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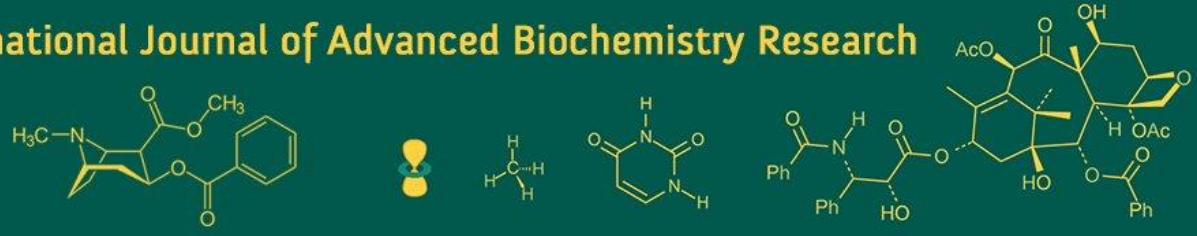

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Effect of different date of sowing and plant geometry on growth and yield of lucerne

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Abstract
A field experiment was conducted during *Rabi* 2024-25 at the Experimental Farm, Department of Agronomy, College of Agriculture, VNMKV, Parbhani (M.S.), to evaluate the effect of date of sowing and spacing on growth and yield of lucerne (*Medicago sativa* L.). The experiment, laid out in a split-plot design with three replications, comprised four date of sowing (D1: 22nd Oct, D2: 12th Nov, D3: 27th Nov, D4: 10th Dec) as main plots and three spacings (S1: 22.5 cm, S2: 30 cm, S3: 45 cm) as sub-plots. The soil was medium black, clay loam, and neutral in reaction (pH 7.15). Early sowing (D1) significantly enhanced plant height (37.98 cm), number of leaves (13.09), leaf area (11.54 dm²), green fodder yield (9186 kg ha^{-1}), dry fodder yield (1837 kg ha^{-1}) and was at par with date of sowing D2. Among spacings, spacing S2 (30 cm) was superior with improved growth plant height: (37.72 cm), leaves: (12.90), yields green fodder: (8506 kg ha^{-1}); dry fodder: (1701 kg ha^{-1}) and was statistically at par with spacing S1.

Keywords: Lucerne, date of sowing, spacing, growth, forage yield

Introduction
Lucerne (*Medicago sativa* L.) or alfalfa, is a globally significant perennial legume valued for its high protein content (15-25% DM), digestibility and rich nutrient profile of fibers, minerals and vitamins (Fulgueira *et al.*, 2007) [6]. Its deep roots confer drought resilience, while nitrogen fixation enhances soil fertility, supporting sustainable agriculture. Originating in Southwest Asia and the Middle East, cultivated lucerne (tetraploid, 2n = 4x = 32) likely evolved from *M. coerulea* (diploid, 2n = 16), native to southwestern Iran and the Caucasus (Batello *et al.*, 2008; Kapadia, 2019) [2, 9]. Though widely cultivated worldwide, its area in India has declined with breeder seed demand dropping by 85.58% from 1998-99 to 2021-22 (Chand *et al.*, 2023) [4]. of 14 released varieties, only nine remain in use, with Anand-2 dominant. Traditional practices such as broadcast sowing and fixed harvest schedules persist (Kad *et al.*, 2013) [8], limiting productivity. Studies indicate that early to mid-November sowing optimizes yield via favorable photoperiod and moisture (Wigley *et al.*, 2012; Kumar & Patel, 2017) [26], whereas delays reduce radiation use efficiency (Khumalo & Qakathekile, 2012) [11]. Narrow row spacing boosts forage yield (Garner *et al.*, 2009) [7], while wider spacing favors seed production (Askarian *et al.*, 1995; Pedersen & Allister, 1955) [1, 20]. Cutting at ~30-day intervals maximizes regrowth and dry matter (Kumar & Patel, 2017) [19]. In Gujarat, intercropping with wheat improves land-use efficiency and soil fertility (Patel *et al.*, 2020) [15] and improved varieties like Anand-2 offer higher returns and benefit-cost ratios (Khadda *et al.*, 2015) [10]. Known regionally as Rajka, Chara Methi, and Gajaro (Kapadia, 2019) [9], lucerne is integrated into diverse farming systems. Beyond forage, it contributes to soil conservation, crop rotation, hay/silage production, human nutrition (sprouts) and environmental remediation (Dunbier *et al.*, 1982; Venkatanagappa *et al.*, 2012) [5, 24]. Despite its adaptability and multifunctionality, suboptimal yields persist, with research recommending October to early November sowing for best establishment and biomass (Kumar *et al.*, 2020) [15].

Material method

An experiment on effect of date of sowing and plant geometry on growth and yield of lucerne (*Medicago sativa*) was carried out during *Rabi* season of 2024-25 at experimental farm of Department of Agronomy, College of Agriculture, VNMKV, Parbhani (M.S.). The soil of the experimental site was medium black and well drained with uniform depth up to 90 cm. The soil was medium in available nitrogen (162.20 kg ha^{-1}), medium in available phosphorus (16.45 kg ha^{-1}) and high in available potassium (458.25 kg ha-1) while, medium in organic carbon content (0.55%) having pH value of 7.15. Total 12 treatment combinations comprising four dates of sowing in main plot Viz., 22nd October (D1), 12th November (D2), 27th November (D3) and 10th December (D4) and three spacing in sub-plot Viz., 22.5 cm (S1), 30 cm (S2) and 45 cm (S3) were laid out in split plot design with three replications. The observations were recorded on plant height (cm), number of leaves plant^{-1}, leaf area plant^{-1} (dm^2), green fodder plant^{-1} (g), dry fodder plant^{-1} (g) and green fodder yield (kg ha^{-1}), dry fodder yield (kg ha^{-1}).

Results and Discussion

Dates of sowing

The dates of sowing had a significant impact on various growth parameters, including plant height, number of leaves plant^{-1}, leaf area plant^{-1}, and yield characters like green fodder plant^{-1}, dry fodder plant^{-1} at 15, 30 DAS at harvest and at successive cuttings. Among the different dates of sowing, date of sowing D1 (22nd Oct) resulted in the higher plant height, number of leaves plant^{-1}, leaf area plant^{-1}, green fodder plant^{-1}, dry fodder plant^{-1} than dates of sowing D2 (12th Nov) and it was found at par with dates of sowing D2 (12th Nov). The lower values for these parameters were consistently observed in the date of sowing D4 (10th Dec). Similar result observed by Patel and Sharma (1999) [18], Brown *et al*., (2005) [3], Kumar & Patel (2013) [12], Sheoran *et al*., (2021) [21]. The higher performance under dates of sowing D1 (22nd Oct) can be attributed due to mild temperature which favours better seed germination, root establishment and early vegetative growth.

The dates of sowing had significant impact on green fodder yield (kg ha^{-1}), dry fodder yield (kg ha^{-1}). Among the treatments, date of sowing D1 (22nd Oct) produced the maximum green fodder yield and dry fodder yield than dates of sowing D2 (12th Nov) and it was found at par with dates of sowing D2 (12th Nov). The lower green fodder yield and dry fodder yield produced by dates of sowing D4 (10th Dec). Similar result obtained by Singh *et al*., (2014) [22], Patel *et al*., (2017) [19]. The improved results under dates of sowing D1 (22nd oct) can be attributed due to availability of longer growing season, soil moisture, temperature and humidity for its growth.

Spacing

The different spacings had a statistically significant effect on various growth parameters, including plant height, number of leaves plant^{-1}, leaf area plant^{-1}, green fodder plant^{-1}, dry matter plant^{-1} at 15,30 DAS at harvest and at successive cuttings. Among the different spacing, spacing S2 (30 cm) recorded higher plant height, number of leaves plant^{-1}, leaf area plant^{-1}, green fodder plant^{-1}, dry fodder plant^{-1} than spacing S3 (45 cm) it was found at par with spacing S1 (22.5 cm). The lower growth was recorded by spacing S3 (45cm). This might be due to efficient light interception and nutrient uptake. Similar results were observed by Kumar *et al*., (2016) [14], Mattera *et al*., (2012) [14], Askarian *et al*., (1995) [1], Tiwana *et al*., (2007) [23], Kumar *et al*., (2005) [13].

The different spacing have significant impact on green fodder yield (kg ha^{-1}) and dry fodder yield (kg ha^{-1}). Among the different spacing, spacing S2 (30 cm) produced the maximum green fodder yield and dry fodder yield than S3 (45 cm) and it found at par with spacing S1 (22.5 cm). The lower yield produced by spacing S3 (45 cm). This might be due to optimal balance between plant population, light interception, airflow which promote efficient use of nutrient and water. Similar result was observed by Tiwana *et al*., (2007) [23] and Kumar *et al*., (2005) [13].

Interaction

The interaction effect between dates of sowing and spacing found to be non-significant for plant height, number of leaves plant^{-1}, leaf area plant^{-1}, green fodder plant^{-1}, dry fodder plant^{-1} at 15, 30 DAS at harvest and at successive cuttings and yield attributes such as green fodder (kg ha^{-1}) and dry fodder (kg ha^{-1}) found to be non-significant at harvest and successive cuttings.

Table 1: Mean plant height (cm) as influenced periodically by different dates of sowing and spacing of lucerne.

Treatments	15 DAS	30 DAS	1st harvesting (45 DAS)	First Cutting (75 DAS)	Second Cutting (105 DAS)	Third Cutting (135 DAS)
Date of sowing						
D1-22nd Oct	9.58	18.98	28.31	35.71	36.00	37.98
D2-12th Nov	8.82	18.22	26.65	34.05	34.47	36.43
D3-27th Nov	7.25	16.65	24.40	31.80	32.22	34.18
D4-1oth Dec	6.40	15.80	22.48	29.88	30.30	32.15
SEm.±	0.23	0.5	0.71	0.92	0.88	0.90
C.D. at 5%	0.81	1.73	2.46	3.19	3.06	3.14
Spacing						
S1-22.5 cm	8.30	17.70	25.32	32.72	33.14	35.10
S2-30 cm	9.00	18.40	28.02	35.42	35.74	37.72
S3-45 cm	6.74	16.14	23.05	30.45	30.87	32.75
SEm.±	0.26	0.60	0.88	1.13	1.15	1.14
C.D. at 5%	0.79	1.80	2.65	3.40	3.45	3.43
Interaction						
SEm.±	0.52	1.20	1.77	2.27	2.30	2.29
C.D. at 5%	NS	NS	NS	NS	NS	NS
G. Mean	8.01	17.41	25.46	32.86	33.25	35.19

Table 2: Mean number of leaves plant-1 as influenced periodically by different dates of sowing and spacing of lucerne.

Treatments	15 DAS	30 DAS	1st harvesting (45 DAS)	First Cutting (75 DAS)	Second Cutting (105DAS)	Third Cutting (135 DAS)
Date of sowing						
D1-22nd Oct	2.71	6.59	9.20	11.30	12.89	13.09
D2-12th Nov	2.61	5.83	8.13	10.32	11.78	11.98
D3-27th Nov	1.81	4.29	7.43	8.12	9.56	9.96
D4-1oth Dec	1.38	3.25	6.43	7.49	8.66	8.86
SEm.±	0.06	0.14	0.32	0.31	0.36	0.36
C.D. at 5%	0.21	0.49	1.10	1.08	1.26	1.26
Spacing						
S1-22.5 cm	2.28	5.49	8.47	10.38	11.68	11.93
S2-30 cm	2.45	5.99	9.35	11.42	12.65	12.90
S3-45 cm	1.65	3.49	5.57	6.13	7.85	8.10
SEm.±	0.07	0.18	0.29	0.35	0.38	0.38
C.D. at 5%	0.23	0.53	0.89	1.05	1.15	1.15
Interaction						
SEm.±	0.15	0.36	0.59	0.70	0.76	0.76
C.D. at 5%	NS	NS	NS	NS	NS	NS
G. Mean	2.13	4.99	7.80	9.31	10.73	10.98

Table 3: Mean leaf area plant-1 (dm2) as influenced periodically by different dates sowing and spacing of lucerne.

Treatments	15 DAS	30 DAS	1st harvesting (45DAS)	First Cutting (75 DAS)	Second cutting (105 DAS)	Third cutting (135 DAS)
Date of sowing						
D1-22nd Oct	3.01	6.48	6.95	8.56	9.91	11.54
D2- 12th Nov	2.81	5.87	6.62	8.13	9.46	10.28
D3-27th Nov	1.81	5.21	5.66	7.00	8.16	7.68
D4-10th Dec	1.21	4.07	4.76	5.96	6.51	6.94
SEm.±	0.07	0.21	0.24	0.31	0.43	0.91
C.D. at 5%	0.24	0.73	0.84	1.09	1.50	3.17
Spacing						
S1-22.5 cm	2.26	6.06	6.27	8.45	9.07	9.23
S2-30 cm	2.39	6.61	7.13	9.40	10.20	10.52
S3-45 cm	1.99	3.56	4.59	4.40	6.26	7.58
SEm.±	0.08	0.25	0.30	0.42	0.56	0.71
C.D. at 5%	0.24	0.75	0.91	1.27	1.68	2.13
Interaction						
SEm.±	0.16	0.5	0.61	0.85	1.12	1.42
C.D. at 5%	NS	NS	NS	NS	NS	NS
G. Mean	2.21	5.41	6.00	7.41	8.51	9.11

Table 4: Green fodder plant-1 (g) as influenced periodically by different dates of sowing and spacing of lucerne.

Treatments	15 DAS	30 DAS	1st Harvesting (45 DAS)	First Cutting (75 DAS)	Second cutting (105 DAS)	Third cutting (135 DAS)
Date of sowing						
D1-22nd Oct	2.22	3.31	5.96	7.76	9.27	10.52
D2-12th Nov	1.70	2.92	5.62	7.42	8.09	8.85
D3-27th Nov	1.46	1.66	3.81	5.97	6.58	7.51
D4-10th Dec	1.17	1.37	2.52	4.82	5.64	6.06
SEm.±	0.04	0.06	0.13	0.18	0.21	0.24
C.D. at 5%	0.17	0.22	0.45	0.64	0.74	0.83
Spacing						
S1-22.5 cm	1.92	2.52	4.65	6.58	7.50	8.40
S2-30 cm	1.97	2.91	5.27	7.28	8.34	9.51
S3-45 cm	1.02	1.52	3.51	5.61	6.35	6.79
SEm.±	0.06	0.09	0.16	0.23	0.26	0.29
C.D. at 5%	0.18	0.27	0.49	0.69	0.79	0.88
Interaction						
SEm.±	0.12	0.18	0.33	0.46	0.53	0.59
C.D. at 5%	NS	NS	NS	NS	NS	NS
G. Mean	1.64	2.31	4.48	6.49	7.40	8.24

Table 5: Dry fodder plant-1 (g) as influenced periodically by different dates of sowing and spacing of lucerne.

Treatments	15 DAS	30 DAS	1st harvesting (45 DAS)	First Cutting (75 DAS)	Second cutting (105 DAS)	Third cutting (135 DAS)
Date of sowing						
D1-22nd Oct	0.44	0.66	1.19	1.55	1.85	2.10
D2-12th Nov	0.34	0.58	1.12	1.48	1.61	1.77
D3-27th Nov	0.29	0.33	0.76	1.19	1.31	1.50
D4-10th Dec	0.23	0.27	0.50	0.96	1.12	1.21
SEm.±	0.02	0.02	0.03	0.06	0.07	0.10
C.D. at 5%	0.09	0.09	0.13	0.22	0.25	0.35
Spacing						
S1-22.5 cm	0.38	0.50	0.93	1.31	1.50	1.68
S2-30 cm	0.39	0.58	1.05	1.45	1.66	1.90
S3-45 cm	0.20	0.30	0.70	1.12	1.27	1.36
SEm.±	0.03	0.03	0.04	0.07	0.09	0.12
C.D. at 5%	0.09	0.10	0.13	0.23	0.26	0.37
Interaction						
SEm.±	0.06	0.07	0.09	0.15	0.17	0.24
C.D. at 5%	NS	NS	NS	NS	NS	NS
G. Mean	0.32	0.46	0.89	1.29	1.48	1.64

Table 6: Green fodder yield (kg ha-1) as influenced by different dates of sowing and spacing of lucerne.

Treatments	1st harvesting (45DAS)	First Cutting (75DAS)	Second Cutting (105DAS)	Third Cutting (135DAS)	Total
Date of sowing					
D1-22nd Oct	4500	6882	8445	9186	29013
D2-12th Nov	4016	6424	7801	8400	26640
D3-27th Nov	3330	5903	6978	7229	23439
D4-10th Dec	2621	5277	6461	6822	21180
SEm.±	158	175	214	228	--
C.D. at 5%	545	606	740	790	--
Spacing					
S1-22.5 cm	3641	6169	7479	7978	25268
S2-30 cm	4084	6553	7935	8506	27079
S3-45 cm	3124	5641	6848	7244	22858
SEm.±	163	220	258	277	--
C.D. at 5%	488	659	775	830	--
Interaction					
SEm.±	326	440	517	553	--
C.D. at 5%	NS	NS	NS	NS	--
G. Mean	3617	6121	7421	7909	25068

Table 7: Dry fodder yield (kg ha-1) as influenced by different dates of sowing and spacing of lucerne.

Treatments	1st harvesting (45DAS)	First Cutting (75 DAS)	Second Cutting (105 DAS)	Third Cutting (135 DAS)	Total
Date of sowing					
D1-22nd Oct	900	1376	1689	1837	5803
D2-12th Nov	803	1285	1560	1680	5328
D3-27th Nov	666	1181	1396	1446	4688
D4-10th Dec	524	1055	1292	1364	4236
SEm.±	21	35	43	46	--
C.D. at 5%	73	122	148	158	--
Spacing					
S1-22.5 cm	728	1234	1496	1596	5054
S2-30 cm	817	1311	1587	1701	5416
S3-45 cm	625	1128	1370	1449	4572
SEm.±	26	42	52	55	--
C.D. at 5%	77	127	155	166	--
Interaction					
SEm.±	51	85	103	111	--
C.D. at 5%	NS	NS	NS	NS	--
G. Mean	723	1224	1484	1582	5014

Conclusion

The effect of different dates of sowing and spacing on the growth and yield of the lucerne crop was evaluated. Among the different treatments, the date of sowing *i.e* 22nd Oct in combination with spacing *i.e* 30 cm was found to be suitable for higher growth and yield.

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