ECONOMICS OF INTEGRATED WEED MANAGEMENT IN 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 economics of integrated weed management in soybean. The experiment was laid out in Randomized Complete Block Design (RCBD) with ten treatments, replicated thrice. At harvest, intercultivation fb hand weeding at 20 and 40 DAS was found effective for controlling grasses, broad leaved weeds and sedge weeds, registered higher grain (2570 kg ha-1) and haulm yield (2964 kg ha-1). However, intercultivation fb.hand weeding at 20 and 40 DAS remained at par with pre-emergence application of metribuzin 70 WP fb. imazethapyr as well as metribuzin 70 WP fb.intercultivation at 30 DAS as compared to unweeded check. Nevertheless, benefit cost ratio was recorded higher (3.55) under the metribuzin 70 WP fb. imazethapyr.

Key Words: *Economics, pre and post-emergence herbicides, soybean, weeds, yield*

Introduction

Soybean (Glycine max), is an important oil-yielding rainy-season (kharif) crop having multiple uses. It has revolutionized the rural economy and has improved socio-economic status of the farmers. Soybean produces 2-3 times more high quality protein yield per hectare than other pulses and cholesterol free oil (Kumari et al., 2002). It is preferred especially by vegetarians on account of its richness in protein, fat, carbohydrates, mineral, salts and vitamins. Among the various factors responsible for the low yield of soybean, weeds have been considered to be of prime importance.

The losses caused by weeds exceed the losses from any other category of biotic factors like insects, nematodes, diseases, rodents, mites, etc. Soybean is mostly grown in kharif season and suffers from severe weed crop competition due to continuous rain, which do not permit hand weeding operation timely resulted in yield loss to the tune of 30–80 per cent (Yaduraju, 2002).

In general, judicious use of herbicides in crop land generally increase crop yield, improve crop quality and reduce production costs (Balyan and Malik, 2003). Therefore, an experiment was planned to study the economics of integrated weed management in soybean.

Material and Methods

Field experiment was conducted in zonal agricultural research station, university of agricultural sciences, GKVK Bengaluru during Kharif, 2012 to study the economics of integrated weed management in 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 Randomized Complete Block Design as an experimental design in which the experimental units are divided into blocks and, separately within each block; treatments are assigned at random to the experimental units within that block. In this design, every experimental unit within the same block has an equal chance to receive any one of the treatments. The experiment was composed of ten treatments replicated thrice *viz* $\mathbf{T_1}$: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS (days after sowing), $\mathbf{T_2}$: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS followed by *(fb)*. intercultivation (IC) at 30 DAS, $\mathbf{T_3}$: 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, $\mathbf{T_4}$: 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, $\mathbf{T_5}$: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS, $\mathbf{T_6}$: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS *fb*. IC at 30 DAS, $\mathbf{T_7}$: 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, $\mathbf{T_8}$: 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, $\mathbf{T_9}$: Intercultivation *fb*. hand weeding (HW) at 20 and 40 DAS, $\mathbf{T_{10}}$: Unweeded check. Variety MAUS-2 was sown on 12^{th} 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 weeds density and dry weight, yield and yield attributes were recorded at harvest. The economics of weed control was worked out based on agricultural inputs and outputs. Data on weed density and weed dry weight showed high variation. To make the analysis of variance more valid, the data on weed density and weed dry weight were subjected to square root transformation by using formula $\sqrt{x} + 0.5$ (Chandel, 1984). Later the data were analyzed statistically for test of significance following the procedure described by Gomez and Gomez (1984). 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=0.05.

The major weed flora observed in the experimental plot was 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

Effectiveness of pre and post-emergence herbicides on weed growth

At harvest, among the weed control treatments significantly lower total weed density was recorded under intercultivation fb two hand weedings at 20 and 40 DAS (8.00) 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 (8.67) (Table 1). Similarly, significantly lower total weed dry weight as well as more than 96 per cent weed control efficiency were recorded in intercultivation fb two hand weedings at 20 and 40 DAS (1.00 g 0.25 m^2). However, intercultivation fb two hand weedings at 20 and 40 DAS 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 (1.17 g 0.25 m^2). Similar trend was also noticed by **Tiwari *et al.*2007 and Shete *et al.*2008**. Unweeded check treatment registered significantly higher total weed population (125.33), dry weight of weeds (30.72 g 0.25 m^2) as well as lower weed control efficiency (0.00 %). Better weed control efficiency could be attributed to better efficacy of this pre and post-emergence herbicides used in controlling grasses, broad leaved weeds as well as sedge weeds, which is evidenced by lower number of weeds per 0.25 m^2 and weed dry weight at harvest.

Effectiveness of pre and post-emergence herbicides on yield and economics

Intercultivation fb two hand weedings at 20 and 40 DAS registered higher grain yield (2570 kg ha^{-1}), haulm yield (2964 kg ha^{-1}), and higher net returns (49652 $Rs.ha^{-1}$) which 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 (2497 kg ha^{-1}, 2867 kg ha^{-1} and 49013 $Rs.ha^{-1}$, respectively) (Table 2). Unweeded check recorded lower grain yield (496 kg ha^{-1}) haulm yield (864 kg ha^{-1}) and lower negative returns (-2374 $Rs.ha^{-1}$).

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 herbicides 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 **Suresh Kumar *et al.*2008.** Moreover, benefit cost ratio was recorded higher (3.55) under the 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, followed by Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. IC at 30 DAS (3.33) and intercultivation fb. hand weeding at 20 and 40 DAS (3.29) as compared to unweeded check (-0.87) (Table 2). This was mainly due to lesser cost of cultivation. These results are in conformity with **Vijayalaxmi *et al.*2012**.

Conclusions

In light of the results obtained from the present investigation, it was concluded that for effective weeds control and securing maximum grain yield of soybean as well as economic returns, intercultivation fb two hand weedings at 20 and 40 DAS or application of pre-emergence herbicide metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS followed by a post-emergence herbicide imazethapyr 10 SC at 100 g a.i. ha^{-1} at 20 DAS may be adopted. This herbicide weed management method found to be promising to control weeds in soybean crop and would play an important role in areas where labor is too expensive and time is a constraint.

Table 1: Effectiveness of weed management practices on weed density, weed dry weight and weed control efficiency (WCE)

Weed management practices	Weed density(no.0.25m^2)	Weed dry weight(g 0.25m^2)	WCE (%)
T_1: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS (days after sowing)	5.29(27.67)	3.27(10.28)	66.55
T_2: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS followed by (fb) intercultivation (IC) at 30 DAS	3.26(10.67)	1.63(2.24)	92.72
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	4.81(22.67)	2.77(7.26)	76.36
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	3.89(14.67)	2.45(5.54)	81.96
T_5: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS	4.91(23.67)	3.15(9.50)	69.08
T_6: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. IC at 30 DAS	3.18(9.67)	1.32(1.26)	95.91
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	4.34(18.33)	2.63(6.44)	79.05
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	2.85(8.67)	1.29(1.17)	96.19
T_9: IC fb. HW at 20 and 40 DAS	2.90(8.00)	1.22(1.00)	96.75
T_{10}: Unweeded check	11.20(125.33)	5.55(30.72)	0.00
CD (P = 0.05)	0.88	0.60	-

Data within parentheses are original values; data analyzed using transformation -$\sqrt{x}$ + 0.5

Table 2: Effectiveness of weed management practices on grain yield, haulm yield, net returns, benefit cost ratio and weed index of soybean

Weed management practices	Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Net returns (Rs/ha)	Benefit cost ratio	Weed index (%)
T_1: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS (days after sowing)	1500	2422	26517	2.43	41.63
T_2: Pendimethalin 30 EC at 0.75 kg a.i ha^{-1} at 3 DAS followed by (fb) intercultivation (IC) at 30 DAS	2105	2669	40796	3.16	18.09
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	1767	2607	32180	2.63	31.24
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	2087	2469	37878	2.86	18.79
T_5: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS	1733	2458	31408	2.65	32.56
T_6: Metribuzin 70 WP at 0.5 kg a.i ha^{-1} at 3 DAS fb. IC at 30 DAS	2491	2693	48501	3.33	3.07
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	1850	2110	31109	2.55	28.01
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	2497	2867	49013	3.55	2.84
T_9: IC fb. HW at 20 and 40 DAS	2570	2964	49652	3.29	0.00
T_{10}: Unweeded check	496	864	-2374	-0.87	80.70
CD (P = 0.05)	405.72	421.12	-	-	-

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