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# EFFECT OF CHEMICAL AND MECHANICAL WEED MANAGEMENT ON YIELD OF FRENCH BEAN-SORGHUM CROPPING SYSTEM

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## Abstract

A field experiment was conducted during 2016, experimental farm, Annamalai University, Annamalai Nagar to develop an effective weed management practice to study the effect of weed management practice in French bean cropping system under subtropical agro-ecosystems of western Uttar Pradesh. Pre-planting and pre-emergence application of fluchloralin 1.0 kg/ha and pendimethalin 1.0 kg/ha reduced the population of *Anagallis arvensis, Melilotus alba, Melilotus indica* and *Phalaris minor* significantly than weedy check and other herbicide treatments and resulted significant increase in growth and yield attributes, *viz.* plant height, no. of branches, dry matter accumulation, no. of pods/plant and seeds/pod, seed and straw yield of french bean. Maximum yield was recorded in fluchloralin 1.00 kg/ha and pendimethalin 1.00 kg/ha treatments with a corresponding value of 1.11 and 1.11 t/ha of French bean and 37.1 and 36.2 t/ha of fodder sorghum during both the years of experimentation. Application of fluchloralin 1.0 kg/ha and pendimethalin 1.0 kg/ha increased the net return of French bean significantly over weedy check, besides at B:C ratio of 1.18 and 1.12 during two cropping seasons.

***Key words:*** Cropping system, Economics, Fodder sorghum, French bean, N uptake, Weed management.

## Introduction

French bean *(Phaseolus vulgaris* L.) is an important and highly profitable crop in hilly tracts of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Tamilnadu and parts of Maharashtra as a *Kharif* season crop due to its specific adoption to a cool and long growing season (Tripathi *et al.,* 1986). It occupies an important position among various *Kharif pulses* crops grown in temperate hills of India. In north-eastern plains of India, this has been introduced as non-traditional winter season crop. The initial growth rate of French bean is slow and the inter-spaces are in-fested with weeds. The losses in general, due to weed depend on composition of weed flora, extent of infestation and the crop canopy, but it has been estimated that losses due to weeds alone can reduce the yield to the tune of 20-60 percent. To keep the weeds within a desirable limit, various methods which include physical, mechanical, chemical and biological are in use and among these methods, control of weeds through herbicide use is not only efficient method but is easily adopted by farmers. French bean-sorghum is one of the most prevalent cropping systems and sorghum being the important *Rabi* fodder crop in Uttar Pradesh is generally grown in a sequence with French bean.

## Materials and Methods

A field experiment was conducted at the experimental farm, Annamalai University, Annamalai Nagar during 2016. 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 30 cm inter row and 10 cm intra row spacing on 25$^{th}$ of October during both the years of experimentation using 120 kg seed/ha. Recommended doses of 120 kg N, 60 kg $P_2O_5$ and 50 kg $K_2O$ were uniformly applied to all the treatments. Full dose of P and K and half dose of N were applied as basal at the time of sowing and rest half of the N total as per treatment was applied before second irrigation at 47 DAS. The experiment of 12 treatments comprising of weedy check, hand weeding at 30 DAS, weed free, fluchloralin 0.75 kg/ha, fluchloralin 1.0 kg/ha, fluchloralin 0-.75 kg/ha with hand weeding at 30 DAS, pendimethalin 0.75 kg/ha,

**Table 1:** Effect of various treatments on dry matter of weeds in French bean and sorghum at 60 DAS.

| Treatments | Plant height (cm) | No. of branches /plant | Dry matter accumulation /plant (g) | Stover yield (t/ha) | Plant height (cm) | No. of branches /plant |
|---|---|---|---|---|---|---|
| Weedy check | 18.48(4.36) | 16.58(4.13) | - | 17.19(4.20) | 20.11(4.54) | - |
| Hand weeding at 30 DAS | 14.24(3.84) | 12.21(3.56) | 24.6 | 8.49(3.00) | 11.49(3.46) | 46.4 |
| Weed free | 0.00(0.71) | 0.00(0.71) | 100.0 | 4.04(2.13) | 4.68(2.27) | 76.6 |
| Fluchloraiin 0.75 kg/ha | 6.98(2.73) | 5.92(2.53) | 63.2 | 4.72(2.28) | 5.23(2.39) | 73.3 |
| Fluchloralin 1.00 kg/ha | 3.84(2.08) | 3.34(1.88) | 80.5 | 4.29(2.19) | 4.73(2.29) | 75.8 |
| Fluchloraiin 0.75 kg/ha + HW 30 DAS | 4.98(2.34) | 4.16(2.16) | 73.9 | 4.47(2.23) | 4.98(2.34) | 74.7 |
| Pendimethalin 0.75 kg/ha | 7.62(2.85) | 6.13(2.57) | 60.8 | 4.40(2.21) | 5.47(2.44) | 73.5 |
| Pendimethalin 1.00 kg/ha | 4.03(2.13) | 3.55(2.01) | 78.4 | 4.1 1(2.15) | 5.04(2.35) | 75.5 |
| Pendimethalin 0.75 kg/ha + HW 30 DAS | 5.65(2.48) | 4.78(2.30) | 70.2 | 4.2 9(2.19) | 5.29(2.41) | 74.3 |
| Oxyfluorfen 0.1 5 kg/ha | 8.84(3.06) | 7.08(2.75) | 54.6 | 4.63(2.26) | 5.53(2.45) | 72.7 |
| Oxyfluorfen 0.20 kg/ha | 5.89(2.53) | 5.14(2.37) | 68.5 | 4.22(2.17) | 5.09(2.36) | 75.0 |
| Oxyfluorfen 0.15 kg/ha + HW 30 DAS | 6.38(2.62) | 5.61(2.47) | 65.8 | 4.39(2.21) | 5.29(2.41) | 74.0 |
| LSD (P=0.05) | 0.20 | 0.31 | 4.3 | NS | NS | NS |

pendimethalin 1.0 kg/ha, pendimethalin 0.75 kg/ha with hand weeding at 30 DAS, oxyfluorfen 0.15 kg/ha, oxyfluorfen 0.20 kg/ha, oxyfluorfen 0.15 kg/ha with hand weeding at 30 DAS and were arranged in a randomized block design with three replications. Herbicide treatments were applied pre-planting and pre-emergence with the help of knapsack sprayer fitted with flat fan T-jet nozzle at a spray volume of 500 litre. In weed free plots, weeds were removed manually.

## Results and Discussion

### Floristic composition

The experimental field was infested with weeds as well as sedges. The dominant weeds in French bean were *Anagallis arvensis, Melilotus alba*, *Melilotus indica* and *Phalaris minor*. The Sorghum crop in weedy check plot was *Cynodon dactylon, Altenanthera* sp., *Cyperus iria etc.*

### Weed biomass

Weeds population was significantly affected in French bean by different weed management practices. During first year, fluchloralin 1.0 kg/ha and pendimethalin 1.0 kg/ha were comparable for weed population and these were significantly superior over weedy check and application of hand weeding at 30 DAS treatments. Dry matter of weeds was minimum (3.84 g/m$^2$) with fluchloralin 1.0 kg/ha due to higher weed control efficiency (80.48 %). But during second year, dry matter of weed was lowest (3.34 g/m$^2$) with fluchlorlin kg/ha closely followed by pendimethalin 1.0 kg/ha in ascending order, respectively (Table 1). All these treatments were significantly superior to weedy check due to their higher weed control efficiencies. There was no impact of treatments applied on weed dry matter accumulation in sorghum crop.

**Table 2:** Growth attributes of French bean at 90 DAS as influenced by various herbicides.

| Treatments | Plant height (cm) | No. of branches /plant | Dry matter accumulation /plant (g) | Stover yield (t/ha) |
|---|---|---|---|---|
| Weedy check | 20.7 | 4.19 | 7.2 | 1.09 |
| Hand weeding at 30 DAS | 23.1 | 4.83 | 7.4 | 1.13 |
| Weed free | 27.5 | 6.53 | 10.0 | 1.60 |
| Fluchloraiin 0.75 kg/ha | 24.5 | 5.14 | 7.6 | 1.26 |
| Fluchloralin 1.00 kg/ha | 26.8 | 6.11 | 10.0 | 1.58 |
| Fluchloraiin 0.75 kg/ha + HW 30 DAS | 25.0 | 5.62 | 9.7 | 1.50 |
| Pendimethalin 0.75 kg/ha | 24.6 | 5.27 | 8.3 | 1.26 |
| Pendimethalin 1.00 kg/ha | 25.7 | 6.05 | 10.0 | 1.58 |
| Pendimethalin 0.75 kg/ha + HW 30 DAS | 25.0 | 5.58 | 9.7 | 1.50 |
| Oxyfluorfen 0.1 5 kg/ha | 23.1 | 5.47 | 7.5 | 1.18 |
| Oxyfluorfen 0.20 kg/ha | 24.9 | 5.44 | 8.5 | 1.48 |
| Oxyfluorfen 0.15 kg/ha + HW 30 DAS | 23.2 | 5.35 | 8.6 | 1.29 |
| LSD (P=0.05) | 1.86 | 0.54 | 0.98 | 0.94 |

### Yield

Fluchloralin 1.0 kg/ha produced taller plant closely followed by pendimethalin 1.0 kg/ha as compared to weedy check. The superiority of fluchloralin 1.0 kg/ha and pendimethalin 1.00 kg/ha at 90 DAS in term of shoot height might have accrued to increase (Table 2). These results were akin to Mishra *et al.,* (1998). Similarly, dry matter production was the result of growth characters, *viz.* plant height, no. of branches/plant and leaf area index. The highest dry matter and maximum

**Table 3:** French bean equivalent yield of system.

| Treatments | Yield (t/ha) | Green fodder yield (t/ha) | French bean equivalent yield of system (t/ha) |
|---|---|---|---|
| Weedy check | 0.64 | 26.87 | 2.88 |
| Hand weeding at 30 DAS | 0.67 | 29.85 | 3.16 |
| Weed free | 1.13 | 31.95 | 3.79 |
| Fluchloralin 0.75 kg/ha | 0.86 | 30.25 | 3.38 |
| Fluchloralin 1.00 kg/ha | 1.11 | 31.76 | 3.76 |
| Fluchloralin 0.75 kg/ha + HW 30 DAS | 0.95 | 31.03 | 3.53 |
| Pendimethalin 0,75 kg/ha | 0.85 | 30.36 | 3.38 |
| Pendimethalin 1.00 kg/ha | 1.11 | 31.54 | 3.74 |
| Pendimethalin 0.75 kg/ha + HW 30 DAS | 0.94 | 30.65 | 3.50 |
| Oxyfluorfen 0.15 kg/ha | 0.69 | 29.82 | 3.18 |
| Oxvfluorfen 0.20 kg/ha | 0.91 | 30.62 | 3.46 |
| Oxyfluorfen 0.15 kg/ha + HW 30 DAS | 0.86 | 30.05 | 3.37 |
| LSD (P=0.05) | 1.08 | NS | 1.84 |

**Table 4:** Total N uptake (kg/taa) of French bean, sorghum and system as influenced by various herbicides at harvest.

| Treatment | Total N uptake of French bean (kg/ha) | Total N uptake of sorghum (kg/ha) | Total N uptake of system (kg/ha) |
|---|---|---|---|
| Weedy check | 22.6 | 70.1 | 92.6 |
| Hand weeding at 30 DAS | [f]27.8 | 83.3 | 111.1 |
| Weed free | 58.7 | 94.9 | 153.5 |
| Fluchloralin 0.75 kg/ha | 38.5 | 84.3 | 122.7 |
| Fluchloralin 1.00 kg/ha | 55.9 | 90.4 | 146.3 |
| Fluchloralin 0.75 kg/ha + HW 30 DAS | 46.1 | 86.7 | 132.8 |
| Pendimethalin 0,75 kg/ha | 38.0 | 83.9 | 121.9 |
| Pendimethalin 1.00 kg/ha | 55.3 | 90.1 | 145.5 |
| Pendimethalin 0.75 kg/ha + HW 30 DAS | 45.4 | 86.6 | 132.0 |
| Oxyfiuorfen 0.15 kg/ha | 34.3 | 82.7 | 117.0 |
| Oxyfluorfen 0.20 kg/ha | 43.3 | 89.6 | 133.0 |
| Oxyfiuorfen 0.15 kg/ha + HW 30 DAS | 39.7 | 85,7 | 125.4 |
| LSD (P=0.05) | 3.3 | NS | 10.0 |

**Table 5:** Relative economics of different weed control treatment in French bean .

| Treatment | Cost of cultivation (× $10^3$ ' /ha) | Net returns (× $10^3$ ' /ha | B:C ratio |
|---|---|---|---|
| Weedy check | 22.09 | 6.61 | 0.30 |
| Hand weeding at 30 DAS | 23.14 | 6.96 | 0.30 |
| Weed free | 26.29 | 24.37 | 0.93 |
| Fluchloralin 0.75 kg/ha | 22.69 | 15.82 | 0.70 |
| Fluchloralin 1.00 kg/ha | 22.94 | 27.09 | 1.18 |
| Fluchloralin 0.75 kg/ha + HW 30 DAS | 23.74 | 18.91 | 0.80 |
| Pendimethalin 0,75 kg/ha | 23.08 | 15.25 | 0.66 |
| Pendimethalin 1.00 kg/ha | 23.43 | 26.43 | 1.13 |
| Pendimethalin 0.75 kg/ha + HW 30 DAS | 24.13 | 18.34 | 0.76 |
| Oxyfiuorfen 0.15 kg/ha | 23.14 | 8.00 | 0.34 |
| Oxyfluorfen 0.20 kg/ha | 23.19 | 17.84 | 0.73 |
| Oxyfiuorfen 0.15 kg/ha + HW 30 DAS | 24.19 | 14.69 | 0.61 |

yield was recorded in fluchloralin 1.0 kg/ha (1.11 and 0.97 t/ha) and pendimethalin 1.0 kg/ ha (1.11 and 0.96 t/ha) during both the crop seasons. Since no weed was observed in both treatments which may have resulted in increased nutrient, water, space and light supply to the French bean crop due to no crop-weed competition thereby resulting in more photosynthesis and hence better translocation of photosynthates besides larger sink and stronger reproductive in weed control treatments have reported by Dhanapal *et al.,* (1989) and Rao *et al.,* (1997). Application of weed control measures in preceding French bean crop affected plant height and dry matter yield/plant of succeeding fodder sorghum in both the years. Similarly, different treatments applied in preceding French bean failed to cause significant variation in green fodder yield of fodder sorghum crop in both the years (Table 3). Maximum equivalent yield by system of French bean was recorded with fluchloralin 1.00 kg/ha (3.76 and 4.06 t/ha) and pendimethalin 1.00 kg/ha (3.74 and 3.98 t/ha) than weedy check treatments.

## N uptake

The availability of nitrogen, space, light and water to French bean crop due to absence of crop-weed competition, provided a favorable environment for growth and development of the crop. The herbicide fluchloralin 1.00 kg/ha and pendimethalin 1.0 kg/ha significantly affected the maximum total nitrogen uptake (55.95 and 49.95 kg/ ha) and (55.3 and 49.7 kg/ha) by seed and stover in French bean crop than weedy check at harvest. Weed control measures had non-significant improvement in nitrogen uptake by succeeding fodder crop during both the years. Maximum N-uptake (kg/ha) by system (kg/ha) was recorded with fluchloralin 1.0 kg/ha (146.3 and 145.6 kg/ha) and pendimethalin 1.0 kg/ha (145.4 and 144.4 kg/ha) as comparable to other weed control treatments during

the year 2016 (Table 4). Similar findings were reported by Pandey and Prakash, 2002; Pandey *et al*., 2003 and Rajesh kumar *et al*., 2018.

**Economics**

The variables like seed, fertilizer and weed management were considered as cash inputs for the demonstrations as well farmers practice. Economic returns as a function of seed yield and sale price varied during different years. More returns during 2012 were obtained due to higher sale price and higher seed yield. The maximum gross returns 50,040 per hectare and 49,860 per hectare and net returns of 27,095 per hectare and 26,432 per hectare was recorded with fluchloralin 1.00 kg/ha and pendimethalin 1.00 kg/ha and tire highest B.C. ratio of 1.18 and 1.13 was recorded with fluchloralin 1.00 kg/ha and pendimethalin 1.00 kg/ha (Table 5). This show that French bean is more responsive towards the inputs use and under good management and it can give even higher returns. Thus, the result of two year study clearly indicated that weed management treatments in French bean crop by fluchloralin 1.00 kg/ha and pendimethalin 1.00 kg/ha treatments were recording higher productivity and profit-ability of French bean.

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