

PRODUCTION POTENTIAL OF FENUGREEK (*Trigonella foenum-graecum*) INFLUENCED BY DIFFERENT WEED MANAGEMENT PRACTICES

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ABSTRACT

A field experiment was undertaken at Campus for Research and Advance Studies, Dhablan, P.G. Department of Agriculture, G.S.S.D.G.S. Khalsa College, Patiala, during *rabi* season of 2019-20. The experiment was laid out in randomized block design with 12 treatments and 3 replications. All the growth parameters, yield attribute and weed control efficiency found maximum and weed density, dry weight of weeds, weed index found minimum under weed free treatment. Among the other weed treatments, pre-emergence application of Pendimethalin 1 kg a.i. ha⁻¹fb with one hand weeding at 25 DAS was found effective in controlling number of weeds, dry weight of weeds and improving growth attributes *viz.*, plant height, number of branches plant⁻¹, yield attributes *viz.*, pod length, number of pods plant⁻¹, number of seeds pod⁻¹, test weight of fenugreek and having highest B:C (2:37) ratio. Therefore, pendimethalin 1 kg a.i. ha⁻¹fb with one hand weeding at 25 DAS is most cost-effective weed management treatment in fenugreek.

(Key words: Fenugreek, weed, Pendimethalin and hand weeding)

INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) 2n=16 locally known as *Methi*, is an important multiuse spice crop of arid and semi-arid regions of India. It is an annual herb that grows in *rabi* season with trifoliate leaves and it can be growing to be about two feet tall. It belongs to family Leguminosae also known as Fabaceae and sub-family Papilionaceae. It blooms white colour flowers with violet margin into the early summer. The flower develops into long brown pods which contain bright yellow and bold fenugreek seeds. Major fenugreek producing countries are Nepal, India, Pakistan, Bangladesh, Argentina, Egypt, France, Spain, Turkey, Morocco and China. India is the largest producer, consumer and exporter of fenugreek in the world. Where Rajasthan, Gujarat, Uttaranchal, Uttar Pradesh, Haryana and Punjab are major fenugreek producing states where Rajasthan is the leading state in the production of fenugreek in India, it accounting for 80 % of the nation's total fenugreek output (Anonymous, 2018). In India it is grown over 149140 ha area with the production of 202380 tonnes (Anonymous, 2018).

Weed is an important factor responsible for causing huge loss in fenugreek as they compete for light, water, nutrients and space with crop plant. Fenugreek is very slow growing crop during early stage and it does not form canopy that can terminate weed growth until several weeks after sowing (Patel *et al.*, 2018). If field remained unchecked, weed reduces seed yield to the tune of 14.2 to 69.0%

depending upon their density and duration of competition. In this crop hand weeding is common practice used by farmers but sometimes due to high wages and unavailability of labour for weeding at right time farmer opting for alternative cheaper and easier method of weed control. Manual weed control is labour intensive and therefore limits the production area (Bhutia *et al.*, 2017). Therefore, herbicidal weed management seems to be the most appropriate proposition. The advantage of chemical weeding lies its superior weed control at most critical stage of crop growth. Dinitroaniline herbicides that may have potential for weed control in this crop are trifluralin and pendimethalin @ 1 kg ha⁻¹ in conjunction with one hoeing (Banga *et al.*, 2002 and Kamboj 2001). Imazethapyr, a new herbicide of imidiazolinone group registered for use in soybean, groundnut and other legumes (Anonymous, 2002). It has been found very effect in fenugreek without any toxicity to crop if used post emergence up to 50 g ha⁻¹ (Fraser *et al.*, 2003). Weed free treatment recorded highest plant height, number of branches, leaf area plant⁻¹, dry matter plant⁻¹, which resulted increasing seed yield, straw yield and B:C ratio followed by treatment with one hand hoeing+ one weeding+ imazethapyr+ imazamox @ 70 g a.i. ha⁻¹ (Vanisree *et al.*, 2020). Similarly, Deshkariet *al.* (2019) concluded that weed control through herbicidal treatment in combination with mechanical weed control were found comparable to weed free treatment. Weed free check treatment being at par with treatments imazaethapyr+ imazamox @ 100 g a.i. ha⁻¹ at 20 DAS + 1 hoeing at 35 DAS, imazethapyr + imazamox @ 75 g a.i. ha⁻¹ at 20 DAS + 1 hoeing at 35 DAS, imazethapyr @ 75 g a.i. at

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20 DAS + 1 hoeing at 35 DAS and recorded significantly higher plant height, number of branches plant⁻¹ and dry matter accumulation plant⁻¹, thereby improving yield contributing characters viz., number of pods plant⁻¹, seed yield plant⁻¹ and consequently recorded highest seed and straw yield. Rice straw gives so many benefits when used as mulching helps to control of weeds, soil moisture and also to stabilize the soil temperature which facilitate vigorous crop growth.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of the year 2019-2020 at Campus for Research and Advanced studies, Dhablan. The experimental field is situated at 30° North latitude and 76° East longitudes and at an altitude of 250 meter above the mean sea level. The experimental field has subtropical climate and average rainfall of 754 mm. The soil of experimental field was clayey in texture slightly basic in reaction (pH 7.3). The soil was low in available nitrogen (236.12 kg ha⁻¹) and medium in available phosphorus (20.58 kg ha⁻¹), potassium (146.6 kg ha⁻¹) and moderate in organic carbon (0.63 %). The experiment was laid out in randomized block design with three replications. There were 12 weed control treatments viz., weedy check (T₁), weed free (T₂), one hand weeding at 25 DAS (T₃), two hand weeding at 25 and 45 DAS (T₄), pendimethalin PE @ 1 kg a.i. ha⁻¹ (T₅), pendimethalin PE @ 1 kg a.i. ha⁻¹ one hand weeding at 25 DAS (T₆), oxyflurofen PE @ 0.25 kg a.i. ha⁻¹ (T₇), oxyflurofen PE @ 0.25 kg a.i. ha⁻¹ one hand weeding at 25 DAS (T₈), mulching with paddy straw @ 5 tonnes ha⁻¹ (T₉), mulching with saw dust @ 2 t ha⁻¹ (T₁₀), one wheel hoeing at 25 DAS (T₁₁), Imazethapyr @ (55 g ha⁻¹) at 2-4 trifoliolate leaf stage (T₁₂). The required quantity of herbicides was worked out and mixed with water and sprayed uniformly at different stages of crop growth with knapsack sprayer fitted with flat fan nozzle at a spray volume of 500 l ha⁻¹. Category-wise weed density (number of weeds meter⁻¹ sq.) and dry weight of weeds (g m⁻²) were recorded by putting a square (1×1 m²) at random spot in each plot at 30 days interval till harvest. Fenugreek cultivar 'ML-150' was sown in lines of 22.5 cm apart during last week of October in each experimental unit. All the recommended package of practices was followed to raise the crop. The crop was harvested during first week of April, 2020. Data on weed density and dry weight of weeds were transformed using $\sqrt{x+1}$ before subjected to statistical analysis and weed control efficiency (WCE) was calculated.

RESULTS AND DISCUSSION

The data showed that weed control treatments significantly affected the numbers of weed (m⁻²) and dry weight of weeds (g m⁻²) at all the stages i.e., 30, 60 and 90 DAS and at harvest. Beside weed free treatment, the lowest number of weeds and dry weight of weeds were found at 30, 60, 90 DAS and at harvest with the application of

pendimethalin PE @ 1 kg a.i. ha⁻¹ with one hand weeding at 25 DAS and treatment oxyflurofen PE @ 0.25 kg a.i. ha⁻¹ with one hand weeding at 25 DAS showed at par results at 30, 60 and 90 DAS in case of number of weeds (m⁻²), it was due to effective control of weeds from the field by hand weeding at 25 DAS which were escaped from herbicide treatment. At harvest dry weight of weeds (g m⁻²) was found statically at par result with the application of pendimethalin PE @ 1 kg a.i. ha⁻¹ with one hand weeding at 25 DAS and treatment oxyflurofen PE @ 0.25 kg a.i. ha⁻¹ with one hand weeding at 25 DAS. The highest number of weeds and dry weight of weeds was found in treatment weedy check. The combined effect of herbicide and hand weeding at 25 DAS resulted in remarkable less dry weight of weeds. Mehta *et al.* (2010) reported reduced weed population and weed biomass with the application of pendimethalin + IC at 40 DAS followed by two HW at 20 and 40 DAS and one HW at 20 DAS + IC at 40 DAS. Fagaria *et al.* (2014) concluded that two hand weedings at 25 and 45 DAS recorded minimum dry matter of weeds and maximum weed control efficiency (94.5%) in fenugreek.

Besides weed free treatment highest weed control efficiency was found with the application of pendimethalin PE @ 1 kg a.i. ha⁻¹ with one hand weeding at 25 DAS followed by treatment oxyflurofen PE @ 0.25 kg a.i. ha⁻¹ with one hand weeding at 25 DAS at 30, 60, 90 DAS and at harvest. Besides weedy check significantly lowest weed control efficiency was found with the application of imazethapyr (55 g ha⁻¹) 2-4 trifoliolate leaf stage at 30 and 60 DAS, at 90 DAS and at harvest with the application of oxyflurofen PE @ 0.25 kg a.i. ha⁻¹. The higher weed control efficiency could be due to better weed control owing to lower dry weight throughout the crop growth under these treatments. Sharma (2009) observed that two hand weedings at 20 and 40 days after sowing (DAS) recorded minimum dry weight of both monocot and dicot weeds with the highest weed control efficiency (63.0%). Among the herbicides, pre planting and incorporation of fluchloralin 0.75 kg ha⁻¹ + one hand weeding at 30 DAS was most effective in reducing the dry weight of both monocot and dicot weeds at harvesting. The lowest weed index was found with the application pendimethalin PE @ 1 kg a.i. ha⁻¹ with one hand weeding at 25 DAS.

Beside weed free treatment, the highest plant height (69.63 cm), number of branches plant⁻¹ (7.31) and dry matter (310.17 g m⁻¹ row length) were recorded with the application of pendimethalin PE @ 1 kg a.i. ha⁻¹ with one hand weeding at 25 DAS and it was at par with treatment oxyflurofen PE @ 0.25 kg a.i. ha⁻¹ with one hand weeding at 25 DAS and treatment two hand weedings at 25 and 45 DAS. The lowest values of all the parameters viz., plant height, dry weight and number of branches plant⁻¹ were recorded under weedy check. Weeds were effectively controlled under these treatments hence, there was no severe competition by weeds for moisture and nutrient which created favourable conditions for better absorption of water and nutrients which maintained higher water potential in

Table 1. Effect of different weed management practices on number of weeds (m⁻²) and dry weight of weeds (g m⁻²) in fenugreek crop

Treatments	Number of weeds (m ⁻²)				Dry weight of weeds (g m ⁻²)			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : Weedy Check	11.85 (139.33)	13.27 (175.00)	14.38 (205.67)	14.20 (200.67)	7.02 (48.27)	8.73 (75.27)	10.41 (107.33)	12.61 (158.07)
T ₂ : Weed Free	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
T ₃ : One hand weeding at 25 DAS	3.11 (8.67)	6.08 (36.00)	7.51 (55.33)	7.23 (51.33)	2.48 (5.13)	4.63 (20.40)	6.77 (44.77)	8.02 (63.37)
T ₄ : Two hand weeding at 25 and 45 DAS	3.11 (8.67)	4.87 (22.67)	6.30 (38.67)	5.97 (34.67)	2.32 (4.40)	3.25 (9.57)	4.88 (22.83)	6.04 (35.53)
T ₅ : Pendimethalin PE @ 1 kg a.i. ha ⁻¹	7.44 (54.33)	9.06 (81.00)	9.83 (95.67)	9.52 (89.67)	3.28 (9.73)	4.67 (20.83)	7.24 (51.43)	9.42 (87.73)
T ₆ : Pendimethalin PE @ 1 kg a.i. ha ⁻¹ /b One HW at 25 DAS	2.77 (6.67)	4.62 (20.33)	6.22 (36.67)	5.08 (32.67)	1.98 (2.93)	3.07 (8.43)	4.77 (21.77)	5.90 (33.77)
T ₇ : Oxyflurofen PE @ 0.25 kg a.i. ha ⁻¹	7.12 (49.67)	9.26 (84.67)	9.93 (97.67)	9.66 (92.33)	3.40 (10.53)	4.74 (21.47)	7.33 (52.80)	9.57 (90.67)
T ₈ : Oxyflurofen PE @ 0.25 kg a.i. ha ⁻¹ /b One HW at 25 DAS	2.94 (7.67)	4.83 (22.33)	6.27 (38.33)	5.92 (34.00)	2.13 (3.53)	3.26 (9.60)	4.94 (23.40)	6.02 (35.23)
T ₉ : Mulching with paddy straw @ 5 t ha ⁻¹	3.70 (12.67)	6.30 (38.67)	7.00 (48.00)	6.81 (45.33)	2.54 (5.43)	4.08 (15.67)	6.57 (42.13)	8.11 (64.73)
T ₁₀ : Mulching with saw dust @ 2 t ha ⁻¹	5.07 (24.67)	7.90 (61.33)	8.93 (78.67)	8.70 (74.67)	3.34 (10.17)	4.95 (23.47)	7.06 (48.87)	8.44 (70.17)
T ₁₁ : One wheel hoeing at 25 DAS	3.27 (9.67)	6.03 (35.33)	7.39 (53.67)	7.70 (48.33)	2.33 (4.43)	4.64 (20.50)	6.56 (42.00)	7.85 (60.60)
T ₁₂ : Imazethapyr (55 g ha ⁻¹) 2-4 trifoliolate leaf stage	5.23 (26.33)	6.73 (44.33)	8.10 (64.67)	7.59 (56.67)	3.81 (13.50)	4.86 (22.60)	5.88 (33.53)	7.66 (57.73)
SE(d)±	0.11	0.57	0.35	0.34	0.15	0.49	0.80	0.76
CD @ 5 %	0.22	1.14	0.73	0.68	0.30	0.98	1.60	1.53

Table 2. Effect of different weed management practices on weed control efficiency (%), weed index (%) and growth parameters of weed in fenugreek crop

Treatments	Weed control efficiency (%)				Weed index (%)	Plant height (cm)	Dry wt. (g m ⁻¹ row length)	Number of branches plant ⁻¹
	30 DAS	60 DAS	90 DAS	At harvest				
T ₁ : Weedy Check	0.00	0.00	0.00	0.00	32.30	60.33	233.03	4.09
T ₂ : Weed Free	100.00	100.00	100.00	100.00	0.00	71.60	315.63	7.57
T ₃ : One hand weeding at 25 DAS	89.37	72.90	58.29	59.91	17.10	64.47	238.47	5.38
T ₄ : Two hand weeding at 25 and 45 DAS	90.89	87.29	78.73	77.52	6.28	69.43	306.50	7.16
T ₅ : Pendimethalin PE @ 1 kg a.i. ha ⁻¹	79.83	72.32	52.08	44.49	13.26	66.67	243.17	6.39
T ₆ : Pendimethalin PE @ 1 kg a.i. ha ⁻¹ /b One HW at 25 DAS	93.93	88.79	79.72	78.63	3.28	69.63	310.17	7.31
T ₇ : Oxyflurofen PE @ 0.25 kg a.i. ha ⁻¹	78.17	71.48	50.81	42.64	15.18	65.40	238.87	6.30
T ₈ : Oxyflurofen PE @ 0.25 kg a.i. ha ⁻¹ /b One HW at 25 DAS	92.68	87.25	78.20	77.71	6.30	69.50	308.60	7.22
T ₉ : Mulching with paddy straw @ 5 t ha ⁻¹	88.74	79.19	60.75	59.05	10.88	67.43	266.63	6.29
T ₁₀ : Mulching with saw dust @ 2 t ha ⁻¹	78.94	68.82	54.47	55.61	14.23	66.63	257.53	6.11
T ₁₁ : One wheel hoeing at 25 DAS	90.82	72.76	60.86	61.66	19.48	65.77	242.23	5.43
T ₁₂ : Imazethapyr (55 g ha ⁻¹) 2-4 trifoliolate leaf stage	72.03	69.97	68.75	63.48	14.08	66.57	238.67	6.31
SE(d)±	0.69	0.79	0.71	0.54	0.79	0.99	2.09	0.26
CD @ 5 %	1.56	1.78	1.61	1.22	1.78	2.24	4.72	0.59

Table 3. Effects of different weed management practices on yield, yield attributes and economy of fenugreek crop

Treatments	Pod length (cm)	No. of pod plant ⁻¹	No. of seeds pod ⁻¹	Test weight (g)	Grains yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Gross returns (Rs. ha ⁻¹)	Net returns (Rs. ha ⁻¹)	B:C ratio
T ₁ : Weedy Check	8.30	15.67	16.30	10.27	10.24	32.14	51216.67	31197.79	1.56
T ₂ : Weed Free	11.80	27.00	22.30	11.57	15.13	41.31	75650.00	51331.79	2.12
T ₃ : One hand weeding at 25 DAS	9.03	19.33	17.20	10.83	12.54	35.15	62716.67	41297.79	1.93
T ₄ : Two hand weeding at 25 and 45 DAS	10.90	25.33	21.37	11.10	14.18	40.39	70900.00	48081.12	2.11
T ₅ : Pendimethalin PE @ 1 kg a.i. ha ⁻¹	9.93	21.33	19.03	10.63	13.12	37.39	65616.67	44577.79	2.12
T ₆ : Pendimethalin PE @ 1 kg a.i. ha ⁻¹ /b One HW at 25 DAS	11.50	26.00	21.77	11.33	14.63	40.58	73166.67	51427.79	2.37
T ₇ : Oxyflurofen PE @ 0.25 kg a.i. ha ⁻¹	9.77	21.00	18.97	10.47	12.83	37.08	64166.67	42997.79	2.03
T ₈ : Oxyflurofen PE @ 0.25 kg a.i. ha ⁻¹ /b One HW at 25 DAS	11.00	25.33	21.20	11.13	14.18	40.36	70883.33	49014.45	2.24
T ₉ : Mulching with paddy straw @ 5 t ha ⁻¹	10.30	21.67	19.83	10.73	13.48	37.80	67416.67	43497.79	1.82
T ₁₀ : Mulching with saw dust @ 2 t ha ⁻¹	9.50	20.67	18.30	10.43	12.98	37.07	64883.33	42464.45	1.89
T ₁₁ : One wheel hoeing at 25 DAS	9.43	20.00	18.50	10.40	12.18	36.13	60900.00	39481.12	1.84
T ₁₂ : Imazethapyr (55 g ha ⁻¹) 2-4 trifoliolate leaf stage	9.80	20.67	18.90	10.63	13.00	37.15	65000.00	44215.12	2.13
SE(d)±	0.30	0.63	0.31	0.13	0.38	1.17	2187.67	2351.14	0.11
CD @ 5%	0.67	1.43	0.70	0.29	0.86	2.63	1083.04	1168.24	0.06

leaf and plant resulting in higher plant height, number of branches plant⁻¹ and dry matter. Bagri *et al.* (2014) founds that application of herbicides or hand weeding treatment gave significantly higher plant height, number of branches plant⁻¹, fresh weight plant⁻¹, least days taken to flower initiation and 50 % flowering over weedy check.

Yield attributes as well as seed and straw yield were significantly influenced with the application of different weed control treatments. Results showed that beside weed free treatment the highest yield attributes like pod length (11.50 cm), number of pods plant⁻¹ (26.00), number of seeds pod⁻¹ (21.77) and test weight (11.33) as well as seed yield (14.63 q ha⁻¹) and straw yield (40.58 q ha⁻¹) were recorded with the application of pendimethalin PE @ 1 kg a.i. ha⁻¹fb with one hand weeding at 25 DAS followed by treatment oxyflurofen PE @ 0.25 kg a.i. ha⁻¹fb with one hand weeding at 25 DAS and two hand weedings at 25 and 45 DAS. The lowest value of yield attributes and yield were recorded in weedy check. It might be due to the complete removal of weeds throughout the crop growth period with the application of pendimethalin PE @ 1 kg a.i. ha⁻¹ with removal of weeds by hand weeding, which have resulted in maintaining high soil fertility status by way of removing less plant nutrients through weeds which created favourable effect on yield attributes. While, increase in the yield attributes under treatment pendimethalin PE @ 1 kg a.i. ha⁻¹fb with one hand weedings at 25 DAS might be due to effective control of weeds like *Chenopodium album*, *Melilotus indica*, *Amranthus viridus* and *Cyperus rotundus* resulting in lesser competition of weeds, which ultimately resulted in better utilization of nutrients and moisture available in the soil by the crop. Patel *et al.* (2005) also reported that treatment of hand weeding at 20 and 40 DAS was found at par with treatment oxadiargyl @ 75 g ha⁻¹ as pre-emergence fb HW at 30 DAS (2503.66 kg ha⁻¹) and oxyflourfen @ 80 g ha⁻¹ as pre-emergence fb HW at 30 DAS (2490.86 kg ha⁻¹). Singh *et al.* (2014) observed that application of pendimethalin @ 0.75 kg ha⁻¹fb with hand weeding at 40 DAS gave maximum seed yield (1.64 t ha⁻¹) and haulm yield (2.50 t ha⁻¹) and it was at par with treatment two hand weedings at 20 and 40 DAS (1.5 t ha⁻¹ and 2.42 t ha⁻¹ respectively).

Gross return, net return and B:C ratio were significantly influenced with the application of different weed control treatments. The highest gross returns (Rs. 75650.00) was obtained from weed free treatment followed by treatment pendimethalin PE @ 1 kg a.i. ha⁻¹fb with one hand weeding at 25 DAS (Rs. 73166.67), however the highest net return (Rs. 51427.79) and B:C ratio (2.37) was recorded with the application of pendimethalin PE @ 1 kg a.i. ha⁻¹fb with one hand weeding at 25 DAS. Sharma (2009) recorded highest net monetary return (Rs.16904 ha⁻¹) with the application of fluchloralin @ 0.75 kg ha⁻¹ as pre plant incorporation + one hand weeding at 30 DAS followed by application of pendimethalin @ 0.75 kg ha⁻¹ + one hand weeding at 30 DAS (Rs. 16684 ha⁻¹).

Hence, it is inferred from the investigation that the application of pendimethalin PE @ 1 kg a.i. ha⁻¹fb one hand weeding at 25 DAS is the best economically (2.37 B:C ratio) feasible weed control treatment and ultimately leads to higher yields.

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