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Effect of dates of sowing and row spacing on yield attributes and economics of Lentil (*Lens Culinaris* Medik) under Nagaland condition

RAJKUMAR NAIN[1], T. GOHAIN[2], VISHNU SUMAN[3], ROHIT MEENA[4] AND MADHUDWISHA CHETIA[5]

Department of Agronomy, School of Agricultural Sciences, Nagaland University, Campus-Medziphema, Nagaland-797106, India

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ABSTRACT

A field experiment was conducted at Agronomy experimental farm of School of Agricultural Sciences (SAS), Nagaland University, Medziphema campus, entitled with "Effect of dates of sowing and row spacing on lentil (Lens culinaris Medik) under Nagaland condition" during the rabi season from October 2025 to March 2026. The experiment was laid out in randomized block design with nine treatments and replicated thrice. The treatments consisted of three sowing dates viz. D_1- 30thOctober, D_2- 15thNovember and D_3- 30thNovember and three levels of row spacing viz. S_1- 15 cm, S_2- 20 cm and S_3- 25 cm. However, number of pods cluster^{-1}, number of pods plant^{-1}, number of grain pod^{-1} was found to be higher in the row spacing 25 cm. Maximum seed yield (823.93 kg ha^{-1}) and stover yield (3270.63 kg ha^{-1}) were recorded with 20 cm spacing and was found to be statistically at par with 25 cm row spacing. It was observed that the interaction effect of different sowing dates and row spacing was significant in plant height at all stages, number of clusters plant^{-1} at all stages, plant dry weight at all stages, crop growth rate at both time interval and stover yield. Economic analysis revealed that D_2S_2 i.e. 15thNovember sowing + 20 cm recorded the maximum net return (₹45016.75 ha^{-1}) and benefit cost ratio (2.47).

Keywords: Lentil, dates of sowing, row spacing, growth, yield and economics

INTRODUCTION

Lentil (*Lens culinaris* Medik.) is one of the world's oldest and most nutritionally significant cool-season food legumes, belonging to the family Fabaceae, with a diploid chromosome number of 2n = 2x = 14 (Maphosa *et al.*, 2023). It is globally cultivated in over 46 countries across diverse agro-ecological regions and is valued for its role in providing affordable dietary protein for both humans and animals (Ramirez and Valencia-Cantero, 2024). Lentil seeds are nutrient-dense, containing high levels of protein, complex carbohydrates, essential minerals and vitamins, phytochemicals, and dietary fibres; the seeds also have the potential to provide a major portion of the recommended iron and zinc dietary allowances in deficient populations (Parihar *et al.*, 2025). According to the Food and Agriculture Organization (FAO), the world's top lentil producers in 2022 were Canada, India, Australia, Turkey, and Russia (Anon, 2022). In India, lentil ranks as the second most important *rabi* pulse crop after chickpea (Mukherjee *et al.*, 2023). India's lentil production is estimated to have reached an all-time high of 1.6 million tonnes in the 2023–24 *rabi* season on account of higher acreage. Despite being among the largest producers, India still relies on imports to meet domestic demand, making it essential to bridge the existing yield gap through improved agronomic practices (Anon., 2024). Lentil also plays a crucial role in sustainable agriculture by enriching soil nutrient status through biological nitrogen fixation; lentils alone can fix nitrogen in the range of 35–107 kg ha^{-1}, reducing dependence on chemical fertilizers and promoting environmental sustainability (Anon., 2016). Dhakad *et al*. (2024) recommend lentil variety RVL13-7 with 3.3 lac/ha to the farmers in Eastern part of Vindhyan Plateau in sub-tropical zone of Madhya Pradesh in a sustainable way. Among the media, Richard's medium gave the bigger sclerotia (2.159 mm) followed by Asthana and hawkers medium (1.814 mm) and in PDA, small sized sclerotia were produced (1.195 mm) followed by Cornmeal agar medium (1.263 mm) (Jasudasu *et al*., 2022).

[2]*Corresponding address: Professor, Dept. of Agronomy, SAS, NU, tgohain@nagalanduniversity.ac.in,* [1 3 4] *PG passed out students,* [5]*PhD scholar, SAS, NU*

Among the key agronomic management factors governing lentil productivity, the date of sowing and row spacing are considered the most critical. Time of sowing significantly affects crop duration, temperature utilization, solar radiation interception, and consequently, yield attributes and seed yield (Maphosa *et al.*, 2023). Studies have consistently shown that sowing earlier or later than the optimum date decreases grain yield due to altered phenological development and exposure to unfavorable temperature or moisture stress conditions during critical growth stages (Maphosa *et al.*, 2023; Pramanik *et al.*, 2025). The MSP for lentil has also been raised from Rs. 5,100 per quintal in 2020–21 to ₹ 6,700 per quintal in 2026–27, indicating increasing economic importance of the crop for farmers (Anon., 2025). The INM practices Significantly affected the yield and yield attributes parameters like no. of pods /plant, pod length (cm), no of grains/pods, 1000 seed weight, grain yield (kg ha^{-1}), stalk yield (kg ha^{-1}), biological yield(kg ha^{-1}) and harvest index (%) was recorded under the treatment (T10-125% RDF + vermicompost @ 0.5t/ha + Rhizobium + PSB) but it was at par with (T9 -100%RDF +vermicompost @1t/ha + Rhizobium + PSB), (T8 - 75% RDF + vermicompost @1.5t ha^{-1} + Rhizobium +PSB) and at par with rest of the treatments. and minimum yield parameters were recorded under control (Shaju *et al*., 2024).

Row spacing is equally important as it governs plant population density, canopy architecture, light interception, nutrient and water use efficiency, and inter-plant competition, all of which directly influence yield attributes such as number of pods plant^{-1}, test weight, and seed yield. Studies have demonstrated that the effect of row spacing and plant seeding rates along with their interaction were significant on all measured yield parameters of lentil (Aski *et al.*, 2023). Singh *et al.* (2005) reported that 20 cm row spacing resulted in significantly higher seed yield and net economic returns compared to both narrower and wider spacings. Similarly, Venugopalan *et al.* (2021) confirmed that optimum sowing time combined with appropriate crop management significantly enhanced yield attributes and economics of lentil under rainfed conditions. However, location-specific research on the influence of sowing dates and row spacing on yield attributes and economics of lentil under the agroclimatic conditions of Nagaland, northeast India, remains largely inadequate. Farmers in this region generally do not cultivate pulses during the off-season due to limited irrigation facilities, and increasing weather uncertainty further constrains crop productivity (Anon., 2013). Therefore, the present investigation was undertaken to study the effect of different dates of sowing and row spacing on yield attributes and economics of lentil (*Lens culinaris* Medik.) under Nagaland condition, so as to identify the most productive and economically viable treatment combination for local farmers.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2025-2026 at Agronomy Research Farm of SAS, Medziphema (Nagaland), India. There were 9 treatments, which were laid out in Randomized Block Design with three replications net plot size was 4m × 3m with different row spacing respectively. Soil of the experimental field was sandy loam in texture with 4.1pH and high in organic carbon (1.04) and low in available nitrogen (272 kg ha^{-1}), medium phosphorous (15 kg ha^{-1}) and medium in potassium (209 kg ha^{-1}). The crop was sown on 30 October,15 November and 30 November 2025 and harvested according to maturity stage. Data on growth, yield etc. were recorded as per standard procedures. Economics of the different treatments was also computed as per standard procedures.

RESULTS AND DISCUSSION

The first date of sowing (15thNovember) significantly gave the maximum number of clusters plant^{-1} (3.60), while the lowest (3.22) were recorded in 30thNovember sowing. Similarly, there was significant result of row spacing on number of clusters plant^{-1}, 20 cm spacing significantly recorded the maximum number of clusters plant^{-1} (3.72) and minimum was recorded in 15 cm spacing (3.31). The interaction effect of different sowing dates and row spacing on number of clusters plant^{-1} was found significant,

Table 1: Effect of date of sowing and spacings on yield attributes, yield of lentil crops

Treatments	No. of Cluster plant^{-1}	No. of Pods Cluster^{-1}	No. of pods palnt^{-1}	No. of seeds pods^{-1}	Test weight (g)	Grain yield (kg ha^{-1})	Harvest Index (%)
Dates of sowing (D)							
D1: 30th Oct.	3.36	18.87	62.89	1.63	14.54	652.94	26.96
D2: 15th Nov.	3.60	20.89	74.93	1.76	15.53	982.30	25.40
D3: 30th Nov.	3.22	17.02	55.21	1.69	14.64	736.41	25.66
SEm$\pm$	0.19	0.95	4.27	0.04	0.40	10.19	1.29
CD(p=0.05)	0.58	2.86	12.81	0.12	NS	30.55	3.87
Spacing (S)							
S1: 15cm x 10cm	3.31	18.96	58.23	1.70	15.40	749.87	27.21
S2: 20cm x 10cm	3.72	17.93	67.83	1.67	14.89	823.93	25.20
S3: 25cm x 10cm	3.36	19.89	66.98	1.71	14.42	797.86	25.61
SEm$\pm$	0.19	0.95	4.27	0.04	0.4	10.19	1.29
CD(p=0.05)	0.58	2.86	12.81	0.12	NS	30.55	3.87
Interaction (D x S)							
D_1S_1	3.06	22.27	67.40	1.57	15.30	578.53	34.77
D_1S_2	3.50	14.53	51.22	1.60	14.56	705.33	25.75
D_1S_3	3.53	19.80	70.07	1.70	13.27	674.97	20.37
D_2S_1	3.67	19.47	68.65	1.57	15.60	964.87	25.30
D_2S_2	4.00	23.73	95.23	1.77	15.79	1026.07	25.64
D_2S_3	3.13	19.47	60.91	1.63	15.69	955.97	25.24
D_3S_1	2.60	15.13	38.63	1.77	14.81	706.20	21.56
D_3S_2	3.67	15.53	57.04	1.70	14.83	740.40	24.22
D_3S_3	3.40	20.40	69.69	1.80	14.29	762.63	31.20
SEm+	0.33	1.65	7.40	0.07	0.69	17.65	2.24
CD(p=0.05)	1.00	4.95	22.19	0.20	NS	52.92	6.70

15th November+ 20 cm spacing significantly recorded the maximum number of clusters plant^{-1} (4.00) which was statistically at par with 15th November + 15 cm (3.67) and 30th November sowing + 20 cm spacing (3.67).

There was a significant effect on the number of pods cluster^{-1} as a result of different sowing dates. The number of pods cluster^{-1} was significantly maximum in 15thNovember sowing (20.89), while the minimum was observed 30thNovember sowing (17.02). Row spacing 25 cm recorded the maximum number of pods cluster^{-1} (19.89) and the minimum was observed under 20 cm spacing (17.93). The interaction effect of different sowing dates and row spacing show a significant effect on number of pods cluster^{-1}, 15th November+ 20 cm spacing significantly recorded the maximum number of pod cluster^{-1} (23.73) which was statistically at par with 30th October + 15 cm (22.27) and 30th November sowing + 25 cm spacing (20.40). There was a significant effect on the number of pods plant^{-1} as a result of different sowing dates. The number of pods plant^{-1} was significantly maximum in 15th November sowing (74.93), while the minimum was observed 30thNovember sowing (55.21). Row spacing 20 cm recorded the maximum number of pods plant^{-1} (67.83) and the minimum was observed under 15 cm spacing (58.23). The interaction effect of different sowing dates and row spacing show a significant effect on number of pods plant^{-1}, 15thNovember+ 20 cm spacing significantly recorded the maximum number of pod plant^{-1} (95.23) which was statistically at par with 30thOctober + 25 cm (70.07).

There was a significant effect on the number of grain pod^{-1} as a result of different sowing dates. The number of grain pod^{-1} was significantly maximum in 30th November sowing (1.76), while the minimum was observed 15thNovember sowing (1.63). Row spacing 25 cm recorded the maximum number of grain pod^{-1} (1.71) and the minimum was observed under 20 cm spacing (1.67). The interaction effect of different sowing dates and row spacing show a significant effect on number of grain pod^{-1}, 30thNovember+ 25 cm spacing significantly recorded the maximum number of grain pod^{-1} (1.80) which was statistically at par with 30th November+ 15 cm (1.77) and 30thoctober sowing + 15 cm spacing (1.77).

There was non-significant effect on test

Table 2: Effect of date of sowing and spacings on economics of lentil crops

Treatments (D x S)	Cost of cultivation (₹ha^{-1})	Gross return (₹ha^{-1})	Net return (₹ha^{-1})	B:C ratio
D_1S_2	31417.50	41861.30	10443.80	1.33
D_1S_3	30527.50	51921.10	21393.60	1.70
D_2S_1	29837.50	50553.90	20716.40	1.69
D_2S_2	31417.50	71127.90	39710.40	2.26
D_2S_3	30527.50	75544.30	45016.80	2.47
D_3S_1	29837.50	70551.50	40714.00	2.36
D_3S_2	31417.50	52700.00	21282.60	1.67
D_3S_3	30527.50	54735.80	24208.30	1.79
	29837.50	55448.80	25611.30	1.85

weight as a result of different sowing dates. Similarly, the result obtained on test weight due to varying row spacing did not show a significant effect. The interaction effect of date of sowing with row spacing did not show any significant effect.

There was significant variation in the seed yield of lentil as a result of different dates of sowing. The maximum seed yield (982.30 kg ha^{-1}) was recorded at mid date of sowing *i.e.* November15 and the minimum seed yield (652.94 kg ha^{-1}) was recorded in October 30 sowing. Under varying row spacing, the maximum seed yield (823.93 kg ha^{-1}) was recorded in row spacing of 20 cm which was at par with 25 cm spacing (797.86 kg ha^{-1}) and the minimum was recorded in row spacing of 15 cm (749.87 kg ha^{-1}). The interaction effect of different sowing dates and row spacing show a significant effect on seed yield, 15thNovember + 20 cm spacing significantly recorded the maximum seed yield (1026.07) which was statistically at par with 15$^{t\ h}$November + 25 cm (955.97) and 15thNovember sowing + 15 cm spacing (964.87).

The different sowing dates had a significant effect on harvest index. The maximum harvest index (26.96 %) was observed in 30th October sowing which was statistically at par with 30th November sowing (25.66 %) and the minimum harvest index (25.40 %) was observed in 15thNovember sowing. Row spacing also had a significant influence on the harvest index. 15 cm spacing recorded in maximum harvest index (27.21 %) while minimum harvest index was recorded in 20 cm spacing (25.20 %). The interaction effect of different sowing dates with row spacing was found to be significant where 30thOctober sowing with row spacing 15 cm recorded maximum harvest index (34.77 %) and the minimum was recorded in 30th October sowing + 25 cm row spacing (20.37 %).

ECONOMICS

Maximum net returns (₹45016.75 ha^{-1}) and maximum benefit cost ratio (2.47) was obtained from treatment combination of15thNovember sowing + 20 cm spacing among all the treatments. Higher gross return (₹98,160.00/ha), higher net return (₹ 67,318.00 ha^{-1}) and higher B:C ratio (2.18) were also recorded in treatment-9 (Nitrogen 30 kg ha^{-1} + Zinc - 3 kg ha^{-1} + Boron – 0.75 kg ha^{-1}) (Naik *et al*., 2023).

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