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Effect of crop-weed competition on growth, yield attributes and yield of rabi fenugreek (*Trigonella foenum-graecum* L.) under south Gujarat condition

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Abstract

A field experiment was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during the rabi season of 2024-25. There were different eight critical crop weed competition treatments and randomized block design with three replications. The results revealed that the treatment T₄ (weed free up to harvest) recorded significantly higher plant height at 60 DAS (45.20 cm) and at harvest (65.10 cm), number of branches per plant (6.33), number of pods per plant (34.60) and pod length (13.78 cm), which were statistically at par with the treatments T₃ (weed free up to 45 DAS) and T₅ (weedy up to 15 DAS). Significantly maximum seed yield (1954 kg/ha) and stover yield (3335 kg/ha) were also recorded under T₄ (weed free up to harvest), which remained at par with T₃ (weed free up to 45 DAS) and T₅ (weedy up to 15 DAS). The highest weed control efficiency at harvest (96.91%) was recorded under T₄ (weed free up to harvest), while the lowest weed index (0.00%) was also recorded under T₄ (weed free up to harvest), followed by T₃ (weed free up to 45 DAS) (4.61%), T₅ (weedy up to 15 DAS) (5.80%) and the highest weed index (48.01%) was under T₈ (weedy up to harvest). From the economic point of view, maximum net return (Rs. 84,028/ha) with a benefit cost ratio of 2.54 was obtained under T₃ (weed free up to 45 DAS). Based on the experimental results, it can be concluded that for obtaining higher yield and net income, rabi fenugreek should be kept weed free up to 45 days after sowing under south Gujarat condition.

Keywords: Fenugreek, critical period, crop-weed competition, seed yield, weed control efficiency, weed index, net return

Introduction

India, often called the 'Land of Spices', has a long history of spice cultivation and remains a leading producer, consumer and exporter of spices worldwide. Seed spices are important due to their aroma, pungency and taste. Rajasthan and Gujarat are the major contributors to India's seed spice production, together accounting for more than 75 per cent of the total output. Fenugreek (*Trigonella foenum-graecum* L.), commonly known as methi, belongs to the sub-family papilionaceae of leguminosae. Fenugreek is the third most important seed spice in India after coriander and cumin. It is an annual legume plant with potential to fix atmospheric nitrogen and tolerance to mild salinity. Chemical analysis of fenugreek seed reveals that it contains 26.2 per cent protein, 5.8 per cent fat, 7.2 per cent fibre, 4.41 per cent carbohydrate, 0.16 per cent calcium, 0.37 per cent phosphorus and 160 IU carotene per 100 g (Agarwal *et al.*, 2001) ^[1]. Its leaves and tender pods are consumed as vegetables, while seeds are widely used in food, pharmaceuticals and as a source of diosgenin.

In India, fenugreek is grown on about 1,47,000 hectares with an annual production of about 2,26,853 metric tonnes during 2024-25. In Gujarat, it was cultivated on approximately 8,033 hectares, producing about 15,155 metric tonnes of seeds during the same period (Anon., 2025). Despite its importance, weed infestation remains one of the primary constraints leading to low yields. The slow initial growth of fenugreek makes it extremely susceptible to weed competition during early stages, potentially reducing yields by 34 to over 50 per cent if uncontrolled.

Understanding the critical period of crop-weed competition helps growers identify the stages during which weed control is essential to protect crop yields while avoiding unnecessary labor costs.

Materials and Methods

The field experiment was conducted at the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat) during the rabi season of 2024-25. The experimental soil was clayey in texture, classified under the order 'Inceptisols', belonging to the fine montmorillonitic, isohyperthermic family of Vertic Ustrochrepts (Jalalpur soil series). Initial physico-chemical analysis revealed a pH of 7.80, EC of 0.37 dS/m, organic carbon content of 0.44%, available nitrogen of 246.90 kg/ha, available P₂O₅ of 36.33 kg/ha, and available K₂O of 356.20 kg/ha.

There were eight different critical crop weed competition treatments viz., T₁ (weed free up to 15 DAS), T₂ (weed free up to 30 DAS), T₃ (weed free up to 45 DAS), T₄ (weed free up to harvest), T₅ (weedy up to 15 DAS), T₆ (weedy up to 30 DAS), T₇ (weedy up to 45 DAS) and T₈ (weedy up to harvest). The experiment was laid out in randomized block design with three replications. The test crop variety was 'Gujarat Methi-3' (GM-3), sown at a spacing of 30 cm × 10 cm with a seed rate of 20 kg/ha. The recommended fertilizer dose (20:40:00 kg/ha N:P₂O₅:K₂O) was applied entirely as a basal dose using urea and DAP at sowing.

Biometric observations on growth parameters and yield attributes were recorded from five randomly selected and tagged plants from each net plot. Weed parameters including weed control efficiency (WCE) and weed index (WI) were monitored and calculated using standard formulas. Data were statistically analyzed using analysis of variance (ANOVA) for RBD as described by Panse and Sukhatme (1954) [8].

Weed flora: The weed flora noticed in experimental field were monocot weed like *Sorghum halepense* L. Pers., *Echinochloa crusgalli* L. Beauv., *Dinebra retroflexa* Vahl. Panzer, *Cynodon dactylon* LinnPers., *Dactyloctenium aegyptium*, *Digitarias anguinalis* L. Scop., *Eleusina indica* L. Gaertn. Sedges like

Cyperus rotundus and dicot weed like *Convolvulus arvensis* L., *Chinopodium album* L., *Amaranthus viridis* L., *Trianthema portulacastrum* L., *Portulaca oleraceae* L., *Euphorbia geniculate* Orteg., *Euphorbia hirta* L., *Cleome viscosa* L., *Abutilon indicum* L., *Physalis minima* L., *Eclipta alba* Hassak., *Phyllanthus niruri* L., *Alternanthera sessilis* L. and *Chrozophora tinctoria* L. Raf.

Results and Discussion

Effect on growth parameters

The data pertaining to different growth parameters are presented in Table 1. The experimental data revealed that different crop-weed competition treatments did not significantly influence the plant height at 30 DAS. The results show that the treatment T₄ (weed free up to harvest) recorded significantly higher plant height (45.20 cm and 65.10 cm at 60 DAS and at harvest, respectively), which was at par with the treatments T₃ (weed free up to 45 DAS), T₅ (weedy up to 15 DAS). Whereas, the treatment T₈ (weedy up to harvest) recorded significantly lower plant height at 60 DAS (31.50 cm) and at harvest (50.03 cm). The changes in plant height became significant from 60 days onward. which is due to increasing competition with increasing population of weed as well as fast growth of weed as compared to crop plant, which had smothering effect on crop, resulted in differential growth of fenugreek plant in different treatments under study. Similar conclusion also drawn by Rashid *et al.* (2025) [12] and Rathod *et al.* (2023) [13].

The results show that the maximum number of days for 50 per cent flowering (46 days) was recorded under weed free check T₄ (weed free up to harvest), which was statistically at par with the treatment T₃ (weed free up to 45 DAS), T₅ (weedy up to 15 DAS) and T₂ (weed free up to 30 DAS). While significantly minimum number of days for 50 per cent flowering was recorded under the treatment T₈ (weedy up to harvest) (39 days). The early flowering was with weedy treatments it might be because of stress and it was due to competition with weed plant for light, nutrient, moisture, etc. resulted in shortage of required nutrient and other growth factors for proper growth. Similar conclusion was also drawn by Punia *et al.* (2018) [11].

Table 1: Effect of different treatments on growth parameters of rabi fenugreek

Treatments	Plant height at 30 DAS (cm)	Plant height at 60 DAS (cm)	Plant height at harvest (cm)	Days to 50% flowering	No. of branches/plant at harvest
T ₁ : Weed free up to 15 DAS	10.20	31.70	50.53	41.00	3.20
T ₂ : Weed free up to 30 DAS	11.34	38.00	57.36	44.00	4.53
T ₃ : Weed free up to 45 DAS	12.07	44.50	64.43	45.00	5.86
T ₄ : Weed free up to harvest	12.53	45.20	65.10	46.00	6.33
T ₅ : Weedy up to 15 DAS	11.67	44.10	63.73	45.00	6.00
T ₆ : Weedy up to 30 DAS	11.13	37.56	57.26	43.00	4.73
T ₇ : Weedy up to 45 DAS	11.53	32.43	50.90	42.00	3.26
T ₈ : Weedy up to harvest	10.73	31.50	50.03	39.00	3.06
SEm±	0.54	1.67	2.06	0.85	0.24
CD (P=0.05)	NS	5.07	6.25	2.60	0.73
CV (%)	8.27	7.60	6.22	3.45	9.04

The treatment T₄ (weed free up to harvest) recorded significantly higher number of branches per plant (6.33) which was statistically at par with the treatments T₅ (weedy up to 15 DAS) and T₃ (weed free up to 45 DAS). While significantly lower number of branches per plant (3.06) were recorded with the treatment T₈ (weedy up to harvest). Weed free treatments might have caused in lesser competition of weed for crop growth. This facilitates the fenugreek crop to utilize more moisture, nutrients and solar radiation. Higher growth and resource utilization turned into a greater number of branches which results into a greater number

of pods per plant under these treatments. Similar conclusion was also drawn by Singh *et al.* (2021) [14] in mung bean and Rathod *et al.* (2023) [13].

Effect on yield attributes, yield and harvest index

The data pertaining to the yield attributes, yield and harvest index are presented in Table 2. The experimental data revealed that significantly the highest number of pods per plant (34.60) and pod length (13.78 cm) were recorded under T₄ (weed free up to harvest), which was statistically at par with T₃ (weed free up to

45 DAS) and T₅ (weedy up to 15 DAS). The lowest values were recorded under T₈ (weedy up to harvest). Weed-free conditions during the critical growth period reduced competition for resources, enabling efficient photosynthate partitioning toward

reproductive growth, which facilitated greater pod setting and pod elongation. The similar trend was observed by Bairwa (2002) [4] and Rathod *et al.* (2023) [13].

Table 2: Effect of different treatments on yield attributes, yield and harvest index of rabi fenugreek

Treatments	No. of pods/plant	Pod length (cm)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
T ₁ : Weed free up to 15 DAS	22.86	9.10	1157	2308	33.39
T ₂ : Weed free up to 30 DAS	28.06	10.98	1537	2744	35.90
T ₃ : Weed free up to 45 DAS	33.40	13.44	1864	3204	36.77
T ₄ : Weed free up to harvest	34.60	13.78	1954	3335	36.94
T ₅ : Weedy up to 15 DAS	33.13	12.98	1841	3116	37.13
T ₆ : Weedy up to 30 DAS	27.80	11.06	1471	2707	35.20
T ₇ : Weedy up to 45 DAS	22.46	9.06	1224	2339	34.35
T ₈ : Weedy up to harvest	21.06	9.00	1016	2142	32.17
SEm±	1.61	0.61	74.45	120.25	1.62
CD (P=0.05)	4.90	1.85	225.83	364.74	NS
CV (%)	10.03	9.49	8.55	7.60	7.95

The maximum seed yield (1954 kg/ha) and stover yield (3335 kg/ha) were achieved under treatment T₄ (weed free up to harvest), which was statistically equivalent to T₃ (weed free up to 45 DAS) and T₅ (weedy up to 15 DAS). The continuous weed pressure in T₈ (weedy up to harvest) resulted in the lowest seed yield (1016 kg/ha) and stover yield (2142 kg/ha). Clean cultivation in T₄ (weed free up to harvest) led to a 92.32% increase in seed yield over the unweeded check T₈ (weedy up to harvest). Continuous weed infestation under weedy up to harvest created severe crop-weed competition throughout the crop growth period, resulting in poor vegetative growth, reduced reproductive development and ultimately lower seed yield and stover yield. Similar findings were also reported by Patel *et al.* (2019) [9], Ahlawat *et al.* (2024) [2] and Malunekar *et al.* (2024) [7] in. The results show that different weed treatments in fenugreek did not exert their significant effect on harvest index.

Effect on weed control efficiency, weed index and economics

At harvest, the highest weed control efficiency (96.91%) was recorded under the treatment T₄ (weed free up to harvest) followed by the treatment T₆ (weedy up to 30 DAS) (96.84%). The lowest weed control efficiency (0.00%) was recorded under the treatment T₈ (weedy up to harvest). Higher weed control efficiency was recorded under weed-free for longer periods due to reduced weed emergence and biomass accumulation. In contrast, lower weed control efficiency was observed where weeds were allowed to grow for longer durations, resulting in greater weed density and biomass. These results were tune with findings of Rathod *et al.* (2023) [13], Singh *et al.* (2022) [15] and Fagaria *et al.* (2014) [5]. Weed competition index is the indicator of losses in seed yield due to presence of weed. The treatment T₄

(weed free up to harvest) was considered as base for calculating weed competition index. The lowest weed index (4.61%) was recorded under the treatment T₃ (weed free up to 45 DAS) followed by the treatment T₅ (weedy up to 15 DAS) (5.80%). The highest weed index (48.01%) was recorded under the treatment T₈ (weedy up to harvest). The treatment T₄ (weed free up to harvest) produced zero weed index value. This might be due to effective weed control achieved under these treatments in terms of reduced weed biomass resulting in to higher seed yield under these treatments. These results were tune with findings of Rathod *et al.* (2023) [13] and Singh *et al.* (2022) [15].

Data on economics (Table 3.) show that higher total cost of cultivation was recorded with the treatment T₄ (weed free up to harvest) (64437 ₹/ha) and treatment T₅ (weedy up to 15 DAS) (64437 ₹/ha). This was followed by the treatments T₆ > T₃ > T₇ > T₂ > T₁ > T₈. While lower total cost of cultivation was recorded in the treatment T₈ (weedy up to harvest) (38502 ₹/ha)). Gross return was significantly influenced by different weed management treatments. Significantly higher gross return was recorded under treatment T₄ (weed free up to harvest) (1,45,118 ₹/ha). It was statistically at par with the treatments T₃ (weed free up to 45 DAS) and T₅ (weedy up to 15 DAS). While significantly lower gross return was recorded under treatment T₈ (weedy up to harvest) (76,475 ₹/ha).

In case of net return, significantly higher net return was recorded under the treatment T₃ (weed free up to 45 DAS) (84,028 ₹/ha). It was statistically at par with the treatments T₄ (weed free up to harvest) and T₅ (weedy up to 15 DAS). Significantly lower net return was recorded under treatment T₈ (weedy up to harvest) (37,973 ₹/ha).

Table 3: Effect of different treatments on weed control efficiency (%), weed index (%) and economics

Treatments	WCE at harvest (%)	Weed index (%)	Gross return (₹/ha)	Net return (₹/ha)	Total cost of cultivation (₹/ha)	B:C ratio
T ₁ : Weed free up to 15 DAS	29.14	40.77	86760	42273	44487	1.95
T ₂ : Weed free up to 30 DAS	45.22	21.32	114450	63978	50472	2.26
T ₃ : Weed free up to 45 DAS	57.78	4.61	138490	84028	54462	2.54
T ₄ : Weed free up to harvest	96.91	0.00	145118	80681	64437	2.25
T ₅ : Weedy up to 15 DAS	96.79	5.80	136660	72223	64437	2.12
T ₆ : Weedy up to 30 DAS	96.84	24.74	109738	51286	58452	1.87
T ₇ : Weedy up to 45 DAS	96.77	37.35	91528	39061	52467	1.74
T ₈ : Weedy up to harvest	0.00	48.01	76475	37973	38502	1.98
SEm ±			5200	5200		0.09
CD at 5%			15774	15774		0.30
CV (%)			8.01	15.28		8.23

In case of BCR, significantly higher BCR was recorded under the treatment T₃ (weed free up to 45 DAS) (2.54), which was statistically at par with treatment T₄ (weed free up to harvest) and treatment T₂ (Weed free up to 30 DAS). Significantly lower BCR was recorded under the treatment T₇ (weedy up to 45 DAS) (1.74).

The superiority of T₃ (Weed free up to 45 DAS) in net return and B:C ratio was due to effective weed control at lower cost compared to T₄ (weed free up to harvest), resulting in comparable yield at reduced input expenditure. These results are in accordance with those reported by Malunekar *et al.* (2022)^[6] and Pithiya *et al.* (2023)^[10].

Conclusion

On the basis of experimental results, the treatment T₄ (weed free up to harvest) recorded the highest seed yield (1954 kg/ha), stover yield (3335 kg/ha), maximum weed control efficiency (96.91%) and lowest weed index (0.00%). However, considering both yield and economic returns, the treatment T₃ (weed free up to 45 DAS) proved equally effective in crop performance and economically superior, recording the maximum net return (Rs. 84,028/ha) with a B:C ratio of 2.54. therefore, it can be concluded that for obtaining higher yield and net income of rabi fenugreek crop, the crop should be kept weed free up to 45 days after sowing under south Gujarat condition.

Author's contributions

Varmora Ashishkumar B.: P. G. Student

Dr. M. S. Dudhat: Major guide

K. H. Thummar: P.G. Student, for his assistance in editing and formatting the manuscript.

Kachhadiya Janvibahen U.: P. G. Student helps during recording observations.

J. B. Gaadhe: P. G. Student helps during recording observations.

J. V. Patel: Assistant Research Scientist helps in supervision of field operations and facilitation of necessary farm resources during the experimental period.

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