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EFFICACY OF INTERACTION OF HERBICIDES AND VARIETIES FOR YIELD AND PRODUCTIVITY OF DIFFERENT SOYBEAN VARIETIES

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Abstract: A field experiment was conducted during kharif season of 2015, at the Research Farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) to assess the efficacy of different post emergence herbicides on soybean varieties (*Glycine max* L.). The investigation was aimed to study the efficacy of herbicides as applied post-emergence for weed control in different soybean varieties and to determine economic feasibility of treatments. Application of weed control treatments Imazethapyr, Quizalofop-p-ethyl, Chlorimuron ethyl and Quizalofop-p-ethyl +Chlorimuron ethyl and weedy check were laid out in Split Plot Design with three replications. The experimental area has the natural weed flora comprising of grassy as well as broad leave weeds. 15 treatments comprised three (main plot treatments) variety JS 20-29, JS 20-69 and JS 20-34 and 5 (sub plot treatments). The variety JS 20-29 with application of Quizalofop-p-ethyl+Chlorimuron ethyl@ (50g+9g/ha) was given maximum yield (1412.70kg/ha) than other interactions.
Keywords: Interaction, weed density Weed control efficiency and yield of soybean, Weed management practice.

INTRODUCTION

Soybean *(Glycine max* (L) Merill) belongs to family "Legumenaceae or Papilionaceae" has been called "Goldan bean" or "Miracle crop" of twentieth century. Soybean is an important oilseed crop and playing a vital role in sustaining the oilseed production in India in excess of the past few years. Madhya Pradesh is the soybean bowl of India, contributing 65-70 % of country is soybean production. In the year (2014-15), soybean cultivation reached to 116.29 lakh hactares recording production of 88.43 lakh tones in India. In Madhya Pradesh (2014-15), area reached about lakh ha 56.13 hactares, production 44.00 lakh tones /ha.(SOPA,2014-15). In the constraints, the weed management assumes the major importance for increasing the productivity of soybean. The varieties grow in filed and concentrated use of agro-chemicals tied with affable edaphic and weather conditions during Kharif season further intensify the weed menace, resulting into low yields of soybean, if weeds are not controlled during proper time. Hand weeding is widely practiced for eliminating the weeds, though it is

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costly and time consuming. Now a day, pre emergence herbicides are not very popular among the farmers due to short time span for sowing during *kharif* season. Therefore, farmers are using the post emergence herbicide for control of weeds in different crops including soybean**.** Hand weeding is the most efficient mean to control weeds in soybean, but it is time consuming and difficult due to unavailability of labourers during peak period of demand. The weather conditions many times restrict the manual weed control. Hence, the use of suitable herbicide appears to be an alternative option to minimize the weed problem. But, each herbicide has its own spectrum of weed control. Secondly, the timing of herbicides application also has much concern on weed control efficiency. Therefore, there is need to explore the possibility post emergence herbicides for effective weed control in soybean.

Several herbicides like fluchloralin, pendimethalin, metribuzin, alachlor, etc. were in use. But wide spectrum weed control in soybean from aforesaid herbicides has not been observed (Kundu et al. 2011). Propaquizafop and imazethapyr have been found very effective post emergence herbicides for controlling both grassy and broad-leaf weeds in soybean in different parts of the country. Propaquizafop has only for controlling the grassy weeds and imazethapyr has for controlling both grassy and broad-leaf weeds in soybean, but information regarding its efficacy against weeds under Jabalpur conditions is very meagre.It is, therefore, the present investigation was carried out to assess the effect of propaquizafop, imazethapyr and their combination on weeds and yield of soybean. Cultivars and wedding regime had significant effect on grain, pod and yield observed that (Rezvani et al.,2012). The variety JS-335 gave maximum yield 1912 kg/ha than JS 93-05 and reduce the weed density observed that (Jadhav et al.,2013). Indeterminate cultivar duo-crop showed significantly more rapid canopy development than determinate hutton, ramson and wright, with duo-crop yielding significantly than determinate cultivar in soybean showed that (Newcomer et al., 1986)

METHODOLOGY

A field experiment was conducted during kharif season of 2015, at the Research Farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) to study the efficacy of different post emergence herbicides on soybean varieties(*Glycine max* L.). The present experiment was carried out on clayey soil which was medium in organic carbon (0.65 %), available nitrogen (352 kg/ha) and phosphorus (16.60 kg/ha) but high in potassium (335 kg/ha), pH neutral in reaction (7.2) and EC neutral in reaction (0.33ds/m). The investigation was aimed to study the efficacy of herbicides as applied post-emergence for weed control in different soybean varieties and to determine economic viability of treatments.

The experimental area has the natural weed flora comprising of grassy as well as broad leave weeds. 15 treatments comprised three (main plot treatments) variety JS 20-29, JS 20-69 and JS 20-34 and 5 (sub plot treatments) weed control treatments Imazethapyr, Quizalofop-p-ethyl, Chlorimuron ethyl and Quizalofop-p-ethyl +Chlorimuron ethyl and weedy check were laid out in Split Plot Design with three replications. All herbicides treatments were applied in 500 liters of water per hectare, using flat fan nozzle. Different observations on the weeds and crop parameters were carried out during the course of investigation.

RESULT AND DISCUSSION

1. Effect of Interaction

The interaction between varieties and weed control treatments table 19 showed that the total weed density is minimum in the weed control treatments Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha in variety JS 20-29.The weed control efficiency was highest in the application of Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha in the variety JS 20-29.The interaction of variety and weed control treatments was also significant for number of branches and the maximum number of branches per plant was noted under variety JS 20-29 and Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha at all groth stages. Seed yield was highest in the application of Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha in the variety JS 20-29 and economically profitable interaction the application of Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha in variety JS 20-29.

2. Effect of weed control treatments

The data on yield table revealed significantly the lowest yield (395.10kg/ha) under weedy check treatment as compared to (1247.40kg/ha) of Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha, Imazethapyr100g/ha (1226.00kg/ha), Quizalofop-p-ethyl 50g/ha (1160.60kg/ha) and Chlorimuron ethyl 9g/ha(1174.70kg/ha), vyas and jain, (2003). The lowest yield under weedy check was due to the highest weed density from the begning of the growth which created competition with the soybean plants for atmosphere and rhizosphere, which was reflected in lowest growth and yield attributary characters.Under weedy check soybean crop had the lowest number of branches, leaf area index, dry wieght, pods per plant, seed yield, seed index, dry wieght and harvest index the above characters ultimately resulted in the lowest seed yield. Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha highest seed yield of soybean with(1247.40 kg/ha). The highest yield of in this treatment may be attributed to lowest weed density from begning of the growth phase, thus providing minimum competition with the crop plants.

The plant population per meter square (Table 1) was not affected significantly different weed control treatments at 30 DAS and harvest stage, indicating that the post-emergence application of combined application with Quizalofop-p-ethyl+Chlorimuron ethyl and application imazethapyr, Quizalofop-p-ethyl and Chlorimuron ethyl alone have no adverse effect on crop plants. The subsequent observation at harvest revealed slight declining trend under all the treatments but a greater drop was recorded in weedy check which may be attributed to severe competitional stress by weeds for space, light, moisture and nutrients, resulting in mortality of some of the crop plants (Yaduraju 2002).

Plant height of soybean did not vary due to treatments at early growth stage (30 DAS) of crop (Table 1). But during advanced stages (45, 60 DAS and harvest). It was affected significantly by various treatments. The plant height of soybean considerably more under Quizalofop-p-ethyl+Chlorimuron ethyl (48.79, 58.24, & 56.02 cm at 45, 60 DAS, and harvest, respectively) as compared to rest of the treatments this may be due to crop was free from weed stress and all the growth resources were optimally utilized by the crop plants. This led to better plant height. Among the alone herbicidal treatments long stature plants were recorded plant height in Imazethapyr (44.94), Quizolofop-p-ethyl (43.52), Chlorimuron ethyl (41.37) and weedy check (28.38) cm at 45, 60 DAS & harvest respectively. However, all the herbicidal treatments showed better plant height over weedy check plots. The excellent control of weeds under treatments Quizalofop-p-ethyl+Chlorimuron ethyl led to optimal utilization of growth resources, therefore, these treatments have long statured plants. These results are in close conformity with the finding of Kushwah and Vyas (2005).

Branches per plant remarkably differed due to different treatments at various growth intervals of crop (30, 45 and 60 DAS). The number of branches per plant were less (1.94, 2.44 & 4.87 at 45, 60 & 90 DAS, respectively) (Table 1) when Chlorimuron ethyl @ 9g/ha was applied at the rate at 9g/ha, followed by at Quizalofop-p-ethyl @ 50 g/ha (2.06, 2.63 & 4.21) due to poor control of associated weeds. Application of Imazethapyr @ 100.0 g/ha resulted in increased in the number of branches per plant at all the stages. This may be attributed to reduced weed competition during critical period of crop growth as a result of effective weed control coupled with no phytotoxicity on soybean seedlings. But found significantly inferior to that of Quizalofop-p-ethyl+Chlorimuron ethyl at 50+9 g/ha (2.42, 3.04 & 4.67 at 30, 45 and 60 DAS respectively), the treatments provided excellent control of associated weeds, resulting in almost weed free environment throughout the critical period of crop-weed competition which, led to optimum growth and development of crop. Plants and

ultimately resulted in more number of branches per plant under these treatments. Almost similar results were obtained by Raghuwanshi et al., (2005) and Shete et al., (2008).

The photosynthetic area was measured in terms of LAI. Leaf area index (LAI) was similar at 30 DAS but differed significantly due to different treatments at 60 DAS (Table 1). The LAI was maximum in herbicidal treatments Quizalofop-p-ethyl+Chlorimuron ethyl at 50+9 g/ha W_4 (5.28) at 60 DAS stage among the herbicidal treatments where minimum value of LAI was recorded in weedy check plots. Application of Imazethapyr @100g/ha, Quizalofop-p-ethyl 50 g/ha, Chlorimuron ethyl at 9 g/ha also produced significantly higher LAI as compared to weedy check. But, they were inferior to Quizalofop-p-ethyl+Chlorimuron ethyl that of at 60 DAS stage. However, the highest LAI was recorded Quizalofop-p-ethyl+Chlorimuron ethyl followed by Imazethapyr, Quizalofop-p-ethyl, Chlorimuron ethyl. This may be because of better growth and development of foliage under weed free environment and consequently resulted in more assimilatory area per unit land area. Relatively poor LAI under plots, Chlorimuron ethyl were on account of higher crop weed competition, which did not compensate the leaf area index. Almost similar results were obtained by Shivakumar (1978) and Thakur and Kaur (2001).

Crop biomass was statistically similar during early growth stage (30 DAS) but varied during 60 DAS and harvest (Table 1). Weedy check had significantly minimum crop biomass among all the treatments at 60DAS and harvest due to severe competition between crop and weeds for growth resources during critical period of crop growth. The increased crop biomass in plots receiving the combine application of Quizalofop-p-ethyl+Chlorimuron ethyl (50+9) g/ha as post emergence were recorded. This is attribute to reduced weed competition as a result of effective control of weeds, which promoted the better growth and development of plants and ultimately produced higher biomass as compared to imazethpyr@100g/ha, Quizalofop-p-ethyl 50g/ha, Chlorimuron ethyl 9g/ha. Relatively more competitional stress due to weeds under latter could be assigned the reason for lower crop biomass at all the stages of crop growth. The weed control treatments application of Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha was superior than other treatments. Application of Imazethapyr 100g/ha, Quizalofop-p-ethyl 50g/ha, Chlorimuron ethyl 9g/ha as applied as post emergence produced better yield attributing characteers (pods per plant, seeds per pod and seed index)as compared to weedy check on account of maximum reduction in weed growth coupled with no inhibitory effects on soybean plants. These results are in conformity to the finding of Kothawade et al.,(2007).

The seed yield was lowest (395.10kg/ha) in the plots receiving no weed control measures (weedy check) due to severe competition stress right from crop establishment up to the end of critical period of crop growth, leading to poor growth parameters and yield attributing traits and finally the seed yield (Table 2). All the herbicidal treatments as post emergence produced significantly higher grain yield over the weedy check. Among the herbicidal treatments, application of Imazethapyr@100 g/ha(1226.00kg/ha), Quizalofop-p-ethyl 50g/ha(1160.60 kg/ha), Chlorimuron ethyl @9 g/ha(1174.70kg/ha). The grain yield of soybean was significantly higher under W_4 Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha (1247.40kg/ha) and found superior over the all the treatments, because of relatively low competitional stress and better yield attributes. The results are in conformity to the the findings of vyas and jain ,(2003), Kothawade et al., (2007) and Shete et al.,(2008). The harvest index of soybean was higher under W_4 (Quizalofop-p-ethyl+Chlorimuron ethyl 50+9 g/ha) and superior over the treatments. Lowest under weedy check receiving no weed control measures.

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Table No-1 Influence of weed control treatments on Plant population, Plant height, No. of branches, LAI and Dry matter production.

Treatment		Plant population/ (m^2)		Plant height				Number of branches/plant			LAI		Dry matter Production (g/m^2)		
Varieties		30 DAA	At harvest	30 DAA	45 DAA	60 DAA	At harvest	30 DAA	45 DAA	At harvest	45 DAA	At harvest	30 DAS	60 DAS	Harvest
V_1	JS 20-29	26.10	25.18	27.78	44.22	52.95	51.43	2.22	2.79	4.27	1.42	5.98	132.76	318.15	676.76
V_2	JS 20-34	26.02	24.12	20.73	34.20	36.75	35.65	2.01	2.50	3.97	1.37	5.59	129.29	283.72	571.97
V_3	JS 20-69	25.99	25.14	25.13	43.78	50.45	49.35	2.08	2.48	4.13	1.38	5.51	129.52	312.97	672.69
SEm±		0.24	0.30	0.30	0.24	0.91	0.41	0.05	0.16	0.06	0.004	0.03	0.39	0.43	0.07
CD at 5%		NS	NS	1.19	0.97	1.60	1.63	0.20	0.64	0.26	0.015	0.13	1.53	1.71	0.30
Weed control treatments															
W_1	Imazethapyr100.0 g/ha	26.02	24.15	26.96	44.94	55.37	54.23	2.23	2.86	4.42	1.43	5.19	138.78	326.64	709.04
W_2	Quizalofop-p-ethyl @50 g/ha	25.98	24.21	24.99	43.52	52.14	51.70	2.06	2.63	4.21	1.41	5.26	133.31	335.66	673.26
W_3	Chlorimuron ethyl @ 9g/ha	26.00	24.13	23.70	41.37	48.27	46.11	1.94	2.44	4.87	1.38	5.12	126.17	301.33	646.23
W_4	Quizalofop-p-ethyl+ Chlorimuron ethyl @(50+9)g/ha	26.04	24.23	28.72	48.79	58.24	56.02	2.42	3.04	4.67	1.45	5.28	150.92	353.57	723.16
W_5	Weedy check (Control)	25.90	24.12	18.38	28.38	29.54	26.98	1.86	1.98	2.46	1.29	4.62	103.44	257.53	616.85
Sem±		0.17	0.34	0.26	0.37	0.29	0.37	0.02	0.13	0.06	0.005	0.10	0.87	1.60	1.11
CD at 5%		NS	NS	0.76	1.10	0.85	1.08	0.07	0.06	0.19	0.015	0.31	2.56	4.68	3.25

*figure in parenthesis are the original value

Table 2. Influence of varieties and weed control treatments on seed and stover yields (kg/ha) of soybean

Treatments		Yields (kg/ha)							
		Seed yield				Stover yield			
Varieties / Weed control treatments		V_1 JS 20-29	V_2 JS 20-34	V_3 JS 20-69	Mean	V_1 JS 20-29	V_2 JS 20-34	V_3 JS 20-69	Mean
W_1	Imazethapyr	1307.00	985.2	1262.00	1226.00	2797.00	2931.00	2885.33	2871.11
W_2	Quizolofop-p-ethyl	1284.30	987.80	1209.70	1160.60	2924.33	2763.67	2781.33	2823.11
W_3	Chlorimuron ethyl	1245.30	1099.70	1179.00	1174.70	2807.33	2595.33	2683.67	2695.44
W_4	Quizolofop-p-ethyl +Chlorimuron ethyl	1412.70	1171.90	1321.30	1247.40	3126.33	3012.33	3040.00	3059.56
W_5	Weedy check	412.30	385.70	387.30	395.10	1841.67	1736.67	1717.33	1765.22
Mean		1132.30	918.00	1071.90		2701.2	2607.80	2646.40	
		S.E. (m) ±		CD at (5%)		S.E. (m) ±		CD at (5%)	
Varieties		14.81		58.19		16.53		63.80	
Weed control		13.82		40.36		45.94		133.81	
V X W		23.94		69.96		79.57		231.93	