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EFFECT OF IMAZETHAPYR + IMAZAMOX ON WEED CONTROL IN SOYBEAN

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ABSTRACT

A field experiment was carried out during the *kharif* season of 2015-16 at Agronomy Farm, College of Agriculture, Nagpur to study the relative efficacy of herbicides on weed control in soybean.Weed control through herbicidal treatment in combination with mechanical weed control viz., Imazaethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_{10}), Imazethapyr + Imazamox @75 g a.i. ha^{-1}at 20 DAS + 1 hoeing at 35 DAS (T_9) and Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_7), Pre-emergence Pendimethalin @ 1 kg a.i. ha^{-1} + 1 hoeing at 35 DAS (T_8) were found comparable to weed free (T_2) treatment in respect of reduction in weed population, weed dry matter and weed index. Weed free check treatment being at par with herbicidal treatment provided most effective control of weeds throughout the crop growth period of soybean, thereby improving growth and yield contributing characters and consequently recorded highest seed and straw yield.

(Key words. soybean, Imazethapyr , Imazamox weed control)

INTRODUCTION

Soybean (*Glycine max*. L.) is one of the important oilseed as well as leguminous crop prefered as a miracle "Golden bean" of the 21st century mainly due to its high protein (40%) and oil (20%) content. Soybean revolutionized the rural economy and improved socio-economic status of farmers. Soybean cultivation has placed India on the world map in recent past. Soybean has not only gained the vital importance in Indian Agriculture, but also plays a decisive role in oil economy of India.

Soybean being *kharif* season and slow growing crop, in early growth stages severe weed competition, resulting in a loss of about 40-60% of the potential yield, depending on the intensity, nature and duration of weed competition. It is heavily infested with grasses, sedges and broad leaf weeds which proliferates intensively due to slow crop growth during the initial period.

The losses comprised of direct yield loss resulting from cropweed competition and indirect losses from reduced crop quality, increased cost of cultivation incidence of insect pest and diseases. In soybean crop first 20 to 45 days after sowing is considered as the most critical period for crop weed competition and weeds are to be kept under control for optimum yield (Sharma, 2007).

Pre and post emergence application of herbicides is becoming popular and regarded as one of the most labour saving innovation in modern agriculture which helps to minimize the crop weed competition during critical growth stages resulting in higher crop yields. Recently some new molecular selective post-emergence herbicide viz., Imazethapyr, Imazathapyr + Imazamox are being marketed with the assurance of selective control of early post emergent weeds in soybean.

Hence, present investigation was conducted to study the "Effect of Imazethapyr + Imazamox on weed management in soybean (*Glycine max* L.)" with the object to study the efficacy of newer molecule of herbicide on weed management in soybean.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of 2015-2016 at Agronomy Section, College of Agriculture, Nagpur. The experiment was laid out in randomized block design with ten treatments replicated thrice. The treatments comprised of Weedy check (T_1), Weed free (T_2), Imazethapyr @ 75 g a.i. ha^{-1}at 20 DAS (T_3), Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1} (T_4), Imazethapyr + Imazamox @ 75 g a.i. ha^{-1}at 20 DAS (T_5), Imazethapyr + Imazamox @ 100 g a.i. ha^{-1}at 20 DAS (T_6) and

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combination of chemical and mechanical weed management practices i.e. Imazethapyr @ 75 g a.i. ha^{-1}at 20 DAS + hoing at 35 DAS (T_7), Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1} + 1 hoing at 35 DAS (T_8), Imazethapyr+ Imazamox @75 g a.i ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_9) and Imazethapyr+ Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_{10}). Soybean variety NRC-37 was grown at 45 x 05 cm spacing with 30:75:00 NPK kg ha^{-1} on clayey soil with slightly alkaline in reaction (pH 7.7). The soil was moderate in organic carbon, low in nitrogen, medium in available phosphorus and high in potassium. The recommended production practices were followed for soybean cultivation.

For weed population study in each net plot, by using a quadrate of 1m x 1m area was randomly fixed. Number of weed observed in that area was counted at 30 days interval. The weed samples were collected at 30, 60, 90 days and at harvest from 1.0 m^2 area and allow them to air dry for few days. The dry weight of weeds was recorded after weed samples were oven dried at 70°C and expressed in gram.

The weed control efficiency was calculated by the following formula (Gautam *et al*., 1975).

$$WCE\ (\%) = \frac{DMC\text{-}DMT}{DMC} x100$$

Where,

WCE : Weed control efficiency

DMC : Dry matter of weeds in control plots

DMT : Dry matter of weeds in treated plots

The weed index was calculated by the formula proposed by Gill and Vijaykumar, (1969).

$$WI = \frac{X - Y}{X} \times 100$$

Where,

WI - Weed index in per cent

X - Yield from maximum yielding plot

Y - Yield under the treatment for which weed index is to be calculated

RESULTS AND DISCUSSION

The experimental field was infested with *Cyperus rotundus,, Lagasca mollis, Digera arvensis, Parthenium hysterophorus, Celosia argentea, Euphorbia spp. Alternanathera triandra,Phyllanthus niruri,, Commelia bengalensis.* The data presented in table 1 revealed that the weed control treatments influenced significantly the total weed count m^{-2} at all the growth stages of soybean crop.

Weed count and weed control efficiency

At 30 DAS, weed free check treatment (T_2) recorded significantly lowest total weed count m^{-2} amongst all the other treatments. In respect of herbicidal treatments, application of Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1} + 1 hoing at 35 DAS (T_8),Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1} (T_4),Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_{10}), Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS (T_6), Imazethapyr+ Imazamox @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_9) and Imazethapyr + Imazamox @ 75 g a.i. ha^{-1} at 20 DAS(T_5), were found significantly lower in recording weed count m^{-2} over weedy check (T_2). Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS (T_3) and Imazethapyr @ 75 g a.i. ha^{-1} 20 DAS + 1 hoeing at 35 DAS (T_7), however, these treatments were found at par with each other.The weedy check treatment (T_1) recorded significantly higher total weed count m^{-2} at 30 DAS.

At 60 DAS and 90 DAS treatment weed free check (T_2) recorded significantly lower total weed count m^{-2} over rest of the treatments. Amongst herbicidal weed control treatments, application of Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_{10}) recorded significantly lowest total weed count m^{-2} than other treatments but was at par with treatments Imazethapyr + Imazamox @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_9),Imazethapyr @ 75 g a.i. ha^{-1} 20 DAS + 1 hoeing at 35 DAS (T_7),Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1} + 1 hoeing at 35 DAS (T_8). Weedy check (T_1) recorded maximum number of total weeds m^{-2}.

The total weed count m^{-2} was reduced significantly due to various weed control treatments at all stages of crop growth. This might be due to the herbicidal application alone and in combination with hoeing operation at 35 DAS which were effective in timely reducing total weed population. Similar results were reported by Mishra *et al.* (2013) that application of odyssey (Imazethapyr + Imazamox) between 75 g and 100 g ha^{-1} with 1000 ml adjuvant ha^{-1} as early post-emergence, controlled most of the weed flora and improve the weed control index as compared to weedy check.

The highest weed control efficiency was observed in treatment weed free check (T_2) from 30 DAS up to harvest, because of keeping weed free environment and found superior over rest of all herbicidal treatments. Among the herbicidal treatments, data revealed that at 30 DAS,Pre-emergence Pendimethalin @ 1 kg a.i. ha^{-1} + 1 hoing at 35 DAS (T_8), recorded highest weed control efficiency followed by treatment Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1}(T_4),Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_{10}),Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} 20 DAS (T_6). Lowest weed control efficiency was observed with treatment Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS(T_3).

The highest weed control efficiency was recorded in treatment weed free (T_2) from 30 DAS up to at harvest, because of keeping weed free environment, very less crop-weed competition occured that produced less weed biomass and found superior over rest of all herbicidal treatments. Amongst the various herbicidal treatments, Imazethapyr +

Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_{10}) recorded maximum weed control efficiency from 60 DAS up to harvest, it might be due to combination of both herbicide application and hoeing at 35 DAS that have longer effect on controlling the monocot as well as dicot weed population producing less weed biomass and thereby increasing weed control efficiency. In consistent with this results Girothia and Thakur (2006) also reported highest weed control efficiency by the weed free treatments (93.8%) followed by Imazamox + Imazethapyr at 1000 ml (84.8%) common product and Imazethapyr at 100 g a.i. ha^{-1} (79.7%). Also Kothawade *et al.* (2007) conducted a field experiment at Rahuri, during k*harif* season and concluded that application of Odyssey (Imazamox + Imazethapyr) at 0.8 and 1.0 litre ha^{-1} recorded the greatest weed control efficiency (75.77 and 76.15%) and lowest weed index (2.33 and 1.82%), respectively.

Dry matter production by weeds and yield

At 30 DAS, the treatment T_2- weed free check produced significantly lower dry matter over rest of the treatments. Regarding the herbicidal treatments, treatment T_8–Pre-emergence Pendimethalin @ 1 kg a.i.ha^{-1} + 1 hoing at 35 DAS being statistically at par with other treatments viz., T_4-Pre-emergence Pendimethalin @ 1 kg a.i.ha^{-1}, T_{10}-Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS, T_6-Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS, T_9-Imazethapyr+ Imazamox @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS and T_5-Imazethapyr + Imazamox @ 75 g a.i. ha^{-1} at 20 DAS and recorded significantly lower weed dry matter m^{-2} over weedy check (T_1), Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS and Imazethapyr @ 75 g a.i. ha^{-1}at 20 DAS + 1 hoeing at 35 DAS.

At 60, 90 DAS weed free (T_2) treatment recorded significantly lowest weed dry matter, amongst all the other treatments. In respect of the different herbicidal treatments applied, Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_{10}), recorded significantly lowest weed dry matter than weedy check (T_1) and other herbicidal treatments found at par with treatments Imazethapyr + Imazamox @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_9), Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_7), Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1} + 1 hoeing at 35 DAS (T_8). The alone application of pre-emergence Pendimethalin @ 1 kg a.i. ha^{-1} was not effective in lateral stages of crop growth.

The lowest weed dry matter was observed in weed free (T_2) because of keeping weed free environment during different stages of crop growth. Among the herbicidal treatments, from 60 DAS onward highest reduction of weed dry matter, might be due to combination of both herbicides and hoeing operation that have longer effect on controlling weed population and brought significant reduction in weed dry matter as compared to weedy check.These results are in agreement with the results reported by Upadhaya *et al.* (2012). They reported maximum weed control efficiency with the application of Imazethapyr + Imazamox (87.5 g) combined with hoeing operation and reduced the dry weight weed than the weedy check. Wadafale *et.al*. (2011) also reported that lower weed count, weed dry matter and higher weed control efficiency was obtained with the application of Imazethapyr @ 75g a.i. ha^{-1} at 15 DAS + 1 hoeing and 1 hand weeding at 35 DAS.

The seed yield and straw yield ha^{-1} of soybean was significantly influenced by various weed control treatments. The treatment of weed free check (T_2) produced significantly maximum soybean seed yield (1503 kg ha^{-1}) and straw yield (2122 kg ha^{-1}) as compared to other treatments. However, the integrated weed control treatments viz., Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_{10}),Imazethapyr + Imazamox @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_9),Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS (T_7), Pre-emergence Pendimethalin @ 1 kg a.i. ha^{-1} + 1 hoeing at 35 DAS (T_8),recorded statistically similar seed yield and straw yield ha^{-1} with the treatment of weed free check (T_2). The control treatment (T_1) i.e. weedy check recorded lowest soybean seed yield (839 kg ha^{-1}).

Different weed management practices significantly improved the seed and straw yield over weedy check; this might be due to the better weed control associated with decrease in weed population and improvement in yield contributing characters in these treatments. This result is in accordance to the findings of Meena *et al.* (2012).They observed that maximum grain yield (17.94 q ha^{-1}) was recorded under weed free treatment (two hand weeding) which was at par with treatment of Imazamox + Imazethapyr. Singh *et al.* (2016) revealed that among weed management practices, application of Imazaethapyr @ 35 g a.i.ha^{-1} + Imazamox@ 35 g a.i.ha^{-1} was the best weed management practice in soybean to obtain higher seed yield ha^{-1} and B:C ratio followed by chlorimuron ethyl 9 g ha^{-1}+ Quizalofop ethyl 50 g ha^{-1}

Hence, in situation where timely weeding is not feasible due to paucity and high cost of labour as well as unfavorable weather and soil condition, integrated weed management through post emergence application of Imazaethapyr + Imazamox @ 75 or 100 g a.i.ha^{1} at 20 DAS + 1 hoeing at 35 DAS or Imazethapyr @ 75g a.i. ha^{1} at 20 DAS + 1 hoeing at 35 DAS or Pre-emergence Pendimethalin @ 1 kg a.i. ha^{-1} + 1 hoing at 35 DAS may be preferred to farmers practice for better weed management in soybean.

Table 1. Mean total weed count, mean weed dry matter, weed control efficiency and yield as influenced by different treatments

Treatments	Total weed count m^2			Weed dry matter (g)			Weed control efficiency			Weed index (%)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS			
T_1 :Control (Weedy check)	35.34 (5.99)	66.17 (8.29)	91.90 (9.61)	13.51 (3.74)	52.49 (7.28)	60.67 (7.82)	-	-	-	44.18	839	1425
T_2 :Weed free check	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	100.00	100.00	100.00	-	1503	2122
T_3 :Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS	25.30 (5.08)	40.40 (6.40)	50.34 (7.13)	5.65 (2.48)	16.18 (4.08)	27.23 (5.27)	58.18	69.18	55.12	18.90	1219	1803
T_4 : Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1}	16.05 (4.07)	39.72 (6.34)	48.33 (6.99)	3.07 (1.89)	16.75 (4.15)	28.87 (5.42)	77.28	68.09	52.41	24.88	1129	1724
T_5 : Imazethapyr + Imazamox @ 75 g a.i. ha^{-1} 20 at DAS	18.18 (4.32)	34.34 (5.90)	42.82 (6.58)	4.01 (2.12)	15.40 (3.99)	24.10 (4.96)	70.32	70.66	60.28	17.70	1237	1812
T_6 :Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS	17.39 (4.23)	30.40 (5.56)	39.54 (6.33)	3.52 (2.00)	14.65 (3.89)	22.50 (4.80)	73.95	72.09	62.91	16.77	1251	1825
T_7 :Imazethapyr @ 75 g a.i. ha^{-1} 20 DAS + 1 hoeing at 35 DAS	21.76 (4.72)	19.94 (4.52)	26.67 (5.21)	5.50 (2.45)	10.80 (3.36)	17.30 (4.22)	59.29	79.42	71.49	7.32	1393	1988
T_8 : Pre- emergence Pendimethalin @ 1 kg a.i. ha^{-1}+ 1 hoeing at 35 DAS	15.00 (3.94)	21.22 (4.66)	30.50 (5.57)	2.77 (1.81)	11.56 (3.47)	18.06 (4.31)	79.50	77.98	70.23	8.32	1378	1977
T_9 :Imazethapyr + Imazamox @ 75 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS	17.87 (4.29)	18.36 (4.34)	25.68 (5.12)	3.90 (2.10)	10.22 (3.27)	17.01 (4.18)	71.13	80.53	71.96	5.72	1410	2015
T_{10} :Imazethapyr + Imazamox @ 100 g a.i. ha^{-1} at 20 DAS + 1 hoeing at 35 DAS	16.50 (4.12)	16.67 (4.14)	24.67 (5.02)	3.45 (1.99)	9.40 (3.15)	16.29 (4.10)	74.46	82.09	73.15	3.66	1448	2069
SE (m) ±	0.25	0.26	0.27	0.11	0.13	0.16					42.00	49.00
CD at 5%	0.75	0.80	0.82	0.32	0.39	0.48					125.00	147.00
GM	4.15	5.09	5.83	2.13	3.74	4.58					1281	1887

Upper values are original values

Figures in parentheses are transformed values($\sqrt{x + 0.5}$)

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