RESEARCH ARTICLE

EFFECT OF POST EMERGENCE HERBICIDES ON GROWTH AND YIELD OF SOYBEAN

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Received-02.02.2019, Revised-24.02.2019

Abstract: Soybean (*Glycine max* L. Merrill) is one of the commercial crops in India. It grown as *kharif* crop, but weed infestation is the major constraint in soybean produce in rainy season A field experiment was conducted at Research farm, Department of Agronomy, Jawaharlal Nehru Kirshi Vishwa Vidyalaya, Jabalpur (M.P.) during *kharif* 2016 to evaluate the bio-efficacy of post emergence herbicides against weed control in soybean. Among all herbicidal treatment the post emergence application of Imazethapyr+Propaquizafop 75.0+62.5 g/ha recorded highest number of pods/plant (26.10), higher number of seed/pod (2.40), 100 seed weight (9.93), seed yield (2100 kg/ha), haulm yield (3900 kg/ha), net returns (26585 Rs/ha) and B:C ratio (1.75), which was comparable with the application of Imazethapyr + Bentazone 75+75 g/ha.

Keywords: Herbicide, Benefit cost ratio, Net return, Weed control efficiency

INTRODUCTION

Soybean (*Glycine max* L. Merrill) is one of the commercial crops in India. It is called "Golden Bean" or "Miracle crop" of the 21st century because of its multiple uses, which contains 35-40% protein, 19% oil, 35% carbohydrate, 5% minerals and several other components including vitamins. The quality of soya protein is equivalent to that of animal protein and is also a good source of dietary fibre, calcium, magnesium, phosphate, thiamine, riboflavin, niacin etc. It has been reported to have in India it is grown under 11.65 million hectares area with the production of 8.0 million tonnes. In Madhya Pradesh it is cultivated under 5.9 million hectare area with production of 4.5 million tonnes (SOPA, 2016).

In the state it grown as *kharif* crop, but weed infestation is the major constraint in soybean produce in rainy season (Vollmann *et al*. 2010), it is heavily infested with grasses, sedges and broad leaved weeds. During the initial period, the crop growth is very slow which resulted vigorous growth of weeds in *kharif* season. Thus intense weed competition for nutrients, sunlight, space and water, reduces the crop productivity. If weeds are not controlled at critical stage that is 20-40 DAS period of crop-weed competition, there may be identical reduction in the seed yield of soybean. The yield losses due to uncontrol weeds are ranging from 31 – 84 % as reported by Karchoo *et al*. (2003). According to Kundu *et al.* (2011) the loss in yield of soybean due to weeds was 43% in control which indicates the necessity of controlling weed for exploiting the yield potential of soybean.

There are so many herbicides reported to control weeds in soybean but they are less effective to control. The pre-emergence herbicides like alachlor and metalachlor have been recommended for weed control in soybean and are being used by the farmers since long period. Presently, Imazethapyr is being in use as a post-emergence herbicide for controlling weeds in soybean (Patel *et al.* 2009). However, its efficacy has not been tested with Propaquizafop and Bentazone alone or in combination for wide spectrum weed control in soybean. At present, imazethapyr is being in use as a post-emergence herbicide for controlling weeds in soybean but some weeds had reported to uncontrol when imezethapyr was applied in alone (Patel *et al*. 2009).

Objective

Effect of post emergence herbicides on growth and yield of soybean'' has been proposed to conduct with an objective:

To see the effect of weed control treatments on growth and yield of soybean.

MATERIALS AND METHODS

A field experiment was conducted at Research farm, Department of Agronomy, Jawaharlal Nehru Kirshi Vishwa Vidyalaya, Jabalpur (M.P.) during *kharif* 2016. The soil of the experimental field was clay loam in texture, neutral in reaction (7.1), medium in organic carbon (0.60 %), available nitrogen (367 kg/ha), available phosphorus (16.23 kg/ha) and available potassium (317.10 kg/ha) contents. The ten treatments comprising of different doses of imazethapyr + propaquizafop (75+62.5 g/ha), imazethapyr + bentazone (75+75 and 75+62.5 g/ha), propaquizafop +bentazone (75+75 and 62.5+75 g/ha), and alone application of imazethapyr (100 g/ha), propaquizafop (75 g/ha) and bentazone (150 g/ha) as post-emergence, hand weeding twice at 20 and 40 DAS including weedy check, were laid out in randomized block design with 3 replications. Seeds were sown manually on 11th July 2016. The rows were opened with the help of pick axe and later sowing was done in each plot using a seed rate of 70

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kg/ha. Seeds were sown manually in each experimental plot keeping a row to row distance of 30 cm at the depth of 3-4 cm. The spray of herbicides was done with the help of knap-sack sprayer fitted with flat fan nozzle using 500 liters of water/ha. Other practices were adopted as per the recommendations.

The data on weeds were recorded by putting of 0.25 square meter (0.5 m x 0.5 m) was randomly placed at four places in each plot and then the species wise weed count was noted. At maturity, data on plant height, branches/plant, dry weight/plant, pods/plant, number of seeds/pod and 100-seeds were recorded. Grain yield and haulm yield were recorded on plot basis and harvest index was calculated. Data so collected were analyzed statistically using analysis of variance (ANOVA). Weed control efficiency (WCE) was calculated by the given formula: WCE= [(Dry weight of weeds in control plots- Dry weight of weeds in treated plots) *100]/ Dry weight of weeds in control plots. Gross returns were calculated by taking the sell price of soybean Rs 27.75/kg. Net returns and benefit:cost ratio were also worked out.

RESULTS AND DISCUSSION

There are several weed flora found in soybean but, *Trieanthema portulaca, Digera arvensis, Phyllanthus niruri, Commelina benghalensis, Convolvulus arvensis* are the most severe broad leaf weeds in soybean. Whereas, *Digitaria sangunalis, Echinocloa crusgalli ,Dactyloctenium aegyptium* and *Cyperus rotundus are the major narrow leaf weeds also found in soybean* under Kymore Plateau and Satpura hills zone of Madhya Pradesh (Kewat and Pandey 2001). The severe infestation of *Echinochloa crusgalli, Commelina communis, Cyperus rotundus, Phyllanthus niruri, Digitaria adscendens* and *Acalypha strumarium,* in soybean at Gwalior (MP). Dhane *et al.* (2009). Hence, due to the diverse weed flora, weed control become very difficult in *kharif* soybean.

All weed control treatments significantly reduced the weed dry weight (Table 1) at 45 DAA, the minimum dry weight of weeds was recorded in two hand weeding (20 and 40 DAS) which was significantly lower than all other weed control treatments. Among the different herbicide treatments, lowest weed dry weight, when recorded at 45 DAA during 2016, was recorded in Imazethapyr+Propaquizafop 75+62.5 g/ha at 20 DAS and which was at par with the application of Imazethapyr 100 g/ha, Imazethapyr + Bentazone 75+75 g/ha and Imazethapyr+Bentazone 75 + 62.5 g/ha. The maximum dry weight was recorded in weedy check plot similar results observed by Sandil *et al.* (2015).

Table 1. Effect of different weed control treatments on dry matter of weeds and weed control efficiency at 45 DAA in soybean.

Treatments	**Dose g/ha**	Total dry weight of weed	WCE %
T_1-Imazethapyr	100	117.81	70.76
T_2-Propaquizafop	75	155.61	61.38
T_3-Bentazone	150	232.28	42.35
T_4-Imazethapyr+Propaquizafop	75+62.5	109.96	72.71
T_5-Imazethapyr+Bentazone	75+75	127.40	68.38
T_6-Propaquizafop+Bentazone	62.5+75	146.16	63.72
T_7-Imazethapyr+Bentazone	75+62.5	135.70	66.32
T_8-Propaquizafop+Bentazone	75+75	139.87	65.28
T_9-Hand weeding(20 and 40DAS)	-	39.37	90.23
T_{10}-Weedy-check (Control)	-	402.91	0.00
SEm±		-	-
CD at 5%		-	-

Weed control efficiency (WCE) was calculated on the basis of weed biomass obtained under weedy check plots and other treatments. The data on WCE at 45 DAA are presented in Table1. Among the different weed control treatments, the higher WCE (72.71%) was found in plots receiving combined application of Imazethapyr+Propaquizafop 75+62.5 g/ha followed by alone application of Imazethapyr at

100 g/ha (70.76%). However WCE was further reduced with application of Bentazone in alone at 150 g/ha (42.35%) However, the WCE was maximum (90.23%) under hand weeding twice (20 and 40 DAS) in soybean (Thakre *et al.* 2015)

The weed management practices improved growth (plant height and branches/plant) and yield attributes (pods/plant and seeds/pod) of soybean over unweeded control (Table 2). The differences with the respect to plant height and branches/plant were found significantly, maximum plant height was recorded in two hand weeding which was significantly higher than all other weed management treatments and unweeded control. All the weed management treatments resulted in significantly higher branches/plant over unweeded control. This sows the application of Imazethapyr, Propaquizafop and Bentazone alone and combination had no adverse effect on growth of soybean. The application of Imazethapyr + Propaquizafop 75.0+62.5 g/ha registered highest number of pods/plant followed by combined application of Imazethapyr + Bentazone 75+75 g/ha and alone application of Imazethapyr 100 g/ha and significantly higher than all other weed control treatments. However hand weeding twice had the maximum pods/plant. Differences with respect to seeds/pod were found to be significant, the seeds per pod were numerically higher under weed free treatment closely followed by combined application of Imazethapyr + Propaquizafop at 75.0+62.5 g/ha and significantly higher than all other weed control treatments, while it was lowest under weedy check. The differences with respect to100-seeds were found to be non-significant. Similar work was also reported by Kulal *et al.* (2017).

The seed yield of weedy check plot was very poor (1104 kg/ha) due to maximum crop weed competition throughout the growing season. It increased markedly with the Bentazone 150 g/ha which gave the seed yield of 1323 kg/ha. This was at par with the alone application of Propaquizafop at 75 g/ha (1400 kg/ha). Alone application of Bentazone at 150 g/ha (1323 kg/ha) further increased the seed yield over Propaquizafop at 75 g/ha. But the difference between these treatments was not marked. It was noticed that alone application of Imazethapyr 100 g/ha markedly higher seed yield (1834 kg/ha) than alone application of Propaquizafop and Bentazone at 75 and 150 g/ha as well as the combined application of Propaquizafop+Bentazone 62.5+75 g/ha (1556 kg/ha) and Imazethapyr + Bentazone 75 +62.5 g/ha (1655 kg/ha). Among all the herbicidal treatments combined application Imazethapyr+Propaquizafop 75+62.5 g/ha registered maximum seed yield of 2100 kg/ha which was at par to hand weeding twice 2190 kg/ha. (Kulal *et al.* 2017). Haulm yield significantly varied due to different weed control treatments and the treatments exhibited almost similar trends as observed in case of seed yield. All the treated plots produced significantly higher haulm yield over weedy check. Haulm yield curbed higher at large extent with the application of Imazethapyr alone at 100 g/ha (3788 kg/ha) while the more pronounced increase in the yield was obtained with the combined application of Imazethapyr+Propaquizafop 75.0+62.5 g/ha (3900 kg/ha) which was at par to the obtained under hand weeding twice at 20 and 40 DAS. The ratio of economic yield and biological yield (HI) expressed in percentage was affected by various treatments Table 2. Among weed control treatments, the minimum harvest index was recorded in weedy check plots (23.69%). The combined application of Imazethapyr +Propaquizafop 75.0+62.5 g/ha had higher value of HI (35.00). Hand weeded plots had harvest index (34.41). Similar work was also reported by Kushwah and Vyas, 2005.

The combined application of Imazethapyr + Propaquizafop (75.0+62.5 g/ha) fetched the maximum net return of Rs 26585/ha followed by Imazethapyr + Bentazone 75+75 g/ha (Rs 21247/ha) and Imazethapyr 100 g/ha (Rs 19779/ha). B-C ratio was minimum (1.03) under weedy check. B-C ratio was maximum (1.75) with Imazethapyr + Propaquizafop (75.0 + 62.5g/ha) followed by Imazethapyr + Bentazone 75+75 g/ha (1.60) and application of Imazethapyr 100 g/ha alone (1.57) similar results observed by Bali *et al.*2016.

Table 2. Growth, yield attributes, yield and economics of soybean as influenced by different weed control treatments

Treatments	Dose g/ha	Plant Height	Branches /plant	Pods/ plant	Seeds/ pod	Seed index (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)	Net monetary returns (Rs/ha)	B:C Ratio
T_1-Imazethapyr	100	52.33	4.00	25.00	2.27	9.71	1834	3788	32.62	19779	1.57
T_2-Propaquizafop	75	48.08	3.40	23.62	2.00	9.62	1400	3927	26.28	8922	1.26
T_3-Bentazone	150	54.47	3.00	23.10	1.73	9.71	1323	2911	25.69	5659	1.17
T_4-Imazethapyr+Propaquizafop	75+62.5	53.73	4.47	26.10	2.40	9.93	2100	3900	35.00	26585	1.75
T_5-Imazethapyr+Bentazone	75+75	53.25	4.33	25.67	2.27	9.59	1903	3779	33.49	21247	1.60
T_6-Propaquizafop+Bentazone	62.5+75	48.85	3.40	24.00	2.07	9.82	1556	3892	28.56	11200	1.32

T_7-Imazethapyr+Bentazone	75+62.5	51.00	3.73	24.79	2.20	9.89	1655	3679	31.03	14390	1.41
T_8-Propaquizafop+Bentazone	75+75	49.97	3.60	24.38	2.13	9.60	1626	3812	29.90	12477	1.35
T_9-Hand weeding(20 and 40DAS)		55.30	4.73	26.87	2.47	10.07	2190	4176	34.41	19696	1.44
T_{10}-Weedy-check (Control)		47.30	2.40	22.12	1.53	9.22	1104	3556	23.69	939	1.03
SEm±		0.50	0.34	1.01	0.19	0.80	31.42	37.20	-		
CD at 5%		1.48	1.03	3.00	0.55	NS	94.56	110.60	-		

CONCLUSION

Application of Imazethapyer + Propaquizafop 75 + 62.5 g/ha had higher growth and yield of soybean followed by Imazethapyr+Bentazone 75+75 g/ha and proved superior than the other treatments.

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