively) (Table 2).

Phytotoxicity ratings on soybean crop

Higher phytotoxicity ratings recorded at 7, 14 and 21 days after herbicide spraying in Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE (3.67, 1.67 and 0.67, respectively). Howerer, it was followed by Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE (2.34, 1.40 and 0.00, respectively) and Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE (1.34, 1.00 and 0.00, respectively).

There was no phytotoxicity recorded in Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE (Table 3). Similar findings were reported by Sangeetha *et al.,* (2012).

Dry weight of weeds

At 60 DAS, among different herbicide treatments, Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE recorded significantly lower weed dry weight (1.99 g m^{-2}) as compared to other treatments. However, it was on par with Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE and Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE (2.06 and 2.28 g m^{-2}, respectively) (Table 4).

Table.1 Qualitative description of treatment effects on crop in the visual scoring scale of 0 to 10 (Rao, 1986)

Effect	Rating	Description crop
None	0	No injury, normal
Slight	1	Slight stunting, injury or discoloration
	2	Some stand loss, stunting or Discoloration
	3	Injury more pronounced but not persistent
Moderate	4	Moderate injury, recovery possible
	5	Injury more persistent, recovery doubtful
	6	Near severe injury, no recovery possible
Severe	7	Severe injury, stand loss
	8	Almost destroyed, a few plants surviving
	9	Very few plants alive
Complete	10	Complete destruction

Table.2 Number of grassy weeds, broad leaved weeds, sedges and total number of weeds at 60 DAS as influenced by Imazethapyr 10 % SL at different doses as early POE

Treatments	Grassy weeds (m^{-2})	Broad leaved weeds (m^{-2})	Sedges (m^{-2})	Total number of weeds m^{-2}
T_1 = Imazethapyr 10 % SL @ 75 g a.i. ha^{-1} as early POE	2.43* (5.00)	2.63* (6.00)	2.76* (6.67)	4.32* (17.67)
T_2 = Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE	1.90 (2.67)	2.30 (4.30)	2.44 (5.00)	3.59 (12.00)
T_3 = Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE	1.82 (2.33)	2.14 (3.67)	2.31 (4.33)	3.36 (10.33)
T_4 = Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE	1.63 (1.67)	1.99 (3.00)	1.90 (2.67)	2.89 (7.33)
T_5 = Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE	1.97 (3.00)	2.44 (5.00)	2.44 (5.00)	3.74 (13.00)
T_6 = Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE	2.28 (4.33)	2.58 (5.67)	2.44 (5.00)	3.98 (15.00)
T_7 = Weed free check	1.41 (1.00)	1.41 (1.00)	1.41 (1.00)	2.00 (3.00)
T_8 = Weedy check	3.56 (11.67)	3.64 (12.33)	3.60 (12.00)	6.08 (36.00)
S.Em. ±	0.15	0.16	0.13	0.15
C.D. at 5 %	0.47	0.49	0.40	0.46

Early POE : Early Post Emergence **PE:** Pre Emergence **DAS:** Days after sowing, * Figures indicate square root transformed values ($\sqrt{(x+1)}$)

Table.3 Phytotoxicity ratings on soybean as influenced by Imazethapyr 10 % SL at different doses as early POE

Treatments	Phytotoxicity ratings on soybean		
	7 DAHS	14 DAHS	21 DAHS
T_1 = Imazethapyr 10 % SL @ 75 g a.i. ha^{-1} as early POE	0.34	0.00	0.00
T_2 = Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE	1.34	1.00	0.00
T_3 = Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE	2.34	1.40	0.00
T_4 = Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE	3.67	1.67	0.67
T_5 = Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE	0.34	0.00	0.00
T_6 = Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE	0.00	0.00	0.00
T_7 = Weed free check	-	-	-
T_8 = Weedy check	-	-	-

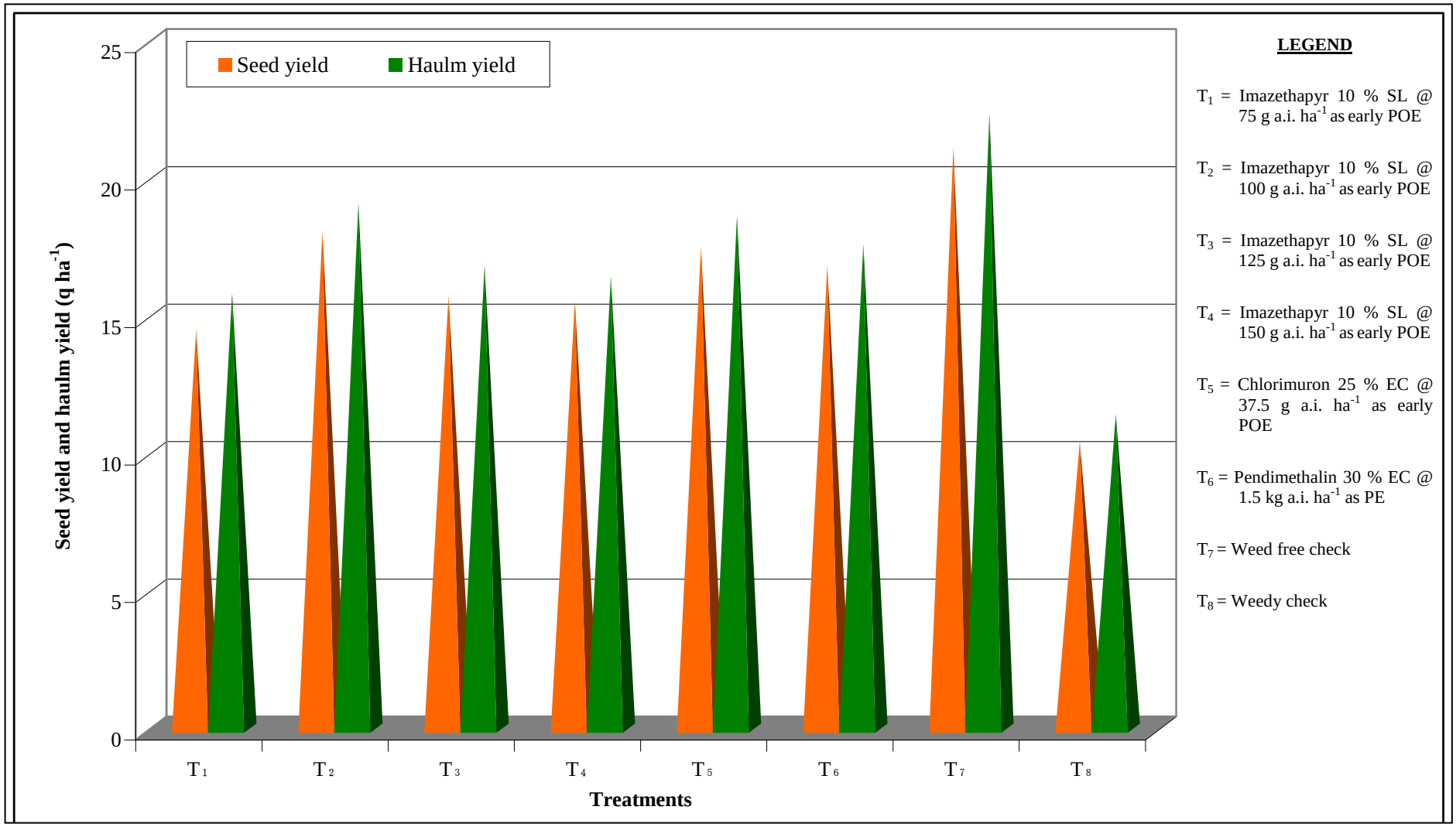
Early POE: Early Post Emergence **PE:** Pre Emergence **DAHS:** Days after Herbicide spraying

Table.4 Weed dry matter, Weed control efficiency at 60 DAS and yield of soybean as influenced by Imazethapyr 10 % SL at different doses as early POE

Treatments	Weed dry matter (g m^{-2})	Weed control efficiency (%)	Weed index (%)	Seed yield (q ha^{-1})	Haulm yield (q ha^{-1})
T_1 = Imazethapyr 10 % SL @ 75 g a.i. ha^{-1} as early POE	2.75* (6.58)	73.60	30.41	14.52	15.83
T_2 = Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE	2.28 (4.21)	83.52	14.27	18.08	19.10
T_3 = Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE	2.06 (3.25)	86.98	25.23	15.73	16.84
T_4 = Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE	1.99 (2.95)	88.51	25.92	15.53	16.44
T_5 = Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE	2.41 (4.85)	80.54	16.92	17.50	18.65
T_6 = Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE	2.43 (4.95)	80.80	19.82	16.82	17.61
T_7 = Weed free check	1.23 (0.51)	98.05	-	21.12	22.36
T_8 = Weedy check	5.16 (25.68)	-	50.32	10.42	11.42
S.Em. ±	0.12	2.03	3.05	0.76	0.89
C.D. at 5 %	0.36	6.17	9.25	2.30	2.69

Early POE : Early Post Emergence **PE:** Pre Emergence **DAS:** Days after sowing, * Figures indicate square root transformed values ($\sqrt{(x+1)}$)

Fig.1 Seed yield and haulm yield as influenced by Imazethapyr 10 % SL at different doses as early POE



Weed control efficiency

At 60 DAS, among different herbicide treatments, Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE recorded significantly higher weed control efficiency (88.51 %) as compared to other treatments. However, it was on par with Imazethapyr 10 % SL @ 125 g a.i. ha^{-1} as early POE and Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE (86.98 and 83.52 % respectively) and it was followed by Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE and Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE (80.80 and 80.54 %, respectively). (Table. 4)

Weed index

Among different herbicide treatments Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE recorded significantly lower weed index (14.27 %) as compared to other treatments. However, it was on par with Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE and Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE (16.92 and 19.82 %, respectively). (Table. 4)

Seed yield and haulm yield

Among different herbicide treatments, significantly higher seed yield (18.08 q ha^{-1}) was recorded with the Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE compared to other treatments. However, it was on par with Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE and Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE (17.50 and 16.82 q ha^{-1}, respectively) and significantly lower seed yield recorded in Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE and Imazethapyr 10 % SL @ 75 g a.i. ha^{-1} as early POE (15.53 and 14.52 q ha^{-1}, respectively). (Table. 4 and Fig1)

Among different herbicide treatments, Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} as early POE recorded the higher haulm yield (19.10 q ha^{-1}) as compared to other treatments. However, it was on par with Chlorimuron 25 % EC @ 37.5 g a.i. ha^{-1} as early POE and Pendimethalin 30 % EC @ 1.5 kg a.i. ha^{-1} as PE (18.65 and 17.61 q $ha^{-1,}$ respectively) and significantly lower haulm yield recorded in Imazethapyr 10 % SL @ 150 g a.i. ha^{-1} as early POE and Imazethapyr 10 % SL @ 75 g a.i. ha^{-1} as early POE (16.44 and 15.83 q ha^{-1}, respectively). (Table. 4 and Fig1)

At higher dose of Imazethapyr 10 % SL causes phytotoxicity on soybean crop. Hence yield was reduced with the application of Imazethapyr 10 % SL at higher doses. Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} decreased competition of weed with crop for space, water, air, nutrients and sunlight because of their effectiveness as early post emergence and less phytotoxicity compare to higher doses. Our findings are accordance with those of Kundu *et al.*, (2011).

In conclusion, the investigation revealed that application of Imazethapyr 10 % SL @ 100 g a.i. ha^{-1} was good weed controller in soybean and less phyotoxicity on soybean. Imazethapyr 10 % SL @ 150 and 125 g a.i. ha^{-1} as early post emergent even though effective against weeds in soybean ecosystem but phyotoxicity effect on soybean was more.

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