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Effect of planting time and spacing on growth of garlic (*Allium sativum* L.) cv. Anand Kesari

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Abstract
The field experiment entitled "Effect of planting time and spacing on growth of garlic (*Allium sativum* L.) cv. Anand Kesari" was conducted during *rabi* season of the year 2022-23. There were nine treatments consisting of three planting time (P_1: 1st week of October, P_2: 3rd week of October and P_3: 1st week of November) and spacing (S_1: 15 x 10 cm, S_2: 15 x 15 cm and S_3: 20 x 10 cm). Results revealed that planting time P2 (3rd week of October) led to the most favorable outcomes, with maximum germination, plant height, leaf number, leaf length, fresh and dry plant weight, crop growth rate and relative growth rate. Spacing S2 (15 x 15 cm) also exhibited positive effects on several growth parameters. The most productive combination was P_2S_3, resulting in significant increases in plant height, leaf characteristics, plant weight and physiological parameters (crop growth rate and relative growth rate).

Keywords: Planting time, spacing, garlic, crop growth rate, bulb weight

1. Introduction
Garlic (*Allium sativum* L.) is a significant bulb crop, second only to onions, and is believed to have originated from Central Asia and Southern Europe. It is grown in India on a large scale, with Gujarat, Madhya Pradesh, Maharashtra, Uttar Pradesh, and Rajasthan being major garlic-growing states. Garlic is known for its numerous medicinal properties and culinary uses, containing essential minerals, vitamins, and other beneficial substances. The growth, yield, and quality of garlic bulbs are influenced by environmental factors and agricultural practices, such as planting time and spacing. Temperature, photoperiod, and soil conditions play crucial roles in garlic cultivation. Proper management of these factors is essential to optimize growth, maximize yield, and enhance the quality of garlic bulbs. Determining the ideal spacing between plants is crucial to achieving the best results. While wider spacing promotes larger bulb size, closer spacing increases overall yield by accommodating more plants per unit area. Additionally, selecting appropriate planting dates can significantly impact garlic's growth cycle and final yield. Research on specific planting time and spacing for garlic cv. Anand Kesari can provide valuable insights for farmers in Gujarat to enhance their garlic production.

2. Materials and Methods
The field experiment was carried out during *rabi* season of the year 2022-23 at Horticulture Research Farm, Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand. It was laid out in Randomized Block Design concept (Factorial). The soil of the experimental plot was sandy loam type. There were three levels of planting time *viz.*, P_1 – 1st week of October, P_2 – 3rd week of October and P_3 – 1st week of November and three levels of spacing *viz.*, S_1 - 15 x 10 cm, S_2 – 15 x 15 cm and S_3 – 20 x 10 cm. Recommended dose of farm yard manure and NPK fertilizers were given as common dose in all the treatments. The germination % was calculated using the formula:

$$Germination\ percentage = \frac{number\ of\ germinate\ cloves}{total\ number\ of\ cloves\ planted}\ x\ 100$$

The plant height and length of leaves, was measured using a measuring scale. Clove parameters were taken after harvesting of cloves. The entire plant was uprooted and then dried in oven until constant weight was found to record dry weight of plant. The Crop Growth Rate (CGR) and Relative Growth Rate (RGR) was calculated by the given formulas:

$$CGR = \frac{1}{P} \times \frac{W_2 - W_1}{(t_2 - t_1)}$$

W_1 = Dry weight of plant at t_1
W_2 = Dry weight of plant at t_2
t_2 and t_1 = time interval
P = plant spacing

$$RGR = \frac{(\ln W_2 - \ln W_1)}{(t_2 - t_1)}$$

W_1 = Dry weight of plant at t_1
W_2 = Dry weight of plant at t_2

3. Result and Discussion

The planting time P_2 (3rd week of October) showed a significant maximum germination percentage (93.82%), which was at par with planting time P_1 (1st week of October) *i.e.* (91.02%). The effect of different spacing and interaction was found non-significant concerning germination (%) of garlic. The planting time P_2 (3rd week of October) showed significantly higher plant height (42.06 cm and 48.10 cm). The investigation period witnessed plants being exposed to favorable climate elements like temperature, humidity, and day length. These conducive conditions likely encouraged meristematic elongation, leading to wider intermodal lengths in the plants and, consequently, an overall increase in plant height. Similar results were reported by Abdalbagi *et al*. (2010) [1] in tomato, Bhuiya *et al*. (2003) [3] and Rahim *et al*. (2003) [4] in garlic. The significantly the highest plant height (41.55 cm and 46.96 cm respectively) was found at spacing S_2 (15 x 15 cm), Gashaw and Haile (2020) [5] and Moniruzzaman (2006) [6] reported similar findings in lettuce. The interaction effect of planting time and spacing gave significantly the highest plant height at 90 DAP and 120 DAP (45.64 cm and 54.03 cm respectively) were recorded in P_2S_3 (Planting time 3rd week of October with spacing 20 x 10 cm), whereas, significantly lowest plant height (35.87 cm and 41.77 cm) was found in P_3S_1 (Planting time 1st week of November with spacing 15 x 10 cm) at 90 and 120 DAP respectively.

The planting time P_2 (3rd week of October) showed significantly maximum number of leaves (5.77) and the significantly maximum number of leaves (5.36 and 6.90 respectively) was found at spacing S_2 (15 x 15 cm), that wider spaced plants tend to generate more axial branching compared to plants spaced closer together, which could account for the increased number of leaves. This aligns with the discoveries made by Om and Srivastava (1977) [7] in garlic and Singh and Sachan (1998) in garlic and onion.

The interaction effect of planting time and spacing at P_2S_3 (Planting time 3rd week of October with spacing 20 x 10 cm) registered significantly maximum number of leaves (6.6 and 7.74 respectively) of garlic and the minimum number of leaves was found in P_3S_1 (Planting time 1st week of November with spacing 15 x 10 cm) at 90 and 120 DAP *i.e.* (4.10 and 5.93 respectively).

The planting time P_2 (3rd week of October) was found to have significantly maximum length of leaves (32.36 cm and 36.08 cm respectively) at 90 and 120 DAP. The spacing S_2 (15 x 15 cm) was found to have significantly maximum length of leaves (31.81 cm and 34.93 cm respectively) at 90 and 120 DAP. The interaction effect of planting time and spacing was registered significantly maximum length of leaves (34.88 cm and 38.29 cm respectively) in treatment combination P_2S_3 (Planting time 3rd week of October with spacing 20 x 10 cm) and The minimum length of leaves (31.28 cm and 35.81 cm respectively) was found in P_1S_3 (Planting time 1st week of October with spacing 20 x 10 cm) at 90 and 120 DAP.

The planting time P_2 (3rd week of October) was found to have significantly highest dry weight of plant (6.35 g and 9.20 g respectively) at 90 and 120 DAP. Increased dry matter in comparison to other planting dates, the third week of October's planting of plants resulted in higher plant development in terms of plant height, leaf number, and leaf length, which may have contributed to the production of the entire plant. Similar trend was observed by Adekpe *et al*. (2008) [12] in garlic. The spacing S_2 (15 x 15 cm) was found to have significantly highest dry weight of plant (6.16 g and 8.77 g respectively), Better vegetative growth may be the reason for the higher production of dry matter in the whole plant, as it is apparent that growth characteristics such as plant height, length of leaves and number of leaves have increased. This result is in agreement with Vidya, G. (2015) [8].

The interaction effect of planting time and spacing was registered significantly maximum dry weight of plant (7.06 g and 10.41 g respectively) in treatment combination P_2S_3 (Planting time 3rd week of October with spacing 20 x 10 cm) and the minimum dry weight of plant (4.65 g and 6.08 g respectively) was found in P_1S_3 (Planting time 1st week of October with spacing 20 x 10 cm) at 90 and 120 DAP.

Table 1: Effect of planting time and spacing on growth attributes of garlic.

Treatment	Germination %	Plant height (cm)		Number of leaves		Length of leaves (cm)		Dry weight of plant (g)	
		90 DAP	120 DAP	90 DAP	120 DAP	90 DAP	120 DAP	90 DAP	120 DAP
Planting time (P)									
P_1 -1st week of October	91.02	39.69	45.80	5.01	6.57	28.99	32.63	5.71	8.12
P_2 - 3rd week of October	93.82	42.06	48.10	5.77	7.19	32.36	36.08	6.35	9.20
P_3 – 1st week of November	85.42	37.56	43.11	4.50	6.23	27.20	30.77	5.21	6.90
S. Em±	2.02	0.96	1.12	0.15	0.15	0.68	0.67	0.11	0.20
CD (P = 0.05)	6.05	2.87	3.35	0.46	0.44	2.04	2.01	0.33	0.61
Spacing (S)									
S_1 - 15 x 10 cm	92.98	37.83	43.24	4.66	6.33	27.33	31.33	5.18	6.96
S_2 - 15 x 15 cm	89.86	41.55	46.96	5.36	6.90	31.81	34.93	6.16	9.04
S_3 - 20 x 10 cm	87.42	39.94	46.80	5.27	6.76	29.40	33.22	5.93	8.23
S. Em±	2.02	0.96	1.12	0.15	0.15	0.68	0.67	0.11	0.20
CD (P = 0.05)	NS	2.87	3.35	0.46	0.44	2.04	2.01	0.33	0.61
P x S Interaction									
S. Em±	3.49	1.66	1.94	0.26	0.25	1.18	1.16	1.66	1.94
CD (P = 0.05)	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
CV (%)	6.72	7.21	7.34	9.00	6.57	6.91	6.06	7.21	7.34

Table 1 (a): Interaction effect of planting time and spacing on plant height, number of leaves at 90 and 120 DAP respectively.

Spacing / Planting time	Plant height at 90 DAP			Plant height at 120 DAP			Number of leaves at 90 DAP			Number of leaves at 120 DAP		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
P_1	37.24	43.87	37.98	42.42	51.67	43.30	4.43	5.90	4.70	6.06	7.34	6.30
P_2	40.37	40.35	45.46	45.54	44.73	54.04	5.43	5.27	6.60	7.00	6.83	7.74
P_3	35.88	40.42	36.38	41.77	44.49	43.06	4.10	4.90	4.50	5.93	6.53	6.23
S. Em±	1.66			1.94			0.26			0.25		
CD (P = 0.05)	4.96			5.80			0.79			0.76		
CV (%)	7.21			7.34			9.00			6.57		

Table 1 (b): Interaction effect of planting time and spacing on length of leaves and dry weight of plants at 90 and 120 DAP respectively.

Spacing / Planting time	Length of leaves at 90 DAP			Length of leaves at 120 DAP			Dry weight of plant (g) at 90 DAP			Dry weight of plant (g) at 120 DAP		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
P_1	26.88	34.09	25.99	30.40	36.90	30.58	5.07	6.53	5.51	6.63	10.33	7.40
P_2	30.90	32.66	34.88	33.49	32.66	38.29	5.80	6.20	7.06	8.18	9.01	10.41
P_3	23.84	30.44	27.31	27.77	33.75	30.78	4.66	5.75	5.22	6.08	7.76	6.87
S. Em±	1.18			1.16			0.19			0.35		
CD (P = 0.05)	3.53			3.48			0.57			1.06		
CV (%)	6.91			6.06			7.21			7.34		

The planting time P_2 (3rd week of October) gave significantly highest CGR (0.376 mg.cm^{-2}.day^{-1} and 0.5 mg.cm^{-2}.day^{-1} respectively), the primary reason for the higher CGR observed in the third planting date is the favorable temperature conditions during the growth and development stages. These optimal temperatures not only lead to an increase in crop growth rate but also serve as a significant factor in enhancing the overall yield. The present results are in conformity with the previous reports by Sobhani *et al.* (2012) [9] in buckwheat.

The CGR at 60-90 DAP was found to be significantly highest (0.304 mg.cm^{-2}.day^{-1}) at spacing S_2 (15 x 15 cm). The CGR was found to be significantly highest (0.423 mg.cm^{-2}.day^{-1}) at spacing S_2 (15 x 15 cm).

The higher Crop Growth Rate observed in wider spacing can be attributed to the efficient utilization of available nutrients and moisture, coupled with the maximum absorption of solar radiation. This combination facilitates the accelerated growth of crop plants. Similar result was obtained by Mahato and Adhikari (2017) [10] in rice and Singh *et al.* (2006) [11] in wild turmeric.

The maximum Crop Growth Rate at 60-90 DAP (0.430 mg.cm^{-2}.day^{-1}) was observed in P_2S_3 (Planting in 3rd week of October at spacing 20 x 10 cm), while the minimum Crop Growth Rate was recorded in P_3S_1 (0.180 mg.cm^{-2}.day^{-1}) (Planting in 1st week of November at spacing 15 x 10 cm). The planting time P_2 (3rd week of October) gave significantly highest Relative Growth Rate (0.0136 g.g^{-1}.day^{-1} and 0.0123 g.g^{-1}.day^{-1} respectively). The Relative Growth Rate at 60-90 DAP and 90-120 DAP was found to be significantly highest (0.0137 g.g^{-1}.day^{-1} and 0.0127 g.g^{-1}.day^{-1} respectively) at spacing S_2 (15 x 15 cm). The interaction effect of planting time and spacing resulted in significantly maximum Relative Growth Rate at 90-120 DAP (0.01513 g.g^{-1}.day^{-1}) in P_2S_3 (Planting in 3rd week of October at spacing 20 x 10 cm) and minimum Relative Growth Rate was recorded in P_1S_1 (Planting time 1st week of November with spacing 15 x 10 cm) *i.e.* (0.00640 g.g^{-1}.day^{-1}). The P_3S_2 (Planting time 1st week of October with spacing 15 x 15 cm) registered significantly maximum Relative Growth Rate (0.01513 g.g^{-1}.day^{-1}) for 90-120 DAP. While, minimum Relative Growth Rate was recorded in P_3S_1 Planting time 1st week of November with spacing 15 x 10 cm) *i.e.* (0.00890 g.g^{-1}.day^{-1}).

Table 2: Effect of planting time and spacing on CGR and RGR at 60-90 DAP and 90-120 DAP of garlic respectively.

Treatment	Crop Growth Rate (mg.cm^{-2}.day^{-1})		Relative growth rate (g.g^{-1}.day^{-1})	
	60-90 DAP	90- 120 DAP	60-90 DAP	90-120 DAP
Planting time (P)				
P_1 -1st week of October	0.290	0.408	0.0118	0.0114
P_2 - 3rd week of October	0.376	0.500	0.0136	0.0123
P_3 – 1st week of November	0.219	0.296	0.0094	0.0094
S. Em±	0.006	0.011	0.0003	0.0003
CD (P = 0.05)	0.018	0.032	0.0011	0.0008
Spacing (S)				
S_1 - 15 x 10 cm	0.278	0.397	0.0092	0.0098
S_2 - 15 x 15 cm	0.304	0.423	0.0137	0.0127
S_3 - 20 x 10 cm	0.302	0.383	0.0120	0.0107
S. Em±	0.006	0.011	0.0004	0.0003
CD (P = 0.05)	0.018	0.032	0.0011	0.0008
P x S Interaction				
S. Em±	0.011	0.018	0.0019	0.0005
CD (P = 0.05)	Sig	Sig	Sig	Sig
CV (%)	6.20	7.94	9.28	7.16

Table 2 (a): Interaction effect of planting time and spacing on CGR and RGR at 60-90 DAP and 90-120 DAP of garlic respectively

Spacing / Planting time	Crop Growth Rate ($mg.cm^{-2}.day^{-1}$) at 60-90 DAP			Crop Growth Rate ($mg.cm^{-2}.day^{-1}$) at 90-120 DAP			Relative growth rate ($g.g^{-1}.day^{-1}$) 60-90 DAP			Relative growth rate ($g.g^{-1}.day^{-1}$) 90-120 DAP		
	S_1	S_2	S_1	S_2	S_3	S_1	S_1	S_2	S_3	S_1	S_2	S_3
P_1	0.263	0.347	0.263	0.347	0.263	0.347	0.0091	0.0151	0.0113	0.0090	0.0153	0.0099
P_2	0.390	0.307	0.390	0.307	0.390	0.307	0.0121	0.0136	0.0151	0.0116	0.0125	0.0130
P_3	0.180	0.260	0.180	0.260	0.180	0.260	0.0064	0.0124	0.0096	0.0098	0.0127	0.0092
S. Em±	0.011			0.018			0.0006			0.005		
CD (P = 0.05)	0.032			0.055			0.0014			0.0014		
CV (%)	6.20			7.94			9.28			7.16		

Conclusions

Based on the preceding analysis, it can be deduced that the optimal results for garlic cultivation were achieved by planting during the third week of October, which led to enhanced vegetative growth characteristics and greater yield, while planting at spacing 15 x 15 cm resulted in improved vegetative growth. Consequently, the most favorable combination for augmented growth involved the cultivation of the Anand Kesari garlic variety in the third week of October and spacing it at 15 x 15 cm.

References

1. Hamid AA, Salih SO, Abdalla AE, El-Naim AM. Effect of sowing date and plant density on growth and yield of tomato (*Lycopersicon esculentum* Mill.). Research Journal of Agriculture and biological Sciences. 2010;6(5):665-669.
2. Kutte MM. Effect of garlic (*Allium sativum*) and Ginger (*Zingiber officinale*) on the microbial and sensorial quality of smoked mackerel fish (*Scomber scombrus*). Int. J Biol. Sci. 2022;4(1):188-191. DOI: 10.33545/26649926.2022.v4.i1c.105
3. Bhuiya MAK, Rahim MA, Chowdhury MNA. Effect of planting time, mulch and irrigation on the growth and yield of garlic. Asian Journal of Plant Sciences. 2003;2(8):639-643.
4. Rahim MA, Chowdhury MNA, Anwar HRMM, Alam MS. Effect of planting dates on the growth and yield of garlic germplasm. Asian Journal of Plant Sciences. 2003;2(2):171-174.
5. Gashaw B, Haile S. Effect of different rates of N and intrarow spacing on growth performance of lettuce (*Lactuca sativa* L.) in Gurage Zone, Wolkite University, Ethiopia. Advances in Agriculture; c2020. p. 1-6.
6. Moniruzzaman M. Effects of plant spacing and mulching on yield and profitability of lettuce (*Lactuca sativa* L.). Journal of Agriculture & Rural Development. 2006;4(1):107-111.
7. Om H, Srivastava RP. Influence of the planting material and spacing on the growth and yield of garlic. Indian Journal of Horticulture. 1977;34(2):152-156.
8. Vidya G. Effect of planting time and plant densities on yield and yield contributing characters in garlic (*Allium sativum* L.) cv. Jamnagar. Plant Archives. 2015;15(2):947-952.
9. Sobhani MR, Rahmikhdoev G, Mazaheri D, Majidian M. Effects of sowing date, cropping pattern and nitrogen on CGR, yield and yield component summer sowing buckwheat (*Fagopyrum esculentum* Moench). Journal of Applied Environmental and Biological Sciences. 2012;2(1):3546.
10. Mahato M, Adhikari BB. Effect of planting geometry on growth of rice varieties. International Journal of Applied Sciences and Biotechnology. 2017;5(4):423-429.
11. Singh RD, Meena RL, Singh MK, Kaul VK, Lal B, Acharya R, *et al*. Effect of manure and plant spacing on crop growth, yield and oil-quality of *Curcuma aromatica* Salisb. in mid hill of western Himalaya. Industrial crops and products. 2006;24(2):105-112.
12. Adekpe DI, Shebayan JAY, Ishaya DB, Shinggu CP, Mahadi MA, Mansir Y. Effect of weed control, date of planting and intra-row spacing on the performance of garlic (*Allium sativum* L.) under irrigation at kadawa, Nigeria. Crop Research. 2008;35(1):35-41.