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# Integration of Chemical and Cultural Methods for Weed Control Management in Soybean (*Glycin Max. L*)

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## ABSTRACT

A field experiment was conducted during *kharif* season 2012 and 2013 at Rajmata Vijayaraje Scindia Krishi Vishwa Vidhyalaya RVSKVV, College Farm Gwalior (M.P.) to asses the suitable method for weed control in soybean. On the basis of two years pooled data results weeding twice at 20 and 40 DAS significantly highest growth, yield attributes and seed yield as compared to the un-weeded control and was at par with pendimethalin (750 g a.i./ha) + one hand weeding, trifluralin (1000 g a.i./ha) + one hand weeding at 20 DAS and imezathapyr(100 g a.i./ha) + one hand weeding at 40 DAS. These treatments also recorded lower weed dry biomassand higher weed control efficiency. –Pendimethalin (750 g a.i./ha) + one hand weeding at 20 DAS resulted higher net return (` 63500) and B:C (2.58) ratio followed by trifluralin + one hand weeding and hand weeding twice at 20 and 40 DAS. In addition to hand weeding twice, pre emergence herbicide Pendimethalin (750g a.i/ha) + one hand weeding at 20 DAS can be effectively used as an alternative for controlling weeds for obtaining optimum seed yield in soybean.


**Key words:** Economics, Herbicides, Soybean, Water use efficiency, Weed index, Yield.

## INTRODUCTION

India is the fifth largest producer of soybean in the world, which is grown in an area of 9673 thousand hectares with the production of 9720 thousand tonnes (SOPA, 2010). The average productivity of the crop is 1021 kg/ha which is lower as compared to other soybean growing countries of the world. Madhya Pradesh being “Soya State” accounts for 54.96% of area and 57.62% of production of soybean in the country with an average productivity of 1052 kg/ha. Madhya Pradesh coverage of 5.76 million hectare recording production of 6.49 million tonnes with an average productivity of 1124 kg/ha (Anonymous 2011). Weed infestation is one of the major constraints that limit the productivity of soybean. Critical period of crop-weed competition for soybean crop ranges between 20 to 45 days after sowing. Crop is highly susceptible to weed infestation, because of its slow growth in the initial stage up to 45 days. Soybean weeds comprise diverse plant species from grasses to broad leaf weeds and sedges and cause substantial yield losses. In India yield losses of soybean due to weeds ranged from 30-80% depending upon the type of weed flora and weed density (Kuruchania *et al.,* 2000). The incessant rains do not permit timely inter-cultivations and manual control of weeds on account of high cost labour shortage during weed peaks. During the peak period of weed infestation incessant rains do not permit timly inter-cultivation and manual weeding on high cost and shortage of labour.

Besides this, weeds are preferred host of several insect-pests and vectors of many important organisms causing diseases in soybean. Therefore, there is a need for alternative method for reducing the weed infestation. Herbicides, though, selective, efficient and cost effective weed control measure in controlling weeds in soybean.

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Selective herbicides are efficient and cost effective control measure for weed control in soybean. The maximum benefit can be achieved by combining herbicides with manual, cultural and mechanical weed control methods. Thus, the present study was undertaken to find out suiTable herbicides that would control the weeds econumbermically and safely.

## MATERIALS AND METHODS

A field experiment was conducted during *kharif* 2012 and 2013 at RVSKVV, college of agriculture farm Gwalior (M.P.) situated at 22° 43’ N latitude and 76° 54 E Lonngitude to asses the suitable method for weed control in soybean. The experiment was laid out in randomized block design with 12 treatments *viz*., $T_1$ Un-weeded control, $T_2$ Hand weeding twice at 20 and 40 DAS, $T_3$ Hand weeding at 20 DAS + Hoeing at 40 DAS, $T_4$Imezathapyr @ 100g/ha POE, $T_5$ Quizalofop-ethyl @ 50g/ha POE, $T_6$ Pendimethalin @ 750g/ha PE, $T_7$ Trifluralin @ 1000g/ha PPI, $T_8$ Quizalofop-ethyl + Chlorimuron @ 750 + 40g/ha, $T_9$ T4+one hand weeding at 40 DAS, $T_{10}$ T5+one hand weeding at 40 DAS, $T_{11}$ T6+ one

hand weeding at 20 DAS $T_{12}$ T7+one hand weeding at 20 DAS and replicated three time. The spraying of herbicides were done as per different treatments. The experimental soil was sandy clay loam, low in organic carbon (0.45), available nitrogen (112.5), available phosphorus (11.22) and medium in available potassium (224.0). The crop was fertilized with 20:80:20 kg N, $P_2O_5$ and $K_2O$ /ha through urea, single super phosphate and muriate of potash, respectively. The half N, full $P_2O_5$ and $K_2O$ were mixed in soil at the time of field preparation and remaining half N was top dressed at 25 days after sowing. Soybean variety JS-9560 was sown on July I$^{st}$ week during both the years at 30 cm x10 cm spacing using a seed rate of 80kg/ha. The crop was harvested in September I$^{st}$ week during both the years. Weed density was recorded from pre-marked quadrants of 1.0 m$^2$ area. The weed count data were subjected to square root transformation $\sqrt{x+1}$ to normalize the distribution. Weed control efficiency and weed index were worked out to assess the efficiency of different weed control treatments. The economics was calculated based on prevailing market prices of inputs such as pendimethalin @ ` 380/lit.quizalofop-ethyl@ ` 300/lit, imezathapyr@ ` 1670/lit, trifloralin@ ` 650/ lit, chlorimuron@ ` 450/lit, labour charge@ ` 200/ Monday and out puts *viz*; soybean seed@ ` 100/kg. The yield of soybean was recorded separately for each net plot and converted into kg/ha. To calculate weed control efficiency (WCE) and weed index (WI) following formula were used (Ref).

$$WCE\ \% = \frac{DWC\text{-}DWT}{DWC} \times 100$$

Where,

WCE weed control efficiency; DWC, dry weight of weeds in un-weeded control plot. DWT, dry weight of weeds in treated plot.

$$WI\% = \frac{Y_{HW} - Y_T}{Y_{HW}} \times 100$$

Where,

WI, weed index; $Y_{HW}$, Average yield of crop in weed free plot, $Y_T$ Average yield of crop in plot under other weed control treatments.

## RESULTS AND DISCUSSION

### Weed study

**Weeds flora:** Weed flora in the experimental field consistedof monocot weeds (Narrow leaf weeds), *viz*,*Cynodondactylon*, *Panicumcolonum, Indigofer aglandulesa, Aeluropusvillasus* and dicot weeds (broad leaf weeds) *viz*. *Digeraarvensis, Euphorbia hirta, Amaranth-usviridis, Leucasaspera, Boerhaviadiffusa, Commelina-benghalensis, portulacaoleracea, Tranthamamonom bergayana Partheniumhysterophorus* and sedge weed *Cyperusrotundus* during both the years of study.

**Weeds density and biomass:** On the basis of two years pooled data, all the treatments were found to decrease significantly population density of monocot, dicot and total weeds at 30 DAS as compared to un-weeded control. Hand weeding twice at 20 and 40 DAS was found to have significantly lowest weed density as compared to un-weeded control. Similarly pendimethalin PE +one hand weeding at 20 DAS reduce the weed density followed by trifluralion +one hand weeding at 20 DAS and imezathapyr +one hand weeding at 40 DAS. Pre emergence application of pendimethalin prevents emergence of monocot and grassy weeds by inhibiting root and shoot growth, which causes destruction of these weeds. Our results support the findings of Kalhapure *et al*. (2013). Hand weeding twice at 20 and 40 DAS followed by pendimethalin@750g/ha+ one hand weeding, trifluralin @ 1000g/ha+ one hand weeding and imezathapyr + one hand weeding were found to have the highest weed control efficiency. However, pendimethalin @750gai/ha + one hand weeding at 20 DAS and trifluralin 1000g/ha+ one hand weeding at 20 DAS and imezathapyr +one hand weeding at 40 DAS resulted in the lowest weed index. Meena *et al.* (2011) and Kushwaha and Vyas (2006) also reported higher WCE and lower weed index with pendimethalin+one hand weeding at 20 DAS and imezathapyr + one hand weeding at 40 DAS (Vijaylaxhmi *et al.,* 2012) found higher WCE and lower weed index with imezathapyr + two hand weeding in Ground nut. Similarly, weed dry weight was recorded significantly lower under trifluralin + one hand weeding followed by pendimethalin + one hand weeding, imezathapyr +one hand weeding and they were at par to each other and significantly superior over other treatments. (Rana *et al*., 2015 and Kujur *et al*., 2015).

**Growth attributes:** The results revealed that all the weed control measures including hand wedding twice significantly improved the growth parameters, except plant population over un weeded control (Table 1). Pendimethalin + one hand weeding and trifluralin + one hand weeding, imezathapyr + one hand weeding had almost equal effects on plant height, branches/plant and were at par with hand weeding twice. This is attributed to better control of weeds from the initial stage and later supplemented with hand weeding as evident by less count and dry weight of weeds (Table1).

Timely and effective control of weeds is expected to have better availability of moisture, nutrients and solar radiation to the crop plants thereby increasing chlorophyll content, photo synthetic rate (Singh *et al*. 2014) leading to higher supply of carbohydrates, which resulted in higher increase in growth attributes than un-weeded control. Less weed population also provides ample space for root growth and numberdulation (Meena *et al.* 2014 and Nandini Devi *et al*., 2016).

**Yield and yield attributes:** Yield and yield attributes were significantly affected by weed control measures (Table 2). Among the weed control measures, hand weeding twice at 20 and 40 DAS significantly highest number of pods/plant, number of seeds/pod, 1000 seed weight and seed yield compared to the un-weeded control. It was at par with pendimethalin + one hand wedding, trifluralin + one hand weeding and imezathapyr + one hand weeding resulted in

46.45, 46.33, 46.0 and 43.51 % higher seed yield, respectively, compared to un-weeded control. These results are in conformity with the findings of (Singh *et al*., 2014). Weed free environment facilitates better growth development of plants which tends to increase pods/plant, test weight and consequently seed yield/ha. (Kumar *et al*., 2016 and Raman and Krishnamoorthy, 2005).

**Economics:** Pendimethalin + one hand weeding at 20 DAS resulted in the highest net return followed by trifluralin + one hand weeding and hand weeding twice at 20 and 40 DAS (` ). The un-weeded control gave the lowest net returns. Similarly, pendimethalin + one hand weeding recorded the highest benefit cost ratio (2.58) followed by trifluralin+ one hand weeding (2.55), imezathapyr + one hand weeding (2.43) and hand weeding twice at 20 and 40 DAS (2.38). Sharma *et al*. (2015) also reported the highest net return and benefit cost ratio with pendimethalin + one hand weeding at 20 DAS.Thus, pre-emergence application of pendimethalin@ 750g ai/ha + one hand weeding at 20 DAS, trifluralin+ one hand weeding and imezathapyr + one hand

**Table 1:** Effect of weed management treatments in soybean on weed count, weeds dry weight, weed control efficiency and weed index (Pooled over two years).

| S. No. | Treatments | Weed population at 30 DAS (Number / $m^2$) | | Total weed population (NLW+BLW) at 30 DAS (number/$m^2$) (Unit) | Weed dry weight ($g/m^2$) (NLW+BLW) at 30 DAS | Weed Control Efficiency at 30 DAS | Weed Index at 30 DAS |
|---|---|---|---|---|---|---|---|
| | | NLW | BLW | | | | |
| $T_1$ | Un weeded control | 191.9 (12.8) | 59.9 (7.7) | 251.7 (15.4) | 93.6 (8.6) | 0.0 | 60.2 |
| $T_2$ | Hand weeding +hoeing (farmers practices) | 19.1 (4.2) | 23.0 (4.2) | 78.67 (8.7) | 49.4 (5.7) | 55.0 | 32.1 |
| $T_3$ | Hand weeding twice (20 and 40 DAS) | 0.0 (0.7) | 0.0 (0.7) | 0.0 (0.7) | 0.0 (0.7) | 100.0 | 0.0 |
| $T_4$ | Imezathapyr 100g/ha PoE | 58.4 (7.4) | 32.0 (5.5) | 100.77 (9.7) | 47.8 (6.1) | 48.5 | 40.2 |
| $T_5$ | Quizalofop-ethyl @50g/ha PoE | 79.4 (8.5) | 32.9 (5.7) | 106.8 (10.1) | 49.0 (6.2) | 43.6 | 42.6 |
| $T_6$ | Pendimethalin @750g/ha PE | 75.7 (8.2) | 31.1 (5.5) | 111.8 (10.3) | 53.4 (6.5) | 41.0 | 43.1 |
| $T_7$ | Trifluralin @ 1000g/ha PPA | 76.0 (8.2) | 35.8 (5.9) | 112.3 (10.4) | 59.7 (6.6) | 40.0 | 48.3 |
| $T_8$ | Quizalofop-ethyl +chlorimuron (750+40g/ha) | 71.1 (7.8) | 29.7 (5.4) | 96.23 (9.5) | 64.6 (7.0) | 50.0 | 38.7 |
| $T_9$ | T4 + one hand weeding at 40 DAS | 70.4 (7.8) | 25.8 (5.0) | 90.4 (9.3) | 19.1 (4.8) | 69.6 | 35.3 |
| $T_{10}$ | T5 + one hand weeding at 40 DAS | 29.2 (5.1) | 17.4 (4.8) | 78.67 (8.7) | 15.1 (3.7) | 58.1 | 16.2 |
| $T_{11}$ | T6 + one hand weeding at 20 DAS | 28.2 (5.0) | 11.0 (3.3) | 39.23 (6.1) | 13.5 (3.5) | 80.11 II | 6.1 |
| $T_{12}$ | T7 + one hand weeding at 20 DAS | 19.1 (4.2) | 23.0 (4.2) | 46.67 (6.5) | 12.3 (3.2) | 76.9 III | 14.2 |
| | SEm± | 0.4 | 0.3 | 0.4 | 0.5 | - | - |
| | CD at 5% | 1.1 | 1.0 | 1.1 | 1.4 | - | - |

NLW- Narrow Leaved Weed.

BLW – Broad Leaved Weed.

**Table 2:** Yield and yield attributes of soybean under different weed control treatments (pooled data of two years).

| S. No | Treatments | Plant height (cm) | Branches /plant | Number of pod/ plant | Number of seed/ pod | 100 seed weight (g) | Seed yield (kg/ha) | Net Return (` /ha) | B:C ratio |
|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | Un weeded control | 52.5 | 4.3 | 55.5 | 1.70 | 10.88 | 1575 | 25250 | 1.14 |
| $T_2$ | Hand weeding +hoeing (farmers practices) | 57.7 | 4.8 | 74.2 | 2.17 | 11.62 | 1890 | 32600 | 1.35 |
| $T_3$ | Hand weeding twice (20 and 40 DAS) | 60.7 | 6.4 | 82.1 | 2.83 | 12.69 | 2969 | 62570 | 2.36 |
| $T_4$ | Imezathapyr 100g/ha PoE | 57.5 | 5.1 | 76.6 | 2.21 | 12.22 | 2375 | 47750 | 2.03 |
| $T_5$ | Quizalofop-ethyl @50g/ha PoE | 56.9 | 5.3 | 77.1 | 2.18 | 12.24 | 2380 | 47800 | 2.03 |
| $T_6$ | Pendimethalin @750g/ha PE | 57.5 | 5.9 | 79.8 | 2.26 | 12.51 | 2687 | 57060 | 2.42 |
| $T_7$ | Trifluralin @ 1000g/ha PPA | 57.9 | 5.8 | 79.6 | 2.28 | 12.25 | 2688 | 56990 | 2.41 |
| $T_8$ | Quizalofop-ethyl +chlorimuron (750+40g/ha) | 57.5 | 5.2 | 78.9 | 2.22 | 12.31 | 2677 | 56460 | 2.36 |
| $T_9$ | T4 + one hand weeding at 40 DAS | 59.8 | 6.1 | 80.2 | 2.68 | 12.65 | 2790 | 59200 | 2.43 |
| $T_{10}$ | T5 + one hand weeding at 40 DAS | 59.9 | 6.3 | 81.1 | 2.69 | 12.67 | 2772 | 58560 | 2.41 |
| $T_{11}$ | T6 + one hand weeding at 20 DAS | 60.5 | 6.5 | 82.6 | 2.84 | 12.79 | 2935 | 63500 | 2.58 |
| $T_{12}$ | T7 + one hand weeding at 20 DAS | 60.4 | 6.4 | 82.4 | 2.82 | 12.77 | 2922 | 63010 | 2.55 |
| | SEm ± | 1.3 | 0.4 | 2.2 | 0.2 | 0.4 | 102 | - | - |
| | CD at 5% | 3.9 | 1.2 | 6.6 | 0.3 | 1.2 | 305 | - | - |

weeding or hand wedding twice at 20 and 40 DAS can be used to get higher productivity and economic return in *kharif* soybean.

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