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Effect of variety and row spacing on growth and yield of Lentil (*Lens culinaris* L.) in Prayagraj region

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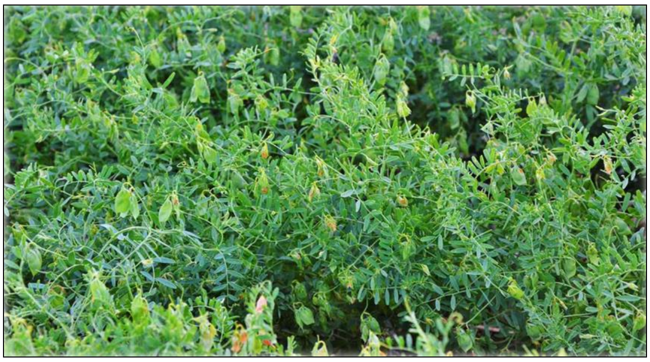
Abstract
A field experiment was conducted during *Rabi* 2024-26 at Crop Research Farm, Department of Agronomy, PRSU, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice on the basis of oneyear experimentation. The experiment will be conducted at the Agriculture Research Field, Prof. Rajendra Singh (Rajju Bhaiya) University, Naini, Prayagraj, Uttar Pradesh during the *Rabi* 2026. The treatments consisted of 10 nutrient management will be T_1- V_1 + 25×5 cm, T_2 - V_1 + 30×5 cm T_3 - V_1 + 35 × 5 cm, T_4 - V_2 + 25 × 5 cm, T_5 - V_2 + 30 × 5 cm ,T_6 - V_2 + 35 × 5 cm, T_7 - V_3 + 25 × 5 cm, T_8 - V_3 + 30 × 5 cm, T_9 - V_3 + 35 × 5 cm, T_{10} - Control ,will be tested in randomized block design (RBD) with 3 replications, to the experimental design use in this study and critical difference means of treatments.

Keywords: *Lens culinaris* L, RDF, effect of variety and row spacing

Introduction
Lentil (*Lens culinaris* L.) is an edible pulse. It is a bushy annual plant of the legume family, grown for its lens-shaped seeds. It is about 40 cm (16 in) tall and the seeds grow in pods, usually with two seeds in each. Among various grain legumes grown, lentil (*Lens culinaris* Medikus subsp. *culinaris*), is one of the most important pulse crop of India, grown in winter season and belonging to tribe- Vicieae, order- Rosales, suborder- Rosneae, family– leguminosae (fabaceae), sub-family- papilionaceae, genus– Lens and species– *culinaris* with chromosome number 2n = 14. Lentil has versatile uses as food, feed, fuel and fodder. Lentils have been part of the human diet since the aceramic (before pottery) Neolithic times, being one of the first crops domesticated in the Near East. Lentil is a very important pulse crop in Western Canada. It is grown to improve economic returns to producers, diversify and lengthen crop rotations and reduce the requirement for nitrogen fertilizer. lentil is held by Canada and USA. Countries in the Indian subcontinent, West Asia and North Africa are the major importers of the red lentil. Southern Europe and South America import large-seeded green lentils only. Although lentil has been cultivated as early as 8000 BC, it remained an under-exploited and under-researched crop, compared to other early domesticated crops. the states that produce the most lentils are Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Rajasthan, Jharkhand, Assam, Maharashtra, Karnataka, Gujarat, Punjab, and Andhra Pradesh. The type and extent of variety present in germplasm collections determine the success of any crop breeding operation. In order to create high-yielding varieties by incorporating and enhancing the traits, the plant must be genetically reconstructed. When using genetic methods to increase yield, new germplasm or characteristics are typically used. The most useful natural source for the characteristics required to design successful cultivars is germplasm. Faqeer, M *et al.* (2020).

Although there is a good amount of research on lentil germplasm evaluation, variability, correlation, route analysis, and genetic divergence investigations, it is focused on testing a small number of germplasm lines. Furthermore, the findings of previous research on these topics are specific to the materials and settings used in a given study and cannot be applied to other contexts. Therefore, in order to successfully use genetic resources for the generation of superior varieties, a study of the aforementioned elements of the available germplasm in the environment, where it is to be utilized, is necessary.



Lentil crop

Materials and Method
The experiment was conducted at the Agriculture Research Field, Prof. Rajendra Singh (Rajju Bhaiya) University, Naini, Prayagraj, Uttar Pradesh during the Rabi 2025. The seeds was planted in each plot at a depth of 2.5 to 5 cm. The

suggested nutrient dose is 20: 40: 20 N, P_2O_5, K_2O, In the first week of October, the tractor-drawn disc plough was used to open the field for the first time. After that, the ground was ploughed and then ploughed again. The ploughing and harrowing processes then produced the desired fine tilth in the ploughed soil. Laddering comes next. To facilitate the germination of lentil seedlings, the field was cleared of weeds and stubble. First fort night of October, the first ploughing was completed, on last week. The experimental design led to the division of the experimental land into unit plots. One day prior to seeding, the plots were spaded, and the soil was fully mixed with the base fertiliser dosage.

Treatment	Detail
T_1	IPL-315 + 25 × 5 cm
T_2	IPL-315 + 30 × 5 cm
T3	IPL-315 + 35 × 5 cm
T4	DPL15 (Priya) + 25 × 5 cm
T5	DPL15 (Priya) + 30 × 5 cm
T6	DPL15 (Priya) + 35 × 5 cm
T7	Pant lentil-19+ 25 × 5 cm
T8	Pant lentil-19+ 30 × 5 cm
T9	Pant lentil-19+ 35 × 5 cm
T10	Control

Result and Discussion

Plant height is a vital indicator of plant vegetative growth and development. The data regarding plant height as influenced by different varieties and spacing treatments at 20, 40, 60, and 80 DAS (Days After Sowing) are presented in the table and interpreted below:

Plant height

Plant height is a vital indicator of plant vegetative growth and development. The data regarding plant height as influenced by different varieties and spacing treatments at 20, 40, 60, and 80 DAS (Days After Sowing) are presented in the table and interpreted below:

At 20 DAS, At the initial growth stage, the variation in plant height due to different treatments was found to be statistically non-significant. However, numerically, the maximum plant height was recorded under treatment T_8 (Pant lentil-19 + 30 × 5 cm) with 4.42 cm, while the minimum plant height was observedin T_1 (IPL-315 + 25 × 5 cm) with 3.23 cm.

At 40 DAS, the effect of various treatments on plant height was found to be statistically significant. The maximum plant height was significantly higher under treatment T_9 (Pant lentil-19 + 35 × 5 cm) recording 18.16 cm, which was closely followed by T_8 (16.78 cm). Conversely, the minimum plant height was recorded under T_{10} (Control - Farmer Practices) with 10.52 cm.

At 60 DAS, A significant difference in plant height was observed among the treatments at this stage. Treatment T_9 (Pant lentil-19 + 35 × 5 cm) continued to maintain its dominance, recording the maximum plant height of 34.64 cm. On the other hand, the control treatment (T_{10}) recorded the lowest plant height of 19.52 cm.

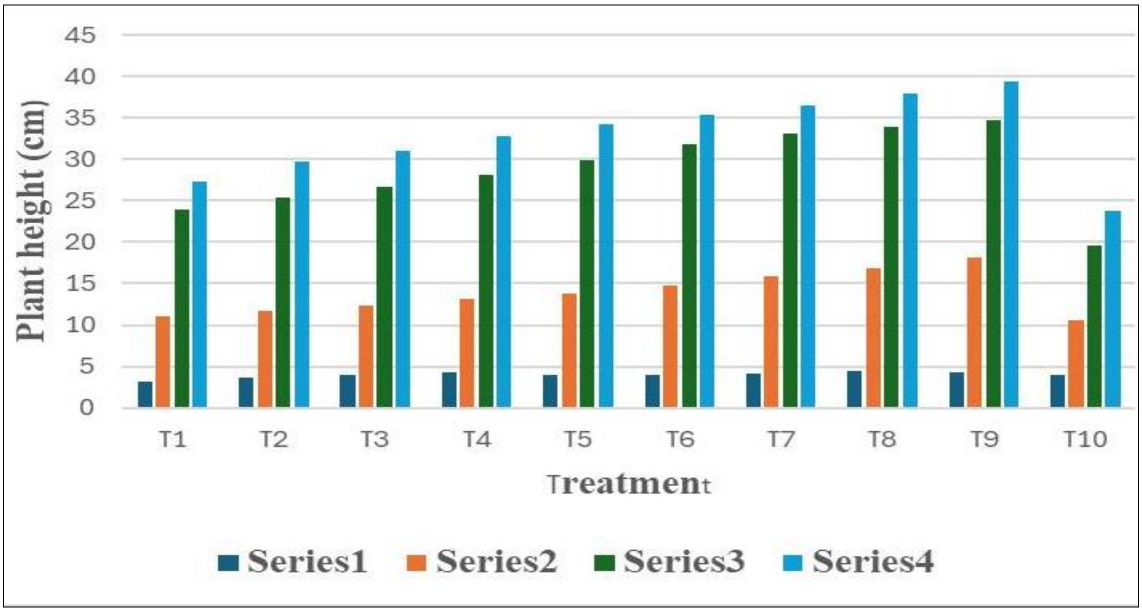
At 80 DAS, At the final observation stage, the treatments exhibited a significant impact on plant height. The highest plant height was successfully achieved under treatment T_9 (Pant lentil-19 + 35 × 5 cm) with 39.36 cm, followed by T_8 (37.98 cm). The minimum plant height at this stage was noted in T_{10} (Control) with 23.76 cm.

At 20 DAS, the treatment effect on plant height was non-significant due to minimal inter-plant competition and underutilized growth resources at the early seedling stage. However, from 40 to 80 DAS, variations became statistically significant. Treatment T_9 (Pant lentil-19 + 35×5 cm) consistently recorded the maximum plant height (39.36 cm at 80 DAS). This superiority is attributed to the genetic vigor of variety \ Pant lentil-19 and optimal crop geometry, which minimized nutrient competition and enhanced light interception. Conversely, T_{10} (Control) showed minimum height due to severe resource competition under unscientific spacing. These findings align with Tripathi *et al.* (2025).

Plant height

Table 1: Plant height (*Lens culinaris* L.) (20,40,60,80 DAS and at harvest)

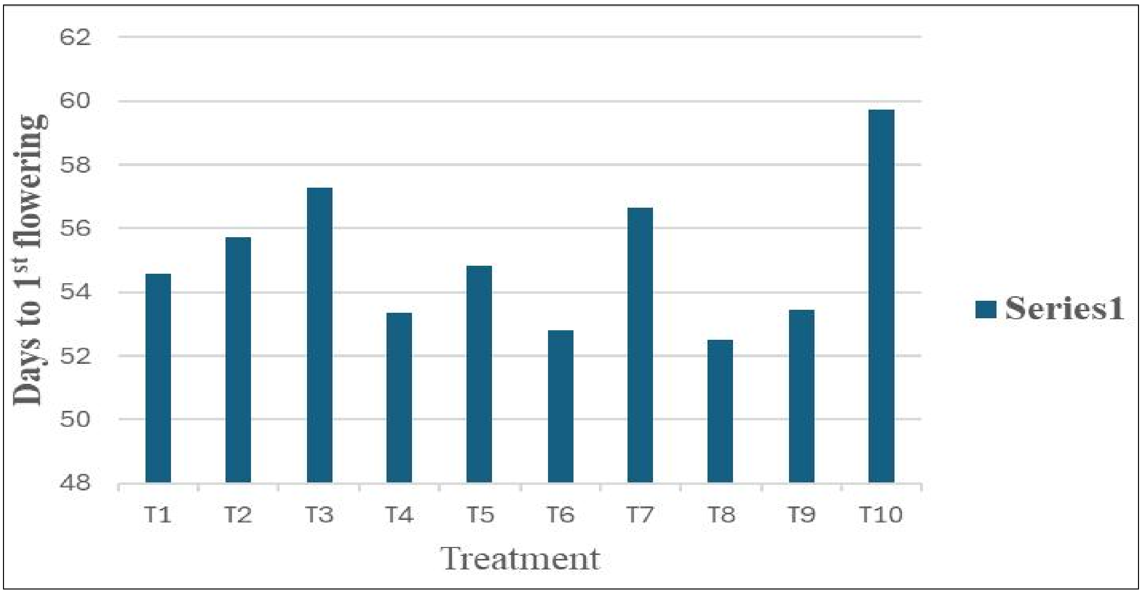
S. No	Treatment	Growth Parameter
T_1	IPL-315 + 25 × 5 cm	27.38
T_2	IPL-315 + 30 × 5 cm	29.74
T3	IPL-315 + 35 × 5 cm	30.93
T4	DPL15 (Priya) + 25 × 5 cm	32.77
T5	DPL15 (Priya) + 30 × 5 cm	34.15
T6	DPL15 (Priya) + 35 × 5 cm	35.41
T7	Pant lentil-19+ 25 × 5 cm	36.51
T8	Pant lentil-19+ 30 × 5 cm	37.98
T9	Pant lentil-19+ 35 × 5 cm	39.36
T10	Control	23.76
	F-test	S
	SE m (±)	2.07
	CD at 5%	6.15



Days to 1st flowering

Numerically, the minimum number of days to first flowering was recorded under treatment T_8 (Pant lentil-19 + 30 × 5 cm) with 52.49 days, closely followed by T_6 (52.81 days) and T_9 (53.45 days). This indicates a slightly earlier reproductive onset in these treatment combinations. On the higher end, excluding the control, treatment T_3 (IPL-315 + 35 × 5 cm) took the maximum time among the regular treatments to reach first flowering with 57.26 days.slightly earlier onset of flowering under T_8 (Pant lentil-19 + 30 × 5 cm) and T_9 indicates that the genetic predisposition of variety Pant lentil-19, coupled with optimal plant density, accelerated the transition from the vegetative to the reproductive phase due to efficient assimilation of nutrients and light. Conversely, the delayed flowering in T_3 (IPL-315 + 35 × 5 cm) suggests prolonged vegetative growth caused by wider spacing and genetic traits of IPL-315. These findings are in close agreement with Rao, A. K. (2023).

S. No	Treatment	Growth Parameter
T_1	IPL-315 + 25 × 5 cm	54.59
T_2	IPL-315 + 30 × 5 cm	55.71
T3	IPL-315 + 35 × 5 cm	57.26
T4	DPL15 (Priya) + 25 × 5 cm	53.35
T5	DPL15 (Priya) + 30 × 5 cm	54.83
T6	DPL15 (Priya) + 35 × 5 cm	52.81
T7	Pant lentil-19+ 25 × 5 cm	56.66
T8	Pant lentil-19+ 30 × 5 cm	52.49
T9	Pant lentil-19+ 35 × 5 cm	53.45
T10	Control	59.74
	F-test	S
	SE m (±)	3.77
	CD at 5%	-



Fresh weight (g)

Fresh weight per plant is a direct reflection of the crop's biomass accumulation and metabolic activity. The data recorded at 20, 40, 60, and 80 DAS (Days After Sowing) reveal how different varieties and spacing combinations influenced biomass production over time:

At 20 DAS, During the early seedling stage, the variation in fresh weight among the treatments was statistically non-significant. Numerically, the maximum fresh weight was recorded in treatment T_3 (IPL-315 + 35 × 5 cm) with 0.36 g, while the minimum was recorded in T_1 (IPL-315 + 25×5 cm) with 0.121 g.

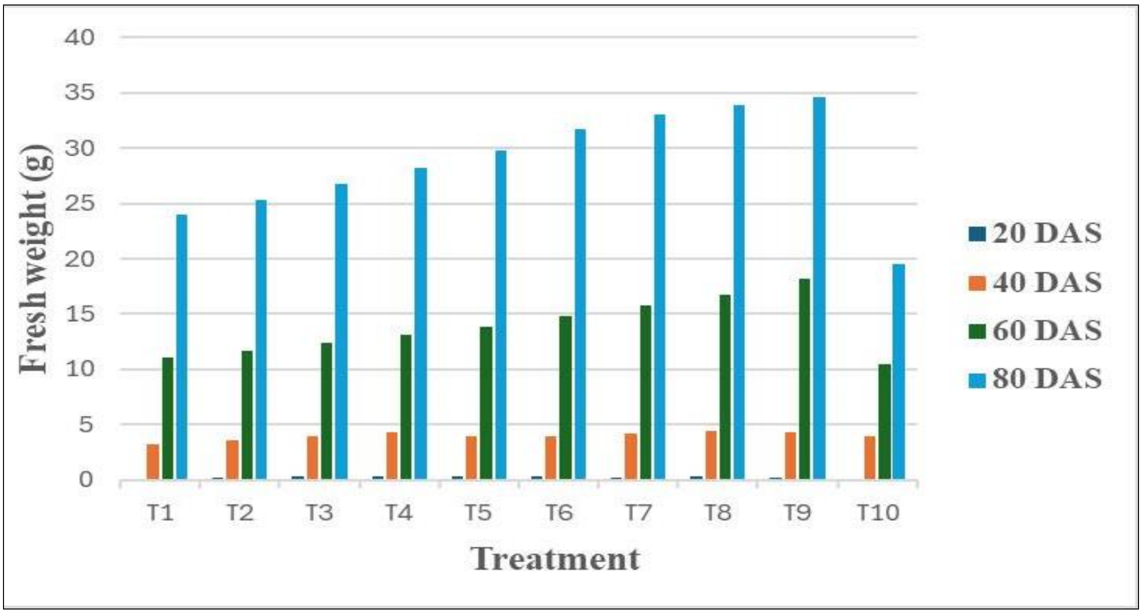
At 40 DAS**,** the treatment effects on fresh weight remained statistically non-significant at this vegetative phase. However, numerically, treatment T_8 (Pant lentil-19 + 30 × 5 cm) accumulated the highest fresh weight of 4.42 g, closely followed by T_9 (4.30 g) and T_4 (4.27 g). The lowest value was observed in T_1 (IPL-315 + 25×5 cm) with 3.23 g.

At 60 DAS, the differences in fresh weight became statistically significant during this active growth period. Treatment T_9 (Pant lentil-19 + 35 × 5 cm) recorded the highest fresh
weight of 18.16 g, which was significantly superior to most treatments. Conversely, T_{10} (Control - Farmer Practices) recorded the minimum fresh weight of 10.52 g.

At 80 DAS, At the final maturity stage, the treatments demonstrated a highly significant impact on biomass accumulation. The maximum fresh weight per plant was achieved under treatment T_9 (Pant lentil-19 + 35 × 5 cm) with 34.64 g, followed closely by T_8 (33.94 g) and T_7 (33.03 g). The minimum fresh weight was recorded under the T_{10} (Control) treatment with 19.52 g.

At 20 and 40 DAS, non-significant fresh weight variations occurred because young seedlings underutilize spatial resources, limiting biomass differentiation. However, by 60 and 80 DAS, T_9 (Pant lentil-19 + 35 × 5 cm) produced significantly maximum fresh weight (34.64g), driven by the high genetic vigor of variety Pant lentil-19 ,3 and wider spacing, which optimized photosynthesis and resource distribution. Conversely, T_{10} (Control) suffered intense crowdinduced stress, yielding the minimum weight (19.52 g). These outcomes align with Ahmed *et al*. (2023)

S. No	Treatment	Growth Parameter
T_1	IPL-315 + 25 × 5 cm	23.98
T_2	IPL-315 + 30 × 5 cm	25.30
T3	IPL-315 + 35 × 5 cm	26.72
T4	DPL15 (Priya) + 25 × 5 cm	28.17
T5	DPL15 (Priya) + 30 × 5 cm	29.82
T6	DPL15 (Priya) + 35 × 5 cm	31.77
T7	Pant lentil-19+ 25 × 5 cm	33.03
T8	Pant lentil-19+ 30 × 5 cm	33.94
T9	Pant lentil-19+ 35 × 5 cm	34.64
T10	Control	19.52
	F-test	S
	SE m (±)	1.64
	CD at 5%	4.87

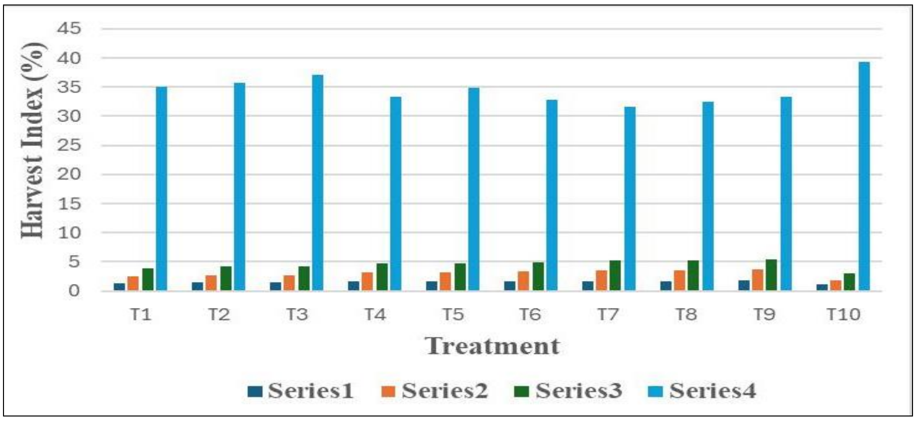


Harvest Index (%)

Regarding the harvest index, the values fluctuated from a maximum of 39.24% in the control plot (T_{10}) to a minimum of 31.65% in treatment T_7 (Pant lentil-19 + 25× 5cm). Among the explicit treatment variants, T_3 performed best with a harvest index of 37.06%. these results align demonstrated that optimized plant density (like the 35 × 5cm spacing in T_9) maximizes light interception and nutrient use efficiency, directly boosting both grain (1.77 t/ha) and stover (3.61 t/ha) yields recent findings by (Sharma *et al*. (2025),

Interestingly, the inverse relationship observed here where the lowest-yielding control plot (T_{10}) exhibited the highest harvest index (39.24) is a known physiological phenomenon. lower plant populations reduce vegetative competition, altering the source-sink relationship to favor efficient biomass partitioning into grain, even if overall areal yield remains low as noted by Khan and
Mishra (2025)

T. No	Treatment	Grain yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
T_1	IPL-315 + 25×5 cm	1.33	2.47	3.80	34.99
T_2	IPL-315 + 30×5 cm	1.54	2.72	4.26	35.77
T_3	IPL-315 + 35×5 cm	1.55	2.72	4.27	37.06
T_4	DPL15(Priya)+25×5cm	1.57	3.12	4.69	33.34
T_5	DPL15(Priya)+30×5cm	1.61	3.19	4.80	34.86
T_6	DPL15(Priya)+35×5cm	1.62	3.34	4.96	32.80
T_7	Pant lentil-19+25×5 cm	1.66	3.50	5.16	31.65
T_8	Pant lentil-19+30×5 cm	1.68	3.53	5.21	32.45
T_9	Pant lentil-19+35×5 cm	1.77	3.61	5.38	33.35
T10	Control (Farmer Practices)	1.21	1.87	3.08	39.24
F-test		S	S	S	NS
Sem (±)		0.24	0.34	0.46	3.77
CD at 5%		0.72	1.03	1.28	-



Final Seed submite (Advisor sir)

Conclusion

For nearly all growth, yield, and economic characteristics, Treatment T9 (Pant lentil-19 + Spacing 35 × 5 cm) proved to be the best combination. At 80 DAS, treatment T9 had the largest plant height (39.36 cm), maximum dry weight (7.67 g), and highest number of pods per plant (84.97). As a result, it yielded a maximum of one grain. 77 t/ha and a 3.61 t/ha stover yield. With the highest Net Returns (93,725.10 INR/ha) and the best Benefit-Cost ratio (B:C ratio of 2.1), T_9 turned out to be the most profitable. To increase productivity and profitability, farmers are advised to grow the Pant Lentil-19 variety at a spacing of 35 × 5 cm. This combination has been shown to be the most successful in terms of growth, yield, and financial returns.

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