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Influence of different weed management practices on weed flora, growth, yield and economics of Indian bean (*Lablab purpureus* L.) under south Gujarat condition

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Abstract
A field experiment was conducted at College Farm, Navsari Agricultural University, Navsari during *rabi* season of 2016-17 to study the "Effect of weed management practices on growth and yield of vegetable Indian bean (*Lablab purpureus* L.) under south Gujarat condition." Application of weed free treatment significantly reduced the weed count and dry weed biomass, increased the weed control efficiency. Nutrient losses by weeds were observed highest under unweeded control treatment and lowest with weed free condition followed by application of pendimethalin (CS) @ 0.5 kg/ha as PE. weed free treatment, three hand weeding (HW) at 20, 40 and 60 DAS, Pendimethalin (EC) @ 1.0 kg/ha as PE + HW at 40 DAS (T_5), imazethapyr @ 75 g/ha at 20 DAS + HW at 40 DAS (T_8) and pendimethalin (CS) @ 0.5 kg/ha as PE + HW at 40 DAS (T_6) enhanced the growth characters *viz*., plant height, number of branches per plant, dry matter accumulation, days to 50% flowering along with the yield attributes like pod length, number of pods per plant and number of seeds per pod. Pod and stover yields of Indian bean were significantly higher under weed free treatment being at par with the application of pendimethalin (EC) @ 1 kg/ha as PE + HW at 40 DAS (T_5), pendimethalin (CS) @ 0.5 kg/ha as PE + HW at 40 DAS (T_6) and imazethapyr @ 75 g/ha at 20 DAS +HW at 40 DAS (T_8) for pod yield, while in addition to these treatments, imazethapyr @ 75 g/ha at 20 DAS (T_7) was also found at par for stover yield. Maximum net returns of Rs. 26343/ha were incurred due to the application of pendimethalin (EC) @ 1 kg/ha as PE + HW at 40 DAS (T_5), and resulted into maximum beneficial treatment for *rabi* Indian bean.

Keywords: Influence, management, practices, economics, *Lablab purpureus* L.

Introduction
Pulses in India have unique importance to the vegetarian peoples as nutritionally balanced food defined over thousand years ago, besides cereals, vegetables, fruits and milk products (Ayachit, 2002) [3]. Indian bean (*Lablab purpureus* L. Sweet) is a multipurpose crop grown for pulse, vegetable and forage. Its fresh green pod contain 86.1% moisture, 3.8% protein, 6.7% carbohydrates, 0.75% fat, 0.9% mineral matter and vitamin-A (Singh et al., 2004), while mature dry seeds contain 23% protein, 625 carbohydrates and 340 calories per 100g of edible portion (Tindall, 1983) [16].

Weeds are one of the major problems in limiting the productivity of Indian bean. At initial, Indian bean plants grow slowly and are weak competitors to most of the weeds; even lesser weed infestations in the early growth period reduce Indian bean yields significantly (Bhan and Singh, 1991) [4], whereas weeds emerge fast and grow rapidly competing with the crop severely for growth resources *viz*., nutrients, moisture, sunlight and space during entire vegetative and early reproductive stages of Indian bean. They also transpire lot of valuable conserved moisture and absorb large quantities of nutrients from the soil which cannot be admired especially during *rabi* season. Even though such huge crop produce losses are caused by the weeds, Indian farmers do not pay a quantifiable attention towards weed management as compared to pest, disease, fertilizer and irrigations. This can be observed from the pattern of pesticides usage in agriculture in India. Use of herbicides, insecticides and fungicides in India is 10%, 76% and 13% respectively, while at global level these figures are 30%, 44% and

21%, respectively (Akhtar *et al.*, 2009) [2]. This may be one reason for low crop productivity in India. The traditional methods of inter-culturing and manual weeding are more effective in controlling weeds, but are tedious and time consuming besides labour intensive and costly. However, chemical method of weed control has become efficient and time saving with the introduction of herbicides this is particularly true under intensive crop production practices.

Unavailability of labour at the time of weeding resulting in sever field infestation which make mechanical weeding ineffective, tedious and costly. Under such circumstances, chemical control of weeding may be the viable and cost effective alternative for this crop. Effective herbicide at appropriate rate may prove as an effective weed control method and replace conventional method of weed control. So if weed growth is minimize during the period of crop weed competition, crop yield will be equivalent to that of weed free crop. There for it is essential to control weed by any means during crop weed competition. This paper deals with the objective of to study different weed flora, effect of different weed control practices on growth and yield efficiency of different herbicide for controlling weed in vegetable Indian bean.

Material and Methods

A field experiment was carried out during *rabi* season of 2016. The experiment was laid out in randomized block design, with three replication and eight treatments comprising of weed management practices. The soil of experimental field was clay in texture and showed low, moderately high and very high rating for available nitrogen (172.50 kg/ha), Phosphorus (38.20 kg/ha), Potassium (323.18 kg/ha), respectively. The soil was slightly alkaline (pH 7.8) with normal electric conductivity (0.36 ds/m). The seed of Indian bean variety GNIB-21 was sown on 16th November 2016 at a row spacing of 45 x 10 cm using seed rate of 40 kg/ha and fertilized with 20-40-00 NPK kg/ha. Pre emergence herbicide spray was done using 500 liters of water per hectare as per treatment. Pre emergence herbicides *viz*. pendimethalin (EC) was sprayed in respective plots, next days after sowing of Indian bean crop while, pendimethalin (CS) was sprayed to the soil before application of irrigation. The pre-emergence application was made on the soil surface uniformly within respective plots. The crop was grown with recommended package and practices for South Gujarat Heavy Rainfall Agro climatic Zone and was harvested in three picking for green pods.

Result and Discussion

Effect of weed population, dry weight of weed, WCE and WI: In experimental field different types of weed flora were observed. The dominant weeds comprise of grassy weeds *viz.*, *Echinochloa crusgalli, Cynodon dactylon, Sorghum halepense, Digitaria sanguinalis, Bracharia spp.;* broadleaf weeds *viz., Amaranthus viridis, Alternanthera sessillis, Digera arvensis, Convolvulus arvensis, Trianthema portulacastrum, Euphorbia hirta, Phyllanthus maderaspatensis, Physalis minima;* and among sedge *Cyperus rotundus* which were predominantly present during the course of experimentation. Similar weed flora was noticed by Raj *et al.* (2012) [8, 9, 13] and Reddy *et al.* (1994) [14].

All weed management treatment significantly reduces the production of weeds as compare to unweeded control (T_1). Among the different tried (Table 1), treatment T_2 (weed free) recorded significantly lowest number of Grassy (6.67 m^2), broadleaf (8.33 m^2), sedge (4.00 m^2) and total weed population (19.00 m^2) at 60 DAS compare to rest of the treatments. This might be due to effect of weed control in respective treatments either manual or herbicidal or both resulted in remarkable reduction in weed population. The findings are confined with those reported by Chandrakar *et al.* (2015) [5] and Chavan *et al*. (2016) [8, 9].

Table 1: Influence of different weed management treatments on weed population at 60 DAS, dry weed biomass, WCE and WI

Treatments	Weed population at 60 DAS (m^2)				Dry weed biomass (g/m^2)	WCE (%)	WI
	Grassy	Broad leaf	Sedge	Total			
T_1:Unweeded control	7.05 (49.33)	6.49 (42.00)	6.66 (44.33)	11.66 (135.66)	98.55	0.00	30.4
T_2:Weed free (Hand weeding at 20, 40 and 60 DAS)	2.65 (6.67)	2.96 (8.33)	2.09 (4.00)	4.41 (19.00)	16.95	82.79	0.0
T_3:Pendimethalin (EC) @ 1.0 kg/ha as Pre-emergence (PE)	4.66 (21.33)	4.18 (17.00)	4.23 (17.67)	7.50 (56.00)	41.29	58.08	19.3
T_4:Pendimethalin (CS) @ 0.5 kg/ha as PE	4.23 (17.67)	4.16 (17.00)	4.56 (20.67)	7.47 (55.34)	41.46	57.91	24.3
T_5:Pendimethalin (EC) @ 1.0 kg/ha as PE + HW at 40 DAS	3.18 (9.67)	3.65 (13.00)	4.44 (19.67)	6.53 (42.34)	30.71	68.82	5.9
T_6:Pendimethalin (CS) @ 0.5 kg/ha as PE + HW at 40 DAS	3.24 (10.33)	3.42 (11.33)	4.93 (24.00)	6.79 (45.66)	40.78	58.60	6.1
T_7:Imazethapyr @ 75 g/ha at 20 DAS	4.24 (17.67)	3.74 (13.67)	4.23 (17.67)	7.01 (46.01)	34.23	65.25	20.3
T_8:Imazethapyr @ 75 g/ha at 20 DAS + HW at 40 DAS	2.96 (9.33)	3.18 (9.67)	4.22 (17.67)	5.99 (36.67)	24.32	75.31	9.1
S.Em. ±	0.30	0.29	0.41	0.33	3.37		
C.D (*P*=0.05)	0.90	0.87	1.26	1.02	10.23		
C.V.(%)	12.78	12.53	16.34	8.16	14.23		

* Figures indicating ($\sqrt{X+0.5}$) transformed values, Figures in parenthesis are indicating original values.

Minimum dry weed biomass and maximum weed control efficiency was observed in treatment T_2 which was at par with post emergence application of imazethapyr @ 75 g/ha at 20 DAS + HW at 40 DAS (T_8). Better weed control efficiency of herbicides along with hand weeding resulted into the lowest weed counts and finally reduced the total dry weed biomass at

60 DAS combined with more number of branches per plant, dry weed biomass (Table 1) which did not allow weeds to grow vigorously due to smothering effect. Similar results were also reported by Chaudhary *et al.* (2005) [6] and Chavan *et al*. (2016) [8, 9].

Weed index is the indicator of losses in seed yield due to presence of weeds therefore in this experiment treatment T_2 was considered as base for calculating weed index. In this, treatment T_5 (pre-emergence application of pendimethalin (EC) @ 1 kg/ha + HW at 40 DAS) and T_6 (pre-emergence application of pendimethalin (CS) @ 1 kg/ha + HW at 40 DAS) found to have better weed index value (Table 1) as compared to rest of the treatments. This might be due to effective weed control achieved under these weed management treatments in terms of reduced biomass of weeds and higher weed control efficiency which converted in to higher yields of crop. Similar results were also reported by Chaudhary *et al.* (2005) [6] and Chavan *et al*. (2016) [8, 9].

Effect on crop

Growth attributes: The plant height at 60 DAS showed significant effect in all the treatments (Table 2). Significantly taller plant seen in weed free treatment (T_2) were also at par with the treatment T_5 (pre-emergence application of pendimethalin (EC) @ 1.0 kg/ha followed by HW 40 DAS) and T_8 (post-emergence application of imazethapyr @ 75 g/ha followed by HW at 40 DAS). The lowest plant height in unweeded control might be due to more crop–weed competition. The number of branches per plant recorded 60 DAS showed significant effect due to different weed management practices. Highest branches per plant were observed in weed free treatment (T_2) which was at par with pre-emergence application of pendimethalin (EC) @ 1.00 kg/ha + HW at 40 DAS (T_5) and post-emergence application of imazethapyr @ 75 g/ha +HW at 40 DAS (T_8). The results pertaining to the dry matter accumulation per plant at 60 DAS showed significant effect.

Table 2: Influence of different weed management treatments on growth and yield attributes and yield of Indian bean

Treatments	Plant height (cm) at 60 DAS	No. of branches per plant at 60 DAS	Dry matter accumulation (g/m^2) at 60 DAS	Pod length (cm)	Number of pods per plant	Pod yield per plant (g)	Pod yield (kg/ha)	Stover yield (kg/ha)
T_1:Unweeded control	36.80	8.93	8.33	3.53	18.93	11.70	1770	2500
T_2:Weed free (Hand weeding at 20, 40 and 60 DAS)	46.00	12.47	11.20	4.60	27.60	16.37	2544	3336
T_3:Pendimethalin (EC) @ 1.0 kg/ha as Pre-emergence (PE)	38.93	9.80	8.93	3.80	22.00	12.93	2054	2866
T_4:Pendimethalin (CS) @ 0.5 kg/ha as PE	40.53	10.40	9.65	3.73	21.67	14.73	1927	2963
T_5:Pendimethalin (EC) @ 1.0 kg/ha as PE + HW at 40 DAS	44.00	11.80	10.07	4.33	24.33	15.57	2395	3005
T_6:Pendimethalin (CS) @ 0.5 kg/ha as PE + HW at 40 DAS	40.67	10.40	9.68	3.80	24.53	15.20	2390	3050
T_7:Imazethapyr @ 75 g/ha at 20 DAS	40.07	9.93	9.30	3.80	23.80	14.37	2028	3140
T_8:Imazethapyr @ 75 g/ha at 20 DAS + HW at 40 DAS	42.20	11.13	10.37	4.27	25.60	15.00	2311	3116
S.Em. ±	1.72	0.67	0.49	0.22	1.11	0.96	153.91	143.63
C.D (*P*=0.05)	5.22	2.04	1.51	0.66	3.38	2.66	466.89	435.70
C.V. (%)	7.28	11.02	8.91	9.59	8.19	11.59	12.24	8.3

The maximum dry matter accumulation per plant obtained in the weed free treatment (T_2) and was found at par with treatment T_8, T_5, T_6, T_4, T_7 and T_3.The overall improvement in plant growth under these treatments can chiefly be attributed to greater availability of light, moisture and nutrients resulting from decreased weed competition as evident from significantly lower weed population. These results are in agreement with those reported by Nagender (2014) [10], Sharma *et al*. (2014) [5, 8, 9, 15, 17] and Chaudhari *et al.* (2016) [7].

Yield attributes

The results about pod length, number of pod per plant, pod yield per plant, pod yield and stover yield revealed significant effect (Table 2). Maximum pod length, number of pod per plant, pod yield per plant, pod yield and stover yield were recorded in the weed free treatment (T_2). Pod length was found statistically at par with treatment T_8 and T_5 while number of pod per plant was also found at par T_6. Weed free treatment (T_2) recorded maximum pod yield per plant but remained statistically at par with T_5, T_6, T_8, T_4 and T_7. The lowest pod yield per plant was found under unweeded control (T_1). The results are in close association with the findings of Patel *et al.* (2006) and (Makwana, 2008) [6, 13]. Significantly higher pod and stover yield was observed in weed free treatment (T_2) which remained at par with T_5, T_6 and T_8 while, stover yield was also found at par under T_7 and T_4 treatment. This might be due to effective control of weeds in terms of reduced weed population and dry weed biomass under these treatments. This may also be attributed with the better growth of crop in terms of higher leaf area index and dry matter accumulation in these treatments, which may have resulted in better translocation of photosynthetic for development of all the yield attributes. These results are in close conformity with Poonia and Pithia (2013) [12] and Vikas *et al.* (2013) [17].

Economics

Economics is the major consideration for the farmers while taking a decision regarding the adoption of new technology. Hence, the cost of cultivation, gross realization, net realization and benefit cost ratio were computed for all weed management treatments (Table 3). Although weed free treatment (T_2) recorded significantly higher crop yield but owing to the use of labours its cost of production (Rs.36098/ha) increased due to which it fetched lesser net monetary returns of Rs. 24807/ha as compared to T_5 treatment fetching Rs. 26343/ha with CBR ratio 1.86, followed by treatment of pendimethalin (CS) @ 0.5kg/ha as PE + HW at 40 DAS (T_6) with CBR value of 1.84 and imazethapyr @ 75 g/ha at 20 DAS + HW at 40 DAS (T_8). The whole and sole reason for this is the labour cost incurred in treatment T_2 which were also observed by Overfield *et al.* (2001) [11] and Aggarwal *et al.* (2014) [1].

Table 3: Influence of different weed management treatments on economics of Indian bean

Sr. No.	Yield (kg/ha)		Cost of cultivation (Rs/ha)	Gross monetary return (Rs/ha)	Net monetary returns (Rs/ha)	B:C ratio
	Pod	Stover				
T_1	1770	2500	25418	42907	17489	1.69
T_2	2544	3336	36098	60905	24807	1.69
T_3	2054	2866	27028	49691	22663	1.84
T_4	1927	2963	27461	47439	19978	1.73
T_5	2395	3005	30588	56931	26343	1.86
T_6	2390	3050	31021	56951	25930	1.84
T_7	2028	3140	26796	49996	23200	1.87
T_8	2311	3116	30356	55589	25232	1.83

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