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Effect of weed management practices on weed dynamic, yield of isabgol (*Plantago ovata* Forsk) and germination of succeeding crop

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Abstract

A field experiment was carried out during rabi season of 2012-13 to study the effect of Integrated weed management in isabgol (*Plantago ovata* Forsk). Twelve treatments of weed control were evaluated in Randomized Block Design with three replications. Crop kept weed free (T_{12}) recorded the maximum seed (1225 kg ha^{-1}) and straw (2930 kg ha^{-1}) yields and were statistically just to similar with physical method i.e., interculturings followed by two hand weedings at 20 and 40 DAS (T_{10}) and integrated weed management practices i.e., oxadiargyl @ 100 g/ha at 15 DAS + interculturing followed by hand weeding at 30 DAS (T_9) but significantly higher over alone post-emergence application of oxyfluorfen (T_1 and T_3) or oxadiargyl (T_6 and T_8) or unweeded control (T_{11}). Further, in general, isoproturon as pre-emergences and oxadiargyl as post-emergences at various doses were more effective herbicide in isabgol than oxyfluorfen as post-emergence. Integrated approach of weed management were more effective than alone use of physical and chemical methods. Moreover, herbicides used in experiment have no any harmful residual effect on germination of succeeding green gram crop.

Key words: Germination, herbicide, interculturing, isabgol and weed

Introduction

The name Isabgol (*Plantago ovata* Forsk) derived from two Persian words "Isab"and "Ghol" meaning horse's ear is one of the important medicinal plants, known to be grown during *rabi* season and introduced into India during Muslim settlement in middle ages.The seed of isabgol are mainly valued for their mucilaginous rosy white husk (24.26%) an economical product. In addition to medicinal uses, it has a place in dyeing, printing, ice-cream, confectionary and cosmetic industries. In India, isabgol is cultivated on commercially in Gujarat, Rajasthan, Haryana, Punjab, Uttar Pradesh, Madhya Pradesh and Bihar. Isabgol is a late *rabi* cash crop. Due to lower production cost and higher market price it is, as known as low volume but high value crop. Initial slow growth rate of isabgol may pose sever, weed problem during early stage which is responsible up to 50 per cent loss in yield. During recent past, fast development in industries and infrastructure sectors which reduced labour availability in agriculture and also increased labour wages. In these circumstances, it is quite difficult to control weeds in time by hand weeding which reduced yield and quality of produce also. Integrated weed management approach involving the physical and chemical weed control techniques, achieve complete, long and effective control of weeds during crop season. Keeping this in view, the present experiment was planned as per the methods below.

Materials and methods

The field experiment consisting of twelve treatments of weed control i.e.,T_1: oxyfluorfen @ 50 g/ha post-emergence at 20 DAS, T_2: oxyfluorfen @ 50 g/ha at 15 DAS + interculturing followed by hand weeding at 30 DAS, T_3: oxyfluorfen @ 75 g/ha post-emergence at 20 DAS, T_4: oxyfluorfen @ 75 g/ha post-emergence at 15 DAS + interculturing followed by hand weeding at 30 DAS, T_5: isoproturon @ 500 g/ha as pre-emergence, T_6: oxadiargyl @ 80 g/ha at 20 DAS, T_7: oxadiargyl @ 80 g/ha at 15 DAS + interculturing followed by hand weeding at 30 DAS, T_8: oxadiargyl @ 100 g/ha at 20 DAS, T_9: oxadiargyl @ 100 g/ha at 15 DAS + interculturing followed by hand weeding at 30 DAS, T_{10}: interculturing followed by hand weedings at 20 and 40 DAS, T_{11}: unweeded, T_{12}: weed free evaluated in randomized block design with three replications was conducted at Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University,

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Sardarkrushinagar during the *rabi* 2012-13. The soil was loamy sand having low organic carbon (0.27 %) and available nitrogen (149 kg/ha), medium in available phosphorus (38.9 kg/ha) and high in available potash (287.0 kg/ha) with 7.7 pH. The crop was fertilized with recommended dose of fertilizer i.e., 40 kg N/ha and 20 kg P_2O_5/ha in the form of urea and di -ammonium phosphate respectively in manually opened furrows at 30 cm distance. Half nitrogen in the form of urea was applied at the time of sowing and remaining half N was top-dressed at 30 DAS. Isabgol (variety - GI 3) was sown on December 1st, 2012 and crop was harvested on March 25th, 2013. Weeding and interculturing were carried out during crop season for weed management as per treatments.

The observations were recorded on yield of isabgol. Among the weed biomass studies, on the basis of visual observation, occurrence of dominant weed species and other weed species were classified and recorded accordingly. Weed population counts were taken at 30, 60 DAS and at harvest by using 1.0 m^2 quadrate from net area. Dry weight of weeds from each plot was recorded at the time of harvest. Weeds were dried under the sun light for 10 days and the dry weight of weeds was recorded for each treatment and converted to kilogram per hectare. The weed control efficiency was determined as per the method suggested by Kondap and Upadhyay (2) and Weed index by (Gill and Kumar, 1). Germination percentage of succeeding green gram crop was calculated by counting the number of germinated seeds to number of total seeds sown multiplied by hundred and simple correlation coefficient (r) of each character was also calculated.

Results and discussion

Influence of integrated weed management on yield

Different integrated weed management practices (Table 1) recorded marked effect on yield of isabgol. The maximum seed and straw yield of 1225 and 2930 kg ha^{-1}, respectively were found under treatment of weed free crop condition (T_{12}) which was significantly superior over rest of the treatments except treatment (T_7) oxadiargyl @ 80 g/ha at 15 DAS + interculturing followed by hand weeding at 30 DAS, (T_9) oxadiargyl @ 100 g/ha at 15 DAS + interculturing followed by hand weeding at 30 DAS and (T_{10}) inter-culturing followed by hand weedings at 20 and 40 DAS. The per cent increase in seed yield/ha due to weed free condition (T_{12}) were 28.0, 32.6, 35.4, 36.6, 51.8, 91.4, 103.2, 123.9, 141.1 and 221.5 over treatments T_9, T_7, T_4, T_5, T_2, T_8, T_6, T_3, T_1 and T_{11}, respectively. Per cent increase in yield due to treatment T_{10} over T_{11}, T_1 and T_3 were 185.6, 114.2 and 98.9 per cent whereas, it was 151.2, 88.4 and 75.0 due to treatment T_9, respectively. Effective removal of weeds throughout the crop growth period by physical and integrated weed control practices provided better space and resources i.e., moisture, nutrients, solar radiation etc., for crop plant which could be improved ultimately to higher yields. These findings corroborate the results reported by Patel *et al.*, (8), Sharma and Jain (10), Kumawat *et al.*, (5) and Sagarka *et al.*, (9) as well as Yadav *et al.*, (12) and Mehariya *et al.*, (7) in case of cumin.

Influence of integrated weed management on weed studies

Detailed studies of weeds with regards to weed flora, weed population, weed dry weight, weed control efficiency and weed index were carried out which are as under;

Weed flora

Weed species found during the course of investigation were monocot, dicot and sedges. The light major weed populations of monocot weed species viz., *Digitaria sanjuinalis* L. Scop, *Cynodon dactylon* (L.) Pers and *Polycuorapea corymbosa* as well as dicot weed species i.e., *Chenopodium album* L., *Portulaca oleracea* L., *Amarantus viridis* L., *Phyllanthus niruri* L., *Asphodelus tenuifolius* L., *Launaea nudicauli* H.K., *Melilotus alba Lamk* and *Argemone maxicana* L. were observed in descending order during the crop growth. *Cyperus rotundus* L. as sedge weed emerged additionally during the year of experiment.

Total weed count

A perusal of data (Table 2) showed that at 30 and 60 DAS as well as at harvest significantly the lowest total weed count was recorded under treatment T_{12} i.e., keeping weed free crop condition which was closely followed by adoption of interculturings done by hand weedings at 20 and 40 DAS (T_{10}). During the periodical observations i.e., 30 and 60 DAS as well as at harvest, the maximum number of weeds i.e., 4.25, 4.76 and 6.23 at 30, 60 DAS and at harvest were recorded under unweeded crop conditions (T_{11}), respectively and was at par with treatments T_1 and T_3.

Among the different integrated weed management treatments, treatments T_9, T_7 and T_4 were at par during all the periodical growth stages except at 60 DAS. During all the periodical growth stages, alone application of oxyfluorfen (T_1 and T_3) as well as oxadiargyl (T_6 and T_8) as post-emergences at different rates were not differed significantly with each other and recorded more number of weeds than integrated approach i.e., herbicides

Table 1: Yield of Isabgol as influenced by different integrated weed management treatments

Treatment		Yield (kg ha^{-1})	
		Seed	Straw
T_1 :	Oxyfluorfen @ 50 g/ha post-emergence at 20 DAS	508	1298
T_2 :	Oxyfluorfen @ 50 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS	807	1956
T_3 :	Oxyfluorfen @ 75 g/ha post-emergence at 20 DAS	547	1686
T_4 :	Oxyfluorfen @ 75 g/ha post-emergence at 15 DAS +Interculturing followed by hand weeding at 30 DAS	905	2035
T_5 :	Isoproturon @ 500 g/ha as pre-emergence	897	1964
T_6 :	Oxadiargyl @ 80 g/ha at 20 DAS	603	1816
T_7 :	Oxadiargyl @ 80 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS	924	2641
T_8 :	Oxadiargyl @ 100 g/ha at 20 DAS	640	1917
T_9 :	Oxadiargyl @ 100 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS	957	2727
T_{10} :	Interculturing followed by hand weeding at 20 and 40 DAS	1088	2832
T_{11} :	Un weeded	381	621
T_{12} :	Weed free	1225	2930
	C.D. at 5 %	191	381.40
	C.V. (%)	14.21	11.00

oxyfluorfen and oxadiargyl applied at varying rate as post-emergence with interculturing and hand weeding at 30 DAS i.e., T_2, T_4, T_7 and T_9. Application of oxyfluorfen as post-emergences at different rates (T_1 and T_3) recorded significantly higher weed count over integrated approaches (T_2, T_4, T_7 and T_9) as well as alone pre-emergence application of isoproturon (T_5). Thus, in general, isoproturon as pre-emergences and oxadiargyl as post-emergences at various doses were more effective herbicide in isabgol than oxyfluorfen as post-emergence. Integrated approach of weed management were more effective than alone use of physical and chemical methods. The lowest weed population was observed under weed free condition at any stage of crop growth due to complete elimination of weeds by hand weedings as and when needed. In addition to this, dense crop canopy might have smothering effect on weeds. These findings are in close conformity with the Singh *et al.*, (11), Patel *et al.*, (8), Kumar (6), Yadav, *et al.*, (12) in cumin and Kulmi and Dubey (4).

Dry weight of weeds at harvest

It is explicated from the data (Table 2) that significantly low dry weight (0.0 kg ha^{-1}) of weeds was recorded when crop kept weed free (T_{12}). Interculturings followed by hand weedings at 20 and 40 DAS (T_{10}) recorded lower dry weight of weeds and was at par with treatments T_9, T_7, T_4, T_5 and T_2 but statistically higher over rest of the treatments. Significantly the maximum dry weight of weeds i.e., 1702 kg/ha was recorded under unweeded field (T_{11}).

Weed control efficiency

Different integrated weed management treatments affected the weed control efficiency. Weed free crop condition (T_{12}) recorded the highest weed control efficiency (100%) followed by treatments T_{10}, T_9, T_7, T_4 and T_5. The minimum weed control efficiency was recorded with unweeded plot (T_{11}) which was closely followed by alone post-emergences application of oxyfluorfen at different doses i.e., T_1 and T_3. In this way, dry weight of weeds (kg ha^{-1}) and weed control efficiency (%) were inversely proportional to each other. These findings are confirmed to those reported by Patel *et al.*, (8), Sharma and Jain (10) in isabgol and Yadav *et al.*, (12) in case of cumin.

Weed index

The data on weed index (Table 2) showed that, weed index was 0.00% under weed free crop condition (T_{12}) and closely followed by treatment T_{10} i.e., 11.18 per cent. The highest weed index i.e., 68.88 per cent was recorded under unweeded crop condition (T_{11}). This might be due to poor crop yield. These findings are in agreement with results reported by Sharma and Jain (10).

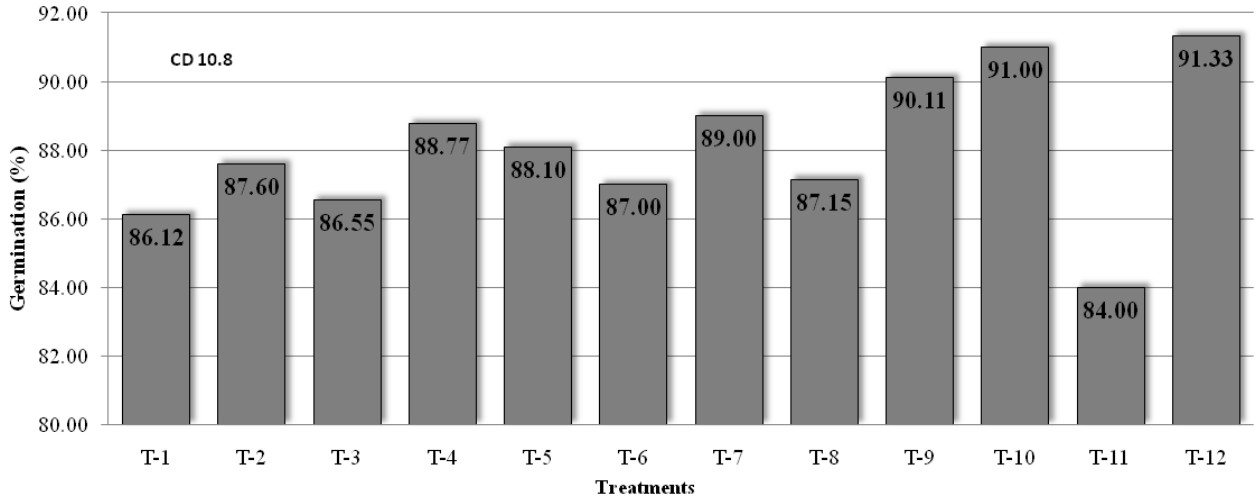
Correlation studies

Yield is a complex quantitative character, which depends on different interrelated characters. These

Table 2: Weed population in isabgol field at initial and at harvest as influenced by different integrated weed management treatments

Treatment	Total weed count per m^2			Weeds dry weight (kg ha^{-1})	Weed control efficiency (%)	Weed index (%)
	30 DAS	60 DAS	At harvest			
T_1: Oxyfluorfen @ 50 g/ha post-emergence at 20 DAS	3.70 (13.19)	4.54 (20.11)	5.53 (30.08)	1440	15.39	58.53
T_2: Oxyfluorfen @ 50 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS	2.57 (6.10)	3.23 (9.93)	3.57 (12.24)	950	44.18	34.12
T_3: Oxyfluorfen @ 75 g/ha post-emergence at 20 DAS	3.66 (12.89)	4.39 (18.72)	5.12 (25.71)	1400	17.74	55.34
T_4: Oxyfluorfen @ 75 g/ha post-emergence at 15 DAS +Interculturing followed by hand weeding at 30 DAS	2.39 (5.21)	2.98 (8.38)	3.23 (9.93)	865	49.17	26.12
T_5: Isoproturon @ 500 g/ha as pre-emergence	2.41 (5.30)	3.16 (9.48)	3.27 (10.19)	933	45.18	26.77
T_6: Oxadiargyl @ 80 g/ha at 20 DAS	2.95 (8.20)	3.43 (11.06)	4.20 (12.46)	1000	41.28	50.77
T_7: Oxadiargyl @ 80 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS	2.33 (4.92)	2.65 (6.52)	2.94 (8.14)	830	51.23	24.57
T_8: Oxadiargyl @ 100 g/ha at 20 DAS	2.84 (7.56)	3.37 (10.85)	3.60 (17.14)	980	42.42	47.75
T_9: Oxadiargyl @ 100 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS	2.30 (4.79)	2.62 (6.36)	2.76 (7.11)	777	54.35	21.87
T_{10}: Interculturing followed by hand weeding at 20 and 40 DAS	2.03 (3.62)	2.31 (4.83)	2.53 (5.90)	725	57.40	11.18
T_{11}: Un weeded	4.25 (17.56)	4.76 (22.15)	6.23 (38.31)	1702	0.00	68.88
T_{12}: Weed free	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.0	100.00	0.0
C.D. at 5 %	0.50	0.79	0.84	230	-	-
C.V. (%)	11.02	14.58	13.46	13.94	-	-

Note: Original data given in parentheses were subjected to square root transformation **($\sqrt{x + 0.5}$)** before analysis



T_1: Oxyfluorfen @ 50 g/ha post-emergence at 20 DAS T_2: Oxyfluorfen @ 50 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS T_3: Oxyfluorfen @ 75 g/ha post-emergence at 20 DAS T_4: Oxyfluorfen @ 75 g/ha post-emergence at 15 DAS + Interculturing followed by hand weeding at 30 DAS T_5: Isoproturon @ 500 g/ha as pre-emergence T_6: Oxadiargyl @ 80 g/ha at 20 DAS T_7: Oxadiargyl @ 80 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS T_8: Oxadiargyl @ 100 g/ha at 20 DAS T_9: Oxadiargyl @ 100 g/ha at 15 DAS + Interculturing followed by hand weeding at 30 DAS T_{10}: Interculturing followed by hand weeding at 20 and 40 DAS T_{11}: Un weeded T_{12}: Weed free

Fig. 1: Germination percentage of green gram crop influenced by different integrated weed management treatments

Table 3: Correlation coefficient (r) between seed yield and characters

S.no.	Character	(r)
1.	Straw yield (kg/ha)	0.808
2.	Total weed count m^{-2} at harvest (kg/ha)	0.889
3.	Dry weight of weeds (kg/ha)	0.842

Note: r value significant at 5 per cent level of probability in all cases.

components may show varying degree of association, either favourable or unfavourable. Hence, in order to attain rational improvement in yield, the extent of relationship between the seed and straw yield (kg ha^{-1}) as well as weed biomass were studied. It was noticed that straw yield (kg ha^{-1}), total weed count m^{-2} at harvest and dry weight of weeds (kg ha^{-1}) showed positive significant correlation with seed yield (Table 3).

Germination percentage

The results presented in fig. 1 indicated that the effect of different integrated weed management treatments on germination percentage of succeeding crop (Green gram) was not observed. There was no any harmful or beneficial effect of various herbicides i.e., oxadiargyl, oxyfluorfen and isoproturon on germination of succeeding green gram crop. Thus, herbicides used in experiment have no any harmful residual effect on germination of succeeding green gram crop. Similar results were also observed by Kulmi (3).

Conclusion

In view of the results obtained from the investigation, it is concluded that the most appropriate weed management strategy for getting higher yields and effective weed control in isabgol on loamy sand soil of North Gujarat was obtained by performing two interculturings followed by hand weedings at 20 and 40 DAS. Under unavailability of labour during peak period, higher production can be achieved by adopting integrated weed management practices i.e., post-emergence application of oxadiargyl @ 100 g/ha at 15 DAS with interculturing followed by hand weeding at 30 DAS, without causing any harmful residual effect on germination of succeeding crop.

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