Original Research Article

Effect of Weed Management Practices on Growth and Yield in Soybean Pigeonpea (4:2) Intercropping System

ABSTRACT

The present investigation was carried at Research Farm of R.A.K. College of Agriculture, Sehore (Madhya Pradesh), during Kharif 2016. Research title" Evaluation of Pre and Post Emergence Herbicides for Weed Control in Soybean (*Glycine max* (L.) *Merrill*) + Pigeonpea (*Cajanus cajan* (L.) *Millsp*.) (4:2) Intercropping system in Rainfed situation".Six weed control practices were evaluated in randomized block design with three replications.The results of present study revealed thathand weeding twice at 30 and 45 DAS recorded higher growth and yield attributes followed by application of imazethapyr 35% + imazemox 35% 70 WG 70 g/ha at 20 DAS (PoE) and pendimethalin 30 EC 1 kg/ha (PE) fb imazethapyr 10 SL 100 g/ha (PoE).

Keywords:Intercropping;Hand weeding;Herbicide;Soybean equivalent yield.

1. INTRODUCTION

'Soybean+Pigeonpea' intercropping system is of immense importance, particularly in rainfed eco-system and has been successfully introduced in Madhya Pradesh, particularly in Malwa and Vindhyan plateau.The system is being a rich and cheaper source of high quality protein (soybean-40%, pigeonpea-20%) and edible oil (soybean-20%) to the ever-increasing population, fetches higher price than other kharif crops to farmers and also is good cover and soil-building crop, as it fixes about 65 to 115 kg Nha-1 [1].Growing soybean in intercopping with pigeonpea is most popular practice in Madhya Pradesh. The prolonged slow growth of pigeonpea provided an excellent opportunity for growing of earlymaturing intercrops, so that resources (moisture,nutrient, solar radiation and space) could be utilized efficiently and quickly. Intercropping systems have provided resource limited farmers with greater yield stability over time, more efficient use of land and better control of weeds, insect, and pathogens through productivity level, being very low compared to productivity potential of sole crop.Thisimplies the need for refinement of agro-technologies such as; Improved cultivars suitable for intercropping, nutrient and weedmanagement of intercrops for getting potential yield from both main and intercrops. The low productivity is attributed to biotic and abiotic stresses like drought, weeds, insect-pests and disease, among these, weeds are also important biotic constraints in achieving higher productivity.In rainy season weeds come in 2-3 flushes and growth is very fast therefore, they compete for light, nutrient, and space and are responsible for considerable reduction in yield. Weeds caused 80 % reduction in pigeonpea grain yield if weeds were allowed to grow till harvest, however, grain yield losses were only 38 % in pigeopea + soybean intercropping system [14].Generally weeds are controlled by mechanical or cultural methods. These methods are efficient to control the weeds but they have some limitations such as unavailability of adequate labours during weeding peaks, labour cost and difficulty in the use of mechanical weeders in heavy soil due to

incessant rains. Manual and mechanical methods of weed control are quite effective, but they are costly and time consuming[10].Therefore, it is necessary to incorporate herbicides in weed management for

reducing the weed load during the crop growth period for sustained yield. Thus herbicides are used to reduce the weed load during crop growth period either through PPI, Pre-emergence and Post emergence but pre and post emergence application is considered to be best in controlling weed flora effectively in Soybean + Pigeonpea intercropping system.

2. MATERIAL AND METHODS

The experiment was conductedat the Research Farm of R.A.K. College of Agriculture, Sehore (Madhya Pradesh), during *Kharif* 2016. The regions soils are medium to deep in depth, black in colour.The soil in the experimental field was, neutral in reaction (pH 7.6) with a medium OC content (0.60%), and EC (0.39 dS/m) and analyzed low in available nitrogen (218 kg/ha), Medium in available phosphorus (16 kg/ha), and high in available potassium (418 kg/ha). Total rainfall during the crop season was 1976.7 mm.The field experiment consisted with 6 treatments and they were tested in randomized block design with 3 replications.Soybean variety JS 95-60 and pigeonpea variety JKM-189 were sown in intercropping system of row ratio 4:2 respectively. Best management were practice were adopted as per recommended for both crops in Madhya Pradesh.The details of the treatments are presented in Table 1.

Table 1: Treatments details

T1	Weedy check
T2	Two hand weeding at 30 & 45 DAS
T3	Imazethapyr 10% SL@ 100 g a.i./ha at 20 DAS (PoE)
T4	Imazethapyr 35% + Imazamox 35% 70WG (Pre-mix formulation) @ 70g a.i./ha at 20 DAS (PoE)
T5	Pendimethalin 30% EC @ 1.00 kg a.i./ha (PE)
T6	Pendimethalin 30% EC @ 1000 g a.i./ha(PE*) fb* Imazethapyr 10% SL 100 g a.i./ha at 30 DAS (PoE)

3. RESULT AND DISCUSSION

Effect on Growth and Yield attributes

Plant height (cm) and branches plant^{-1}

The plant height (cm) & number of branches per plant of soybean and pigeonpea at maturitypresented in (Table-02). Plant height of soybean was quite rapid up to 50 DAS, the height was comparatively slow down and consequently the growth ceased down at harvest stage but in pigeonpea initial growth in height was less and gradually it was increased up to harvest stage. In soybean, at maturity the plant height was maximum in two hand weeding (T_2) and it was significantly at par with imazethapyr35%+ imazamox35% 70 WG @ 70 g/ha (T_4).In case of Pigeonpea, at maturity stages the maximum plant height was found in two hand weeding (T_2) and it was at par with imazethapyr35%+ imazamox35% 70 WG @ 70 g/ha (T_4) and pendimethalin 30 EC @1kg/h (PE) fb imazethapyr 10 SL @ 100 g/ha (PoE) (T_6).

In soybean and pigeonpea the number of branches at all stages were significantly higher in two hand weeding (T_2) and was at par with application of imazethapyr 35%+ imazamox35% 70 WG @ 70 g/ha (T_4), pendimethalin 30 EC @ 1kg/h (PE) fb imazethapyr 10 SL @ 100 g/ha (PoE) (T_6) and higher than remaining treatments.The minimum branches per plant were recorded in weedy check at all stages.

The higher value of both the parameters in respect of weed control treatment may be assigned to the extent of crop weed competition significantly maximum plant height and more number of branches at all successive stages because the two hand weeding provided weed free condition at critical stage of crop weed competition and created favorable condition forgrowthparameters.imazethapyr35%+imazamox35% applied as a post emergence controlled all weeds by suppress their root and shoot growth. Thereafter, extent of crop-weed competition stress mainly for light, nutrient, moisture and space, comparatively weed free environment on individual plant had more favorable growing

condition. Similar, results were obtained by Suresh Kumar *et al.*[13], Upadhyay *et al.* [15] and Jadhav [5].

Number of Pods plant^{-1}

The number of pods per plant is presented in (Table-03) reveals that the effect of weed control treatments on number of pods per plant in soybean and pigeonpea was significant. In soybean as well as in pigeonpea, maximum and significantly more number of pods were recorded in treatment two hand weeding (T_2) and at par with treatment imazethapyr35%+imazamox35% 70WG @70 g/ha (T_4) and treatment pendimethalin 30 EC @1kg/h (PE) fb imazethapyr 10 SL @ 100 g/ha (PoE) (T_6).The lowest number of pods per plant was recorded in weedy check.The treatment could very well be explained in the light of competition stress and clean cultivation.Similar result was reported by Hajari *et al.* [4],Suresh Kumar *et al.*[13], Upadhyay *et al.* [15].

Number of Seeds pod^{-1}

Data of Number of Seeds per podpresented in (Table-03) shows that the effect of different weed control treatments on number of seeds per pod was significant in both the crops. In soybean significantly higher Number of seeds/pod (3.04) recorded in treatment two hand weeding(T_2)andimazethapyr35%+imazamox35% 70 WG @ 70 g/ha (T_4) and it was at par with treatment T_3 and T_5.
In Pigeonpea higher number of seeds/pod (3.37) were obtained in treatment two hand weeding (T_2) which was at par with imazethapyr 35 %+imazamox 35% 70 WG @ 70 g/ha (T_4) and pendimethalin 30 EC @1kg/h (PE) fb imazethapyr 10 SL @ 100 g/ha (PoE) (T_6). Similar result was reported by Mishra *et al.*[8].

Grain yield plant^{-1} (g)

TheGrain yield per plant is an important character and directly related with the economic yield of plant. The data on grain yield per plant presented in (Table-03) indicated significant differences due to various treatments. Two hand weeding (T_2)recorded highest grain yield per plant (8.22g & 56.11g) of soybean and pigeonpea and which was significantly at par withapplication of imazethapyr 35 %+imazamox 35% 70 WG @ 70 g/ha (T_4). The lowest grain yield per plant was recorded in weedy check (6.56g and 34.67g) of soybean and pigeonpea.

Seed index (g)

It is evident from the (Table-03) shows that there was no significant differences in seed index due varioustreatments.However,applicationofimazethapyr35%+imazamox35% 70 WG @ 70 g/ha (T_4) recorded higher seed index (9.10 g) in pigeonpea followed by treatment Pendimethalin 30% EC @ 1000 g a.i./ha (PE*) fb* Imazethapyr 10% SL 100 g a.i./ha

at 30 DAS (PoE)(T_6), Imazethapyr 10% SL@ 100 g a.i./ha at 20 DAS (PoE)(T_3).In soybean two hand weeding (T_2) recorded higher seed index (12.93 g) followed by treatments T_3 and T_4.Similar result was opined by Prachand*et al.*[9].

Table-02:Effect of weed control treatments on plant height (cm) and Number of branches plant^{-1}at maturity stage under soybean : pigeonpea(4:2) intercropping system

Treatments	At maturity			
	Plant height (cm)		Number of branches plant^{-1}	
	Soybean	Pigeonpea	Soybean	Pigeonpea

T_1 - Weedy check	37.67	135.22	3.22	13.78
T_2- Two Hand weeding at 30 & 45 DAS	42.89	176.78	4.11	19.78
T_3- Imazethapyr 10% SL 100 g a.i./ha (PoE) 20 DAS	40.00	155.00	3.55	17.22
T_4- [Imazethapyr35%+Imazamox35%] * 70 WG 70 g a.i./ha(PoE) 20 DAS	42.78	173.89	4.00	19.22
T_5- Pendimethalin 30 EC (PE) 1 kg a.i./ha (PE)	37.89	154.67	3.33	17.00
T_6- Pendimethalin 30 EC (PE) 1 kg a.i./ha (PE)fb Imazethapyr 10% SL 100 g a.i./ha(PoE)30 DAS	40.44	168.89	3.89	19.00
S.Em±	0.74	6.33	0.14	0.61
C.D.at 5%	2.33	19.94	0.44	1.92
C.V.%	3.18	6.82	6.55	5.98

[*combi product]

Grain yield (kg/ha)

The grain yield kg/ha significantly influenced due to various treatments and is presented in (Table-04). Two hand weeding(T_2) recorded significantly higher grain yield(soybean-1223 and pigeonpea-1795 kg/ha) except treatments imazethapyr35%+ imazamox 35% 70 WG @ 70 g/ha (T_4) (soybean-1214 and pigeonpea- 1761) and pendimethalin 30 EC1kg/ha (PE) fb imazethapyr 10 SL @ 100 g/ha (soybean-1023,pigeonpea-1537kg/ha) (T_6). The lowest grain yield per hectare was recorded in weedy check(soybean-609 and pigeonpea-938kg/ha). Grain

yield is an important parameter, which decides the efficiency superiority or stability of a particular treatment over treatments. The data of present investigation reveals that all weed control treatments, produced significantly higher grain yield over weedy check. Weed management due to different treatments at optimum time in the season, reduced crop weed competition at the lowest possible limit and provided almost weed free environment. Differences in crops yield were attributed to differences in weed control more the weeds present in treatment lesser will be the grain yield.It may probably the reason for higher yield in two hand weeding followed by application of imazethapyr35%+imazamox35% 70 WG @ 70 g/ha (PoE) and pendimethalin 30 EC @1kg/h (PE) fb imazethapyr 10 SL @ 100 g/ha (PoE) . Similar result was opined byHabimana*et al.* [3],Hajari *et al.* [4],Khan*et al*.[6],Rao et al. [11]and Reddy *et al*. [12].

Straw yield (kg/ha)

Data regarding stover yield (kg ha-1) of soybean and pigeonpea crop was recorded as influenced by weed management practices are presented in (Table-04). In soybean non significant differences was obtained in straw yield due to various treatments. However, two hand weeding (T_2) was observed higher straw yield (1476 kg/ha). But in pigeonpea significantly higher straw yield (4869 kg/ha) was recorded in treatment two hand weeding (T_2) it was at par with treatment imazethapyr35%+ imazamox35% 70 WG @ 70 g/ha (T_4). The lowest straw yield per hectare was recorded in weedy check (soybean-976 and pigeonpea-2713 kg/ha).Increase in straw yield is directly related with increase in vegetative growth of the plant. The straw yield of soybean was not affected significantly whereas, pigeonpea straw yield was significantly affected by weed control treatments. In both crop two hand weeding was recorded higher straw yield and followed by application of imazethapyr35%+ imazamox35% 70 WG @ 70 g/ha (PoE). The lowest straw yield per hectare was recorded in weedy check. Similar result was opined by Dhane *et al.*[2] and Mishra *et al.*[8].

Biological yield (kg/ha)

The biological yield kg/ha was significantly affected due to various treatments and presented in (Table-04).Among the treatments two hand weeding (T_2) gave highest biological

yield (soybean-2699 and pigeonpea-6664 kg/ha) and it was at par with treatment T4. The lowest biological yield per hectare was recorded under weedy check (soybean-1585 and pigeonpea-3651 kg/ha).

Harvest index (%)

The data on harvest index is presented in (Table-04),Harvest index is a highly conservative and stable character and accounts for 95% variation in grain yield along with growth rate. Harvest index is the ratio of economical yield to the biological yield. In soybean the index was higher in application of imazethapyr35%+imazamox35% 70 WG @70 g/ha (PoE) followed by two hand weeding but in pigeonpea the harvest index was highe in imazethapyr35%+imazamox35% 70 WG @70 g/ha (PoE) followed by pendimethalin 30 EC @ 1 kg/ha(PE) fb imazethapyr 10 SL @ 100 g/ha (PoE) . It is also clear from findings that percent seed yield increase was less than stalk yield (reducing the seed: straw ratio) due to weed management which confirms that translocation of assimilated food reserve from source to sink was high in treated plot.

Soybean-equivalent yield (SEY)

The soybean-equivalent yield was worked out under price of soybean and pigeonpea. The observation on SEY kg/ha indicated significant difference due to various treatments and is presented in (Table-04). Two hand weeding (T2) recorded significantly higher soybean-equivalent yield (SEY-3732 kg/ha) than all treatments except application of imazethapyr35%+imazamox35% 70 WG @ 70 g/ha (T4) (SEY-3679 kg/ha) and pendimethalin 30 EC1kg/ha (PE) fb imazethapyr 10 SL @ 100 g/ha (SEY-3180 kg/ha) (T6). The lowest SEY recorded in weedy check (SEY-1923 kg/ha). Similar result was reported by, Hajari *et al.* [4],Jadhav[5]andKushwah and Vyas [7] .

Economics

Treatment imazethapyr35%+imazamox35% 70 WG @ 70 g/ha (T_4) was recorded highest net return of₹.73870/ha followed by treatment two hand weeding₹.713270/ha (T_2) and application of pendimethalin 30 EC1kg/ha (PE) fb imazethapyr 10 SL @ 100 g/ha ₹. 59377/ha (T_6) respectively.

The benefit cost ratio was also higher in imazethapyr 35%+imazamox35% 70 WG @ 70 g/ha (1:3.58) (T_4) and followed by treatment two hand weeding (1:3.05) (T_2) and pendimethalin 30 EC 1kg/ha (PE) fb imazethapyr 10 SL @ 100 g/ha(1:2.95) (T_6). The results are in conformity with the results of Mishra et al. [8] and Upadhyay et al. [15] .

Table 03: Effect of weed control treatments on yield attributing characters of crop under soybean :pigeonpea (4:2) intercropping system

Treatments	Pods / plant (no.)		Seeds/Pod (no.)		Grainyield/plant(g)		Seed index (g)	
	Soybean	Pigeonpea	Soybean	Pigeonpea	Soybean	Pigeonpea	Soybean	Pigeonpea
T_1 - Weedy check	17.89	166.11	2.85	2.92	6.56	34.67	11.83	7.97
T_2- Two Hand weeding at 30 & 45 DAS	23.44	220.00	3.04	3.37	8.22	56.11	12.93	8.57
T_3- Imazethapyr 10% SL 100 g a.i./ha (PoE) 20 DAS	19.67	167.78	2.96	3.05	6.89	38.89	12.57	8.20
T_4- [Imazethapyr35%+Imazamox35%] * 70 WG 70 g a.i./ha(PoE) 20 DAS	22.78	191.55	3.04	3.27	7.78	48.67	12.37	9.10
T_5- Pendimethalin 30 EC (PE) 1 kg a.i./ha (PE)	18.56	166.66	2.91	3.00	6.78	36.00	12.01	8.50
T_6- Pendimethalin 30 EC (PE) 1 kg a.i./ha (PE)fb Imazethapyr 10% SL 100 g a.i./ha(PoE)30 DAS	21.67	189.78	2.96	3.25	7.22	42.89	12.23	8.77
S.Em±	1.16	10.28	0.03	0.09	0.33	2.42	0.40	0.40
C.D.at 5%	3.65	32.38	0.11	0.29	1.04	7.62	NS	NS
C.V.%	9.71	9.69	2.05	5.12	7.87	9.77	5.64	8.24

[*combi product]

Table 04: Effect of weed control treatments on grain yield (kg/ha), straw yield (kg/ha), biological yield (kg/ha), harvest index (%) and soybean-equivalent yield (SEY) (kg/ha) under soybean : pigeonpea (4:2) intercropping system

Treatments	Grain yield (kg/ha)		Straw yield (kg/ha)		Biological yield (kg/ha)		Harvest index (%)		SEY (kg/ha)
	Soybean	Pigeonpea	Soybean	Pigeonpea	Soybean	Pigeonpea	Soybean	Pigeonpea	
T_1 - Weedy check	609	938	976	2713	1585	3651	39.17	25.79	1923
T_2- Two Hand weeding at 30 & 45 DAS	1223	1795	1476	4869	2699	6664	45.33	27.06	3732
T_3- Imazethapyr 10% SL 100 g a.i./ha (PoE) 20 DAS	871	1442	1190	3794	2061	5236	42.50	27.33	2894
T_4- [Imazethapyr35%+Imazamox35%] * 70 WG 70 g a.i./ha (PoE) 20 DAS	1214	1761	1323	3951	2537	5712	47.94	30.71	3679
T_5- Pendimethalin 30 EC (PE) 1 kg a.i./ha (PE)	843	1347	1061	3413	1904	4760	44.17	28.33	2727
T_6- Pendimethalin 30 EC (PE) 1 kg a.i./ha (PE)fb Imazethapyr 10% SL 100 g a.i./ha(PoE)30 DAS	1023	1537	1357	3856	2380	5393	43.58	28.48	3180
S.Em±	100	133	143	295	157	400	4.20	1.34	252
C.D.at 5%	314	419	NS	928	490	1257	NS	NS	795
C.V.%	17.81	15.71	20.00	13.59	12.31	13.17	16.62	8.31	14.44

[*combi product]

4. CONCLUSION

Based on the foregoing discussion, it can be concluded that that amongs weed management practices hand weeding twice at 30 and 45 DAS recorded Higher growth and yield in Soybean - Pigeonpeafollowed by application of imazethapyr 35% + imazemox35% 70 WG 70 g/ha at 20 DAS (PoE) and pendimethalin 30 EC 1 kg/ha (PE) fb imazethapyr 10 SL 100 g/ha (PoE).

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