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Weed management practices on winter French bean (*Phaseolus vulgaris* L.) under western Uttar Pradesh conditions

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ABSTRACT

A Field investigation was conducted during the Rabi season of 2003-04 and 2004-05 at Baraut, Uttar Pradesh, to find out most suitable weed management practices on winter French bean. Among the 12 weed management treatments in French bean viz. weedy check, hand weeding at 30 days after sowing, weed free, fluchloralin @ 0.75 kg/ha, fluchloralin @ 1.0 kg/ha, fluchloralin @ 0.75 kg/ha with hand weeding at 30 days after sowing, pendimethalin @ 0.75 kg/ha, pendimethalin @ 1.0 kg/ha, pendimethalin @ 0.75 kg/ha with hand weeding at 30 days after sowing, oxyfluorfen @ 0.15 kg/ha, oxyfluorfen 0.20 kg/ha, oxyfluorfen @ 0.15 kg/ha with hand weeding at 30 days after sowing. Application of fluchloralin (pre-planting) @ 1.0 kg a.i./ha had maximum weed control efficiency (79.8%), which was at par to pre-emergence application of pendimethalin1.0 kg/ha (78.7%). The effect of these herbicides were also pronomced in terms of different growth and yield attributes of French bean crop and had maximum number of branches/plant (6.16 to 6.23), leaf area index (1.06 to 1.07), number of pods/plant (5.51 to 5.53) and 100-seed weight (316.2 to 316.7). The highest yield (1.11 to 1.10 t/ha) and N uptake (52.52 to 52.95 kg/ha) was noticed under fluchloralin or pendimethalin applied plot 1.0 kg/ha also it had reduced N losses through weeds. Economic evaluation in terms of returns Rs./Re invested was maximum under fluchloralin or pendimethalin applied plot reveals the significance of these herbicides in western Uttar Pradesh.

Key word- Weeds management, French bean, N-uptake and Economics

French bean *(Phaseolus vulgaris* L.*)* is one of the most important pulse crops cultivated in hilly tracts of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh and parts of Maharashtra as a *kharif* season crop due to its specific adaption to a cool and long growing season (Tripathi et al. 1986). In north eastern plains of India, this has been introduced as non–traditional winter season crop. In spite of its popularity, its productivity in India is very low (300 kg/ha) as compared to the world average of 520 kg/ha (Ali and Kushwaha, 1987).

Among the major constraints, initial heavy infestation weeds is one of the important factor, which hinders its overall growth and productivity (Malik and Malik, 1994) since initial growth rate of French bean is slow compared to weeds and the interspaces covered by weeds severely affected crop growth and yield. Although the yield losses due to weed depend on composition of weed flora, extent of infestation and the crop canopy decides yield loss but it has been estimated that weeds alone can reduce the yield to the tune of 20-60 per cent. Among the various weed management options herbicide use is not only efficient method but it is cost effective also. On the other had, physical weed control measure *viz.* hand weeding are safe but labour intensive. The present study deals with the optimizing herbicide treatments and its appropriate combination of hand weeding for obtaining maximum yield and profit and reducing weeds population upto thresh hold level.

MATERIALS AND METHODS

Field experiment was conducted at the research farm of Janta Vedic College Baraut, Baghpat Uttar Pradesh (20.6^0N and 77.15^0E longitude at an elevation of 236.6 m above the sea level) during the *rabi* 2003-04 and 2004-05. Treatments were compared under randomized block design with three replications. The average annual rainfall of experimental site 651 mm extending over the period of mid July to October and few scattered showers during winter months from south-west monsoon. Whereas, the average minimum and maximum temperature vary from 5^0C to 45^0C. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction, low in organic carbon (0.35%) and available nitrogen (235 kg/ha) and was medium in available phosphorus (13.2 kg/ha) and potassium (260.2 kg/ha). French bean variety “PDR-14” was sown in rows 30 x 10 cm apart on 25 October during both the years using 120 kg seed/ha. Single super phosphate and muriate of potash were used to supply phosphorus and potassium at the rate of 60 kg P_2O_5 per hectare as per treatment and 50 kg K_2O per hectare, respectively. A basal dose of half of the nitrogen (60 kg/ha) was applied as per treatment and full dose of phosphorus and potassium was applied to the experimental plots by placement method just after demarcation of layout and the remaining half of Nitrogen (60 kg/ha) was

top dressed at maximum flowering stage. Fluchloralin was applied as pre-planting; pendimethalin and oxyfluorfen were applied pre–emergence with the help of knapsack sprayer fitted with flat fan T-jet nozzle at a spray volume of 500 litres. In weed free plots, weeds were removed manually as and when required with the help of *khurpi*. Other standard agronomical package and practices were followed uniformly in both the years. Weed and crop dry matter (DM) productions were measured at mid season and at final harvest. Different yield and yield attributing parameters were measured at the time of harvest and adjusted to 14% moisture contents. For midseason sampling, weed and crop DM were measured from two using 0.25 m^2 quadrats from each plot. At 90 days after sowing leaf area was measured by taking 10 leaves randomly from each plot and leaf area index (LAI) was computed. The weed control efficiency (WCE) of individual herbicide was calculated using following formula i.e.

$$WCE = \frac{\text{Weedy check treatment} - \text{Weed control treatment}}{\text{Weedy check treatment}} \times 100$$

The N uptake through weeds as well as French bean crop was measuring Micro-Kjeldalal method (Black, 1965). The economic assessment of each treatment were made taking into the account of individual herbicide/labours use under weed control treatment and yield increase due to these treatment options. For this cost of herbicide was taken as Rs. 850/kg for fluchloralin, Rs. 1333/kg of pendimethalin and Rs 10500/kg of oxyfluorfen. The labour cost was Rs. 70.00/day and the economic cost of French bean was Rs. 45.00/kg grain. The treatment means were compared using ANOVA (Choran and coz, 1957).

RESULTS AND DISCUSSION

Effect on weed growth

Different herbicides as well as mechanical weed control measure had significant influence on weed population as their dry matter (Table 1). Among the herbicides used fluchloralin @ 1.0 kg/ha applied as pre-planting which was on par to pendimethalin @ 1.0 kg/ha as pre-emergence had most effective weed control as compared to weedy check treatment in French bean. Of these the maximum reduction of weeds population was recorded in fluchloralin 1.0 kg/ha (79.81%) followed by pendimethalin 1.0 kg/ha treatments (78.71%). Comparative performance of individual herbicides indicates that use of fluchloralin 1.00 kg/ha or pendimethalin 1.00 kg /ha had almost equal effect on weed control and these were (50.53 %) more effective than that of oxyfluorfen. Almost similar results were noticed for weed dry weight (g/m^2) in French bean crop. Further, the gradient doses of herbicide use has also a significant effect on weed population and maximum efficacy was obtained at 1.0 kg/ha of fluchloralin or pendimethalin dose, which had 79.52% and 78.38% respectively, more weed control efficiency over their 0.75 kg/ha application rate and 60.81% and 70.28% respectively, over 0.75 kg/ha along with hand weeding at 30 days after sowing.

The maximum efficacy of integrated HW and herbicide use may be ascribed in term of regrowth of weeds at grand growth stage i.e. 40-45 DAS. These results are in close conformity with the earlier report by Mishra *et. al.* (1999) and Prajapati *et. al*. (2003).

Yield and yield attributes

The weed control measures exhibited significant variation in respect of different growth parameters. Fluchloralin 1.00 kg/ha produced taller plant closely followed by pendimethalin 1.0 kg/ha as compared to weedy check treatment. The superiority of fluchloralin 1.0 kg/ha and pendimethalin 1.0 kg/ha at 90 DAS stage in term of shoot height might have accrued due to better growth environment to the crop and non-smothering environment. This result confirms the findings of Mishra *et al.* (1998). The effect of fluchloralin @ 1.0 kg/ha or pendimethalin @ 1.0 kg/ha use was also seen in other growth parameters *viz*. number of branches (6.16 to 6.23) and leaf area index (1.06 to 1.07). The dry matter production which is the resultant of all these growth characters *viz*. plant height,

number of branches/plant and leaf area index, was maximum under fluchloralin 1.00 kg/ha and pendimethalin 1.0 kg/ha treatments. The cumulative effect of all these growth parameters ultimately reflected on various yield attributes also and number of pods/plant, 1000-seed weight, Harvest Index was higher over other weed management options by 65.6 to 66.4 %, 75.12 to 75.23 % and 75.47 to 75.93 %. Almost weed free situation under these treatments resulted in increased crop canopy development, which induced more nutrient and water uptake and better photosynthetic activities for French bean crop and ultimately resulted effective translocation of photosynthesis thousands grain development. (Dhanapal *et al.* 1989 and Rao *et al.* 1997).

Nitrogen uptake

Weed-management practices significantly affected the N uptake of French bean crop, the highest N uptake was recorded under the treatment of fluchloralin 1.00 kg/ha and pendimethalin 1.00 kg/ha (52.5n to 53 kg/ha) treated plot, which was significant at par to weed free situation. Such results may be visualized as lesser weed crop competition under these plots and thus more effective N uptake translocation towards the sink. The combined effect of more N content and yield was seen in terms of total uptake. The remaining weed management option did not prove significance in terms of N uptake value were significantly inferior to 1.0 kg fluchloralin or pendimethalin application (Table 3). The higher N uptake values may also be envisaged as decay of weeds after herbicidal treatment might have enriched the soil led more N supply to the French bean crop.

Nitrogen depletion by weeds

Use of various formulations of herbicides had significant influence on nitrogen removal by weeds. The maximum N depletion (6.23 kg/ha) was noticed under weedy conditions followed by hand weeding (5.28 kg/ha). The other herbicides or integrated weed-management practices significantly reduced the nitrogen depletion and maximum nitrogen drain was restricted with use of fluchloralin 1.00 kg/ha or pendimethalin 1.00 kg/ha (0.71 kg/ha), which was at par to the weedy check treatment. Hence it is pertinent mention that smaller and better crop smothering effect led to smaller N loss through weeds. Findings are its dose conformity with the reports of Mishra *et. al.* (1999).

Economics

The highest additional net returns were obtained due to higher sale price and higher seed yield respectively. The maximum additional net return due to weed management of Rs 21852 /ha was recorded under fluchloralin 1.00 kg/ha treatment, which was at par of pendimethalin 1.00 kg/ha treatment Rs 21189 /ha and the highest return/ rupees invests (Rs./Re investment) of (25.71 to 22.71) was recorded with fluchloralin 1.00 kg/ha or pendimethalin 1.00 kg/ha. This showed that French bean is more responsive towards the inputs use and under good management and it can give even higher returns (Table 4).

Thus, the result of two year study clearly indicated that weed management practices in French bean crop by fluchloralin @ 1.00 kg/ha and pendimethalin @ 1.00 kg/ha treatments were recorded higher productivity and profitability of French bean

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(Tables & Figures)

Table 1. Weed population and dry weight in french bean at 60 DAS as influenced by herbicides management options

Treatments	Weed Population (no./m^2) in French bean	Dry weight of weeds (g/m^2) in French bean	WCE (%)
Weedy Check	20.01(4.53)	17.53 (4.25)	
Hand weeding at 30 DAS	10.17(3.27)	13.22(3.70)	24.58
Weed free	0.00(0.71)	0.00(0.71)	100.00
Fluchloralin (0.75 kg *a.i.*/ha)	7.69(2.86)	6.45(2.64)	63.20
Fluchloralin (1.00 kg *a.i.*/ha)	4.04(2.13)	3.59(2.02)	79.52
Fluchloralin (0.75 kg *a.i.*/ha) + HW 30 DAS	5.85(2.52)	4.57(2.25)	73.93
Pendimethalin (0.75 kg *a.i.*/ha)	7.48(2.82)	6.87(2.71)	60.81
Pendimethalin (1.00 kg *a.i.*/ha)	4.26(2.18)	3.79(2.07)	78.38
Pendimethalin (0.75 kg *a.i.*/ha) + HW 30 DAS	5.91(2.53)	5.21(2.39)	70.28
Oxyfluorfen (0.15 kg *a.i.*/ha)	8.01(2.92)	7.96(2.91)	54.59
Oxyfluorfen (0.20 kg *a.i.*/ha)	6.67(2.68)	5.51(2.45)	68.57
Oxyfluorfen (0.15 kg *a.i.*/ha) + HW 30 DAS	7.04(2.74)	5.59(2.48)	68.11
S Em ±	0.10	0.11	1.23
CD (P=0.05)	0.22	0.25	4.27

Figures in parenthesis are transformed values subjected to (√x+0.5) transformation

Table 2. *Growth and yield attributes of french bean at 90 DAS as influenced by various herbicide treatment*

Treatments	Plant height (cm)	No. of branches / plant	Dry matter accumulation / plant (g)	Leaf area index	No. of pods/plant	1000-seed weight (g)	Harvest index
Weedy Check	20.09	4.09	7.01	0.73	2.76	237.9	28.99
Hand weeding at 30 DAS	22.69	4.79	7.19	0.85	3.08	252.5	31.87
Weed free	27.35	6.48	9.99	1.08	5.70	323.7	39.85
Fluchloralin (0.75 kg *a.i.*/ha)	24.43	5.07	7.38	0.87	4.17	269.8	33.47
Fluchloralin (1.00 kg *a.i.*/ha)	26.73	6.23	9.96	1.07	5.53	316.7	38.41
Fluchloralin (0.75 kg *a.i.*/ha) + HW 30 DAS	25.05	5.50	8.62	0.98	4.91	297.5	36.47
Pendimethalin (0.75 kg *a.i.*/ha)	24.66	5.40	8.10	0.87	4.29	271.5	33.59
Pendimethalin (1.00 kg *a.i.*/ha)	26.65	6.16	9.96	1.06	5.51	316.2	38.18
Pendimethalin (0.75 kg *a.i.*/ha) + HW 30 DAS	25.17	5.68	8.64	0.96	4.88	297.1	36.38
Oxyfluorfen (0.15 kg *a.i.*/ha)	23.76	5.47	7.33	0.84	3.24	256.7	32.12
Oxyfluorfen (0.20 kg *a.i.*/ha)	25.04	5.49	8.33	0.94	4.78	279.1	35.11
Oxyfluorfen (0.15 kg *a.i.*/ha) + HW 30 DAS	24.16	5.41	8.36	0.92	4.53	273.8	33.88
S Em ±	0.71	0.19	0.45	0.03	0.17	4.22	0.66
CD (P=0.05)	1.57	0.43	1.01	0.07	0.38	9.29	1.46

Table 3. *Effect of different weed management practices on N-uptake (kg/ha) by weeds and french bean crop*

Treatments	N uptake (kg/ha) by weeds	N uptake (kg/ha) of French bean
Weedy Check	40.28(6.38)	20.01
Hand weeding at 30 DAS	27.44(5.28)	25.12
Weed free	0.00 (0.71)	55.81
Fluchloralin (0.75 kg *a.i.*/ha)	10.46(3.31)	35.14
Fluchloralin (1.00 kg *a.i.*/ha)	0.00(0.71)	52.95
Fluchloralin (0.75 kg *a.i.*/ha) + HW 30 DAS	7.06(2.57)	43.07
Pendimethalin (0.75 kg *a.i.*/ha)	10.48(3.31)	34.76
Pendimethalin (1.00 kg *a.i.*/ha)	0.00(0.71)	52.52
Pendimethalin (0.75 kg *a.i.*/ha) + HW 30 DAS	7.68(2.86)	42.58
Oxyfluorfen (0.15 kg *a.i.*/ha)	13.22(3.70)	29.63
Oxyfluorfen (0.20 kg *a.i.*/ha)	8.23(2.95)	40.16
Oxyfluorfen (0.15 kg *a.i.*/ha) + HW 30 DAS	9.52(3.16)	36.24
S Em ±	0.79	1.61
CD (P=0.05)	1.74	3.54

Table 4. *Yield and economics of french bean as influenced by different weed management practices*

Treatments	Seed yield (t/ha)	Stover yield (t/ha)	Cost involve weed management (Rs.)	Additional net return due to weed management (Rs.)	Return/ rupees invests (Rs./Re invests)
Weedy Check	0.53	1.06			
Hand weeding at 30 DAS	0.58	1.13	1050	885	0.84
Weed free	1.06	1.59	4200	19402	4.62
Fluchloralin (0.75 kg *a.i.*/ha)	0.75	1.24	600	9277	15.46
Fluchloralin (1.00 kg *a.i.*/ha)	1.04	1.57	850	21852	25.71
Fluchloralin (0.75 kg *a.i.*/ha) + HW 30 DAS	0.86	1.47	1650	13110	7.95
Pendimethalin (0.75 kg *a.i.*/ha)	0.75	1.24	990	8752	8.84
Pendimethalin (1.00 kg *a.i.*/ha)	1.03	1.57	933	21189	22.71
Pendimethalin (0.75 kg *a.i.*/ha) + HW 30 DAS	0.86	1.47	2040	12427	6.09
Oxyfluorfen (0.15 kg *a.i.*/ha)	0.60	1.15	1045	1857	1.78
Oxyfluorfen (0.20 kg *a.i.*/ha)	0.82	1.47	1100	11157	10.14
Oxyfluorfen (0.15 kg *a.i.*/ha) + HW 30 DAS	0.76	1.28	2095	8052	3.84
S Em±	0.03	0.04	-	-	-
CD (P=0.05)	0.09	0.09	-	-	-