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Effect of weed management and vermicompost on growth dynamics of fenugreek (*Trigonella foenum-graecum* L.)

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Abstract

A field experiment was conducted at the Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, Rajasthan, India, to evaluate the effects of weed management practices and vermicompost application on the growth dynamics of fenugreek (*Trigonella foenum-graecum* L.). The experiment was laid out in a split-plot design with three replications, comprising thirteen weed management treatments assigned to the main plots and two vermicompost levels to the sub-plots. Pooled analysis of two years' data revealed that weed management practices significantly influenced the growth and growth indices of fenugreek. The weed-free treatment recorded the maximum plant height (66.27 cm) and the highest number of branches per plant (6.10), whereas the weedy check produced the lowest values at harvest. The highest dry matter accumulation at harvest (18.35 g plant⁻¹) was recorded with oxadiargyl at 100 g ha⁻¹ applied as pre-emergence (PE), followed by one hoeing at 40 days after sowing (DAS), representing an 84.27% increase over the weedy check (9.96 g plant⁻¹). Crop growth rate (CGR) during 30–60 DAS and 60–90 DAS was also significantly higher under this treatment. The highest relative growth rate (RGR) during 60–90 DAS was recorded with oxadiargyl at 100 g ha⁻¹ PE. The same treatment recorded higher yield (2820 kg ha⁻¹) and economics (Net returns ₹98,158 ha⁻¹ and B: C ratio of 2.63) of fenugreek. Application of vermicompost at 5 t ha⁻¹ significantly enhanced dry matter accumulation, CGR, and RGR compared with the control. Significant interaction effects between weed management practices and vermicompost levels were observed for dry matter accumulation, CGR, and RGR. The study concluded that the integration of oxadiargyl at 100 g ha⁻¹ applied as PE followed by one hoeing at 40 DAS, along with vermicompost at 5 t ha⁻¹, is an effective strategy for enhancing the growth and biomass production of fenugreek under the agro-climatic conditions of southern Rajasthan.

Keywords: Crop growth rate, Dry matter accumulation, Fenugreek, Relative growth rate, Weed Management, Vermicompost

Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is an important seed spice crop widely cultivated in the semi-arid regions of India for its culinary, medicinal, and industrial uses. India, recognized as the "Land of Spices," is the leading producer of fenugreek, with Rajasthan contributing about 64.42 per cent of the country's total production. During 2024–2025, fenugreek was cultivated on 162 thousand hectares with a production of 266 thousand tonnes in India (Agricultural Statistics at a Glance, 2025). In Rajasthan, the crop occupied 67 thousand hectares with a production of 73.4 thousand tonnes during 2022–2023 (Agricultural Statistics, 2023).

Despite its economic importance, fenugreek productivity remains below its potential due to several biotic and abiotic constraints, among which weed infestation is one of the most serious. Weeds compete with the crop for nutrients, moisture, light, and space, particularly during the early growth stages, resulting in substantial reductions in crop growth and yield. Yield losses due to weed competition may reach up to 86 per cent (Tripathi and Singh, 2008). Since the critical period of crop-weed competition occurs during the first 25-30 days after sowing, timely weed management is essential. Although manual weeding is effective, it is labour-intensive and costly; therefore, selective herbicides alone or integrated with cultural practices offer a practical and economical alternative.

Herbicides such as oxadiargyl, oxyfluorfen, imazethapyr, and imazethapyr + imazamox have shown promising efficacy against a broad spectrum of weeds. However, sole dependence on herbicides may not provide complete weed control and may lead to shifts in weed flora. Integrating herbicide application with hoeing can improve weed control efficiency, reduce crop–weed competition, and enhance crop growth and productivity.

Balanced nutrient management is equally important for improving fenugreek productivity. Vermicompost supplies essential macro and micronutrients while improving the physical, chemical, and biological

properties of soil. It enhances soil structure, water-holding capacity, microbial activity, nutrient availability, and root development, thereby promoting crop growth and biomass accumulation. Moreover, organic amendments may influence herbicide behaviour and efficacy in soil, highlighting the need to evaluate their combined effects.

Growth attributes such as plant height, number of branches, and dry matter accumulation are reliable indicators of crop vigour and productivity. Likewise, crop growth rate (CGR) and relative growth rate (RGR) provide quantitative measures of biomass accumulation and growth efficiency at different crop stages. Relative growth rate represents the rate of dry matter accumulation per unit of existing plant biomass (Blackman, 1919). Therefore, the present investigation was undertaken to evaluate the effects of different herbicidal weed management practices and vermicompost application on growth attributes, dry matter accumulation, CGR, and RGR of fenugreek under the agro-climatic conditions of southern Rajasthan.

Materials and Methods

A field experiment was conducted during the rabi seasons of 2016–17 and 2017–18 at the Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, Rajasthan. The experiment was laid out in a split-plot design with three replications. The main plot treatments consisted of thirteen weed management practices, namely: imazethapyr 70 g ha⁻¹; imazethapyr 70 g ha⁻¹ followed by hoeing at 40 DAS; imazethapyr 50 g ha⁻¹ applied at the 2-4 leaf stage of weeds; imazethapyr + imazamox 50 and 60 g ha⁻¹ applied at the 2-4 leaf stage of weeds; pendimethalin 750 g ha⁻¹ as pre-emergence (PE); oxyfluorfen 120 and 150 g ha⁻¹ and oxyfluorfen 120 g ha⁻¹ followed by hoeing at harvest; oxadiargyl 100 g ha⁻¹ and oxadiargyl 100 g ha⁻¹ followed by hoeing at 40 DAS; weed-free; and weedy check. The sub-plot treatments comprised two levels of vermicompost, viz., control and vermicompost 5 t ha⁻¹. Fenugreek variety RMT-305 was sown at a row spacing of 30 cm. The recommended dose of fertilizers, 40 kg N and 40 kg P₂O₅ ha⁻¹, was applied as a basal dose. Pre- and post-emergence herbicides were applied according to the

respective treatments using a knapsack sprayer fitted with a flat-fan nozzle and calibrated to deliver 500 L of water ha⁻¹.

Growth attributes, viz., plant height (cm) and number of branches plant⁻¹, were recorded at different growth stages. The number of branches plant⁻¹ was recorded at harvest. Dry matter accumulation plant⁻¹ was determined at 30, 60, and 90 DAS, and at harvest. Crop Growth Rate (CGR) is defined as the rate of increase in dry matter production per unit land area per unit time. It represents the growth of crop biomass over a specified period and was calculated using the formula proposed by Watson (1958):

$$\text{CGR (g m}^{-2} \text{ day}^{-1}) = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{1}{p}$$

Where, W_1 and W_2 are dry matter (g) at time t_1 and t_2 , respectively and p represents ground area occupied plant⁻¹.

Relative Growth Rate (RGR) represents the increase in plant dry matter per unit of existing dry matter per unit time and is analogous to the concept of compound interest. It was calculated for the growth periods of 30–60 DAS and 60–90 DAS using the formula suggested by Hoffmann and Poorter (2002):

$$\text{RGR (g g}^{-1} \text{ day}^{-1}) = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1}$$

Where, W_1 and W_2 are dry matter (g) at time t_1 and t_2 , respectively.

All experimental data were subjected to statistical analysis using the ANOVA technique as described by Cochran and Cox (1967). Since the error variances were found to be homogeneous, the data from the two years were pooled and analyzed to assess the overall treatment effects following the procedure outlined by Gomez and Gomez (1984).

Results and Discussion

Growth attributes

The data presented in Table 1 revealed that weed management practices significantly influenced plant height and the number of branches per plant. Among the weed management treatments, the weed-free check recorded the greatest plant height at 30 DAS (17.26 cm) and at harvest (66.37 cm), remaining significantly superior to all other treatments. In contrast, the weedy check recorded the lowest plant height,

measuring 13.87 cm at 30 DAS and 50.82 cm at harvest. The highest number of branches per plant (6.10) was recorded under the weed-free check, which was statistically at par with imazethapyr at 70 g ha⁻¹ PE followed by one hoeing at 40 DAS (6.09), oxadiargyl at 100 g ha⁻¹ PE followed by one hoeing at 40 DAS (6.09), imazethapyr at 50 g ha⁻¹ PoE (5.97), imazethapyr + imazamox (RM) at 60 g ha⁻¹ PoE (6.03), oxadiargyl at 100 g ha⁻¹ PE (6.03), and other effective weed management treatments. The minimum number of branches per plant (3.82) was recorded under the weedy check. The improvement in plant height and branching under the weed-free check and effective weed management treatments may be attributed to reduced crop-weed competition for nutrients, moisture, light, and space throughout the crop growth period. Better availability and efficient utilization of these growth resources promoted enhanced vegetative growth and branching in fenugreek.

Vermicompost application also resulted in numerically higher plant height (14.57 and 56.97 cm at 30 DAS and harvest, respectively) and number of branches per plant (5.84) compared with the control (14.41 and 56.56 cm, respectively, with 5.77 branches per plant), although the differences were not significant. The present findings are in agreement with those of Sagarka et al. (2005) and Salvi et al. (2015) in isabgol, Mehriya et al. (2007) in fenugreek, Patel et al. (2019a) in dill, Patel et al. (2019b) in ajwain, and Patel et al. (2022) in isabgol, who also reported improved growth attributes under effective weed and crop management practices.

Dry matter accumulation

Dry matter accumulation in fenugreek increased significantly under effective weed management practices throughout the crop growth period (Table 1). At 30 DAS, oxadiargyl at 100 g ha⁻¹ applied as pre-emergence (PE) followed by one hoeing at 40 DAS recorded the highest dry matter accumulation (0.45 g plant⁻¹), which was statistically at par with imazethapyr at 70 g ha⁻¹ PE followed by one hoeing at 40 DAS and imazethapyr at 50 g ha⁻¹ applied as post-emergence (PoE). At 60 and 90 DAS, oxadiargyl at 100 g ha⁻¹ PE followed by one hoeing at 40 DAS and imazethapyr at 70 g ha⁻¹ PE followed by one hoeing at 40 DAS produced significantly greater dry matter accumulation

than the remaining treatments and were statistically comparable. At harvest, the highest dry matter accumulation ($18.35 \text{ g plant}^{-1}$) was recorded with oxadiargyl at 100 g ha^{-1} PE followed by one hoeing at 40 DAS, representing an increase of 84.27 per cent over the weedy check ($9.96 \text{ g plant}^{-1}$). The enhanced biomass production under these treatments may be attributed to effective weed suppression, which minimized crop-weed competition for nutrients, moisture, light, and space, thereby promoting better vegetative growth and dry matter accumulation.

Application of vermicompost significantly increased dry matter accumulation at all crop growth stages compared with the control. Vermicompost applied at 5 t ha^{-1} recorded dry matter accumulation of 0.42, 4.35, 12.85, and $17.36 \text{ g plant}^{-1}$ at 30, 60, and 90 DAS and at harvest, respectively, representing increases of 10.58, 20.79, 14.26, and 9.73 per cent over the control. The improvement in dry matter accumulation may be attributed to enhanced soil physical, chemical, and biological properties, resulting in greater nutrient availability, improved root development, and more efficient uptake of water and nutrients, which ultimately promoted vigorous crop growth and biomass production.

The interaction between weed management practices and vermicompost application was significant for dry matter accumulation at 30, 60, and 90 DAS as well as at harvest. The data presented in Table 3 indicated that application of vermicompost at 5 t ha^{-1} consistently enhanced dry matter accumulation across all weed management treatments. These findings demonstrate that integrating effective weed management with vermicompost application improved crop growth and biomass production by reducing crop-weed competition and enhancing the availability and efficient utilization of growth resources throughout the crop growth period.

Crop Growth Rate during 30-60 DAS and 60-90 DAS

The data presented in Table 3 revealed that weed management practices significantly influenced the crop growth rate (CGR) of fenugreek. During the 30-60 DAS interval, oxadiargyl at 100 g ha^{-1} applied as pre-emergence (PE) followed by one hoeing at 40 DAS recorded the highest CGR ($4.35 \text{ g m}^{-2} \text{ day}^{-1}$) among the herbicidal treatments and was statistically at par with

imazethapyr at 70 g ha^{-1} PE followed by one hoeing at 40 DAS ($4.14 \text{ g m}^{-2} \text{ day}^{-1}$). During the 60–90 DAS interval, the highest CGR among the herbicidal treatments was recorded with imazethapyr at 70 g ha^{-1} PE followed by one hoeing at 40 DAS ($10.96 \text{ g m}^{-2} \text{ day}^{-1}$), which was statistically comparable with oxadiargyl at 100 g ha^{-1} PE followed by one hoeing at 40 DAS ($10.89 \text{ g m}^{-2} \text{ day}^{-1}$) and oxadiargyl at 100 g ha^{-1} PE alone ($10.81 \text{ g m}^{-2} \text{ day}^{-1}$). The higher CGR under these treatments may be attributed to effective weed suppression, which reduced crop-weed competition and enabled more efficient utilization of nutrients, moisture, light, and space, thereby promoting greater biomass accumulation during the active growth phase of the crop.

Application of vermicompost significantly increased CGR during both growth intervals. During 30–60 DAS, vermicompost applied at 5 t ha^{-1} recorded a CGR of $4.10 \text{ g m}^{-2} \text{ day}^{-1}$ compared with $3.51 \text{ g m}^{-2} \text{ day}^{-1}$ in the control, representing an increase of 14.39 per cent. A similar trend was observed during 60-90 DAS in both years as well as in the pooled analysis. On a pooled basis, vermicompost application recorded a CGR of $9.74 \text{ g m}^{-2} \text{ day}^{-1}$, representing a 13.73 per cent increase over the control ($8.56 \text{ g m}^{-2} \text{ day}^{-1}$). The improvement in CGR following vermicompost application may be attributed to enhanced nutrient availability, improved soil physical properties, and increased microbial activity, which collectively promoted vigorous crop growth and greater dry matter production.

Application of vermicompost at 5 t ha^{-1} enhanced CGR across all weed management treatments and recorded significantly higher values than the corresponding control treatments (Table 5). However, the interaction between weed management practices and vermicompost application was not significant for CGR during the 60-90 DAS interval on a pooled basis.

Relative Growth Rate during 30-60 DAS and 60-90 DAS

On a pooled basis, during the 60-90 DAS interval, the highest relative growth rate (RGR) ($0.0409 \text{ g g}^{-1} \text{ day}^{-1}$) was recorded with oxadiargyl at 100 g ha^{-1} applied as pre-emergence (PE). This treatment was statistically at par with oxadiargyl at 100 g ha^{-1} PE followed by one

hoeing at 40 DAS, imazethapyr + imazamox (RM) at 60 g ha⁻¹, imazethapyr at 70 g ha⁻¹ PE followed by one hoeing at 40 DAS, and imazethapyr at 50 g ha⁻¹ applied as post-emergence (PoE). The higher RGR under these treatments may be attributed to effective weed suppression, which minimized crop-weed competition and enabled efficient utilization of nutrients, moisture, light, and space during the later stages of crop growth. Application of vermicompost significantly influenced RGR. During the 30-60 DAS interval, the highest pooled RGR (0.0774 g g⁻¹ day⁻¹) was recorded with vermicompost application, representing an increase of 2.75 per cent over the control. However, during the 60-90 DAS interval, the control recorded a marginally higher RGR than vermicompost. The relatively lower RGR under vermicompost during the later growth stage may be attributed to greater dry matter accumulation and larger plant size, which reduced the rate of biomass increase relative to the existing plant biomass. The interaction between weed management practices and vermicompost application was significant for RGR during the 30–60 DAS interval on a pooled basis. Application of vermicompost at 5 t ha⁻¹ enhanced RGR across different weed management treatments, with the greatest improvement observed under imazethapyr + imazamox (RM) at 50 g ha⁻¹ PoE and oxyfluorfen at 150 g ha⁻¹ PE compared with the weedy check. Vermicompost application significantly improved RGR under imazethapyr at 70 g ha⁻¹ PE followed by one hoeing at 40 DAS, imazethapyr at 50 g ha⁻¹ PoE, and imazethapyr + imazamox (RM) at 50 and 60 g ha⁻¹ PoE. Irrespective of vermicompost application, all weed management treatments recorded significantly higher RGR than the weedy check. Among the treatment combinations, the highest RGR during 60-90 DAS was recorded with imazethapyr + imazamox (RM) at 60 g ha⁻¹ PoE under the control, whereas oxadiargyl at 100 g ha⁻¹ PE recorded the highest RGR under vermicompost application. These treatment combinations were significantly superior to the remaining treatments under their respective vermicompost levels.

Overall, effective weed management significantly improved the growth and productivity of fenugreek by minimizing weed interference and creating favourable conditions for crop development. The data presented in

Tables 1-4 revealed that all weed management treatments significantly increased plant height, number of branches per plant, dry matter accumulation, CGR, and RGR compared with the weedy check. Among the treatments, oxadiargyl at 100 g ha⁻¹ PE followed by one hoeing at 40 DAS recorded the highest values for growth attributes and dry matter accumulation and remained statistically comparable with imazethapyr at 70 g ha⁻¹ PE followed by one hoeing at 40 DAS, oxyfluorfen at 120 g ha⁻¹ PE followed by one hoeing at 40 DAS, and oxadiargyl at 100 g ha⁻¹ PE alone. The superior crop growth under these treatments may be attributed to effective weed suppression, which reduced crop-weed competition and ensured greater availability of essential growth resources, including light, moisture, nutrients, and space. Reduced weed density and weed dry matter further promoted better canopy development, greater leaf expansion, and enhanced branching, resulting in increased biomass production. Similar findings were reported by Sahoo et al. (2022), who observed the maximum crop growth rate during 45-60 DAS in sesame. The present results are also in agreement with the findings of Gupta et al. (1992), Sharma (2009), Mehta et al. (2010), Meena et al. (2013), Singh et al. (2013), Mundra and Maliwal (2014), Singh et al. (2014), Fageria et al. (2014), Kumar et al. (2016), Singh et al. (2017), and Deewan et al. (2018).

Seed Yield and Economics

Weed management practices significantly influenced seed yield, haulm yield, net returns and benefit: cost ratio (Table 5). Among the treatments, weed-free check recorded the highest seed yield (2908 kg ha⁻¹), which was statistically at par with oxadiargyl 100 g ha⁻¹ PE followed by hoeing at 40 DAS (2820 kg ha⁻¹), but significantly superior to all other weed management treatments. The lowest seed yield (1055 kg ha⁻¹) was recorded under the weedy check. Among the herbicidal treatments, oxadiargyl 100 g ha⁻¹ PE followed by hoeing at 40 DAS produced significantly higher seed yield than all other herbicidal treatments. It was followed by imazethapyr 70 g ha⁻¹ PE followed by hoeing at 40 DAS (2260 kg ha⁻¹) and oxadiargyl 100 g ha⁻¹ PE (2216 kg ha⁻¹). Haulm yield was also significantly affected by weed management practices. Weed-free check recorded the maximum haulm yield

(6863 kg ha⁻¹), which remained statistically at par with oxadiargyl 100 g ha⁻¹ PE followed by hoeing at 40 DAS (6703 kg ha⁻¹). The minimum haulm yield (4220 kg ha⁻¹) was observed under the weedy check.

Economic analysis revealed that weed management practices markedly influenced net returns and benefit: cost ratio. The highest net returns were obtained with oxadiargyl 100 g ha⁻¹ PE followed by hoeing at 40 DAS (₹98,158 ha⁻¹), which was statistically at par with weed-free check (₹96,532 ha⁻¹) and significantly higher than the remaining treatments. The lowest net returns (₹21,774 ha⁻¹) were recorded under the weedy check. The highest benefit: cost ratio (2.63) was also recorded with oxadiargyl 100 g ha⁻¹ PE followed by hoeing at 40 DAS. The weedy check recorded the lowest benefit: cost ratio (0.87). The low investment under integrated management coupled with a good economic yield might be the reason for higher net monetary return and B C ratio, even weed free plot gave maximum gross monetary return but was nullified due to higher variable cost for weed management. Similar findings were also reported by Kumar et al. (2016), (Shivran et al 2016) and Singh et al. (2016).

Effect of vermicompost levels

Vermicompost applied at 5 t ha⁻¹ recorded significantly higher seed yield (2348 kg ha⁻¹) and haulm yield (5860 kg ha⁻¹) compared with the control, which produced 1880 and 5539 kg ha⁻¹, respectively. The control recorded higher net returns (₹73,217 ha⁻¹) and benefit: cost ratio (2.90) than vermicompost applied at 5 t ha⁻¹ (₹64,670 ha⁻¹ and 1.16, respectively). The reduced economic returns under vermicompost application may be attributed to the higher cost of vermicompost, despite the increase in seed and haulm yields. The results obtained in the present study are in close agreement with Owla et al. (2015).

Conclusion

Based on the pooled results of two years, weed management practices and application of vermicompost exerted a significant influence on seed yield, haulm yield and economics of the crop. Among the herbicidal treatments, pre-emergence application of oxadiargyl 100 g ha⁻¹ followed by one hoeing at 40 DAS proved to be the most effective. Effective weed management significantly improved the growth

dynamics and productivity of fenugreek by minimizing weed interference and creating a favorable environment for crop development, yield and economics. Although vermicompost application significantly improved the growth and yield of fenugreek, its higher input cost reduced economic profitability, resulting in lower net returns and benefit ratio.

Conflict of Interest

The authors declare that there is no conflict of interest associated with this publication

References

- Agricultural Statistics 2022–23. Directorate of Economics & Statistics, Government of Rajasthan, pp. 90–113.
- Agricultural Statistics at a Glance. 2025. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, p. 177.
- Blackman, V.H. 1919. The compound interest law and plant growth. *Ann Bot*, 33(3): 353–360.
- Cochran, W.G. and Cox, G.M. 1967. *Experimental designs*, 2nd Edn. John Wiley and Sons, Singapore.
- Deewan, P., Mundra, S.L., Trivedi, J., Meena, R.H. and Verma, R. 2018. Nutrient uptake in maize under different weed and nutrient management options. *Ind J Weed Sci*, 50(3): 278–281.
- Fagaria, V.D., Gupta, K.C. and Saxena, R. 2014. Integrated weed management in fenugreek (*Trigonella foenum-graecum* L.) in semi-arid regions of Rajasthan. *Int J Agric Sci*, 10(1): 302–304.
- Gomez, K.A. and Gomez, A.A. 1984. *Statistical procedures for agricultural research*, 2nd Edn. John Wiley and Sons, Singapore.
- Gupta, U.S. 1992. Photosynthetic efficiency. In: *Crop improvement, Volume 1: Physiological attributes*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Hoffmann, W.A. and Poorter, H. 2002. Avoiding bias in calculations of relative growth rate. *Ann Bot*, 90(1): 37–42.
- Kumar, R., Malik, Y.P. and Punia, S.S. 2016. Weed control in fenugreek with pendimethalin and imazethapyr. *Ind J Weed Sci*, 48(2): 225–227.
- Meena, S.S., Mehta, R.S., Lal, G. and Anwer, M.M.

Table 1: Effect of weed management and vermicompost on plant height at 30 DAS and at harvest, number of branches and dry matter accumulation at different stages (pooled means)

Weed management Treatment	Plant height (cm)		Number of branches (plant ⁻¹)	Dry matter accumulation (g plant ⁻¹)			
	30 DAS	Harvest		30 DAS	60 DAS	90 DAS	Harvest
Imazethapyr 70 g ha ⁻¹ PE	14.93	53.33	5.87	0.44	3.80	10.14	14.92
Imazethapyr 70 g ha ⁻¹ PE <i>fb</i> hoeing at 40 DAS	15.37	55.31	6.09	0.43	4.21	14.10	16.69
Imazethapyr 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	15.49	57.18	5.97	0.41	3.97	12.85	18.13
Imazethapyr + Imazamox (RM) 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	14.99	57.00	5.90	0.38	3.89	12.18	17.20
Imazethapyr + Imazamox (RM) 60 g ha ⁻¹ PoE 2-4 leaf stage of weed	14.57	55.03	6.03	0.41	3.88	13.15	18.23
Pendimethalin 750 g ha ⁻¹ PE	12.25	57.18	5.87	0.38	3.94	12.01	16.21
Oxyfluorfen 120 g ha ⁻¹ PE	13.14	54.07	5.83	0.36	3.81	9.93	14.95
Oxyfluorfen 150 g ha ⁻¹ PE	13.43	55.62	5.88	0.36	3.92	10.10	15.99
Oxyfluorfen 120 g ha ⁻¹ PE <i>fb</i> hoeing at 40 DAS	13.96	59.20	5.93	0.39	3.97	12.45	18.07
Oxadiargyl 100 g ha ⁻¹ PE	14.45	56.97	6.03	0.41	4.05	13.78	18.08
Oxadiargyl 100 g ha ⁻¹ PE <i>fb</i> hoeing at 40 DAS	14.64	59.83	6.09	0.45	4.41	14.14	18.35
Weed free check	17.26	66.37	6.10	0.47	4.67	14.45	18.88
Weedy check	13.87	50.82	3.82	0.33	3.22	7.37	9.96
SEm $\pm$	0.21	0.68	0.08	0.01	0.06	0.17	0.25
CD (P=0.05)	0.66	2.10	0.26	0.02	0.20	0.53	0.78
Levels of vermicompost							
Control	14.41	56.56	5.77	0.38	3.61	11.25	15.82
Vermicompost 5 t ha ⁻¹	14.57	56.97	5.84	0.42	4.35	12.85	17.36
SEm $\pm$	0.10	0.31	0.05	0.00	0.05	0.09	0.10
CD (P=0.05)	NS	NS	NS	0.01	0.14	0.27	0.27

Table 2: Interaction effect of weed management and vermicompost on dry matter accumulation at different stages (pooled)

Weed Management	Dry matter accumulation (g plant ⁻¹)									
	30 DAS				60 DAS				90 DAS	
	Vermicompost		Vermicompost		Vermicompost		Vermicompost		Vermicompost	
	Control	5 t ha ⁻¹	Control	5 t ha ⁻¹	Control	5 t ha ⁻¹	Control	5 t ha ⁻¹	Control	5 t ha ⁻¹
Imazethapyr 70 g ha ⁻¹ PE	0.41	0.47	3.45	4.16	9.33	10.95	14.25	15.58		
Imazethapyr 70 g ha ⁻¹ PE fb hoeing at 40 DAS	0.41	0.46	3.83	4.60	13.27	14.93	16.00	17.39		
Imazethapyr 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	0.39	0.42	3.69	4.25	12.12	13.58	17.47	18.80		
Imazethapyr + Imazamox (RM) 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	0.37	0.39	3.26	4.51	11.47	12.90	16.33	18.07		
Imazethapyr + Imazamox (RM) 60 g ha ⁻¹ PoE 2-4 leaf stage of weed	0.40	0.43	3.42	4.34	12.21	14.10	17.77	18.70		
Pendimethalin 750 g ha ⁻¹ PE	0.36	0.40	3.40	4.48	11.15	12.87	15.28	17.13		
Oxyfluorfen 120 g ha ⁻¹ PE	0.32	0.40	3.25	4.37	8.67	11.19	13.73	16.17		
Oxyfluorfen 150 g ha ⁻¹ PE	0.35	0.38	3.42	4.42	9.27	10.94	15.23	16.75		
Oxyfluorfen 120 g ha ⁻¹ PE fb hoeing at 40 DAS	0.38	0.41	3.55	4.40	11.53	13.37	17.37	18.77		
Oxadiargyl 100 g ha ⁻¹ PE	0.39	0.43	3.92	4.18	13.12	14.43	17.22	18.93		
Oxadiargyl 100 g ha ⁻¹ PE fb hoeing at 40 DAS	0.42	0.47	4.23	4.58	13.50	14.78	17.67	19.03		
Weed free check	0.45	0.49	4.37	4.97	13.60	15.30	17.93	19.83		
Weedy check	0.31	0.36	3.08	3.35	7.00	7.74	9.40	10.52		
	SEM ±	CD (P=0.05)	SEM ±	CD (P=0.05)	SEM ±	CD (P=0.05)	SEM ±	CD (P=0.05)		
Weed management at the same level of vermicompost	0.01	0.03	0.10	0.29	0.19	0.53	0.19	0.54		
Vermicompost at the same or different levels of weed management	0.01	0.03	0.14	0.40	0.33	0.93	0.44	1.25		

Table 3: Effect of weed management and vermicompost on crop growth rate (CGR) and relative growth rate (RGR) during 30-60 DAS and 60-90 DAS (pooled means)

Treatment	Crop Growth Rate ($\text{g m}^{-2} \text{day}^{-1}$)		Relative Growth Rate ($\text{g g}^{-1} \text{day}^{-1}$)	
	30-60 DAS	60-90 DAS	30-60 DAS	60-90 DAS
Imazethapyr 70 g ha ⁻¹ PE	3.56	7.22	0.0784	0.0330
Imazethapyr 70 g ha ⁻¹ PE fb hoeing at 40 DAS	4.24	10.96	0.0756	0.0403
Imazethapyr 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	3.51	10.32	0.0758	0.0391
Imazethapyr + Imazamox (RM) 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	3.44	9.68	0.0763	0.0381
Imazethapyr + Imazamox (RM) 60 g ha ⁻¹ PoE 2-4 leaf stage of weed	3.58	10.58	0.0741	0.0407
Pendimethalin 750 g ha ⁻¹ PE	3.69	9.24	0.0756	0.0372
Oxyfluorfen 120 g ha ⁻¹ PE	3.68	6.99	0.0778	0.0320
Oxyfluorfen 150 g ha ⁻¹ PE	3.58	7.24	0.0796	0.0319
Oxyfluorfen 120 g ha ⁻¹ PE fb hoeing at 40 DAS	3.90	9.51	0.0762	0.0383
Oxadiargyl 100 g ha ⁻¹ PE	4.05	10.81	0.0755	0.0409
Oxadiargyl 100 g ha ⁻¹ PE fb hoeing at 40 DAS	4.35	10.89	0.0762	0.0388
Weed free check	4.69	10.87	0.0765	0.0376
Weedy check	3.21	4.61	0.0754	0.0276
SEm $\pm$	0.06	0.19	0.0007	0.0008
CD (P=0.05)	0.19	0.59	NS	0.0024
Levels of vermicompost				
Control	3.51	8.56	0.0753	0.0375
Vermicompost 5 t ha ⁻¹	4.10	9.74	0.0774	0.0357
SEm $\pm$	0.04	0.10	0.0006	0.0005
CD (P=0.05)	0.12	0.27	0.0016	0.0014

Table 4: Interaction effect of weed management and vermicompost on crop growth rate (CGR) and relative growth rate (RGR) (pooled)

Treatment	CGR 30-60 DAS (g m ⁻² day ⁻¹)	RGR 30-60 DAS (g g ⁻¹ day ⁻¹)	RGR 60-90 DAS (g g ⁻¹ day ⁻¹)
	Vermicompost Control 5 t ha ⁻¹	Vermicompost Control 5 t ha ⁻¹	Vermicompost Control 5 t ha ⁻¹
Weed management			
Imazethapyr 70 g ha ⁻¹ PE	3.38	0.0779	0.0335
Imazethapyr 70 g ha ⁻¹ PE fb hoeing at 40 DAS	3.98	0.0744	0.0415
Imazethapyr 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	3.30	0.0746	0.0395
Imazethapyr + Imazamox (RM) 50 g ha ⁻¹ PoE	3.03	0.0725	0.0414
2-4 leaf stage of weed			0.0349
Imazethapyr + Imazamox (RM) 60 g ha ⁻¹ PoE	3.17	0.0720	0.0422
2-4 leaf stage of weed			0.0392
Pendimethalin 750 g ha ⁻¹ PE	3.37	0.0741	0.0395
Oxyfluorfen 120 g ha ⁻¹ PE	3.26	0.0777	0.0327
Oxyfluorfen 150 g ha ⁻¹ PE	3.22	0.0769	0.0336
Oxyfluorfen 120 g ha ⁻¹ PE fb hoeing at 40 DAS	3.52	0.0745	0.0394
Oxadiargyl 100 g ha ⁻¹ PE	3.91	0.0764	0.0405
Oxadiargyl 100 g ha ⁻¹ PE fb hoeing at 40 DAS	4.09	0.0767	0.0386
Weed free check	4.36	0.0756	0.0377
Weedy check	3.08	0.0764	0.0272
	SEm ±	SEm ±	SEm ±
	(P=0.05)	(P=0.05)	(P=0.05)
Weed management at the same level of vermicompost	0.08	0.0011	0.0010
Vermicompost at the same or different levels of weed management	0.13	0.0016	0.0015
	0.37	0.0045	0.0044

Table 5. Yield and economics of fenugreek as influenced by various weed management treatments and vermicompost (pooled means)

Treatment	Seed yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	Net returns (₹ ha ⁻¹)	B:C ratio
Weed Management				
Imazethapyr 70 g ha ⁻¹ PE	1897	5712	61715	1.94
Imazethapyr 70 g ha ⁻¹ PE fb hoeing at 40 DAS	2260	6122	73940	2.04
Imazethapyr 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	2132	6132	73487	2.36
Imazethapyr + Imazamox (RM) 50 g ha ⁻¹ PoE 2-4 leaf stage of weed	2102	6161	70756	2.23
Imazethapyr + Imazamox (RM) 60 g ha ⁻¹ PoE 2-4 leaf stage of weed	2162	5174	71689	2.24
Pendimethalin 750 g ha ⁻¹ PE	2004	6031	66721	1.87
Oxyfluorfen 120 g ha ⁻¹ PE	1837	5342	57710	1.87
Oxyfluorfen 150 g ha ⁻¹ PE	1976	4916	63010	2.02
Oxyfluorfen 120 g ha ⁻¹ PE fb hoeing at 40 DAS	2114	5377	66421	1.85
Oxadiargyl 100 g ha ⁻¹ PE	2216	5337	74352	2.30
Oxadiargyl 100 g ha ⁻¹ PE fb hoeing at 40 DAS	2820	6703	98158	2.63
Weed free check	2908	6863	96532	2.19
Weedy check	1055	4220	21774	0.87
SEm ±	31	68	1544	0.05
CD (P=0.05)	95	209	4756	0.14
Levels of vermicompost				
Control	1880	5539	73217	2.90
Vermicompost 5 t ha ⁻¹	2348	5860	64670	1.16
SEm ±	18	44	816	0.03
CD (P=0.05)	50	125	2304	

2013. Economic feasibility of weed management practices in fenugreek. *Ind J Hortic*, 70(1): 150–153.
- Mehariya, M.L., Yadav, R.S., Jangir, R.P. and Poonia, B.L. 2007. Nutrient utilization by cumin (*Cuminum cyminum* L.) and weed as influenced by different weed-control methods. *Ind J Agron*, 52(2): 176–179.
- Mehta, R.S., Meena, S.S. and Lal, G. 2010. Effect of irrigation levels and weed control methods on dry matter accumulation, growth dynamics and yield of fenugreek (*Trigonella foenum-graecum* L.). *Ind J Hortic*, 67(2): 219–224.
- Mundra, S.L. and Maliwal, P.L. 2014. Effect of imazethapyr against weeds in groundnut. In: *Emerging challenges in weed management*. Biennial Conference of Indian Society of Weed Science, DWSR, Jabalpur, Madhya Pradesh, India, p. 92.
- Owla, M.L., Nepalia, V., Chouhan, G.S. and Singh, D. 2015. Effect of fertility levels, nutrient sources and weed control on weed dynamics and yield of quality protein maize (*Zea mays*) and relative nitrogen and phosphorus uptake. *Ind J Agron*, 60(2): 267–272.
- Patel, S.M., Amin, A.U. and Patel, H.B. 2019. Integrated weed management practices for dill seed (*Anethum graveolens* L.) cultivation. *Int J Seed Spices*, 9(2): 81–85.
- Patel, S.M., Amin, A.U. and Patel, J.A. 2019. Integrated weed management in ajwain (*Trachyspermum ammi*). *Int J Seed Spices*, 9(2): 37–43.
- Patel, S.M., Patel, K.I., Fadadu, M. and Patel, P.J. 2022. Weed management in isabgol (*Plantago ovata* Forsk.). *Int J Seed Spices*, 12(1): 75–81.
- Sahoo, M., Satapathy, M., Mangaraj, S. and Kumar Paikaray, R. 2022. Effect of integrated nutrient management on yield and nutrient uptake of sesame (*Sesamum indicum* L.). *J Eco-Friendly Agric*, 17(2): 253–258.
- Sagarka, B.K., Ramani, B.B., Mathukia, R.K., Jadav, C.N. and Khanpara, V.D. 2005. Weed management in isabgol (*Plantago ovata* Forsk.). *Ind J Weed Sci*, 34(3–4): 287–288.
- Salvi, D., Amin, A.U., Raval, C.H., Vyas, K.G., Patel, P. and Patel, C.S. 2015. Effect of weed management practices on weed dynamic, yield of isabgol (*Plantago ovata* Forsk.) and germination of succeeding crop. *Int J Seed Spices*, 5(2): 43–48.
- Shivran, A.C., Jat, N.L., Singh, D., Rajput, S.S. and Mittal, G.K. 2016. Effect of integrated nutrient management on productivity and economics of fenugreek (*Trigonella foenum-graecum*). *Legume Res*, 39(2): 279–283.
- Singh, I., Rathore, M.S., Mehriya, M.L., Chawra, R.S. and Chandawat, M.S. 2013. Bio-efficacy of herbicides applied in cumin (*Cuminum cyminum*) and their carryover effects on succeeding pearl millet (*Pennisetum glaucum*). *Ind J Agron*, 58(4): 490–494.
- Singh, M., Dudwe, T.S. and Verma, A.K. 2016. Integration of chemical and mechanical weed management to enhance the productivity of soybean (*Glycine max*). *J Prog Agric*, 7(2): 132–135.
- Singh, N., Mundra, S.L. and Kaushik, M.K. 2014. Production potential of fenugreek as influenced by weed management practices. *Ind J Weed Sci*, 46(2): 197–199.
- Singh, S.P., Yadav, R.S., Bairwa, R.C. and Kumawat, A. 2017. Herbicides efficacy for managing weeds in greengram and their residual effect on succeeding mustard. *Ind J Weed Sci*, 49(3): 248–251.
- Tripathi, S.S. and Singh, G. 1993. Crop-weed competition studies in fenugreek (*Trigonella foenum-graecum* L.). In: *Integrated weed management for sustainable agriculture*. Proceedings of an Indian Society of Weed Science International Symposium, Hisar, India, 2: 41–43.
- Watson, D.J. 1958. The dependence of net assimilation rate on leaf area index. *Ann Bot*, 22(1): 37–54.