

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

**Commented [sd1]:** Change the title and make like this "Optimizing Yield and Quality of Garlic (*Allium sativum* L.) cv. Anand Kesari through Planting Time and Plant Spacing Management"

## ABSTRACT

The field experiment entitled "Effect of planting time and spacing on yield and quality 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<sub>1</sub>: 1<sup>st</sup> week of October, P<sub>2</sub>: 3<sup>rd</sup> week of October and P<sub>3</sub>: 1<sup>st</sup> week of November) and spacing (S<sub>1</sub>: 15 x 10 cm, S<sub>2</sub>: 15 x 15 cm and S<sub>3</sub>: 20 x 10 cm). Results revealed that planting time P<sub>2</sub> (3<sup>rd</sup> week of October) led to the most favorable outcomes, with bulb diameter, and bulb weight. Spacing S<sub>2</sub> (15 x 15 cm) also exhibited positive effects on bulb quality. The most productive combination was P<sub>2</sub>S<sub>3</sub>, resulting in significant increases in bulb quality. However, P<sub>2</sub>S<sub>2</sub> proved to be the optimal choice for achieving the highest yield. These findings provide valuable insights for garlic cultivation, helping farmers optimize planting strategies to enhance crop performance and yield.

**Keywords:** Planting time, Spacing, Garlic, Bulb diameter, Bulb weight, Yield, Sulphur content.

## 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. MATERIAL 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<sub>1</sub> – 1<sup>st</sup> week of October, P<sub>2</sub> – 3<sup>rd</sup> week of October and P<sub>3</sub> – 1<sup>st</sup> week of November and three levels of spacing *viz.*, S<sub>1</sub> - 15 x 10 cm, S<sub>2</sub> – 15 x 15 cm and S<sub>3</sub> – 20 x 10 cm. Recommended dose of farm yard manure and NPK fertilizers were given as common dose in all the treatments. The weight of bulb was taken in grams on average basis. Bulb diameter were taken with the help of vernier caliper in centimeters. Bulb yield was taken on plot basis and then converted into quintals per hectare. Chemical analysis was done using the

standard procedures. T.S.S (<sup>o</sup>Brix) was recorded with Erma pocket hand refractometer and the sulphur content of the bulb (%) was recorded using the Turbidimetric method with a Spectrophotometer.

### 3. RESULTS AND DISCUSSION

The planting time P<sub>2</sub> (3<sup>rd</sup> week of October) gave significantly highest bulb diameter (4.46 cm), which was found to be atpar with the planting time P<sub>1</sub> (1<sup>st</sup> week of October) by recording the bulb diameter of (4.18 cm). The greater number of plant height and number of leaves, the larger bulb diameter. Similar results were reported by Nourbakhsh and Cramer (2022)<sup>[2]</sup> in onion.

The bulb diameter was found to be significantly highest at spacing S<sub>2</sub> (15 x 15 cm) *i.e.* (4.42 cm), it was atpar with the spacing S<sub>3</sub> (20 x 10 cm) *i.e.* (4.25 cm). Each plant in the crop that was more widely spaced out had plenty of space around it, which prevented it from competing with other plants for food and nutrients. As a consequence, each plant performed better in terms of its own personality. The findings align with those of Gaikwad *et al.* (2018)<sup>[3]</sup> and Om and Srivastava (1977)<sup>[1]</sup> in garlic. The interaction effect of planting time and spacing evidenced significantly maximum bulb diameter in P<sub>1</sub>S<sub>2</sub> (Planting in 1<sup>st</sup> week of October at spacing 15 x 15 cm) *i.e.* (4.84 cm), it was at par with P<sub>2</sub>S<sub>1</sub> (Planting in 3<sup>rd</sup> week of October at spacing 15 x 10 cm) recording the bulb diameter of (4.79 cm) and P<sub>2</sub>S<sub>2</sub> (Planting in 3<sup>rd</sup> week of October at spacing 15 x 15 cm) recording the bulb diameter of (4.27 cm). The significantly minimum bulb diameter was noted in P<sub>1</sub>S<sub>1</sub> (Planting in 1<sup>st</sup> week of October at spacing 15 x 10 cm) *i.e.* (3.82 cm).

The planting time showed significant effect on the weight of bulb, the planting time P<sub>2</sub> (3<sup>rd</sup> week of October) gave significantly highest weight of bulb (12.29 g).

The increase in bulb weight might be due to better vegetative growth like plant height, number of leaves/plants there by increasing the sink size in terms of bulb size. Thus, robust growth leads to production of more leaves, which resulted in synthesis of more photosynthates and increased accumulation of carbohydrates and other metabolites which ultimately determined the weight of bulbs. These results are in conformity with the findings of Singh *et al.* (2010) and Savale *et al.* (2015)<sup>[4]</sup> in garlic. The weight of bulb was found to be significantly highest at spacing S<sub>2</sub> (15 x 15 cm) being (12.01 g). This might be due that a plant would be able to get more nutrients and air space with a wider spacing or a lower plant density. The findings aligned with that given by Singh and Singh (2010)<sup>[5]</sup>. The interaction effect of planting time and spacing evidenced significantly maximum weight of bulb in P<sub>2</sub>S<sub>3</sub> (Planting in 3<sup>rd</sup> week of October at spacing 20 x 10 cm) *i.e.* (13.61 g), it was at par with P<sub>1</sub>S<sub>1</sub> (Planting in 1<sup>st</sup> week of October at spacing 15 x 15 cm) recording the weight of bulb of (13.42 g). However, the minimum weight of bulb (9.58 g) was recorded in P<sub>3</sub>S<sub>1</sub> (Planting in 1<sup>st</sup> week of November at spacing 15 x 10 cm). This might be as a result of the optimal plant densities and planting dates. Muhammad Jamroz *et al.* (2001)<sup>[6]</sup> in garlic and Nagre *et al.* (1985)<sup>[7]</sup> in onions.

The planting time P<sub>2</sub> (3<sup>rd</sup> week of October) gave significantly highest yield (1.93 kg/plot). Decrease in yield was observed in early planting which may be due to poor growth and development of plant. As yield potential of a plant depends upon the amount of vegetative growth made before bulbing commences. Number of workers reported the beneficial effects of date of planting in garlic on yield, viz. Savale *et al.* (2015)<sup>[4]</sup> and Quaryouti and Kasrawi (1995)<sup>[8]</sup> in garlic. The yield was found to be significantly highest (1.95 kg/plot) at spacing S<sub>1</sub> (15 x 10 cm). The most intriguing finding was that the bigger bulb size and better morphological character development at S<sub>2</sub> (15 cm x 15 cm) spacing were unable to offset the yield decline caused by the decreased plant population per unit area, Kun *et al.* (1999)<sup>[9]</sup> (Planting time 1<sup>st</sup> week of November with spacing 20 x 10 cm). Higher yield in 3<sup>rd</sup> week of October and closer spacing is because of more plants per hectare and vigorous growth of plants in early planting

dates, and it was noticed that yield decreased as the spacing between plants increased and delayed in planting. The observation is in agreement with the findings of Devulkar *et al.* (2015)<sup>[10]</sup> in garlic and Nagre *et al.* (1985)<sup>[7]</sup> in onion.

Different planting time has a significant effect on the yield of garlic. Planting at P<sub>2</sub> (3<sup>rd</sup> week of October) showed significantly the highest yield (60.7 q/ha). The yield was found to be significantly the highest (59.2 q/ha) at spacing S<sub>1</sub> (15 cm x 10 cm) recorded the highest yield (t/ha), despite having low bulb weight, diameter, and cloves per bulb. Consequently, yield was lower at low plant populations due to narrow spacing. Moravcevic *et al.* (2011)<sup>[11]</sup>, gave similar outcome that the production was best with the narrower planting, but the bulb quality was lowest.

The interaction effect of planting time and spacing depicted significantly maximum yield of garlic in P<sub>2</sub>S<sub>1</sub> (Planting time at 3<sup>rd</sup> week of October with spacing 15x 10 cm) *i.e.* (70.93 q/ha), minimum yield (44.99 q/ha) was found in P<sub>3</sub>S<sub>2</sub> (Planting time 1<sup>st</sup> week of November with spacing 15 x15 cm).

**Table 1a** : Effect of planting time and spacing on yield attributes of garlic.

Treatment	Weight of bulb (g)	Bulb diameter (cm)	Yield (kg/plot)	Yield (q/ha)
Planting time (P)				
<b>P<sub>1</sub> - 1<sup>st</sup> week of October</b>	11.14	4.17	1.73	54.43
<b>P<sub>2</sub> - 3<sup>rd</sup> week of October</b>	12.29	4.46	1.93	60.7
<b>P<sub>3</sub> - 1<sup>st</sup> week of November</b>	9.91	4.00	1.49	46.96
S. Em±	0.24	0.11	0.061	1.91
CD (P = 0.05)	0.72	0.33	0.182	5.72
Spacing (S)				
<b>S<sub>1</sub> - 15 x 10 cm</b>	10.08	3.96	1.95	59.2
<b>S<sub>2</sub> - 15 x 15 cm</b>	12.01	4.42	1.56	49.43
<b>S<sub>3</sub> - 20 x 10 cm</b>	11.25	4.25	1.65	53.46
S. Em±	0.30	0.11	0.061	1.91
CD (P = 0.05)	0.89	0.33	0.182	5.72
S. Em±	0.51	0.19	0.11	3.31
CD (P = 0.05)	Sig	Sig	Sig	Sig
CV (%)	8.57	7.87	10.60	10.60

**Table: 1 (b)** Interaction effect of planting time and spacing on yield attributes of garlic.

Spacing	Weight of bulb (g)			Bulb diameter (cm)			Yield (kg/plot)			Yield (q/ha)		
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>
Planting time												
P <sub>1</sub>	9.75	13.42	10.25	3.78	4.79	3.93	1.91	1.74	1.54	57.8	55.36	50.13
P <sub>2</sub>	10.91	12.34	13.61	4.26	4.27	4.84	2.34	1.48	1.98	70.93	46.93	64.25
P <sub>3</sub>	9.58	10.26	9.89	3.82	4.19	3.98	1.61	1.45	1.42	48.87	46.01	46
S. Em±	0.41			0.19			0.11			3.31		

CD (P = 0.05)	1.24	0.57	0.32	9.91
CV (%)	8.57	7.87	10.60	10.60

The effect of different time of planting time and spacing was found non-significant with respect to TSS and the interaction effect of different planting time and spacing was found non-significant with respect to Total Soluble Solids (TSS). The effect of different time of planting time and spacing was found non-significant with respect to sulphur content of the bulb and interaction effect of different planting time and spacing was found non-significant with respect to sulphur content of the bulb.

**Table 2:** Effect of planting time and spacing on quality attribute of garlic.

Treatment	TSS (° Brix)	Sulphur content of the bulb (%)
Planting time (P)		
<b>P<sub>1</sub> - 1<sup>st</sup> week of October</b>	20.65	0.1331
<b>P<sub>2</sub> - 3<sup>rd</sup> week of October</b>	20.80	0.1339
<b>P<sub>3</sub> - 1<sup>st</sup> week of November</b>	19.58	0.1274
S. Em±	0.44	0.0024
CD (P = 0.05)	NS	NS
Spacing (S)		
<b>S<sub>1</sub> - 15 x 10 cm</b>	20.65	0.1339
<b>S<sub>2</sub> - 15 x 15 cm</b>	20.58	0.1320
<b>S<sub>3</sub> - 20 x 10 cm</b>	19.79	0.1285
S. Em±	0.44	0.0024
CD (P = 0.05)	NS	NS
P x S Interaction		
S. Em±	0.77	0.0042
CD (P = 0.05)	NS	NS
CV (%)	6.54	5.54

#### 4. CONCLUSION

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. The utilization of a spacing configuration of 15 x 10 cm resulted in the highest yield due to the increased plant population per hectare. Consequently, the most favorable combination for maximizing yield without compromising quality involved the cultivation of the Anand Kesari garlic variety in the third week of October and spacing it at 15 x 10 cm

#### REFERENCES

- Om, H., & Srivastava, R. P. (1977). Influence of the planting material and spacing on the growth and yield of garlic. *Indian Journal of Horticulture*, **34**(2), 152-156.
- Nourbakhsh, S. S., & Cramer, C. S. (2022). Onion plant size measurements as predictors for onion bulb size. *Horticulturae*, **8**(8), 682.
- Gaikwad, D. G., Shinde, S. J., Panchal, K. N. & Moklikar, M. S. (2018). Studies on influence response of plant density on growth and yield of garlic (*Allium sativum* L.). *International Journal of Current Microbiology and Applied Sciences*, **6**, 2891-2897.
- Savale, S. V., Patel, B. K., Nanaware, P. R. & More, S. G. (2015). Effect of different methods and time of planting on growth, yield and quality of garlic (*Allium sativum* L.). *Ecology, Environment and Conservation Paper*, **21**(3), 1431-1435.

5. Singh, P. K., & Singh, D. R. (2010). Effect of spacing and levels of nitrogen on growth and yield of garlic. *Indian Journal of Horticulture*, **67**(4), 305-307.
6. Muhammad Jamroz, Muhammad Ishtiaq, Nisar Naeem Niaz, Muhammad Buzerg Jamiher & Javed Iqbal. (2001). Effects of different planting dates and spacing on growth and yield of garlic cv. Bianco. *On line Journal of Biological Sciences*, **1**(4), 206-208.
7. Nagre, P. K., Kulwal, L. V. & Kale, P. B. (1985). Effect of different dates of transplanting and spacing on growth and yield of onion cv. Local White. *PKV Research Journal*, **9**(2),77-80
8. Quaryouti, M. M., & Kasrawi, M. A. (1995). Storage temperature of seed bulbs and planting date influence on garlic in emergence, vegetative growth, bulbing and maturity. *Advances in Horticultural Science*, 12-18.
9. Kun, X., Junhua, Y. & Hong, Q. L. (1999). The influence of seed cloves and plant density on garlic yield. *Journal of Shandon Agricultural University*,**30** (4),409412.
10. Devulkar NG, Bhanderi DR, More, SJ, Jeth BA. (2015). Optimization of yield and growth in onion through spacing and time of planting. *Green farming International Journal*, **6**(2),305-307
11. Moravcevic, D., Bjelic, V., Moravcevic, M., Gyozdanic, J., Varga, Beatovic, D. & Jelacic, S. (2011). The effect of plant density on bulb quality and yield of spring garlic (*Allium sativum* L.). 46<sup>th</sup> Croatian and 6<sup>th</sup> International Symposium on Agriculture. Opatija Croatia (554-557)