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Effect of different weed management practices on growth and yield of lentil (*Lens Culinaris* Medik) under various planting techniques

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ABSTRACT

A field experiment entitled “Effect of Different Weed Management Practices on Growth, Yield Attributes and Yield of Lentil (*Lens culinaris* Medik.) under Various Planting Techniques” was conducted during Rabi season 2025–26 at the Agricultural Research Farm, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan. The experiment was conducted to evaluate the influence of tillage and weed management practices on growth, yield attributes and productivity of lentil. Three tillage practices, viz., zero tillage, reduced tillage and conventional tillage, were assigned to main plots, while five weed management practices, viz., weedy check, weed-free, pendimethalin @ 1.0 kg ha⁻¹ as pre-emergence, quizalofop-ethyl @ 40 g ha⁻¹ at 20 DAS and pendimethalin 30% EC + imazethapyr 2% @ 1.0 kg ha⁻¹ as pre-emergence, were evaluated in sub-plots. Zero tillage recorded higher plant height, dry matter accumulation, pods plant⁻¹, seeds pod⁻¹, seed yield, stover yield and biological yield than reduced and conventional tillage. Among weed management treatments, weed-free treatment recorded the highest growth and yield attributes and produced maximum seed yield (1818.67 kg ha⁻¹), stover yield (4835.33 kg ha⁻¹) and biological yield (6654.00 kg ha⁻¹). The weedy check recorded the lowest values. The interaction between tillage and weed management significantly affected major growth and yield parameters. The combination of zero tillage and weed-free treatment (T_1W_2) recorded the highest plant height, dry matter accumulation, yield attributes, seed yield (1855 kg ha⁻¹), stover yield (4977 kg ha⁻¹) and biological yield (6832 kg ha⁻¹).

Keywords: Lentil, Tillage practices, Weed management, Yield attributes, Seed yield

1. Introduction

Lentil (*Lens culinaris* Medik.) is an important winter-season pulse crop valued for its high-quality protein, dietary fibre, minerals and ability to contribute biologically fixed nitrogen to the soil. It is widely cultivated in the Indian subcontinent and plays an important role in improving nutritional security and diversification of cereal-based cropping systems. However, productivity of lentil remains constrained by several agronomic factors, among which inadequate weed management and unsuitable crop establishment practices are important. Weeds compete with lentil for moisture, nutrients, light and space, particularly during the early stages of crop growth, resulting in reduced biomass accumulation, yield attributes and final seed yield.

Tillage practices influence seedbed condition, soil moisture conservation, root development, crop establishment and weed emergence. Conservation-based tillage, particularly zero and reduced tillage, can improve soil moisture conservation and crop establishment while reducing cultivation costs. Recent studies have reported improved lentil growth and productivity under zero or minimum tillage compared with conventional tillage under suitable production environments (Birla *et al.*, 2023; Frontiers study, 2023).

Weed management is equally important for realizing the yield potential of lentil. Integrated approaches involving pre-emergence and post-emergence herbicides can effectively suppress weed competition. Pendimethalin and pendimethalin-based mixtures with imazethapyr have been reported to reduce weed infestation and improve lentil yield compared with untreated conditions (Gurjar *et al.*, 2024). Similarly, Sahu *et al.* (2024) reported improved crop productivity through appropriate crop establishment and weed-management practices, while earlier research demonstrated the effectiveness of pendimethalin for reducing weed competition in lentil.

Therefore, the present investigation was undertaken to evaluate the effect of different weed management practices on growth, yield attributes and yield of lentil under different tillage/planting techniques under the agro-climatic conditions of Jaipur, Rajasthan.

2. Materials and Methods

A field experiment was conducted during the Rabi season of 2025–26 at the Agricultural Research Farm, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan. The experiment was laid out in a split-plot design with three replications. Three tillage practices were assigned to the main plots: T_1 – zero tillage, T_2 – reduced tillage and T_3 – conventional tillage. Five weed management practices were imposed in the sub-plots: W_1 – weedy check, W_2 – weed-free, W_3 – pendimethalin @ 1.0 kg ha⁻¹ as pre-emergence, W_4 – quizalofop-ethyl @ 40 g ha⁻¹ at 20 DAS and W_5 – pendimethalin 30% EC + imazethapyr 2% @ 1.0 kg ha⁻¹ as pre-emergence. Lentil was grown using recommended agronomic practices. Observations on plant population, plant height, dry matter accumulation, pods plant⁻¹, seeds pod⁻¹, test weight, seed yield, stover yield, biological yield and harvest index were recorded at appropriate growth stages. The recorded data were subjected to analysis of variance (ANOVA), and treatment means were compared using the critical difference (CD) at the 5% probability level.

3. Results and Discussion

3.1 Growth attributes

The data presented in Table 4.1 revealed that tillage practices did not significantly influence plant population at 20 DAS or harvest. Plant population ranged from 8.89 to 9.14 plants m⁻² at 20 DAS and from 8.85 to 9.11 plants m⁻² at harvest. Zero tillage (T_1) recorded the highest population, whereas conventional tillage (T_3) recorded the lowest. Similarly, weed management practices did not cause significant variation in plant population. The highest population was observed under weed-free treatment (9.64 and 9.63 plants m⁻²), while the weedy check recorded the lowest (8.14 and 8.08 plants m⁻²). The non-significant effect indicates that crop establishment was comparatively stable across treatments. Similar observations have been reported where tillage or weed-management treatments did not substantially alter final crop stand when sowing conditions were uniform. *Atta et al.* (2023) also observed that tillage treatments could influence subsequent crop growth and yield without necessarily producing large differences in crop establishment.

Tillage significantly affected plant height at 30, 60 DAS and harvest. Zero tillage (T_1) recorded the maximum plant height of 12.65, 35.75 and 42.83 cm, respectively, followed by reduced tillage (T_2) with 12.50, 35.35 and 42.12 cm. Conventional tillage (T_3) recorded the minimum values of 12.29, 34.71 and 41.73 cm. Better growth under zero tillage may be associated with improved soil-moisture conservation, reduced soil disturbance and more favourable soil conditions for root growth. *Atta et al.* (2023) similarly reported greater plant height under zero tillage and attributed the response partly to better resource utilization and soil-water conditions.

Weed management also significantly influenced plant height. Weed-free treatment (W_2) produced the tallest plants, recording 13.62, 37.91 and 45.69 cm at 30, 60 DAS and harvest, respectively. The weedy check (W_1) recorded the shortest plants (10.92, 32.27 and 39.00 cm). Effective weed suppression reduced competition for moisture, nutrients, light and space, allowing greater vegetative growth. *Sahu et al.* (2024) reported that effective weed management in lentil increased crop dry matter and yield attributes, while *Gurjar et al.* (2024) found that efficient weed-control treatments improved lentil productivity.

Dry matter accumulation was significantly influenced by both tillage and weed management practices. Zero tillage recorded the highest dry matter accumulation of 2.02, 6.83 and 10.30 g plant⁻¹ at 30, 60 DAS and harvest, respectively, whereas conventional tillage recorded 1.19, 6.36 and 9.48 g plant⁻¹. The higher dry matter under zero tillage may be related to better moisture conservation and improved crop resource-use efficiency. Similar beneficial effects of conservation or zero tillage on lentil growth and productivity have been reported by *Atta et al.* (2023), *Nandi et al.* (2021) and *Layek et al.* (2022).

Among weed-management treatments, weed-free conditions resulted in the maximum dry matter accumulation (2.09, 7.12 and 10.87 g plant⁻¹), whereas the weedy check recorded the minimum (0.95, 5.44 and 7.59 g plant⁻¹). Continuous weed competition apparently restricted crop growth and biomass production. *Birla et al.* (2023) also reported substantial effects of weed management on plant dry matter and yield of lentil.

3.2 Yield attributes and yield

Tillage practices significantly affected the number of pods plant⁻¹. Zero tillage recorded the highest number of pods (65.85), closely followed by reduced tillage (65.84), while conventional tillage recorded the lowest (65.36). The favourable response under conservation tillage may be associated with improved soil-water availability and better crop growth. Previous research has similarly demonstrated improved pod formation under zero or minimum tillage in lentil.

Weed management had a pronounced effect. Weed-free treatment recorded the maximum number of pods (71.80 plant⁻¹), followed by pendimethalin + imazethapyr (70.93), pendimethalin (69.96) and quizalofop-ethyl (68.91), whereas the weedy check recorded only 46.82 pods plant⁻¹. Reduced weed competition allowed greater availability of assimilates for reproductive development. *Gurjar et al.* (2024) and *Sahu et al.* (2024) similarly reported higher yield attributes under effective weed-control treatments in lentil.

Zero tillage produced the highest number of seeds pod⁻¹ (1.53), followed by reduced tillage (1.46), whereas conventional tillage recorded 1.40. Weed-free treatment produced the maximum value (1.90), while the weedy check recorded the minimum (1.16). Effective weed control likely improved assimilate production and translocation towards reproductive sinks. Similar improvement in seeds pod⁻¹ under effective weed management has been reported in lentil and other pulse crops.

Although the treatment means differed numerically, the analysis of variance showed that the main effects of tillage and weed management on test weight were non-significant. Tillage treatments recorded 21.07–21.65 g, with zero tillage having the highest numerical value. Weed-free treatment recorded the highest numerical test weight (23.54 g), whereas the weedy check recorded 17.34 g. The interaction effect was significant, with T_1W_2 recording 23.77 g and T_3W_1 recording 17.17 g. The higher numerical test weight under effective weed management suggests improved seed filling because of reduced competition during reproductive growth.

Tillage practices significantly influenced seed yield. Zero tillage recorded the highest seed yield of 1648.60 kg ha⁻¹, followed by reduced tillage (1638.60 kg ha⁻¹), whereas conventional tillage produced 1618.60 kg ha⁻¹. The superior performance of zero tillage may be associated with improved soil-water conservation and more favourable crop growth. *Atta et al.* (2023) reported substantially higher lentil yield under zero tillage than conventional tillage, while *Nandi et al.* (2021) also demonstrated the importance of zero tillage for conserving residual soil moisture and improving lentil productivity.

Weed management exerted a marked influence on seed yield. Weed-free treatment recorded the highest seed yield (1818.67 kg ha⁻¹), followed by pendimethalin + imazethapyr (1689.67 kg ha⁻¹), pendimethalin (1649.33 kg ha⁻¹) and quizalofop-ethyl (1547.33 kg ha⁻¹). The weedy check produced only 1471.00 kg ha⁻¹. Thus, weed-free conditions increased seed yield by approximately 23.6% over the weedy check. Effective weed suppression reduced competition and increased the availability of resources for crop growth and seed development. Similar findings have been reported by *Gurjar et al.* (2024), who observed higher lentil seed yield under effective weed-management treatments, and by *Sirisha et al.* (2020), who found weed-free and sequential herbicide treatments superior to untreated conditions. Zero tillage recorded the maximum stover yield (4391.40 kg ha⁻¹), followed by reduced tillage (4323.40 kg ha⁻¹), whereas conventional tillage recorded 4171.80 kg ha⁻¹. Weed-free treatment recorded the maximum stover yield (4835.33 kg ha⁻¹), while the weedy check

recorded the minimum (3535.67 kg ha⁻¹). Greater vegetative growth and dry matter accumulation under effective weed control contributed to higher stover production. Birla *et al.* (2023) also reported increased straw yield under effective weed management in lentil.

Biological yield followed a trend similar to seed and stover yield. Zero tillage recorded the highest biological yield (6029.80 kg ha⁻¹), followed by reduced tillage (5972.00 kg ha⁻¹), while conventional tillage recorded 5790.40 kg ha⁻¹. Weed-free treatment produced the highest biological yield (6654.00 kg ha⁻¹), whereas the weedy check produced the lowest (5006.67 kg ha⁻¹).

The higher biological yield under weed-free conditions was mainly due to greater plant height, dry matter accumulation and reproductive growth. The interaction effect was significant, and T₁W₂ produced the maximum biological yield (6832 kg ha⁻¹), whereas T₃W₁ produced the minimum (4907 kg ha⁻¹). These findings are consistent with earlier reports that effective weed suppression and suitable tillage improve biomass accumulation and yield formation in lentil.

Harvest index was not significantly influenced by either tillage or weed management practices. Tillage treatments recorded values ranging from 27.29 to 28.10%, while weed-management treatments ranged from 26.99 to 29.39%. The highest numerical harvest index under tillage was observed with conventional tillage (28.10%), whereas the weedy check recorded the highest numerical value among weed-management treatments (29.39%). The non-significant response indicates that although treatments substantially influenced total biomass and seed yield, the proportional partitioning of biomass towards grain remained relatively stable.

Conclusion

The present investigation demonstrated that tillage and weed management practices significantly influenced the growth, yield attributes and productivity of lentil under the agro-climatic conditions of Jaipur, Rajasthan. Zero tillage generally performed better than reduced and conventional tillage, resulting in higher plant height, dry matter accumulation, yield attributes, seed yield, stover yield and biological yield. Among the weed management practices, weed-free treatment

recorded superior growth and yield performance, while the weedy check resulted in the lowest values. The interaction between tillage and weed management was significant for most growth and yield parameters, with zero tillage combined with weed-free conditions (T₁W₂) producing the highest seed yield, stover yield and biological yield. Overall, the results indicated that proper tillage management coupled with effective weed control is important for enhancing lentil productivity and maintaining favourable crop growth under the conditions of Jaipur, Rajasthan.

Table 4.1. Effect of tillage practices and weed management practices on plant height of lentil

Treatments	Plant population per m row length	
	20 DAS	At harvest
Main Plot- Tillage practices		
T ₁ -Zero tillage	9.14	9.11
T ₂ -Reduced tillage	9.05	9.01
T ₃ -Conventional tillage	8.89	8.85
S.Em±	0.24	0.23
CD at 5%	NS	NS
Sub Plot- Fertilizer management		
W ₁ -Weedy check	8.14	8.08
W ₂ - Weed free	9.64	9.63
W ₃ -Pendimethalin @1.00 kg/ha (PRE)	9.20	9.17
W ₄ -Quizalofop-ethyl 40 g/ha at 20 DAS	8.77	8.72
W ₅ -Pendimethalin 30% EC + imazethapyr 2% (1.0 kg/ha) PE	9.37	9.35
S.Em±	0.28	0.27
CD at 5%	NS	NS
CV%	9.15	9.21

Table 4.2. Effect of tillage practices and weed management practices on plant height and dry matter accumulation of lentil

Treatments	Plant height (cm)			Dry matter accumulation (g plant ⁻¹)		
	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest
Main Plot- Tillage practices						
T ₁ -Zero tillage	12.65	35.75	42.83	2.02	6.83	10.30
T ₂ -Reduced tillage	12.50	35.35	42.12	1.21	6.46	9.61
T ₃ -Conventional tillage	12.29	34.71	41.73	1.19	6.36	9.48
S.Em±	0.23	0.41	1.11	0.04	0.14	0.31
CD at 5%	0.69	1.23	3.35	0.11	0.50	0.91
CV%	7.26	7.47	10.17	9.89	7.92	9.80
Main Plot- Tillage practices						
W ₁ -Weedy check	10.92	32.27	39.00	0.95	5.44	7.59
W ₂ - Weed free	13.62	37.91	45.69	2.09	7.12	10.87
W ₃ -Pendimethalin @1.00 kg/ha (PRE)	12.69	35.47	42.04	1.15	5.27	8.23
W ₄ -Quizalofop-ethyl 40 g/ha at 20 DAS	11.69	33.93	40.73	1.24	5.48	8.68
W ₅ -Pendimethalin 30% EC + imazethapyr 2% (1.0 kg/ha) PE	13.48	36.78	43.66	1.29	5.78	8.26
S.Em±	0.22	0.82	0.80	0.03	0.14	0.23
CD at 5%	0.65	2.39	2.33	0.07	0.43	0.71
CV%	7.39	6.96	6.66	6.57	7.18	8.00

(continued on next page)

Table 4.9. Effect of tillage practices and weed management practices on number of pods plant⁻¹, number of seeds pod⁻¹, seed index, seed yield and stover yield

Treatments	Number of pods plant ⁻¹	Number of Seeds pod ⁻¹	Test weight (g)	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
Main Plot- Tillage practices					
T ₁ -Zero tillage	65.85	1.53	21.65	1648.60	4391.40
T ₂ -Reduced tillage	65.84	1.46	21.50	1638.60	4323.40
T ₃ -Conventional tillage	65.36	1.40	21.07	1618.60	4171.80
S.Em±	0.91	0.02	0.32	20.34	87.32
CD at 5%	2.77	0.07	NS	61.86	254.87
CV%	6.36	7.52	7.45	8.82	7.87
Main Plot- Tillage practices					
W ₁ -Weedy check	46.82	1.16	17.34	1471.00	3535.67
W ₂ - Weed free	71.80	1.90	23.54	1818.67	4835.33
W ₃ -Pendimethalin @1.00 kg/ha (PRE)	69.96	1.39	21.94	1649.33	4366.67
W ₄ -Quizalofop-ethyl 40 g/ha at 20 DAS	68.91	1.28	21.28	1547.33	4165.00
W ₅ -Pendimethalin 30% EC + imazethapyr 2% (1.0 kg/ha) PE	70.93	1.60	22.92	1689.67	4575.00
S.Em±	0.88	0.03	0.57	44.88	112.35
CD at 5%	2.57	0.10	NS	132.99	337.92
CV%	7.02	6.98	7.34	8.75	7.85

Table 4.15. Effect of tillage practices and weed management practices on biological yield and harvest index

Treatments	Biological yield (kg ha ⁻¹)	Harvest index (%)
Main Plot- Tillage practices		
T ₁ -Zero tillage	6029.80	27.29
T ₂ -Reduced tillage	5972.00	27.68
T ₃ -Conventional tillage	5790.40	28.10
S.Em±	97.12	0.35
CD at 5%	281.74	NS
CV%	7.35	7.25
Main Plot- Tillage practices		
W ₁ -Weedy check	5006.67	29.39
W ₂ - Weed free	6654.00	27.43
W ₃ -Pendimethalin @1.00 kg/ha (PRE)	6016.00	27.45
W ₄ -Quizalofop-ethyl 40 g/ha at 20 DAS	5712.33	27.20
W ₅ -Pendimethalin 30% EC + imazethapyr 2% (1.0 kg/ha) PE	6264.67	26.99
S.Em±	115.80	0.63
CD at 5%	346.99	NS
CV%	7.86	8.25

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