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Analysis of weed control measures in Kharif french bean

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Abstract
A field experiment was conducted during *Kharif* 2018 at experimental farm, College of Agriculture, Latur (MS), to study the effects of different weed control measures on yield and economics of *Kharif* of french bean *(Phaseolus vulgaris* L.). Though the higher seed yield per plant (9.69 g), 100 seed weight (38.33 g) and seed yield (950 kg/ha) were observed in weed free situation. But these parameters were found statistically at par with the application of pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS. The highest Net Monetary Return (Rs.54850/ha) and BC ratio were recorded with the application of pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS. Among different chemical weed control methods lowest dry weed weight (48.17 g/m^2), weed index (4.24%), and highest weed control efficiency (91.25%) were observed with the application of pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS.

Keywords: French bean, Post-emergence herbicide, Pre-emergence herbicide, Weed management

Introduction
French bean (*Phaseolus vulgaris* L.) is an herbaceous annual plant grown worldwide for its edible grain, green leaves and green pods. However the dry seeds are the ultimate economic product (Anonymous, 2001) [1]. In world French bean is cultivated on an area of 282 M ha with a production of 18.95 M tonnes, in which Brazil rank first. In India french bean is cultivated on an area 3.94 M ha with a production and productivity of 2.8 M tonnes and 7.1 q/ ha respectively (Anonymous 2006) [2]. Among the major constraints, initial heavy infestation of weeds is one of the important factors, which hinders its overall growth and productivity. Since initial growth rate of french bean is slow compared to weeds and the interspaces covered by weeds severely affects crop growth and yield. Although the yield losses due to weed depend on composition of weed flora, extent of infestation and the crop canopy but it has been estimated that weeds alone can reduce the yield to the tune of 20-60%. Among the various weed management options herbicide use is not only efficient method but it is cost effective also. On the other hand, physical weed control measure, *viz.* hand weeding are safe but labour intensive. It is an established fact that weeds, due to their competition for water, light and nutrients reduce crop yields, but little is known about the physiological interaction between crop plants and weeds that brings about the yield reduction (Aspinall and Milthorpe 1959) [3]. In addition, weeds impair the quality of farm products by contamination, hence reduces their quality and market value.
Considering these facts, the present investigation was carried out to test the performance of pre- and post-emergence herbicides alone and in combination with hand weeding to control the weeds in *Kharif* French bean.

Materials and Methods
A field experiment was conducted during *Kharif* season of 2018-19 at Experimental Farm, Agronomy Section, College of Agriculture, Latur (MS). The experimental site was low in available nitrogen (129.31 kg/ ha), medium in available phosphorus (20.42 kg/ ha), high in available potassium (460.00 kg/ ha) and alkaline (p^H 8.1) in reaction.

The soil was clayey in texture with moderate moisture holding capacity which was good for normal growth. The experiment was laid out in a Randomized Block Design with seven treatments, replicated thrice. The details of the treatments and their scheduling are given in Table 1.Gross and net sizes of plots were 4.8m × 4.5m and 4.2m × 3.9m respectively. Sowing was done by dibbling method on 10th July 2018 with spacing 45cm × 10 cm. French bean variety '*HPR 35*' was used for sowing. Half dose of nitrogen and full dose of phosphorous and potassium applied as basal dose and remaining half dose of nitrogen was top dressed at 30 DAS. The crop was harvested on 24 September 2018.The recommended cultural practices and plant protection measures were taken. Pre-emergence application of pendimethalin was done on next day of sowing and post-emergence application of quizalofop-ethyl was done 20 DAS. Weeds at harvest were collected using 1m^2 quadrate (g/m^2).The dry weed weight was subjected to square root transformation ($\sqrt{x+0.5}$) to normalize their distribution (Gomez and Gomez 1984) [4]. Weed control efficiency was worked out by the formula as below.

$$\text{WCE (\%)} = \frac{DWC - DWT}{DWC} \times 100$$

Where, WCE= Weed control efficiency in %; DWC= weed dry weight in control plot; DWT= weed dry weight in treated plot.

Data on various variables were analyzed by analysis of variance (Panse and Sukhatme, 1967) [5]. Total rainfall received during experimental period was 507.00 mm, distributed over 13 rainy days.

Results and Discussion

Weed flora

Weed flora of experimental plot were comprised of broad leaved weeds *Euphorbia geniculata, Leagaceae mollis, Parthenium hysterophorus.L, Amaranthus polygamous, Digera arvensis*; grasses like *Cynodon dactylon, Brachiriae ruciformis, Dinebra retraflexa* and sedges like *Cyprus rotundus.*

The weed free treatment recorded the significantly lowest weed dry weight over all the treatments. Among the chemical weed control treatments application of pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS recorded lowest weed dry weight which was closely followed by application of quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS. It might be due to combined effect of chemical and mechanical weed control treatments, which reduced the weed flora (Patel *et al.* 2017, Patil *et al.* 2018, Raju *et al.* 2017) [7, 8, 9].

Table 1: Mean dry matter of weed, weed control efficiency and weed index at harvest as influenced by different treatment

Treatment details	Dry weed weight (g/m^2)	WCE (%)	WI (%)
Pendimethalin 30% EC (1.0 kg /ha) as PE	14.96 (223.24)	59.46	20.02
Quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS	14.40 (207.54)	62.31	23.00
Pendimethalin 30% EC (1.0 kg /ha) as PE + One hoeing at 30 DAS	6.97 (48.17)	91.25	4.24
Quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + One hoeing at 30 DAS	7.57 (56.78)	89.69	6.50
One hoeing followed by one hand weeding (farmers practice)	8.81 (77.2)	85.98	18.51
Weed free	6.02 (35.85)	93.49	0.00
Weedy check	23.48 (550.68)	0.00	34.22
LSD (p=0.05)	5.72	-	-

Table 2: Seed yield/plant, dry wt. of pod/plant, seed yield /plant and seed index of french bean as influenced by different treatment

Treatment details	No. of pods /plant	Dry wt. of pod/plant	Seed yield /plant (g)	Seed Index (g)
Pendimethalin 30% EC (1.0 kg /ha) as PE	10.60	11.80	6.88	37.12
Quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS	8.53	9.49	4.57	37.70
Pendimethalin 30% EC (1.0 kg /ha) as PE + One hoeing at 30 DAS	11.93	13.28	8.36	38.22
Quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + One hoeing at 30 DAS	11.23	12.50	8.28	37.90
One hoeing followed by One handweeding (farmers practice)	10.93	12.16	7.24	37.80
Weed free	13.13	14.61	9.69	38.33
Weedy check	8.40	9.35	4.43	36.43
LSD (p=0.05)	2.16	2.18	1.43	0.89

Table 3: Seed yield and economics of french bean as influenced by different treatment

Treatment details	Seed yield t/ha	GMR Rs/ha	NMR Rs/ha	B:C ratio
Pendimethalin 30% EC (1.0 kg /ha) as PE	0.76	76000	40845	2.16
Quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS	0.73	73166	38167	2.09
Pendimethalin 30% EC (1.0 kg /ha) as PE + One hoeing at 30 DAS	0.91	91000	54850	2.52
Quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + One hoeing at 30 DAS	0.89	88800	52857	2.47
One hoeing followed by One handweeding (farmers practice)	0.77	77400	37643	1.95
Weed free	0.95	95000	45115	1.90
Weedy check	0.56	55900	22622	1.68
LSD (p=0.05)	0.113	11287	11287	0.31

Weed control efficiency and Weed Index

The weed free treatment recorded the highest weed control efficiency. Among the chemical weed control treatments application of pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS recorded highest weed control efficiency which was closely followed by application of quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS. It might be due to effective control of weeds (Panotra and Kumar 2016, Patel *et al.* 2017, Patil *et al.* 2018, Raju *et al.* 2017) [6- 9].

Among the different chemical weed control treatments application of pendimethalin 30% EC (1.0 kg/ha) as PE + one

hoeing at 30 DAS recorded lowest weed index which was closely followed by application of quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS (Panotra and Kumar 2016, Patel *et al.* (2017) [6, 7].

Yield and Yield Attributes

The weed free treatment produced significantly maximum no of pod per plant (13.13), which was at par with application pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS and found significantly superior over rest of the treatments.

The weed free treatment (T_6) produced highest dry weight of pod per plant (14.61 g), which was at par with treatment pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS and found significantly superior over rest of the treatments.

The weed free treatment produced highest seed yield per plant (9.69 g), which was at par with treatment pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS and found significantly superior over rest of the treatments.

The weed free treatment recorded highest Seed index(38.33 g), which was at par with treatment pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS and found significantly superior over rest of the treatments.

The weed free treatment recorded higher seed yield (0.95 t/ha) which was at par with treatment pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS and found significantly superior over rest of the treatments.

Economics

The weed free treatment recorded significantly higher gross monetary (Rs.950000 /ha) which was at par with pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS and found significantly superior over rest of the treatments. The application of pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS and both were equally effective in producing higher gross monetary return of French bean as that of weed free treatment.

The application pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS recorded significantly higher net monetary return Rs.54850 /ha which was at par with quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS and weed free treatment and found significantly superior over rest of the treatment.

The application pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS recorded higher B:C ratio (2.52) of French bean which was closely followed by quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS with B:C ratio 2.47.

It clearly indicated that pre-emergence application of pendimethalin 30% EC (1.0 kg/ha) as PE + one hoeing at 30 DAS and quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS + one hoeing at 30 DAS were equally effective in giving higher B:C ratio.

From the result it may be concluded that among different herbicide control methods application of pendimethalin 30% EC (1.0 kg/ha) as PE *fb* one hoeing at 30 DAS or application of quizalofop-ethyl 5% EC (100 g/ha) at 20 DAS *fb* one hoeing at 30 DAS were more effective in French bean.

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