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RESPONSE OF INTEGRATED WEED MANAGEMENT ON GROWTH, YIELD AND ECONOMICS OF SOYBEAN UNDER RAINFED CONDITION

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ABSTRACT

The field experiment was conducted during kharif season of 2010-11 at experimental farm, College of Agriculture, Rewa (M.P.) to study the effect of integrated weed management on grain yield and economics of soybean (Glycine max). Treatments were tested in randomized block design with three replications. All weed control measures registered significantly higher seed yields of soybean than weedy check. Among the physical and integrated weed management practices, Pursuit 750 ml ha^{-1} + hand weeding at 45 DAS recorded higher yields of soybean. Integrated use of herbicides gave better seed yield than their individual application. Application of Pursuit 750 ml ha^{-1} + hand weeding at 45 DAS augmented highest pods plant^{-1}, seeds plant^{-1}, grain yield (22.37 qha^{-1}) and stover yield (39.65 qha^{-1}) over other treatments. Hand weeding at 25 and 45 days after sowing (DAS) recorded lowest number of weeds (9.48 m^{-2}) than all rest of treatments. While, the other treatments supplement with or without hand weeding remained comparable to hand hoeing (at 25 DAS) + hand weeding (at 45 DAS). The lowest values of all the characters were recorded in weedy check. The maximum net returns (Rs.30767 ha) and B : (ratio (3.82) were recorded with pursuit 750 ml ha^{-1} + hand weeding at 45 days treatment and lowest with weed check.

Key Words: Integrated weed management, growth, yield, economics, soybean.

INTRODUCTION

Soybean (*Glycine max*) also known as Golden Bean is the largest oilseed crop in world accounting for more than 50% of the world oilseeds production. The processed soybean is the largest source of protein feed and second largest source of vegetable oil in the world (Pawar *et al.,* 2011). Madhya Pradesh being "Soya- State" accounts for 54.96 per cent of area and 57.62 per cent of production of soybean in the country with an average productivity of 933 kg ha^{-1}. The area and production of soybean in Madhya Pradesh increased by 43.18 per cent and 67.20 per cent respectively in the year 2009-10 over the year 1993-94 (Anon. 2014). As a miracle golden bean of 20th century which possesses the potential of revolutionizing the Indian economy by correcting the health of human beings with its wide spectrum of chemical composition) and soil (increasing the C:N ratio) (Kalpana, 2010). However the growth of soybean is greatly affected by inadequate control of seasonal weeds, especially during the early period of the crop growth. Being a rainy season crop, its growth and yield are reduced by 25-77 per cent by weeds (Kurchania *et al.,* 2001). The critical period of crop weed competition ranges from first two weeks to seven weeks after sowing. Any delay in weeding will lead to increased weed biomass as a result drastic reduction in yield. While, weed management in soybean has really been a challenging factor due to non-availability and costly labor, which favors the use of herbicides for weed control in soybean. In advances, the field of selective herbicides has added a new dimension in the modern weed control technology. A number of chemicals for grassy and broadleaved weeds have been developed for soybean. Some of them are commercially available, while the others are in the pipe-line. The most promising ones are alachlor (Lasso) Pre-emergence and fluchloralin (Basalin) pre-plant incorporation for the grass and broad-leaf weed killer. However, to avoid the continuous use of particular herbicide and to reduce the possibility of evolution of resistant biotype of weeds, identification of new herbicides is essential. Hence, new herbicides should be screened for their efficacy against weeds in soybean. Now-a-days, integrated weed control practice is become common in which all the economically, ecologically and toxicologically justifiable methods like chemical,

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cultural and mechanical are employed to keep the weed below the threshold level of economic damage. The integrated weed management has also been found economical and effective as reported by Kushwaha and Vyas (2005). Though many studies have been carried out in other crops, but the study on integrated weed management for the farmers of rain fed region of Rewa (M.P.) is wanted. Therefore, a study was initiated to evaluate the various integrated weed management practices on the productivity, profitability and quality of soyabean.

MATERIAL AND METHODS

Field experiment was conducted during *kharif* season of 2010-11 at the research farm College of Agriculture, Reewa under humid subtropical climate with 860 mm precipitation and average temperature of 25^0C. The soil of the experimental area was silty loam, medium in available potassium (212 kg ha^{-1}), low in available nitrogen (219 kg ha^{-1}) and phosphorus (14 kg ha^{-1}) with neutral in pH (7.4). The treatments namely T_1 Weedy check (control), T_2 Hand weeding at 25 and 45 days after sowing (DAS), T_3 Hand hoeing (at 25 DAS) + Hand weeding (at 45 DAS) as physical method, T_4 Pendimethlin 1.5 kg ha^{-1} (Pre-emergence), T_6 Alachlor 2 lit ha^{-1} (pre-emergence), T_8 Pursuit 750 ml ha^{-1} (post-emergence) as chemical method and integrated used treatment as T_5 Pendimethlin 1.5 kg ha^{-1} (Pre-emergence) + Hand weeding (at 45 DAS), T_7 Alachlor 2 lit ha^{-1} (pre-emergence) + Hand weeding (at 45 DAS) and T_9 Pursuit 750 ml ha^{-1} (post- emergence) + hand weeding (at 45 DAS) were arranged in a randomized block design with three replications. The soybean cv. JS 93-05 was sown on 9 July, 2010 @ 100 kg seed ha^{-1} at a row distance of 30 cm under rainfed condition. Uniform doses of 20 kg N, 60 kg P_2O_5 and 20 kg K_2O ha^{-1} were applied as basal at the time of sowing of soybean. After complete germination, soybean seedlings were thinned to secure two plants $hill^{-1}$. The number of leaves $plant^{-1}$, number of branches $plant^{-1}$ and plant height were taken at fully development phase.At maturity, soybean crop was harvested and yield attributes i.e. number of pods $plant^{-1}$, pod weight $plant^{-1}$, number of seeds $plant^{-1}$, grain yield and 100-seed weight were recorded. -

Weed control efficiency (WCE) was calculated by the following formula

$$WCE = \frac{\text{Weed dry mass from the control plot- weed dry matter from treated plot}}{\text{Weed dry mass from the control plot}} \times 100$$

Weed index (%) = (X-Y/X) x 100

Where, X = weight of grain yield (qha^{-1}) in treatment which has highest yield and Y = weight of grain yield (qha^{-1}) in treatment for which weed index is to be calculated. Economics of various treatments was calculated on the basis of prevailing market price of inputs and produce. The collected data were analysed using analysis of various techniques.

RESULTS AND DISCUSSION

Weed incidence

The data on the common weeds in the unweeded check revealed that the major grassy weeds were *Echinochloa spp*., *Cyperusrotundus*, *Cynodondactylon* and *Phyllanthus niruri, Commelina benghalensis, Euphorba spp., Convolvulus arvenis* as only broad leaved weeds.At harvest, the highest dry matter (55.65 g m^{-2}) and population density (50.35 m^{-1}) of weeds were recorded under weedy check. The integrated weed management practices significantly reduced the dry weight with minimum density of weeds and weed control efficiencies (Table 1). Among the physical methods, hand weeding at 25 and 45 DAS proved most effective in minimizing the weed and recorded significantly lower weed density and dry matter (8.35 g m^{-2}); which at par with one hand hoeing at 25 DAS and one hand weeding at 45 DAS. Among the integrated weed management practices, minimum weed densities (15.28 m^{-2}) and dry matter (15.35 g m^{-2}) were recorded with the application of pursuit 750 ml ha^{-1} + HW (at 45 DAS) followed by Alachlor 2 lit ha^{-1} + hand weeding at 45 DAS, Pendimethlin @ 1.5 kg ha^{-1}, Pendimethlin @ 1.5 kg ha^{-1} + hand weeding at 45 DAS; The data (Table 1) also show that hand weeding done at 25 and 45 DAS had the highest weed control efficiency (81.17 %) closely followed by hand hoeing at 25 DAS + HW at 45 DAS (77.55 %) and Pursuit 750 ml ha^{-1} + HW at 45 DAS (69.65%). Similar findings of higher weed control efficiency with two hand weeding were also reported by Yadav *et al.,* (2009) and Parthipan *et al.,* (2013)**.** These results are in conformity with findings of (Singh *et al.,* 2012) who reported that dry weight of

weeds were greatly reduced under two hand weeding in transplanted rice. Lowest weed dry matter, weed index and highest weed control efficiency was found in Pursuit 750 ml ha^{-1} + hand weeding among chemical treatment.

Table 1: Weed incidence in soybean as influenced by integrated weed management

Treatment	Weed population m^{-2}			Weed dry weight m^{-2} (g)	Weed index (%)	Weed control efficiency (%)
	Monocot	Dicot	Total			
Weedy check (control)	41.05	9.30	50.35	55.65	80.2	0.00
Hand weeding (25 and 45 DAS)	8.08	1.40	9.48	8.35	5.3	81.17
Hand hoeing (25 DAS) + Hand weeding (45 DAS)	9.05	2.25	11.30	10.65	61.9	77.55
Pendimethalin 1.5kg ha^{-1}	32.06	6.33	38.39	38.15	68.2	23.75
Pendimethlin 1.5 kg ha^{-1} + Hand weeding (45 DAS)	34.51	5.28	39.79	42.85	56.6	20.97
Alachlor 2 lit ha^{-1}	30.82	6.32	37.14	40.65	35.4	26.23
Alachlor 2 lit ha^{-1} + hand weeding (45 DAS)	29.88	4.33	34.14	37.15	23.9	32.19
Pursuit 750 ml ha^{-1}	27.68	5.27	33.03	35.85	8.1	34.39
Pursuit 750 ml ha^{-1} + hand weeding (45 DAS)	13.78	1.50	15.28	15.35	0.0	69.65
S.Em.±	0.66	0.65	0.73	0.67	--	--
C.D. at (P=0.05)	1.98	1.96	2.19	2.01	--	--

Growth and yield attributes

Growth attributes of soybean were significantly influenced by integrated weed management practices (Table 2). The taller plants (75.97 cm) with higher branches $plant^{-1}$ (11.58) as well as number of leaves $plant^{-1}$ were significantly recorded by pursuit 750 ml ha^{-1} (post- emergence) supplemented with one hand weeding at 45 DAS, followed by hand weeding at 25 and 45 DAS. Increase in plant height and number of leaves $plant^{-1}$ might be due to better environment with increased uptake of both micro and macro nutrients by soybean due to reduced crop weed competition. While, the other treatments supplement with or without hand weeding were remained comparable to hand hoeing (at 25 DAS) + hand weeding (at 45 DAS). However, Pursuit 760 ml ha^{-1}, alachlor 2 lit ha^{-1} + hand weeding at 45 DAS and alachlor 2 lit ha^{-1} proved superior to hand hoeing (at 25 DAS) + hand weeding (at 45 DAS) in improvement of plant height and branches $plant^{-1}$. The lowest value of respective characters recorded in weedy check. Moreover, the maximum pods $plant^{-1}$ (22.4), grains pod^{-1} (3.00) and seeds $plant^{-1}$ (139.85) of soybean were registered significantly with Pursuit 750 ml ha^{-1} + HW at 45 DAS; which was found significantly highest than HW at 25 and 45 DAS. It might be due to tallest plant and maximum number of leaves $plant^{-1}$. However, the all treatments have not showed significant influence on number of grains pod^{-1} over weedy check. The number of seeds $plant^{-1}$ was recorded significantly higher in pendimethlin 1.5 kg ha^{-1} with one hand weeding at 45 DAS and one hand hoeing at 25 DAS supplemented with hand weeding at 45 DAS than pursuit 150 ml ha^{-1}, alachlor 2 lit ha^{-1}, pendimethlin 1.5 kg ha^{-1} and weedy check. Superiority of two HWs might be ascribed to absence of weed competition with the crop plants for space, light, nutrients and soil moisture due to complete removal of weeds from field and hence better crop growth (Nalini *et al.,* 2012). In control (weedy check) treatment, where maximum weed competition persisted due to unchecked weeds, the yield attributing characters were recorded to be minimum in fact weeds compete with the crop plants for space, light, soil moisture and nutrients which directly affects the vegetative as well as reproductive growth parameters of plants. The findings corroborate with those of Jain and Tomar (2002)**;** Vyas and Jain (2002); Kushswaha and vyas (2005) and (Sharma and Umat 2005).

Yield

Among the integrated weed management practices*,* Pursuit 750 ml ha^{-1} as post-emergence with a hand weeding at 45 DAS, recorded significantly higher plant height, pods $plant^{-1}$, less weed biomass, higher seeds $plant^{-1}$ and number of grains pod^{-1} highest grain

and straw yield (22.37 and 39.65 q ha^{-1}), and remained significantly higher than all the treatments. While, those treatments responded to controlling weeds and showed their efficiency to improve in grain yield of soybean were order of pursuit 750 ml ha^{-1} followed by alachlor 2 lit ha^{-1}+ HW at 45 DAS, alachlor 2 lit ha^{-1}, pendimethlin 1.5 kg ha^{-1} + HW at 45 DAS, hand hoeing at 25 DAS and HW at 45 DAS and pendimethlin 1.5 kg ha^{-1} over weedy check. The hand weeding in twice at 25 and 45 DAS also produced higher grain yield (20.63 q ha^{-1}) and straw yield, owing to maximum all growth and yield attributes; which was closely followed to pursuit 750 ml ha^{-1} + hand weeding at 45 DAS.

Table 2: Growth, yield-attributes, yield and economics of soybean as influences by integrated weed management

Treatment	Branches $plant^{-1}$	Plant height (cm)	Leaves $plant^{-1}$	No. of pod $plant^{-1}$	No. of grains pod^{-1}	No. of seeds $plant^{-1}$	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Net income (`. ha^{-1})	B:C ratio
T_1	5.8	63.55	28.7	2.0	66.8	07.3	07.58	8.67	-	1.69
T_2	10.5	74.88	42.4	2.8	111.5	20.6	36.31	37.21	28725	3.37
T_3	8.5	71.26	39.0	2.9	107.5	11.1	14.62	15.87	7040	2.02
T_4	8.7	72.94	37.2	2.8	75.1	9.4	12.21	14.01	4629	2.06
T_5	8.7	69.42	40.2	2.9	110.3	12.1	16.64	17.43	9051	2.21
T_6	8.8	68.57	36.1	2.6	85.9	14.4	24.76	26.02	17175	3.12
T_7	9.8	70.39	40.1	2.5	93.5	17.1	29.19	30.32	21608	3.10
T_8	9.9	72.14	37.4	2.7	92.6	19.0	35.24	36.45	27665	3.81
T_9	11.6	75.97	49.4	3.0	139.8	22.4	38.35	39.65	30767	3.82
S.Em.±	0.5	0.58	0.66	0.38	0.36	0.51	0.26	0.24	0.70	---
C.D.(P= 0.05)	1.57	1.75	1.98	1.16	NS	1.54	0.80	0.71	2.10	---

Economics

The monetary returns were found to be significantly influenced by different weed control treatments. Pursuit 750 ml ha^{-1} + HW at 45 DAS recorded significantly higher net monetary returns (Rs 38351 ha^{-1}) and B: C ratio (3.82) than others. However, the HW twice was remained second highest producing grain yield and return net income of Rs. 36309 ha^{-1} and B: C ratio (3.37), respectively. The beneficial effect of manual weeding on soybean production has also been reported by Lingaraju and Babalad (2002)**;** Singh *et al.,* (2006) and Gowri *et al.,* (2009). It is apparent from the data that pursuit with HW at 45 DAS proved the best substitute of HW at 25 and 45 DAS looking to the labour problem, timely weed control and high charges on weeding operations. Further, the best performance of other treatments like pursuit 750 ml ha^{-1}, alachlor 2 lit ha^{-1} and pendimethlin 1.5 kg ha^{-1} to controlling seasonal weeds in soybean has also been reported by Jain and Tomar (2002); Vyas and Jain (2003); Kushwaha and Vyas (2005) and Mishra & Singh (2009).

Thus, treatment Pursuit 750 ml ha^{-1} + HW at 45 DAS may be considered as the best substitute of HW at 25 and 45 DAS, to save one HW expenses. In case of scarcity of labour for HW, Pursuit 750 ml ha^{-1} or Alachlor 2 lit ha^{-1} alone may also be used in farmers' field; however, with comparatively lower income.

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