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Advances in Applied Science Research, 2013, 4(4):72-75

ISSN: 0976-8610
CODEN (USA): AASRFC

Effect of pre and post-emergence herbicides on weed dynamics, growth and yield of soybean (*Glycine Max* L.)

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ABSTRACT

A field experiment was conducted in zonal agricultural research station, University of agricultural sciences, (UAS) GKVK Bengaluru during Kharif, 2012 to study the effect of pre and post-emergence herbicide on weed, growth and yield of soybean (Glycine max L.). The experiment was carried out in randomized completely block design (RCBD) wherein there was combination of pre and post-emergence herbicides (pendimethalin 30 EC, metribuzin 70 WP and fenoxaprop–p-ethyl 9 EC, Imazethapyr 10 SC, respectively), farmer's practice of intercultivation fb two hand weeding at 20 and 40 DAS as well as unweeded check, all replicated thrice. The results showed that intercultivation fb.hand weeding at 20 and 40 DAS recorded significantly higher grain and haulm yield (2570- 2964 kg ha^{-1}, respectively), lower weed population and their dry weight (8.00 number and 1.00 g 0.25 m^{-2}, respectively), no.of pods per plant (165), pod weight per plant (77g plant^{-1}), no.of grains per pod (2.79) and hundred grains weight (19.18 g). However, pre-emergence application of metribuzin 70 WP fb. imazethapyr 10 SC and metribuzin 70 WP fb.intercultivation at 30 DAS gave lower weed population, dry weight and higher grain, haulm yield, no.of pods per plant, pod weight per plant, no.of grains per pod and 100 grains weight as compared to other herbicide treatments and unweeded check.

Keywords: Pre-emergence herbicides, post-emergence herbicides, soybean, weed dynamics, yield.

INTRODUCTION

Soybean (*Glycine max*), is an important oil-yielding rainy-season (*kharif*) crop having multiple uses. Weeds are the major biotic factor responsible for poor yield in soybean. Simultaneous emergence and rapid growth of large number of weed species causes severe crop-weed competitions and reduction in crop yields (30-80%) depending upon the type of weed flora and weed density [1]. The incessant rains do not permit timely intercultivations and manual control of weeds is also difficult on large scale on account of high cost and labour shortage during weeding peaks.

Therefore, there is a need for alternative methods of reducing the weed load during early crop growth period of soybean *i.e.* first 30-45 DAS [2].The herbicides presently available are either pre-emergence (PRE) or pre-plant incorporated (PPI) and have a narrow spectrum weed control. The biology of some weeds that occur in soybean makes it difficult to achieve effective weed control with single application of herbicides; PPI or PRE or post emergence (POST). Recent studies [3] clearly indicated that combination application of herbicides (PRE followed by (fb) (POST) will provide more consistent weed control than single application. A well planned PRE fb POST herbicide application would provide more consistent weed control and helps to minimize the weed menace. Hence, present investigation was undertaken to study the effect of sequential application of pre and post-emergence herbicides in soybean.

This study was undertaken to obtain an efficient herbicides weed control system and also to compare the relative efficacy of different herbicides with farmer's practice.

MATERIALS AND METHODS

A field experiment was conducted *in* zonal agricultural research station, University of agricultural sciences, GKVK Bengaluru during *Kharif*, 2012 to study efficacy of pre and post-emergence herbicides on weed, growth and yield of soybean. The soil of the experimental site was red sandy loam, with slightly acidic (pH 6.44), medium in organic carbon (0.55 %), medium in available Nitrogen (288.549 kg ha^{-1}), in available potassium (175.08 kg ha^{-1}) and in phosphorus (38.49 kg ha^{-1}). The experiment was laid out in RCBD composed of ten treatments *viz* **T_1:** Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS (days after sowing), **T_2**: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS followed by *(fb)* intercultivation (IC) at 30 DAS, **T_3**: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS *fb*. fenoxaprop–p-ethyl 9 EC at 70 g a.i ha^{-1} at 20 DAS, **T_4**: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS *fb*. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS, **T_5**: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS, **T_6**: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS *fb*. IC at 30 DAS, **T_7**: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS *fb*. fenoxaprop–p-ethyl 9 EC at 70 g a.i ha^{-1} at 20 DAS, **T_8**: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS *fb*. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS, **T_9**: Intercultivation *fb.* hand weeding (HW) at 20 and 40 DAS, **T_{10}**: Unweeded check; all replicated thrice. Variety MAUS-2 was sown on 12th August 2012. Recommended fertilizer dose of 25 kg N, 60 kg P_2O_5 and 25 kg K_2O ha^{-1} was applied in the form of urea, single super phosphate and muriate of potash, respectively. The observations on yield and yield attributes were recorded at harvest. Weed population and oven dry weight were recorded at harvest. The data were analyzed statistically for test of significance [4]. The level of significance on "F" test was tested at 5 per cent. The interpretation of data was done by using CD values calculated at $p \geq 0.05$.

The major weed flora observed in the experimental plot were the following: *Eleusine indica, Digitaria marginata, Dactyloctenium aegyptium, Eragrostis pilosa, Amaranthus viridis, Oldenlandia corymbosa, Parthenium hysterophorus, Commelina benghalensis, Acanthospermum hispidum, Borreria hispida and Cyperus rotundus.*

RESULTS AND DISCUSSION

Effect of pre and post-emergence herbicides on weeds and weed control efficiency*:*
Application of herbicide evaluated for weed management in soybean significantly reduced the grasses and broad leaved weeds density and its dry biomass at harvest (Table 1 & 2). Intercultivation fb. hand weeding at 20 and 40 DAS proved to be efficient technique for the management of both types of weeds, were at par in their weed control efficiency with pre-emergence application of metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS as well as metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. intercultivation at 30 DAS. However, unweeded check showed lower weed control efficiency than the rest of the treatments. The results generated gains support from the other reports [5, 6].

Effect of pre and post-emergence herbicides on growth and yield of soybean:
The results revealed that, yield contributing factors *viz*. plant height, number of branches per plant, number of leaves per plant, pods per plant, pods weight and number of grains per pod were significantly influenced by weed management practices (Table 3). Higher number of branches, number of leaves and maximum plant height were recorded with intercultivation fb two hand weedings at 20 and 40 DAS and remained at par with metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS as well as metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. intercultivation at 30 DAS. Similarly in number of pods per plant, all the herbicidal treatments showed superiority over unweeded check. Higher number of pods per plant was observed with intercultivation fb two hand weeding at 20 and 40 DAS which was at par with metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS as well as metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3DAS fb. intercultivation at 30 DAS. Moreover, maximum grains per pod were observed with intercultivation fb two hand weeding at 20 and 40 DAS which was at par with metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS as well as metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. intercultivation at 30 DAS. Similar trends were observed in pod weight per plant as well as in hundred grains weight. However, the maximum grain yield was obtained in intercultivation fb two hand weeding at 20 and 40 DAS which was at par with metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3DAS fb. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS as well as metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. intercultivation at 30 DAS and minimum value was associated with unweeded check.

In general all the herbicidal treatments gave superior grain yield over the unweeded check. Similar trend was also recorded in case of haulm yield of soybean. The role of yield contributing factors and enhanced yield on account of herbicidal control of weeds has been documented earlier by [7, 8].

The crop yield is inversely related to the weed index, lower weed index was observed with intercultivation fb. hand weeding at 20 and 40 DAS (0.00) and among the herbicidal treatments, metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS recorded lower weed index (2.84) as it could be attributed to lower dry weight of weeds per ha as well as weed density. Similar results were also reported by [9].

Table 1: Effect of pre and post-emergence herbicides on grass weeds density, weed dry weight and weed control efficiency of soybean

Weed management practices	Weed density (no./0.25m^2)	Weed dry weight (g/0.25m^2)	Weed control efficiency (%)
T_1: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS (days after sowing)	3.08(9.00)	2.06(3.73)	76.71
T_2: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS followed by (fb) intercultivation (IC) at 30 DAS	2.08(4.00)	1.14(0.83)	94.81
T_3: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS fb. fenoxaprop–p-ethyl 9 EC at 70 g a.i ha^{-1} at 20 DAS	3.18(9.67)	2.08(3.81)	76.21
T_4: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha at 20 DAS	2.08(4.00)	2.11(3.99)	75.09
T_5: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS	2.73(7.00)	2.44(5.50)	65.66
T_6: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. IC at 30 DAS	1.76(2.67)	0.97(0.45)	97.19
T_7: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. fenoxaprop–p-ethyl 9 EC at 70 g a.i ha^{-1} at 20 DAS	2.60(6.33)	1.93(3.23)	79.83
T_8: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS	2.08(4.00)	0.91(0.33)	97.40
T_9: IC fb. HW at 20 and 40 DAS	1.64(2.33)	0.90(0.32)	98.00
T_{10}: Unweeded check	7.42(56.00)	3.99(16.02)	0.00
CD (P = 0.05)	0.96	0.58	-

Data within parentheses are original values; data analyzed using transformation -√x + 0.5

Table 2: Effect of pre and post-emergence herbicides on broad leaved weeds density, weed dry weight and weed control efficiency of soybean

Weed management practices	Weed density (no./0.25m^2)	Weed dry weight (g/0.25m^2)	Weed control efficiency (%)
T_1: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS (days after sowing)	3.07(9.00)	2.21(4.54)	65.07
T_2: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS followed by (fb) intercultivation (IC) at 30 DAS	1.64(2.33)	1.16(0.87)	93.30
T_3: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS fb. fenoxaprop–p-ethyl 9 EC at 70 g a.i ha^{-1} at 20 DAS	2.89(8.00)	1.64(2.23)	82.84
T_4: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha at 20 DAS	1.93(3.33)	1.27(1.13)	91.30
T_5: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS	3.18(9.67)	1.94(3.30)	74.61
T_6: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. IC at 30 DAS	1.93(3.33)	1.00(0.50)	96.15
T_7: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. fenoxaprop–p-ethyl 9 EC at 70 g a.i ha^{-1} at 20 DAS	2.16(4.33)	1.73(2.50)	80.76
T_8: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS	1.90(3.33)	0.97(0.45)	96.53
T_9: IC fb. HW at 20 and 40 DAS	1.68(2.33)	0.88(0.28)	97.84
T_{10}: Unweeded check	7.48(56.00)	3.67(13.00)	0.00
CD (P = 0.05)	0.78	0.35	-

Data within parentheses are original values; data analyzed using transformation -√x + 0.5

Table 3: Effect of pre and post-emergence herbicides on growth, yield and yield components of soybean

Treatments	Plant height(cm)	No. of Branches	No.of leaves	Pod plant^{-1}	Pod weight (g plant^{-1})	No.grains pod^{-1}	100 grains weight	Grain yield	Haulm yield	Weed index
T_1	62.85	3.47	16.33	59	27	2.32	16.39	1500	2422	41.63
T_2	72.21	4.60	18.33	98	46	2.41	17.26	2105	2669	18.09
T_3	67.37	4.13	17.07	79	37	2.29	16.79	1767	2607	31.24
T_4	69.22	4.33	17.27	92	43	2.30	17.22	2087	2469	18.79
T_5	66.87	3.80	16.80	75	35	2.29	16.58	1733	2458	32.56
T_6	76.60	6.20	21.93	140	71	2.67	18.73	2491	2693	3.07
T_7	68.29	4.27	17.27	81	38	2.46	16.91	1850	2110	28.01
T_8	77.63	5.60	19.27	144	73	2.71	18.99	2497	2867	2.84
T_9	83.66	8.07	26.07	165	77	2.79	19.18	2570	2964	0.00
T_{10}	56.67	0.87	1.87	16	8	2.26	9.62	496	864	80.70
CD(P=0.05)	8.24	1.39	1.53	37.26	9.14	0.18	1.23	405.72	421.12	-

Plant height, no.branches analysed data were taken at harvest and no.of leaves at 90 DAS

T_1: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS (days after sowing), **T_2**: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS followed by *(fb)* intercultivation (IC) at 30 DAS, **T_3**: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS *fb* fenoxaprop–p-ethyl 9 EC at 70 g a.i ha^{-1} at 20 DAS, **T_4**: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS *fb* imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS, **T_5**: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS, **T_6:** Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS *fb* IC at 30 DAS, **T_7**: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS *fb* fenoxaprop–p-ethyl 9 EC at 70 g a.i ha^{-1} at 20 DAS, **T_8**: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS *fb* imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS, **T_9**: Intercultivation (IC) *fb* hand weeding (HW) at 20 and 40 DAS, **T_{10}**: Unweeded check

CONCLUSION

Pre-emergence application of metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. Imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS resulted in higher grain yield besides giving broad spectrum of weed control. This weed management method found to be promising to control weeds of soybean crop and would play an important role in areas where labor is too expensive and time is a constraint.

Acknowledgement
I would like to thank the Indian Council for Agricultural Research (ICAR), Indo-African fellowship program and Department of Agronomy, UAS GKVK Bengaluru for providing all possible research facilities while executing the field experiment and laboratory analysis.

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