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Effect of FYM and NPK on growth and yield of garlic (*Allium sativum* L.)

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Abstract

The present investigation was conducted during winter season of 2017 at research farm of Agriculture Faculty, Department of Horticulture Kandahar University, Afghanistan the experiment was conducted in randomized block design with nine treatments and three replications. Effect of Garlic (*Allium sativum* L.) on growth and Yield to different levels of Nitrogen, Phosphorus and Potash (NPK). Doses 100:75:75 and 120:75:75 kg per hectare combination with farm yard manure (FYM), 20 and 25 t ha⁻¹. The statistical analysis using F test revealed that FYM, NPK and combination of these two fertilizers significantly affected all growth and yield parameters studied. Maximum plant height (56.25 cm), was recorded in plots fertilized with NPK 120:75:75 kg ha⁻¹ + FYM 25 t ha⁻¹, whereas maximum leaf length (47.33 cm), maximum number of leaves per plant (11.8), Maximum polar diameter of bulb (6.22 cm), maximum equatorial diameter of bulb (5.16 cm), fresh weight of bulb (84.60 g) and bulb yield (19.55 t ha⁻¹).

Keywords: *Allium sativum* L. FYM, NPK, garlic, growth, yield

Introduction

Garlic (*Allium sativum* L.) is the second most widely used bulb crop after Onion (*Allium cepa* L.) which belongs to family Alliaceae. Garlic is sexually sterile and has traditionally been cultivated clonally through cloves. Garlic bulbs consist of small bulbils which range from 5-40, called as cloves. India is the second large producer of garlic in the world. Garlic is rich source of sugar, protein, phosphorus, potassium, sulfur, iodine, fiber, and vitamins. Its pungent flavor makes it used mainly as a spice, seasoning and flavoring for foodstuff involving both green tops and bulbs. In India and other Asian and Middle East countries, it is used in pickles, curry powder, curried vegetables, meat preparation and tomato ketchup. Volatile oils comprise 0.1 to 0.25% of the fresh weight of garlic. Oil of garlic has now been appreciated as a valuable flavoring agent, for use in all kinds of meat preparation, soups, canned foods and sauces (Devendra *et al.* 2014) [3]. Garlic (*Allium sativum* L.) is a diploid species in the *Allium* genus of the Alliaceae family, order Asparagales. There are two subspecies within the species: ssp. *sativum* – common garlic and ssp. *asiae mediae* – Central Asian garlic. Each subspecies consists of two varieties: var. *vulgare* – common (non-bolting) and var. *sagittatum* – bolting garlic (Moravcevic *et al.* 2017) [10].

FAO reported that Afghanistan also produce large number of Garlic vegetable after Onion cultivation and Its grown in vegetable gardens and with out vegetable garden in the house hold. Garlic and leek are grown in about one quarter or one fifth of the gardens. Here are 87,897 Garlic vegetable number of farms and also 10,356 farms with out vegetable garden in house hold.

Primary centre of origin of garlic is Central Asia, i.e., its highland area ranging from Afghanistan, throughout Northwest India, Tajikistan and Kyrgyzstan, and to a lesser degree the territory of China (to the Taklamakan desert), Kazakhstan, Uzbekistan and Turkmenistan. From this area, garlic has spread throughout the world. Garlic was considered to have lost its ability of generative reproduction during cultivation. However, in the last century, ecotypes with fertile seeds were found in the territory of Kazakhstan. The secondary centre of origin of garlic is the Mediterranean region.

China is the largest producer of garlic in the world, containing around 58% of the total world area with garlic (856,500 ha). Owing to its high average annual yield (above 23 t ha⁻¹), China

accounts for 81% of the global output of garlic. The global yield of garlic (16.3 t ha⁻¹) is two times larger than the yield obtained in Europe.

Garlic (*Allium sativum L.*) commonly termed as “Lahsun”, is one of the most important spices as well as bulb crop grown throughout in India because it's higher nutritive value as compared to the other bulbous crops. It is grown all over India on an area of 2.48 lakh hectares with total production of 12.59 lakh metric tons and having productivity of 5.1 MT/ha.

Increase of garlic production has become of great importance to meet the ever increasing demand for local consumption and export. Such increase could be achieved by growing garlic in the reclaimed areas using organic manure for obtaining safe and healthy production than using inorganic fertilizers. Egypt occupied the fourth place in world for garlic production (301270 ton) in 2008 according to the Egyptian Statistics of Ministry of Agric. Organic manure is used as soil amendment, improved characters of sandy soil. It also, contained nutrients needed for onion crop production (Islah and M.El-Hifny 2010) [7]. Despite its importance, great potential for production and high market demand, the current garlic production and productivity is limited and seasonal. Low soil fertility is one of the factors limiting the productivity of garlic. Application of manure enhances soil fertility and increase the productivity of garlic by improving soil properties and nutrient status (Tadila *et al.* 2018) [12].

Therefore, obvious choice is to maintain a natural balance for having a good soil health and to keep clean environment. Natural balance means application of organic/inorganic fertilizers in a balanced form, which is important in improvement in the quality of agricultural produce. The present study was designed to investigate the impact of FYM and NPK on Garlic plants grown under sandy loam soil conditions considering their growth and yield. Therefore, keeping in mind the above mentioned facts, the present experiment was carried out to find out the most suitable dose of FYM and NPK fertilizers for Garlic cultivars, in order to obtain better and higher yield and growth under the agro-climatic conditions of the Kandahar Afghanistan.

Materials and Methods

The field trial was conducted in a RBD with three replications and plot size of 2.25 m² (spacing 10 cm x 20 cm) on Garlic cv. Punjab Garlic at research farm of Agriculture Faculty, Department of Horticulture Kandahar University, Afghanistan during Rabi season of 2017. FYM and NPK was applied as basal dose @ 100:75:75 and 120:75:75 kg ha⁻¹ and FYM 20, 25 t ha⁻¹ respectively. The obtain plant height, leaf length, number of leaves per plant, polar diameter of bulb (cm), equatorial diameter of bulb (cm), fresh weight of bulb (g) and yield tonne ha⁻¹ with application of T₅ (farm yard manure 20 t ha⁻¹ + Nitrogen 100kg ha⁻¹ + P₂O₅ 75kg ha⁻¹ + K₂O 75kg ha⁻¹). Ten plants were randomly selected from each treatment. The data recorded on these factors were subjected to statistical analysis.

Results and Discussion

Plant height (cm)

The data pertaining to the plant height of garlic under different treatments recorded at 30, 50, 70, 90 and 110 days after sowing (DAS) is show in Table 1. Treatment T₃ (farm yard manure 25 t ha⁻¹ + Nitrogen 120 kg ha⁻¹ + P₂O₅ 75 kg ha⁻¹ + K₂O 75 kg ha⁻¹) recorded maximum plant height (56.25 cm) followed by 55.33 cm with T₂ (farm yard manure 25 t ha⁻¹ + Nitrogen 100 kg ha⁻¹ + P₂O₅ 75 kg ha⁻¹ + K₂O 75 kg ha⁻¹) and the minimum (38.67 cm) was recorded with T₀ (Control).

Similar trend was observed at subsequent growth stages also. On increasing the dose of FYM and NPK from 120:75:75 kg ha⁻¹ + 25 t ha⁻¹ increase in plant height was recorded. On decreasing the dose of NPK from 120:75:75 kg ha⁻¹ + FYM 25 t ha⁻¹ to NPK 100:75:75 kg ha⁻¹ + FYM 25 t ha⁻¹ decreasing the plant height slightly was recorded. Similar results were reported by Ahmed abbas *et al.* (2006) [1].

Length of leaves (cm)

Length of leaves under different treatments counted and recorded at 30, 50, 70, 90 and 110 days after sowing (DAS) is shown in Table 1. Treatment T₃ (FYM 25 t ha⁻¹ + NPK 120:75:75 kg ha⁻¹) recorded maximum length of leaves (47.33 cm) followed by 45.92 cm with T₂ (FYM 25 t ha⁻¹ + NPK 100:75:75 kg ha⁻¹) and the minimum (31.17 cm) was recorded with T₀ (Control). Similar trend was observed at subsequent growth stages also. Better photosynthetic activity might have result higher length of leaves these findings are in consonance with the reports Banafer, R. N .S., Namdeo, S. L. and Asati, K. P. (2004) [2].

Number of leaves per plant

Number of leaves per plant under different treatments counted and recorded at 30, 50, 70, 90 and 110 days after sowing (DAT) is shown in Table 1. Treatment T₃ (FYM 25 t ha⁻¹ + NPK 120:75:75 kg ha⁻¹) recorded maximum number of leaves per plant (11.08) followed by 10.33 with T₂ (FYM 25 t ha⁻¹ + NPK 100:75:75 kg ha⁻¹) and the minimum (6.83) was recorded with T₀ (Control). Similar trend was observed at subsequent growth stages also. On decreasing the dose of NPK from 120:75:75 kg ha⁻¹ + FYM 25 t ha⁻¹ to NPK 100:75:75 kg ha⁻¹ + FYM 25 t ha⁻¹ decreasing the number of leaves per plant slightly was recorded. These findings are in consonance with the reports Gowda MC *et al.* (2007) [6].

Neck diameter (cm)

Neck diameter under different treatments counted and recorded at 30, 50, 70, 90 and 110 days after sowing (DAT) is shown in Table 1. Treatment T₃ (FYM 25 t ha⁻¹ + NPK 120:75:75 kg ha⁻¹) recorded maximum neck diameter (1.90 cm) followed by 1.81 cm with T₂ (FYM 20 t ha⁻¹ + NPK 120:75:75 kg ha⁻¹) and the minimum (1.39 cm) was recorded with T₀ (Control). Similar trend was observed at subsequent growth stages also. Neck diameter increased with the increase in doses of FYM and NPK at all the stages of growth. Combination of FYM 20, 25 t ha⁻¹ + NPK 100:75:75 and 120:75:75 kg ha⁻¹ recorded maximum neck diameter. Better photosynthetic activity might have result higher neck diameter. Similar results were reported by Kakar, A.A., M.K. Abdullahzai, M. Saleem and S.A. Qaim, (2002) [8].

Size of bulb in polar diameter (cm)

Size of bulb in polar diameter under different treatments recorded at is presented in Table 2. The table indicates that the effect of size of bulb in polar diameter at different treatments significant effect was observed. Treatment T₅ (FYM 20 t ha⁻¹ + NPK 100:75:75 kg ha⁻¹) recorded maximum equatorial diameter (6.22 cm) followed by 5.83 cm with T₆ (FYM 20 t ha⁻¹ + NPK 120:75:75 kg ha⁻¹) and the minimum (4.18 cm) was recorded with T₀ (Control). Similar results were reported by Kilgori, M.J, M.D. Magaji, and A.I. Yakubu, (2007) [9].

Size of bulb in equatorial diameter (cm)

Size of bulb in equatorial diameter under different treatments recorded at is presented in Table 2. The table indicates that

the effect of size of bulb in equatorial diameter at different treatments significant effect was observed. Treatment T₅ (FYM 20 t ha⁻¹ +NPK 100:75:75 kg ha⁻¹) recorded maximum equatorial diameter (5.16 cm) followed by 4.73 cm with T₆ (FYM 20 t ha⁻¹ +NPK 120:75:75 kg ha⁻¹) and the minimum (3.95 cm) was recorded with T₀ (Control). Similar results were reported by Tadila, G., & Nigusie, D. (2018)^[12].

Fresh weight of bulb (g)

Fresh weight under different treatments recorded at is presented in Table 2. The table indicates that the effect of fresh weight at different treatments significant effect was observed. Treatment T₅ (FYM 20 t ha⁻¹ +NPK 100:75:75 kg ha⁻¹) recorded maximum fresh weight of bulb (84.60 g) followed by 76.17 g with T₆ (FYM 20 t ha⁻¹ +NPK 120:75:75 kg ha⁻¹) and the minimum (34.90 g) was recorded with T₀ (Control). Similar trend was observed at subsequent growth stages also. Fresh weight of bulb increased with the increase in doses of FYM and NPK, at all the stages of growth. Combination of FYM 20 t ha⁻¹ + NPK 100:75:75 and 120:75:75 kg ha⁻¹ recorded maximum fresh weight. Better

photosynthetic activity might have result higher fresh weight. Similar results were reported by Singh, S. Yadav, P.K. and Singh, B. (2004)^[11].

Yield per hectare (q ha⁻¹)

Yield per hectare under different treatments recorded at is presented in Table 2. The table indicates that the effect of yield per hectare at different treatments significant effect was observed. Treatment T₅ (FYM 20 t ha⁻¹ +NPK 100:75:75 kg ha⁻¹) recorded maximum yield per hectare (195.55 q ha⁻¹) followed by 157.44 t ha⁻¹ with T₆ (FYM 20 t ha⁻¹ +NPK 120:75:75 kg ha⁻¹) and the minimum (71.11 q ha⁻¹) was recorded with T₀ (Control). Yield per hectare Fresh weight of bulb increased with the increase in doses of FYM and NPK, at all the stages of growth. Combination of FYM 20 t ha⁻¹ + NPK 100:75:75 and 120:75:75 kg ha⁻¹ recorded maximum yield per hectare. Treatment T₅ (FYM 20 t ha⁻¹ +NPK 100:75:75 kg ha⁻¹) proved to be the appropriate combination of FYM and NPK, which emerged as superior over all other treatments for yield of Garlic. Similar results were reported by Tadila, G., & Nigusie, D. (2018)^[12]

Table 1: Effect of different combinations of FYM and NPK on Plant height (cm), Length of leaves (cm), Number of leaves per plant and Neck diameter (cm) of Garlic (*Allium sativum* L.) at different intervals.

Treatment No.	Treatments	Plant height (cm)	Length of leaves (cm)	Number of leaves per plant	Neck diameter (cm)
T ₀	Control	38.67	31.17	6.83	1.39
T ₁	FYM 25 t ha ⁻¹	53.92	44.42	9.00	1.56
T ₂	FYM 25 t ha ⁻¹ +NPK 100:75:75 kg ha ⁻¹	55.33	45.92	10.33	1.81
T ₃	FYM 25 t ha ⁻¹ +NPK 120:75:75 kg ha ⁻¹	56.25	47.33	11.08	1.90
T ₄	FYM 20 t ha ⁻¹	50.83	39.33	9.08	1.76
T ₅	FYM 20 t ha ⁻¹ +NPK 100:75:75 kg ha ⁻¹	54.08	42.58	11.08	1.79
T ₆	FYM 20 t ha ⁻¹ +NPK 120:75:75 kg ha ⁻¹	53.58	44.08	10.83	1.65
T ₇	NPK 100:75:75 kg ha ⁻¹	48.17	36.83	9.08	1.58
T ₈	NPK 120:75:75 kg ha ⁻¹	49.75	39.25	8.75	1.65
	F-test	S	S	S	S
	S.Ed. (±), C. D. (P = 0.05)	2.578, 5.321	3.605, 7.441	0.849, 1.752	0.128, 0.264

Table 2: Effect of different combinations of FYM and NPK on polar diameter of bulb (cm), equatorial diameter of bulb (cm), fresh weight of bulb (g) and bulb yield (t ha⁻¹) of Garlic (*Allium sativum* L.) at different intervals

Treatment No.	Treatments	Polar diameter of bulb (cm)	Equatorial diameter of bulb (cm)	Bulb fresh weight (g)	Bulb yield (q ha ⁻¹)
T ₀	Control	4.18	3.95	34.90	71.11
T ₁	FYM 25 t ha ⁻¹	4.92	4.09	49.83	101.92
T ₂	FYM 25 t ha ⁻¹ +NPK 100:75:75 kg ha ⁻¹	5.73	4.19	66.83	149.63
T ₃	FYM 25 t ha ⁻¹ +NPK 120:75:75 kg ha ⁻¹	5.82	4.67	70.60	136.29
T ₄	FYM 20 t ha ⁻¹	5.54	4.09	62.83	106.66
T ₅	FYM 20 t ha ⁻¹ +NPK 100:75:75 kg ha ⁻¹	6.22	5.16	84.60	195.55
T ₆	FYM 20 t ha ⁻¹ +NPK 120:75:75 kg ha ⁻¹	5.83	4.73	76.17	157.44
T ₇	NPK 100:75:75 kg ha ⁻¹	5.44	4.23	60.25	114.62
T ₈	NPK 120:75:75 kg ha ⁻¹	5.27	4.16	55.33	88.74
	F-test	S	S	S	S
	S.Ed. (±) C. D. (P = 0.05)	0.389, 0.802	0.333, 0.687	10.362, 21.386	29.587, 61.068

Conclusion

Based on the results of the present study, the planting of Garlic Cv. Punjab Garlic in 2017 Winter season with application of 20 t FYM +100:75:75 Kg/ha-1 may be safely recommended for the farmers of this area.

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