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Research Article

EFFECT OF INTEGRATED WEED MANAGEMENT ON GROWTH AND YIELD OF SOYBEAN

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Abstract: A field experiment on "Effect of integrated weed management on growth, yield and quality of soybean (*Glycine max* L Merrill)" was undertaken during kharif, 2013-14 at Post Graduate Institute Instructional Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The various growth contributing characters viz., plant height, plant spread, number of leaves, leaf area, number of root nodules and dry matter production were significantly higher with treatment weed free *i.e.*, one hoeing at 15 DAS and 2 HW at 25 and 45 DAS, which was at par with PE application of pendimethalin 38.7 per cent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, PE application of metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS and metribuzin @ 525 g a.i. ha^{-1}*fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} The yield contributing characters like number of pods plant^{-1},number of seed plant^{-1},weight of,pod weight plant^{-1}, weight of seeds plant^{-1} were recorded significantly higher with treatment weed free *i.e.*, one hoeing at 15 DAS and 2 HW at 25 and 45 DAS, which was at par with PE application of pendimethalin 38.7 per cent cs @ 677.25 g a.i. ha^{-1} *fb* 1 HW at 30 DAS, PE application of metribuzin @ 525 g a.i. ha^{-1} *fb* 1 HW at 30 DAS, and metribuzin @ 525 g a.i. ha^{-1}*fb* (imazethapyr + propaquizafop-ethyl) @ (80+60) g a.i. ha^{-1} and same pattern also observed in seed and stover yield. All the weed control treatments controlled weeds effectively as compared to unweeded check. Among the weed management treatments One hoeing at 15 days after sowing followed by hand weeding at 25 and 45 days after sowing, metribuzin @ 525 g a.i. ha^{-1} combined with one hand weeding at 30 days and metribuzin @ 525 g a.i. ha^{-1}*fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} after sowing recorded significantly higher values of weed control efficiency, herbicide efficiency index and minimum values of weed index indicating better bio-efficacy of treatments.

Keywords: Weed, Integrated Weed Management, Economics

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Introduction

The Soybean (*Glycine max L* Merrill) is one of the important oilseed crops of the Leguminaceae family having subfamily *Papilionaceae* and genus Glycine. It is originated in eastern Asia or China. In India, it is grown on a large area of Madhya Pradesh, Maharashtra, Utter Pradesh, Rajasthan, Himachal Pradesh, Bihar, Karnataka and Andhra Pradesh It contains 43.2 percent crude protein and 19.5 percent oil. Crude protein of soybean contains lysine (8.4%) and other essential phospholipids [1]. It is rich source of vitamin A, B and D. Soybean sprouted seeds contains 38-42 percent protein, 20 percent oil, 20 percent carbohydrate, 3.82 percent crude fibre, 710 IU vitamin A and 300 IU vitamin B besides its contains the mineral salts of Ca, Mg, Na, P, Fe, Cl, K and S [2]. It is richest, cheapest and easiest source of best quality protein and fat and having a multiplicity of uses as food and industrial products therefore, it is called "Wonder crop". Due to atmospheric nitrogen fixation in the soil to maintain the soil fertility beneficial effect on successive crops so called "*Golden bean" or "Gold of soil*". Soybean plant used as fodder and preparing soya cake. It is used to preparing many another products like macroni, bean curd, soya sauce, green bean, baked bean etc. Its protein creates alkalizing effects. It is also used as green manure, hay and silage. Every part of soybean is useful. Foliage of soybean can also be used as organic material and production of quality hay for feeding animals. Soybean cake is fed to milch cattle which help for enhancing milk yield. The initial growth of soybean is slow and crop face severe competition with weed. The first 30 days after planting of soybean is considered to be critical with respect to weed-crop competition.

Severe weed competition is mainly responsible for low production of soybean. Soybean is very sensitive to early weed competition. Soybean being a rainy season crop is heavily infested with many grasses and broad leaf weeds. Yield losses in soybean may range from 25 to 70 percent depending upon the intensity and infestation of weeds. Besides yield losses, quality also adversely affected. The most critical period of weed infestation is initial 15-45 days [2]. Pre-plant incorporation and pre-emergence herbicides have very short persistence in soil and weed flora may appear again after a time span and compete with the crops at later stages whereas post emergence herbicide kill weeds and keep the hardy uncontrolled weeds under control by arresting their growth through various kinds of deformities in foliage and growing periods. Recent studies conducted by various authors clearly indicated that sequential application of pre-emergence followed by post emergence herbicides will provide more consistent weed control than any one (single application) approach [3-6]. A well-planned PRE *fb* POST will provide more consistent weed control and helps to solve some of the problems in post emergence herbicides. The most complete PRE *fb* POST emergence herbicide application includes use of pre emergence herbicides with activity on key broadleaf weeds that also provides at least some early season control of grasses, followed by post emergence herbicides with activity on grass and broadleaf weeds. It has been also reported that most of the selective herbicide do not control all weeds. Therefore, integrated approaches of chemical and cultural control may be more feasible and practicable.

Method and material

The experiment was conducted during kharif season in the year 2013-14 at Post Graduate Institute Instructional Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri 413722, Dist Ahmednagar, Maharashtra (India). Geographically central campus is situated in between 74º19' N to 19º57' N latitude and between 74º19' E to 74°32' E longitudes. The elevation above mean sea level varied from 495 to 596 meter. The soil was well drained. It was observed that the soil of experimental site was silty clayey in texture. The chemical composition according to criteria laid by Muhr, *et al*., (1965) indicated that, soil was low in available nitrogen (159.93 kg ha^{-1}), medium in available phosphorus (18 kg ha^{-1}) and very high in potassium (480.40 kg ha^{-1}). The soil analysed Modified alkaline permanganate method, Olsen's method- 0.5M NaHCO3, Neutral ammonium extractant method respectively with electrical conductivity of 0.53 dSm^{-1}. The soil was moderately alkaline in reaction (pH 7.66). The experiment was laid out in kharif season. There were eight treatments laid out in randomized block design with three replications. The experiment consists of eight treatments involving two PE herbicides viz., pendimethalin, and metribuzin combined with one hand weeding at 30 DAS, combination of PE and PoE herbicides pendimethalin 38.7 percent cs @ 677.25 g a.i. ha^{-1} *fb* bentazone + fenoxaprop-p-ethyl @ (1000+80) g a.i. ha^{-1}, metribuzin @ 525 g a.i. ha^{-1}*fb* bentazone+ fenoxaprop-p-ethyl @ (1000+80) g a.i. ha^{-1}, pendimethalin 38.7 percent 677.25 g a.i. ha^{-1} *fb* (imazethaypr + propaquizafop-ethyle) @ (80+60) g a.i. ha^{-1}, metribuzin @ 525 g a.i. ha^{-1}*fb* (imazethaypr+ propaquizafop-ethyl) @ (80+60) g a.i. ha^{-1}, weed free (one hoeing at 15 DAS and 2 HW at 25 and 45 DAS) and unweeded control. The allocation of treatments in the replication was done by random method. The gross and net plot sizes were 4.80 m x 4.20 m m4.20 m x 3.00 m, respectively. The recommended dose 120, 40, 40 NPK kg/ha in the form of Single super phosphate and muriat of potash to all plots uniformly in line.

Results and Discussion

Effect on weeds

The weed flora of the experimental field consisted of grasses, sedges and broad-leaved weeds which were observed from the unweeded check plot. The pre-dominant grassy weeds were *Dinebra retroflexa* (Vahl.) and the dominant sedge was *Cyperus rotundus* (L). Among the broad-leaved weeds, *Parthenium hysterophorus* (L), *Acalypha ciliate* (L.), *Vigna trilobata* (L), *Physalis minima* (L) *Commelina benghalensis* (L.), *Acalypha cilliata* (L.), Achyranthus aspera (L.), *Alternanthera triandra* (L.), *Digera arvensis* (L.), *Euphorbia geniculate* (L.), *Phyllanthus niruri* (L.) were the dominant species.

Plant height

The mean plant height at 28, 56, 84 DAS and at harvest were 33.30, 50.32, 54.63 and 56.54 cm, respectively. The average plant height of soybean was significantly higher (40.34, 55.64, 60.82 and 62.64 cm, respectively) in the treatment one hoeing at 15 DAS and two HW at 25 and 45 DAS than rest of treatment but it was at par with treatments PE application of pendimethalin 38.7 percent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} of at all the stagesof observation.

Plant spread

The mean plant spread (24.91, 36.04, 42.74 and 16.47 cm at 28, 56, 84 and at harvest, respectively) were increased with increased in age of crop upto 84 DAS. The plant spread was increased from 24.91 to 42.74 cm from 28 to 84 DAS, respectively but at harvest plant spread was reduces due to falling of leaves. The differences in plant spread $plant^{-1}$ was significant at all stage of crop growth due to different weed control treatments and it was significantly maximum under treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS, and PE application of treatment pendimethalin 38.7 percent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1}at par with it, The significant increase in plant height and spread of soybean crop in weed free treatment weed free check seems to be on account of larger canopy development owing to higher plant height and plant spread which might increase interception, absorption and utilization of radiant energy available for growth and development of crop.

Number of leaves

The data revealed that number of leaves $plant^{-1}$ increased gradually with age of crop till 56 DAS. The increase in number of leaves $plant^{-1}$ was maximum up to 56 DAS. The mean number of leaves $plant^{-1}$ was significantly affected by different weed control treatment. The number of leaves $plant^{-1}$ increased significantly in treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS over rest of treatment however, it was at par with PE application of pendimethalin 38.7 percent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1},While, the minimum number of leaves $plant^{-1}$ in unweeded control treatment was mainly attributed due to intense weed competition for growth resources which is associated with reduce number of leaves.

Leaf area

The maximum leaf area $plant^{-1}$ was recorded at 84 DAS (27.37 dm2) and decrease thereafter at harvest due to senescence. The mean leaf area recorded at 28, 56, 84 DAS and at harvest were 5.75, 24.14, 27.37 and 4.62 dm2, respectively. The leaf area $plant^{-1}$ significantly differed due to different treatments at different growth stage.The leaf area improved significantly in treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS) treatment over rest of treatment however, it was at par with PE application of treatment pendimethalin 38.7 percent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} at all stage of plant growth.

Dry matter of plant

At 28 days of crop growth dry matter accumulation $plant^{-1}$ was differ significantly due to different treatments. From 56 days onward the dry matter accumulation $plant^{-1}$ was significantly higher in treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS treatment over rest of treatments, except the PE application of treatment pendimethalin 38.7 percent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} .

Number of root nodules and its dry weight

Number of root nodules $plant^{-1}$ and its dry weight at flowering was significantly higher in treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS over rest of treatments but it was at par with PE application of treatment pendimethalin 38.7 percent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} , Significantly the minimum number of root nodules $plant^{-1}$ and its dry matter $plant^{-1}$ was noticed in treatment unweeded control (T8) at all the stages of observations.

Yield attributing characters

Number of pods $plant^{-1}$

The mean number of pods $plant^{-1}$ at harvest was 52.15. The highest number of pods $plant^{-1}$ (57.27) were recorded in the treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS, which was significantly superior over rest of the treatments except treatments PE application of treatment pendimethalin 38.7 percent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS (55.60), metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS (56.59), metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} (55.64), It might be inferred that more weed density created more competition with crop plants for light, space and nutrients, therefore, crop plants invested more photosynthetes and resultantly less pod setting was recorded. These results can get support from that of Chandel and Saxena, (2001) Gurjar, *et al*. (2001) [6,7].

Table-1 Plant heightplant^{-1} of soybean as influenced periodically by different weed control treatments

	Treatments	Plant height plant^{-1}(cm)			
		28 DAS	56 DAS	84 DAS	At harvest
T_1:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} + 1 HW at 30 DAS	38.36	52.84	56.78	58.40
T_2:	Metribuzin PE @ 525 g a.i. ha^{-1} + 1 HW at 30 DAS	38.64	53.24	57.29	59.64
T_3:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* bentazone + fenoxaprop-p-ethyl POE @ (1000+80) g a.i ha^{-1} at 20 DAS	34.62	45.84	49.78	51.67
T_4:	Metribuzin PE @ 525 g a.i. ha^{-1} fb Bentazone + Fenoxaprop-p-ethyl POE @ (1000+80) g a.i. ha^{-1} at 20 DAS	37.78	50.87	55.64	57.24
T_5:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80 + 60) g a.i. ha^{-1} at 20 DAS	36.82	50.24	54.34	56.75
T_6:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80+60) g a.i. ha^{-1} at 20 DAS	39.64	54.24	58.68	60.34
T_7:	1 Hoeing at 15 DAS and 2 HW at 25 and 45 DAS (weed free)	40.34	55.64	60.82	62.64
T_8:	Unweeded control	31.24	39.68	43.68	45.65
	S.E.±	0.71	1.31	1.53	1.63
	CD @ 5 %	2.09	3.98	4.64	4.94
	General mean	33.30	50.32	54.63	56.54

Table-2 Plant spread plant^{-1} of soybean as influenced periodically by different weed control treatments

	Treatments	Plant spreadplant^{-1}(cm)			
		28 DAS	56 DAS	84 DAS	At harvest
T_1:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} + 1 HW at 30 DAS	26.45	37.67	44.78	18.24
T_2:	Metribuzin PE @ 525 g a.i. ha^{-1} + 1 HW at 30 DAS	27.36	39.57	46.16	19.20
T_3:	Pendimethalin38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* bentazone + fenoxaprop-p-ethyl POE @ (1000+80) g a.i ha^{-1} at 20 DAS	21.68	31.89	38.64	12.86
T_4:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Bentazone + Fenoxaprop-p-ethyl POE @ (1000+80) g a.i. ha^{-1} at 20 DAS	25.60	36.24	43.02	17.08
T_5:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80 + 60) g a.i. ha^{-1} at 20 DAS	24.78	35.84	42.86	16.23
T_6:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80+60) g a.i. ha^{-1} at 20 DAS	26.75	38.68	45.06	18.67
T_7:	1 Hoeing at 15 DAS and 2 HW at 25 and 45 DAS(weed free)	29.31	40.13	47.12	20.85
T_8:	Unweeded control	17.34	28.26	34.24	8.64
	S.E.±	1.17	1.12	1.30	1.23
	CD @ 5 %	3.56	3.41	3.86	3.72
	General mean	24.91	36.04	42.74	16.47

Figures in parentheses are original, transformed to values √(x+1)

Table-3 Number of leaves plant^{-1} of soybean as influenced periodically by different weed control treatments

	Treatments	Mean number of leaves plant^{-1}			
		28 DAS	56 DAS	84 DAS	At harvest
T_1:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} + 1 HW at 30 DAS	15.02	34.78	20.45	5.04
T_2:	Metribuzin PE @ 525 g a.i. ha^{-1} + 1 HW at 30 DAS	15.64	36.45	20.78	5.24
T_3:	Pendimethalin38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* bentazone + fenoxaprop-p-ethyl POE @ (1000+80) g a.i ha^{-1} at 20 DAS	10.78	29.65	14.60	2.24
T_4:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Bentazone + Fenoxaprop-p-ethyl POE @ (1000+80) g a.i. ha^{-1} at 20 DAS	14.08	34.14	17.78	4.24
T_5:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80 + 60) g a.i. ha^{-1} at 20 DAS	13.46	33.78	16.24	3.78
T_6:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80+60) g a.i. ha^{-1} at 20 DAS	15.24	35.02	19.89	4.86
T_7:	1 Hoeing at 15 DAS and 2 HW at 25 and 45 DAS(weed free)	16.49	37.40	21.6	5.81
T_8:	Unweeded control	8.24	26.28	11.60	1.24
	S.E.±	0.74	0.99	1.18	0.43
	CD @ 5 %	2.22	3.03	3.12	1.30
	General mean	13.62	33.87	17.87	4.06

Figures in parentheses are original, transformed to values √(x+1)

Table-4 Leaf area plant^{-1} of soybean as influenced periodically by different weed control treatments

	Treatments	Leaf areaplant^{-1}(dm^2)			
		28 DAS	56 DAS	84 DAS	At harvest
T_1:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} + 1 HW at 30 DAS	5.82	25.34	28.24	5.28
T_2:	Metribuzin PE @ 525 g a.i. ha^{-1} + 1 HW at 30 DAS	5.84	26.25	29.89	5.48
T_3:	Pendimethalin 38.7% cs PE @ 677.25 g a.i. ha^{-1}*fb* bentazone + fenoxaprop-p-ethyl POE @ (1000+80)g a.i ha^{-1} at 20 DAS	5.65	22.00	25.14	4.02
T_4:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Bentazone + Fenoxaprop-p-ethyl POE @ (1000+80) g a.i. ha^{-1} at 20 DAS	5.75	24.32	27.65	4.43
T_5:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80 + 60) g a.i. ha^{-1} at 20 DAS	5.72	23.65	26.85	4.32
T_6:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80+60) g a.i. ha^{-1} at 20 DAS	5.83	25.64	28.65	5.35
T_7:	1 Hoeing at 15 DAS and 2 HW at 25 and 45 DAS(weed free)	5.86	26.74	30.28	5.65
T_8:	Unweeded control	5.54	19.65	22.24	2.51
	S.E.±	0.03	0.75	0.80	0.14
	CD @ 5 %	0.07	2.27	2.43	0.40
	General mean	5.75	24.14	27.37	4.62

Figures in parentheses are original, transformed to values √(x+1)

Table-5 Dry matter plant^{-1} of soybean as influenced periodically by different weed control treatments

	Treatments	Mean dry matter plant^{-1}(g)			
		28 DAS	56 DAS	84 DAS	At harvest
T_1:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} + 1 HW at 30 DAS	3.36	19.78	33.25	39.65
T_2:	Metribuzin PE @ 525 g a.i. ha^{-1} + 1 HW at 30 DAS	3.51	20.12	34.24	41.65
T_3:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* bentazone + fenoxaprop-p-ethyl POE @ (1000+80) g a.i ha^{-1} at 20 DAS	2.28	16.08	27.94	32.84
T_4:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Bentazone + Fenoxaprop-p-ethyl POE @ (1000+80) g a.i. ha^{-1} at 20 DAS	2.92	18.26	32.24	38.04
T_5:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80 + 60) g a.i. ha^{-1} at 20 DAS	2.76	17.89	31.68	37.52
T_6:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80+60) g a.i. ha^{-1} at 20 DAS	3.45	20.06	33.65	40.45
T_7:	1 Hoeing at 15 DAS and 2 HW at 25 and 45 DAS(weed free)	3.58	20.26	35.88	42.84
T_8:	Unweeded control	1.61	14.60	21.64	26.34
	S.E.±	0.18	0.61	1.12	1.52
	CD @ 5 %	0.55	1.83	3.39	4.61
	General mean	2.73	18.38	31.32	37.42

Figures in parentheses are original, transformed to values √(x+1)

Table-6 Number of root nodules plant^{-1} and its dry weight at flowering as influenced by different weed control treatments

	Treatments	Number of root nodules	Dry weight of root nodules (mg)
T_1:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} + 1 HW at 30 DAS	33.71	124.45
T_2:	Metribuzin PE @ 525 g a.i. ha^{-1} + 1 HW at 30 DAS	34.67	124.76
T_3:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* bentazone + fenoxaprop-p-ethyl POE @ (1000+80) g a.i ha^{-1} at 20 DAS	27.56	101.34
T_4:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Bentazone + Fenoxaprop-p-ethyl POE @ (1000+80) g a.i. ha^{-1} at 20 DAS	31.34	114.56
T_5:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80 + 60) g a.i. ha^{-1} at 20 DAS	30.75	112.68
T_6:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80+60) g a.i. ha^{-1} at 20 DAS	34.02	123.34
T_7:	1 Hoeing at 15 DAS and 2 HW at 25 and 45 DAS(weed free)	35.56	128.34
T_8:	Unweeded control	23.54	87.32
	S.E.±	1.23	4.22
	CD @ 5 %	3.73	12.80
	General mean	31.39	114.85

Figures in parentheses are original, transformed to values √(x+1)

Table-7 Yield contributing characters and yield as influenced by different weed control treatments

	Treatments	Number of pod plant^{-1}	Pod weight plant^{-1} (g)	Number of seed plant^{-1}	Weight of seed plant^{-1} (g)	Seed yield (q ha^{-1})	Stover yield(q ha^{-1})
T_1:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} + 1 HW at 30 DAS	55.60	32.45	152.28	21.56	22.24	24.0
T_2:	Metribuzin PE @ 525 g a.i. ha^{-1} + 1 HW at 30 DAS	56.59	33.30	158.44	22.93	23.79	25.64
T_3:	Pendimethalin 38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* bentazone + fenoxaprop-p-ethyl POE @ (1000+80) g a.i ha^{-1} at 20 DAS	47.06	29.53	133.65	17.84	18.05	20.72
T_4:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Bentazone + Fenoxaprop-p-ethyl POE @ (1000+80) g a.i. ha^{-1} at 20 DAS	52.02	31.25	148.12	21.00	21.24	23.24
T_5:	Pendimethalin38.7 % cs PE @ 677.25 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80 + 60) g a.i. ha^{-1} at 20 DAS	51.34	30.28	147.38	20.65	20.45	22.24
T_6:	Metribuzin PE @ 525 g a.i. ha^{-1} *fb* Imazethapyr + Propaquizafop-ethyl POE @ (80+60) g a.i. ha^{-1} at 20 DAS	55.64	32.78	154.28	21.72	22.84	24.58
T_7:	1 Hoeing at 15 DAS and 2 HW at 25 and 45 DAS (weed free)	57.27	34.68	161.77	23.46	24.68	26.00
T_8:	Unweeded control	41.68	22.56	117.25	14.24	13.24	14.74
	S.E.±	1.64	0.97	4.41	0.77	1.03	1.02
	CD @ 5 %	4.93	2.94	13.25	2.40	3.10	3.10
	General mean	52.15	30.85	146.65	20.43	20.82	22.65

Pod weight plant^{-1}

The mean pod weight plant^{-1} at harvest was 30.85 g. The highest pod weight plant^{-1} (34.68 g) was recorded in the treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS, which was significantly superior over rest of the treatments except treatments PE application of treatment pendimethalin 38.7 per cent cs @ 677.25 g a.i. ha^{-1} *fb* 1 HW at 30 DAS (32.45 g), metribuzin @ 525 g a.i. ha^{-1} *fb* 1 HW at 30 DAS (33.30 g), metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} (32.78 g)

Number of seeds plant^{-1}

The mean number of seed plant^{-1} at harvest was 146.65. The highest number of seed plant^{-1} (161.77) was recorded in the treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS, which was significantly superior over rest of the treatments except treatments PE application of treatment pendimethalin 38.7 per cent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS (152.28), metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS (158.44), metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} (154.28), This might be due to lowering the crop-weed competition during critical crop growth period at pod development stage might have increased the availability of moisture and plant nutrients to the crop resulted in better development of seeds in the pods

Weight of seeds plant^{-1}

The mean weight of seed plant^{-1}at harvest was 20.43 g. The highest weight of seed plant^{-1} (23.46 g) was recorded in the treatment one hoeing at 15 DAS and 2 HW at 25 and 45 DAS, which was significantly superior over rest of the treatments except treatments PE application of pendimethalin 38.7 percent cs @

677.25 g a.i. ha^{-1} +1 HW at 30 DAS (21.56 g), metribuzin @ 525 g a.i. ha^{-1}+1 HW at 30 DAS (22.93 g), metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} (21.72 g).

Seed yield

The data revealed that significantly the highest (24.68 q ha^{-1}) seed yield was recorded by the treatments one hoeing at 15 DAS and 2 HW at 25 and 45 DAS but it was at par with PE application of treatments pendimethalin 38.7 per cent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1}, Unweeded control recorded the lowest seed yield due to heavy infestation of weed, hindering the uptake of nutrients and reducing photosynthesis by shading of main crop. Hence elimination of weeds during early stage of growth would enable the plant to grow better and consequently yield better.

Stover yield

The mean stover yield was 22.65 q ha^{-1}. The stover yield of soybean was significantly influenced due to different weed control treatments. The similar trend to that of seed yield was observed with respect to stover yield treatment *i.e*., one hoeing at 15 DAS and 2 HW at 25 and 45 DAS registered significantly higher stover yield (26 q ha^{-1}) than the rest of the treatments except treatment PE application of treatments pendimethalin 38.7 per cent cs @ 677.25 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1}*fb* 1 HW at 30 DAS, metribuzin @ 525 g a.i. ha^{-1} *fb* imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} .

Effect on weeds

One hoeing at 15 days after sowing followed by hand weeding at 25 and 45 days after sowing, @ 525 g a.i. ha^{-1} combined with one hand weeding at 30 days and metribuzin @ 525 g a.i. ha^{-1}*fb*imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} after sowing recorded significantly higher imazethapyr+ propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} after sowing recorded significantly higher values of weed control efficiency, herbicide efficiency index and minimum values of weed index indicating better bioefficacy of treatments. Maximum net monetary returns, B: C ratio were noticed in metrbuzin @ 525 g a.i. ha^{-1} followed by one hand weeding at 30 days after sowing. Based on one year experimentation it is concluded that pre-emergence application of metribuzin @ 525 g a.i. ha^{-1} followed by one hand weeding at 30 days after sowing was found most economical and remunerative and in case of laboure problem treatment metribuzin @ 525 g a.i. ha^{-1}*fb*imazethapyr + propaquizafop-ethyl @ (80+60) g a.i. ha^{-1} very beneficial to farmer.

Conclusion

Among the integrated weed management treatments one hoeing at 15 days after sowing followed by 2 hand weeding at 25 and 45 days were found superior in reducing crop-weed competition and thereby increasing growth and yield of soybean. Similarly, pre-emergence application of pendimethalin 38.7 per cent cs @ 677.25 g a.i. ha^{-1} and metribuzin @ 525 g a.i. ha^{-1} in combination with one hand weeding at 30 days after sowing and metribuzin @ 525 g a.i. ha^{-1}*fb* (imazethapyr + propaquizafop-ethyl) @ (80+60) g a.i. ha^{-1} was found equally effective.

Application of research: This research is conducted for to know about use of herbicide, when farmer is suffered for labour

Research Category: integrated weed management

Abbreviations:

PE- Pre Emergence, CS –Concentrate Solute

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