Plant Archives Vol. 26, No. 1, 2026 pp. 1667-1672 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.1.229

COMPARATIVE PERFORMANCE OF IMPROVED GARLIC VARIETIES FOR GROWTH, YIELD AND QUALITY UNDER ORGANIC AND INORGANIC CONDITIONS

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(Date of Receiving-28-01-2026; Date of Revision-27-03-2026; Date of Acceptance-08-04-2026)

ABSTRACT

A field experiment was conducted to evaluate the performance of different garlic varieties under organic and conventional growing conditions with respect to growth, yield and quality attributes. Six garlic varieties namely Yamuna Safed-2, Yamuna Safed-5, Yamuna Safed-3, Yamuna Safed-8, Yamuna Safed-9 and Yamuna Purple-10 were assessed under inorganic (conventional) and organic nutrient management systems. The experiment was laid out in a randomized block design with four replications. Observations were recorded on plant height, number of leaves, neck thickness, bulb diameter, fresh bulb weight, number of cloves per bulb, days to maturity, total soluble solids (TSS), bulb yield and economic returns. Results revealed that conventional growing conditions significantly enhanced vegetative growth parameters such as plant height, number of leaves and neck thickness in most varieties. However organic cultivation showed comparable performance in bulb size and quality traits particularly TSS content. Bulb yield was higher under inorganic management in which Yamuna Safed-9 recording the highest yield (78.33 q ha^{-1}). Under organic conditions, Yamuna Purple-10 exhibited superior yield (63.88 q ha^{-1}). Economic analysis indicated higher gross and net returns under conventional cultivation although organic farming demonstrated acceptable benefit-cost ratios. The study concludes that while conventional farming maximizes yield and profitability, organic cultivation of suitable garlic varieties can be a sustainable alternative with improved quality attributes.

Key words : Garlic, Organic farming, Conventional farming, Yield, Quality and Economics.

Introduction

Garlic (*Allium sativum* L.) is one of the most important bulbous spice crops grown throughout the world for its culinary, medicinal and therapeutic properties. India is the second largest producer of garlic with substantial area under cultivation due to its adaptability to diverse agro-climatic conditions. Garlic is rich in sulphur-containing compounds such as allicin, which impart its characteristic aroma and confer health benefits including antimicrobial, antioxidant and cardioprotective properties (Czech *et al.*, 2022).

In recent years, there has been growing concern over the excessive use of chemical fertilizers in agriculture leading to soil degradation, environmental pollution and health hazards (Negi *et al.*, 2024). This has resulted in increasing interest in organic farming systems that emphasize the use of organic manures, biofertilizers and eco-friendly practices. Organic agriculture aims to enhance soil health, biodiversity and produce safe high quality food (Citak and Sonmez, 2010). Garlic is a nutrient exhaustive crop requiring adequate supply of nitrogen, phosphorus, potassium and micronutrients for optimum growth and bulb development (Choudhary *et al.*, 2013). Conventional farming systems rely heavily on synthetic fertilizers to meet these requirements often resulting in higher yields. However organic nutrient sources release nutrients slowly and improve soil physical and biological properties which may positively influence crop performance and quality (Lee *et al.*, 2014).

Varietal response to nutrient management plays a crucial role in determining crop productivity. Different garlic varieties exhibit varied adaptability to organic and inorganic nutrient sources due to differences in growth habit, nutrient uptake efficiency and genetic potential (El-Magd, 2012). Therefore, identifying suitable garlic varieties for organic cultivation is essential for sustainable production.

The present investigation was undertaken to study the effect of organic and conventional growing conditions on growth, yield and economics of different garlic varieties with the objective of identifying high performing varieties under both (Organic and conventional) nutrient management systems.

Materials and Methods

The field experiment was conducted at the Horticultural Research Farm, Dr. B.R. Choudhary Agricultural research station, Mandor, Jodhpur (Rajasthan), India in *Rabi* season of 2023-24 and 2024-25. The experimental field is located at an altitude of 279 m above mean sea level between 26.34°N latitudes and 73.04°W longitudes. The average annual rainfall reaches 438.9 mm, with an average temperature of 10-24! during the growth period of garlic. The soil of the experimental field was sandy loam. The experiment was laid out in a Randomized Block Design (RBD) with four replications. Data pooled over two successive years (2023-24 and 2024-25) were used for statistical analysis. The treatments consisted of six garlic varieties *viz*. V_1-Yamuna Safed-2, V_2-Yamuna Safed-5, V_3-Yamuna Safed-3, V_4-Yamuna Safed-8, V_5-Yamuna Safed-9 and V_6-Yamuna Purple-10, grown under two nutrient management systems. Healthy cloves were planted at a spacing of 8×10 cm. Standard agronomic practices such as irrigation, weeding and plant protection measures were uniformly followed for all treatments. Organic plots were managed without the use of synthetic chemicals. Data about growth components were collected from 10 plants in each replication of the 6 treatments. A random sampling was done from each plot to determine plant height, number of leaves per plant, neck thickness, bulb diameter, fresh bulb weight, number of cloves per bulb, days to maturity, total soluble solids (TSS) and bulb yield. Plant height was measured with the help of measuring tape at 90 days after planting and expressed in centimeters. Number of leaves (30 DAP) was counted from randomly selected plants of different treatment. Stem girth (90 DAP) and diameter of bulb was taken in the with the help of digital vernier calipers in mm and averaged. Yield per hectare was calculated by weighing all bulbs from each treatment, replication wise at the time of harvesting.

$$Yield\ \ per\ hectare\ (kg) = \frac{Garlic\ weight\ (kg)}{Plot\ area\ (m^2)} \times 10{,}000$$

Under conventional farming, recommended doses of NPK fertilizers were applied through urea, single super phosphate and muriate of potash. In organic plots nutrients were supplied through well decomposed farmyard manure, vermicompost and approved organic inputs as per organic standards.

The obtained data was subjected to statistical analysis using the F test according to the procedure of Gomez and Gomez (1984). The critical difference at 5% was calculated to compare the mean value of the determined criteria of different treatments.

Results and Discussion

Growth parameters

The effect of organic and conventional growing conditions on growth attributes of garlic has been presented in Table 1. Plant height varied significantly among garlic varieties under both growing conditions, indicating the influence of nutrient management practices as well as genetic variability. Under conventional farming, Yamuna Safed-9 recorded the maximum plant height (58.28 cm), whereas under organic conditions, Yamuna Purple-10 exhibited the maximum plant height (58.96 cm). The enhanced plant height under inorganic conditions may be attributed to the immediate availability of nutrients, particularly nitrogen, which plays a crucial role in promoting rapid vegetative growth and cell elongation. In contrast, organic plots showed comparatively lower plant height in most varieties, possibly due to the slow and gradual release of nutrients from organic sources, which may not meet the crop demand at early growth stages (Agehara and Warncke, 2005). Similar findings have been reported by Przystalski *et al*. (2008) in cereals and Liopa-Tsakalidi and Giannopoulou (2025) in tomato, highlighting the consistent advantage of readily available nutrients under conventional systems.

The number of leaves per plant followed a trend similar to plant height, further confirming the positive relationship between nutrient availability and vegetative growth. Yamuna Safed-9 recorded the highest number of leaves (8.60) under inorganic conditions, whereas organic cultivation resulted in slightly lower values across most varieties. However, Yamuna Purple-10 (7.63) performed relatively better under organic conditions, suggesting its adaptability and efficient utilization of nutrients derived from organic sources. The increased leaf production under conventional growing conditions has also been reported by El-Magd *et al*. (2012) in various

Table 1 : Effect of organic and conventional growing conditions on growth attributes of garlic varieties (Pooled data of 2023-24 and 2024-25).

Treatments	Plant height		No. of leaves		Neck thickness		Polar diameter		Equatorial diameter of bulb (mm)	
	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic
Yamuna Safed-2	55.34	49.38	7.74	6.71	7.77	7.47	38.50	40.26	38.70	34.49
Yamuna Safed-5	56.38	53.00	8.04	7.01	8.07	7.89	38.69	37.53	38.32	35.46
Yamuna Safed-3	50.58	56.75	7.70	7.51	7.38	8.83	36.03	37.03	37.42	37.27
Yamuna Safed-8	54.50	53.99	7.70	7.36	7.71	8.08	38.09	38.37	37.90	36.98
Yamuna Safed-9	58.28	55.05	8.60	7.51	9.26	8.45	42.56	39.42	39.43	37.08
Yamuna Purple-10	56.84	58.96	8.18	7.63	8.85	9.23	39.69	42.90	38.90	38.91
SEm ±	1.45	2.54	0.16	0.14	0.28	0.33	1.18	0.88	NS	NS
CD at 5%	4.36	7.64	0.48	0.41	0.84	0.99	3.54	2.66	NS	NS
CV (%)	5.23	9.30	3.96	3.77	6.83	7.87	6.04	4.50	NS	NS

garlic varieties, emphasizing the role of balanced fertilization in enhancing foliage development.

Neck thickness, an important parameter influencing bulb formation and overall yield, was also significantly affected by growing conditions. Yamuna Safed-9 recorded the maximum neck thickness (9.26 cm) under conventional management, indicating vigorous growth supported by adequate nutrient supply. Although organic farming resulted in marginally lower values in which varieties such as Yamuna Purple-10 (9.23) and Yamuna Safed-3 (8.83) showed comparatively better performance, which may be attributed to their inherent genetic potential and better adaptation to organic nutrient regimes. Ncayiyana *et al*. (2017) also reported significant variation in neck thickness under different organic and inorganic nutrient management systems, supporting the present findings.

Polar diameters of bulbs were significantly influenced by growing conditions. The polar diameter of bulb under organic treatments ranged from 36.03 to 42.56 mm with a mean value of 38.93 mm whereas under inorganic treatments it ranged from 37.03 to 42.90 mm recording a slightly higher mean of 39.25 mm. Inorganic treatments generally produced larger bulbs because nutrients and growth stimulants could be supplied easily resulting in enhanced bulb diameter and length (Ponti *et al.*, 2012 and Lee *et al*., 2014). However organic conditions produced comparable bulb diameters in some varieties indicating the potential of organic farming for quality bulb production. The findings are in close conformity with the findings of Lee *et al*. (2014) in onion.

The equatorial diameter of bulb under inorganic treatments varied from 37.42 to 39.43 mm with a mean of 38.45 mm. Under organic treatments, it ranged from 34.49 to 38.91 mm with a comparatively lower mean value of 36.70 mm. Statistical analysis indicated that the effects of nutrient management systems on equatorial diameter of bulbs were non-significant (NS). The standard error of mean [SE(m)] and coefficient of variation (CV) values were within acceptable limits that indicating reliable experimental precision.

Yield and Quality parameters

Yield and quality attributes of garlic were significantly influenced by nutrient management systems and varietal differences. Garlic grown under organic conditions matured earlier than that grown under inorganic management. Among the varieties, Yamuna Safed-3 exhibited early maturity under both growing conditions, recording the minimum days to maturity (132 DAP). Overall, the mean days to maturity across all varieties were lower under organic growing conditions. The reduced days to maturity under organic farming could be due to the steady and balanced nutrient availability along with improved soil health, microbial activity, and physiological efficiency of the plants (Avdikos *et al.*,

Table 2 : Effect of organic and conventional growing conditions on yield and quality attributes of garlic varieties (Pooled data of 2023-24 and 2024-25).

Treatments	Days taken for Maturity		Fresh weight of bulb (g)		Number of clove/bulb		TSS (°Brix)		Bulb yield (q/ha)	
	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic
Yamuna Safed-2	147	139	22.25	16.30	15.85	15.81	35.23	36.10	65.93	46.57
Yamuna Safed-5	149	142	23.53	17.74	15.58	18.14	33.68	34.73	71.83	48.51
Yamuna Safed-3	132	132	20.45	19.43	17.20	18.81	36.42	36.43	48.75	58.10
Yamuna Safed-8	157	147	21.45	18.03	16.07	15.00	35.64	36.75	52.47	51.46
Yamuna Safed-9	156	145	26.70	18.91	13.20	16.60	38.21	38.52	78.33	55.03
Yamuna Purple-10	158	151	24.93	22.59	15.14	17.78	38.80	39.53	72.31	63.88
SEm±	4.16	2.79	1.02	0.62	0.48	0.65	0.84	0.49	2.84	1.91
CD at 5%	12.53	8.41	3.09	1.87	1.44	1.96	2.54	1.47	8.57	5.75
CV (%)	5.55	3.91	8.82	6.61	6.16	7.64	4.64	2.63	8.76	7.08

2021).

Fresh bulb weight was significantly higher under inorganic conditions with Yamuna Safed-9 recording the maximum fresh bulb weight (26.70 g) under conventional farming. Under organic conditions, comparatively higher bulb weight was observed in Yamuna Purple-10 (22.59 g). The similar findings for weight of bulb in organic and inorganic nutrient management were also reported by Prabhakar *et al.* (2017). Organic farming resulted in a higher number of cloves per bulb in certain varieties notably Yamuna Safed-3 (18.81) and Yamuna Safed-5 which may be attributed to balanced nutrient supply and improved soil health under organic management (Dhaker *et al.*, 2017). The variety Yamuna Safed-3 also produced the maximum number of cloves under inorganic conditions which may be attributed to its inherent varietal characteristics. The variation in number of clove within organic and conventional growing conditions was also reported by Mirzaei *et al.* (2007).

In addition, total soluble solids (TSS) content was consistently higher under organic cultivation across most varieties. Yamuna Purple-10 recorded the highest TSS (39.53%) indicating superior bulb quality. This improvement in TSS under organic conditions may be associated with enhanced carbohydrate accumulation and better metabolic activity as also reported by Prabhakar *et al.* (2017).

Bulb yield was significantly affected by growing conditions and varieties (Table 2 and Fig. 1) with conventional farming producing higher yields in all varieties. The highest bulb yield was recorded in Yamuna Safed-9 (78.33 q ha^{-1}) under inorganic conditions, while under organic management, Yamuna Purple-10 recorded the maximum yield (63.88 q ha^{-1}) followed by Yamuna Safed-9 (55.03 q ha^{-1}). El-Magd *et al.* (2012) in garlic and Liopa-Tsakalidi and Giannopoulou (2025) in tomato also reported similar results regarding yield performance among different varieties under varying nutrient management systems. The variation in yield among varieties under organic and inorganic growing conditions may be attributed to differences in their genetic potential, nutrient uptake efficiency and adaptability to the source and availability of nutrients (Raslan *et al.*, 2015). Inorganic nutrient sources generally provide readily available nutrients leading to enhanced vegetative growth and higher yield in responsive varieties whereas organic nutrient sources release nutrients more slowly, favoring varieties with better root proliferation, microbial interactions and nutrient use efficiency (Rempelos *et al.*, 2023).

Economics of Garlic cultivation

The economic analysis revealed considerable variation among the varieties under both inorganic and organic growing conditions (Table 3). Under inorganic management, the highest gross return (` 592,188/ha) and

Table 3 : Effect of organic and conventional growing conditions on economics of garlic varieties (Pooled data of 2023-24 and 2024-25).

Treatments	Bulb yield (q/ha.)		Gross Retrun/ha (Rs)		Net Retrun/ha (Rs)		B : C ratio	
	Inrganic	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic
Yamuna Safed-2	65.93	46.57	499792	386542	414162	300912	5.84	4.51
Yamuna Safed-5	71.83	48.51	544063	366923	458433	281293	6.35	4.28
Yamuna Safed-3	48.75	58.10	368750	404726	283120	319096	4.31	4.73
Yamuna Safed-8	52.47	51.46	396042	375334	310412	289704	4.63	4.38
Yamuna Safed-9	78.33	55.03	592188	427110	506558	341480	6.92	4.99
Yamuna Purple-10	72.31	63.88	547292	472875	461662	387245	6.39	5.52
SEm ±	2.84	1.91	-	-	-	-	0.26	0.15
CD at 5%	8.57	5.75	-	-	-	-	0.79	0.45
CV (%)	8.76	7.08	-	-	-	-	9.08	6.25

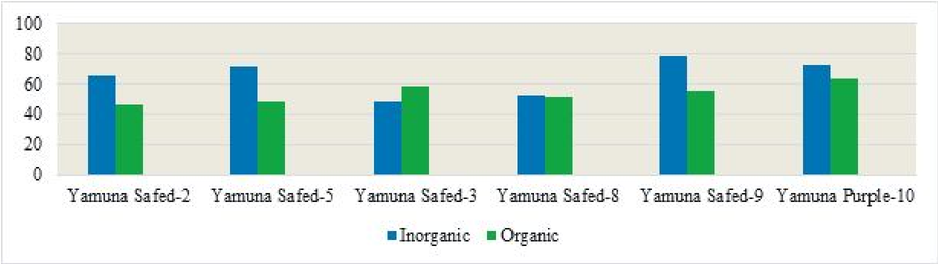

Fig. 1 : Yield performance of different varieties under organic and conventional systems.

net return (` 506,558/ha) were recorded in Yamuna Safed-9 followed by Yamuna Purple-10. Similarly, Yamuna Safed-9 also exhibited the maximum benefit-cost ratio (6.92), indicating superior economic efficiency under inorganic conditions.

Under organic management, Yamuna Purple-10 recorded the highest gross return (` 472,875/ha) and net return (` 387,245/ha), along with the maximum B:C ratio (5.52). It was followed by Yamuna Safed-9 and Yamuna Safed-3 in terms of economic returns. Overall, inorganic management resulted in higher gross and net returns as well as B:C ratio compared to organic management; however, Yamuna Purple-10 proved to be the most economically viable variety under organic conditions. Although organic cultivation resulted in lower net returns, reduced input costs and premium prices for organic produce may improve profitability in the long term.

Conclusion

The present study demonstrated that conventional growing conditions significantly enhanced growth, yield and economic returns of garlic varieties. Yamuna Safed-9 was identified as the best performing variety under inorganic nutrient management. However, organic cultivation produced superior quality bulbs with higher TSS content and acceptable yields particularly in Yamuna Safed-3 and Yamuna Purple-10. Organic garlic cultivation can be promoted as a sustainable alternative especially for quality conscious and health oriented markets. Selection of suitable varieties is crucial for improving productivity under organic systems.

Acknowledgement

The author thankfully acknowledges the Dr. B.R. Choudhary Agricultural Research Station, Mandor, Agriculture University, Jodhpur for providing facilities and necessary help to carry out this research work.

References

Agehara, S. and Warncke D.D. (2005). Soil moisture and temperature effects on nitrogen release from organic nitrogen sources. *Soil Sci. Soc. Amer. J.*, **69(6)**, 1844-1855.

Avdikos, I.D., Tagiakas R., Mylonas I., Xynias I.N. and Mavromatis A.G. (2021). Assessment of tomato recombinant lines in conventional and organic farming systems for productivity and fruit quality traits. *Agronomy*, **11(1)**, 129.

Choudhary, B.S., Soni A.K. and Khaswan S.L. (2013). Growth, yield and quality of garlic (*Allium sativum* L.) as influenced by different nutrient management practices. *Annals Agricult. Res.*, **34(3)**.

Citak, S. and Sonmez S. (2010). Influence of organic and conventional growing conditions on the nutrient contents of white head cabbage (*Brassica oleracea* var. *capitata*) during two successive seasons. *J. Agricult. Food Chem.*, **58(3)**, 1788-1793.

Czech, A., Szmigielski M. and Sembratowicz I. (2022). Nutritional value and antioxidant capacity of organic and conventional vegetables of the genus Allium. *Scientific Reports*, **12(1)**, 18713.

Dhaker, B., Sharma R.K., Chhipa B.G. and Rathore R.S. (2017). Effect of different organic manures on yield and quality of onion (*Allium cepa* L.). *Int. J. Curr. Microbiol. Appl. Sci.*, **6(11)**, 3412-3417.

El-Magd, A.M.M., El-Shourbagy T. and Shehata S.M. (2012). A comparitve study on the productivity of four egyptian garlic cultivars grown under various organic material in comparison to conventional chemical fertilizer. *Austr. J. Basic Appl. Sci.*, **6(3)**, 415-421.

Gomez, K.A. and Gomez A.A. (1984). Statistical procedures for agricultural research. *John Wiley & Sons*.

Lee, J., Hwang S., Lee S., Ha I., Hwang H., Lee S. and Kim J. (2014). Comparison study on soil physical and chemical properties, plant growth, yield and nutrient uptakes in bulb onion from organic and conventional systems. *HortScience*, **49(12)**, 1563-1567.

Liopa-Tsakalidi, A. and Giannopoulou K. (2025). Comparative Assessment of Local Tomato Varieties Under Organic and Conventional Cultivation. *Int. J. Agricult. Environ. Res.*, **11(5)**, 1702-1718.

Mirzaei, R., Liaghati H. and Damghani A.M. (2007). Evaluating yield quality and quantity of garlic as affected by different farming systems and garlic clones. *Pak. J. Biological Sci.*, **10(13)**, 2219-2224.

Ncayiyana, M., Maboko M.M. and Bertling I. (2018). Alterations in yield, physicochemical components and mineral composition of onion following organic manure and inorganic nitrogen application. *Acta Agriculturae Scandinavica, Section B—Soil & Plant Science*, **68(3)**, 213-219.

Negi, P., Goswami G., Pant S.C., Singh K.C., Bahuguna P. and Verma S.K. (2024). Impact of Organic Manures and Liquid Formulations on Garlic Growth, Yield and Quality in Uttarakhand, India. *J. Adv. Biol. Biotechnol.*, **27(9)**, 370-378.

Ponti, T.D., Rijk B. and Van Ittersum M.K. (2012). The crop yield gap between organic and conventional agriculture. *Agricultural Systems*, **108**, 1-9.

Prabhakar, M., Hebbar S.S., Nair A.K., Selvam P.P., Rajeshwari R.S. and Kumar P. (2017). Growth, yield and quality of onion (*Allium cepa* L.) as influenced by organic farming practices. *Int. J. Curr. Microbiol. Appl. Sci.*, **6(8)**, 144-149.

Przystalski, M., Osman A., Thiemt E.M., Rolland B., Ericson L., Ostergård H. and Krajewski P. (2008). Comparing the performance of cereal varieties in organic and non-organic cropping systems in different European countries. *Euphytica*, **163(3)**, 417-433.

Raslan, M., AbouZid S., Abdallah M. and Hifnawy M. (2015). Studies on garlic production in Egypt using conventional and organic agricultural conditions. *Afr. J. Agricult. Res.*, **10(13)**, 1631-1635.

Rempelos, L., Barañski M., Sufar E.K., Gilroy J., Shotton P., Leifert H. and Leifert C. (2023). Effect of climatic conditions, and agronomic practices used in organic and conventional crop production on yield and nutritional composition parameters in potato, cabbage, lettuce and onion; results from the long-term NFSC-trials. *Agronomy*, **13(5)**, 1225.