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WEED MANAGEMENT IN SOYBEAN (*GLYCINE MAX* L.)

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ABSTRACT
A field experiment was conducted during *kharif* season of 2011 at Research Farm, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha-Jammu to evaluate the effect of integrated weed management in soybean. The highest reduction of weed population and weed dry matter was found in two hand weeding at 15 and 35 days after sowing followed by imazethapyr @ 75 g a.iha^{-1} (PoE) + hoeing at 35 days after sowing. Among the herbicidal treatments, highest seed yield, highest weed control efficiency (94.1%) and net return (Rs.24565.17) was observed in imazethapyr @ 75 g a.iha^{-1} (PoE) + hoeing at 35 days after sowing followed by quizalofop-ethyl @ 40 g a.iha^{-1} (PoE) + hoeing at 35 days after sowing. Application of quizalofop-ethyl @ 40 g a.iha^{-1} (PoE) + hoeing at 35 days after sowing recorded the highest benefit cost ratio of 1.44, which was comparable with the application of imazethapyr @ 75 g a.iha^{-1} (PoE) + hoeing at 35 days after sowing (1.43).

INTRODUCTION

Soybean is an important rainy season crop of India. In India, it is grown on an area of 108.834 lakh ha with an annual production of 104.366 lakh million tonnes (SOPA, 2014). Successful weed control is most important factor for fruitful soybean production, because losses due weeds have been one of the major limiting factors in soybean production. Weeds compete with crop for light moisture and nutrients, with early-season competition being the most critical. Being a rainy season crop soybean faces severe weed competition during early stages of crop growth, resulting in a loss of about 40-60 per cent of the potential yield, depending on the weed intensity, nature, environmental condition and duration of weed competition (Kachroo *et al*., 2003). In soybean crop, first 20 to 45 days after sowing is considered the most critical period for weed competition and at that time, weeds are to be kept under control for optimum yield (Sharma *et.al*., 2007). Adverse weather conditions limit the use of tools and implements for clearing weeds in the field. On environmental grounds, emphasis has been given to judicious combinations of cultural and chemical methods of weed control. Therefore, integrated weed management system is a desired practice that aims at reducing the dosage of herbicide to be applied with mechanical weeding, which will help in managing weeds in a best way for realizing to sustain and boost the production of soybean. Similar work has been done by Idapuganti (2003), Singh (2007). The objective of the paper is to study the effect of different weed control treatments on growth and yield of soybean, their effect on weeds and to find out the weed control efficiency of different treatments.

MATERIALS AND METHODS

An investigation was conducted during *kharif* season of 2011 at Research Farm, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha-Jammu. The soil was characterized as sandy-loam in texture and alkaline in reaction with pH 7.7 (Jackson, 1973). It was low in organic carbon content with 0.39% O.C. (Jackson, 1973) and nitrogen (240 kg/ha) (Subbiah and Asija, 1956), medium in phosphorus (12.12 kg/ha) (Olsen *et al*., 1954) and high in available potassium (134 kg/ha) (Jackson, 1973). The experiment comprised of twelve treatments comprising weedy check, weed free check, hand-weeding at 15 and 35 days after sowing (DAS), hoeing at 15 and 35 days after sowing, fluchloralin @ 1.0 kg a.iha^{-1}(PPI), pendimethalin @ 1.0 kg a.iha^{-1} (PE), imazethapyr @ 100 g a.iha^{-1} (PoE), quizalofop-ethyl @ 50 g a.iha^{-1}(PoE), fluchloralin @ 0.75 kg a.iha^{-1}(PPI) + hoeing at 35 days after sowing, pendimethalin @ 0.75 kg a.iha^{-1}(PE) + hoeing at 35 days after sowing, quizalofop-ethyl @ 40 g a.iha^{-1}(PoE) + hoeing at 35 days after sowing and imazethapyr @ 75 g a.iha^{-1} (PoE) + hoeing at 35 days after sowing were tested in randomized block design with three replications. All the post-emergence herbicides were applied at 15 days after sowing. Basal dose of 20: 40: 20 kg ha^{-1}N:P:K was applied. Soybean cultivar SL-525 (with 115-120 DAS maturity) was planted at 45 cm row spacing @ 62.5 kg ha^{-1}seed rate. The herbicide fluchloralin as pre-plant incorporation 2 days before sowing, pendimethalin as pre-emergence one day after sowing, quizalofop-ethyl and imazethapyr as post emergence were applied at 15 DAS. Quantity of water required for spraying (600 l ha^{-1}) was determined by calibration of sprayer.

RESULTS AND DISCUSSION

Weed flora and weed control efficiency

All the weed control treatments significantly reduced the population and dry weight of weeds as compared to weedy

Table 1: Effect of different weed management practices on weed density, weed dry matter weed control efficiency and weed index

Treatments	Weed density (m^{-2})	Weed dry weight (g m^{-2})	Weed Control efficiency(%)	Weed Index
Weedy check	272.00 (16.51)	168.33 (12.98)	-	41.82
Weed free	0.00 (0.71)	0.00 (0.71)	100.0	-
Hand weeding at 15 & 35 DAS	10.00 (3.18)	36.90 (6.11)	96.3	1.55
Hoeing at 15 & 35 DAS	39.00 (6.26)	38.67 (6.25)	85.7	13.40
Fluchloralin @ 1.0 kg a.i ha^{-1} (PPI)	81.00 (9.02)	56.83 (7.56)	70.2	24.87
Pendimethalin @ 1.0 kg a.i ha^{-1} (PE)	90.00 (9.50)	58.30 (7.67)	66.9	27.19
Imazethapyr @ 100 g a.i ha^{-1} (PoE)	39.00 (6.27)	41.70 (6.49)	85.7	27.96
Quizalofop-ethyl @ 50 g a.i ha^{-1} (PoE)	64.00 (8.02)	54.27 (7.39)	76.5	22.55
Fluchloralin @ 0.75 kg a.i ha^{-1} (PPI) + hoeing at 35 DAS	42.00 (6.51)	46.20 (6.83)	84.6	14.50
Pendimethalin @ 0.75 kg a.i ha^{-1} (PE) + hoeing at 35 DAS	46.00 (6.79)	48.27 (6.98)	83.1	15.40
Quizalofop-ethyl @ 40 g a.i ha^{-1} (PoE) + hoeing at 35 DAS	19.00 (4.34)	38.60 (6.26)	93.0	4.90
Imazethapyr @ 75 g a.i ha^{-1} (PoE) + hoeing at 35 DAS	16.00 (4.02)	37.90 (6.19)	94.1	2.84
SEm ±	0.30	0.15	-	-
CD at 5 %	0.89	0.45	-	-

Table 2: Effect of different weed management practices on plant height, number of branches $plants^{-1}$, number of pods $plants^{-1}$, seed yield and straw yield of soybean

Treatments	Plant height (cm)	Number of branches $plant^{-1}$	Number of pods $plant^{-1}$	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})
Weedy check	89.40	2.63	77.77	9.03	15.07
Weed free	127.73	5.22	128.90	15.52	25.92
Hand weeding at 15 & 35 DAS	119.90	4.70	125.27	15.28	25.52
Hoeing at 15 & 35 DAS	106.37	4.13	106.37	13.44	22.45
Fluchloralin @ 1.0 kg a.i ha^{-1}(PPI)	99.70	3.30	95.37	11.61	19.40
Pendimethalin @ 1.0 kg a.i ha^{-1} (PE)	97.63	3.33	93.83	11.30	18.88
Imazethapyr @ 100 g a.i ha^{-1} (PoE)	92.32	3.10	92.87	11.18	18.67
Quizalofop-ethyl @ 50 g a.i ha^{-1} (PoE)	103.07	3.43	97.07	12.02	20.08
Fluchloralin @ 0.75 kg a.i ha^{-1} (PPI) + hoeing at 35 DAS	105.27	3.87	105.07	13.27	22.16
Pendimethalin @ 0.75 kg a.i ha^{-1} (PE) + hoeing at 35 DAS	102.20	3.57	104.47	13.13	21.93
Quizalofop-ethyl @ 40 g a.i ha^{-1} (PoE) + hoeing at 35 DAS	116.13	4.33	118.30	14.76	24.66
Imazethapyr @ 75 g a.i ha^{-1} (PoE) + hoeing at 35 DAS	118.08	4.43	122.23	15.08	25.19
SEm ±	6.26	0.21	6.10	0.65	1.08
CD at 5 %	18.36	0.64	17.89	1.9	3.18

check (Table 1). The highest reduction of population and weed dry matter was found in two hand weeding (15 and 35 DAS). Most mechanical weed control methods, such as hoeing, tillage, harrowing, torsion weeding, finger weeding and brush weeding, are used at very early weed growth stages (Singh, 2014, Kewat, 2014). Hoeing can be effective on older weeds, and remains selective, many mechanical control methods become difficult after the cotyledon stage and their selectivity decreases with increasing crop and weed age (Verma *et al*., 2015). Amongst the treatments, combination of post emergence herbicide and mechanical treatments, imazethapyr @ 75 g a.i. ha^{-1} + one hoeing at 35 DAS and quizalofop- ethyl @ 40 g a.i ha^{-1} + one hoeing at 35 DAS decreased population and weed biomass than other chemical treatments. This may be due to the fact that being a soil active herbicide would influence directly on germination of weed and also controls the early flushes of weeds and later flushes of weeds controlled by one hoeing at 35 DAS. The finding correlates with the findings of Abbasi *et al*. (2006), Kumar and Das (2008) and Meena and Jadon (2009). All the weed control treatments significantly influence weed control efficiency and weed index (Table 1). Among all weed control treatments, weed free plots recorded highest weed control efficiency followed by hand-weeding (15 & 35 DAS), imazethapyr @ 75 g a.iha^{-1} + hoeing (35 DAS) and quizalofop-ethyl @ 40 g a.i ha^{-1} + hoeing (35 DAS). This could be due to lower weed population and weed dry matter. Similarly result was reported by Billore *et al*. (2006). Similarly, lower weed index was observed in hand-weeding (15 & 35 DAS) followed by imazethapyr @ 75 g a.iha^{-1} + hoeing (35 DAS) and quizalofop-ethyl @ 40 g a.i ha^{-1} + hoeing (35 DAS). It might be due to better weed control which provided favorable conditions for crop growth resulted in increased seed yield of soybean crop as compared to un-weeded control treatment. Similar result was also reported by Pandya *et al*. (2006) and Kamdi (2010).

Crop growth and yield

Plant height significantly affected by different weed control treatments (Table 2) as compared to weedy check. The highest plant height was observed in weed free which found at par with hand weeding at 15 and 35 DAS, imazethapyr @ 75 g a.iha^{-1}andquizalofop-ethyl @ 40 g a.i ha^{-1}in combination with hoeing at 35 DAS. This might be due to the increased availability of nutrients and lesser competition of weeds which could possibly result in better accumulation of photosynthates. Similar result has been reported by Thakur (2008) and Dhane *et al*. (2010). The maximum number of $branchesplant^{-1}$ was found in weed free which was statistically at par with hand-

weeding at 15 and 35 DAS. However, highest number of pods was recorded in weed free which was statistically at par with hand weeding at 15 and 35 DAS, imazethapyr @ 75 g a.iha^{-1} and quizalofop-ethyl @ 40 g a.i ha^{-1}in combination with hoeing at 35 DAS. It might be due to reduction in dry matter production by weeds under herbicidal and cultural treatments (hoeing) that subsequently increased nutrient and moisture availability to the soybean crop.Similar results werereported by Gupta and Saxena (2008) and Dhane *et al*. (2009). Mechanical weeding improved the soil aeration and increasednutrient availability to the crop through active mineralizationand decomposition. It was also accordance with Seema *et al*., 2014, Prasad and Pandey, 2005. Seed and straw yields are significantly influenced by different weed control treatments as compared to weedy check (Table 2). The maximum seed and straw yield was obtained with weed free treatment followed by hand-weeding at 15 and 35 DAS. Among various herbicidal weed control treatments, imazethapyr @ 75 g a.i ha^{-1}+ hoeing (35 DAS) recorded maximum seed and straw yield which was found to be at par with quizalofop-ethyl @ 40 g a.i ha^{-1}+ hoeing (35 DAS). It might be due to the fact that both these herbicides when applied as post-emergence suppresses the weed growth efficiently which is supplemented by hoeing at the crucial stage of crop growth which checks the weed growth and resulted in higher seed and straw yield. Similar findings have been reported by Dhane *et al*. (2009), Yadav and Shaikh (2009) and Wadafale *et al*. (2011).

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