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Response of NPK Fertilizer on Enhancing the Soil Properties of Garlic (*Allium sativum* L.) field

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ABSTRACT: Effect of different doses of nitrogen, phosphorous and potassium (NPK) combinations on soil physiochemical property of soil and its component in various garlic (*Allium sativum* L.) genotypes was studied during 2018 and 2019. The experiment comprises three level of fertilizers *i.e*. F1-N100P80K80, F2-N120P90K90, F3-N140P100K100 and five genotypes (V1- BRG-13, V2- BRG-14, V3- BRG-1, V4- G1, V5-G- 323). Parameters like soil pH, electrical conductivity, oxidisable organic carbon, available nitrogen (N), Phosphorus (P), Potassium (K), and sulphur were recorded. Maximum NPK found in third level of fertilizer in BRG-13 and minimum NPK found in first level of fertilizer in G1.

Keywords: Garlic, genotypes, nitrogen, phosphorus, electrical conductivity.

INTRODUCTION

Garlic (*Allium sativum* L.) has pungent characteristics belong to genus Allium (Bose and Som 1985). It belongs under family Amaryllidaceae, having chromosome number 2n (2X) = 16, originated from Central Asia (Thompson and Kelly 1957). After onion, it is most widely grown spices crop of genus Allium (Purseglove, 1985). China, India, Korea, Spain, Russian Federation, Egypt, Myanmar, Thailand, and the USA are major garlic-producing countries in the world (FAO 2004 and Innvista 2005). Garlic is broadly classified into two categories *i.e.* soft neck garlic (*Allium sativum*) and hard neck garlic (*Allium ophioscordon*) (Borek, 2001). The hard necked garlics are the primitive garlics and soft necked are developed/ cultivated varieties through the process of selection over the centuries from the hard neck garlic. Garlic is an underground bulb and vegetative part consists of leaf and flowers. The bulbs have small bulbils known as cloves, which is used as vegetative propagating material (Purseglove, 1972). Garlic is having major economic importance and is cultivated worldwide (Huchette *et al*., 2007). India ranks second in garlic production after China. China produces 21,197,131 tonnes of garlic annually (FAO, 2016). India records very lower productivity of garlic as compared to other garlic growing countries. In India garlic is grown in an area of 393,000 hectares producing 3208 thousands metric tonnes with an average national productivity of 8.16 tonnes/ ha (NHB 2021-22). In Bihar, it is grown in an area of 1.71,000 hectares with production of 2.63,000 metric tonnes and productivity of 1.53 tonnes ha^{-1} (Ministry of Agriculture 2021-22). The major garlic producing states which produce about 80% of country's total output are Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, Orissa and Maharastra. Among all the garlic producing states in India, Rajasthan recorded the highest production in the financial year 2018, amounting to over 582.08 thousand metric tonnes (NHB 2017-18). Punjab has highest productivity 11.41 tonnes/ha.

Garlic is a cool season perennial crop having high requirement of nutrient and water (HCRP 1996). The crop is grown both in rainfed and irrigated conditions. It grows well when grown on fertile well-drained, sand or silt-loam soils, with good moisture properties. Garlic is mainly used for spices, seasoning and flavouring of food both as green tops and bulbs due to its pungency (Teweldebrhan, 2009). It is widely used for culinary and medicinal purposes for centuries. It is still being employed in folk medicine for the treatment of a various diseases worldwide (Ali *et al.*, 2000). Regular consumption of garlic prevents many diseases. The plants are highly effective in treatments of hypertension, heart dysfunctions, arteriosclerosis, diabetes, cholesterol, cancer, gout, arthritis and obesity (Pamplona-Roger, 2005). The plant extracts of *A. sativum* serve as natural source for several active compounds (Borris, 1996). The compounds present in plant extracts naturally, promotes growth and also have antimicrobial activity against fungus, viruses and bacteria (Pretorius *et al.*, 2003). Phosphorus is a structural component of membrane system of cells, mitochondria and chloroplasts which is a constituent of energy phosphates like ADP, ATP, nucleo proteins, nucleic acid, purines, nucleotides, pyrimidine, and several coenzymes. Chemical fertilizers are widely used in vegetables production in tropical areas, particularly, where these are readilyavailable. The use of fertilizer increase production and is somewhat a quick method for achieving maximum yield (Naruka and Dhaka 2001). Potassium (K) is a vital nutrient which increases garlic yields. Optimum applications and timings are critical for higher yield or quality response.

MATERIAL AND METHODS

The experiment on "Response of NPK fertilizer on enhancing the soil properties of garlic field" was conducted in winter season (*Rabi*) of 2018-19 at the vegetable research farm of Bihar Agricultural University, Bhagalpur, Bihar. It fall under tropical to sub- tropical climatic region with slight semi-arid conditions and is characterized by dry summer, moderate rainfall and cold winter. The planting materials comprised five genotypes of garlic- BRG-13, BRG-1, BRG-14, G-1 and G-323 denoted as (V1, V2, V3, V4 and V5, respectively in the treatment combination of experiment). Nitrogen, potash and phosphorous were applied in the three different levels i.e., F1(N100: P80: K80), F2(N120: P90: K90) and F3 (N140: P100: K100) in the form of urea, single super phosphate and murate of potash respectively. The garlic genotypes were sown on 10th October 2019. Thus, total number of treatments were 15. Split Plot Design was followed with three replications. Planting was done at spacing of 15 cm from row to row and 10 cm from plant to plant. Recommended package of practice was followed to raise the crop. Observations were recorded treatment wise on five randomly selected plants for soil pH, Electrical conductivity, Oxidisable Organic carbon, available nitrogen, phosphorus, potassium and sulphur. The data was analyzed according to method outlined by Panse and Sukhatme (1954).

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) revealed significant estimates for fertilizer levels indicating variation among the studied characters for fertilizer level and genotypes due to their interaction effect for soil pH (Fig:1), Electrical conductivity (Fig. 2), Oxidisable Organic carbon (Fig. 3), Available Nitrogen (Fig. 4), Available Phosphorus (Fig. 5), Available Potassium (Table 1)., Available sulphur (Table 2).

The soil pH was maximum in G1 (7.58) at the third level of fertility i.e. F3 (N140P100K100), minimum soil pH was exhibited in BRG-1 (7.27) at fertility level F1 (N100P80K80). These results are quite similar to those of Assefa *et al.* (2014), Shafeek *et al*. (2015) in clove of garlic. The electrical conductivity was highest in BRG-13(0.38 dS m^{-1}) at the fertility level F2 (N120P90K90), however, least electrical conductivity was noticed in G-323(0.24 dS m^{-1}) at the third level of fertility i.e. F3 (N140P100K100). These findings are in agreementwith Shafeek *et al.* (2015) in clove of garlic. The organic carbon was highest in BRG-13 (0.66 %) at the second dose of fertilizer i.e., F2 (N120P90K90), however, least organic carbon was noticed in G-1 (0.54 %) at the first fertility level i.e. F1 (N100P80K80). These results are quite similar to Assefa *et al.* (2015), Shafeek *et al.* (2015) in garlic. The available nitrogen was highestin BRG-13(236.37 kg/ha.) at the third level of fertilizer i.e. F3 (N140P100K100), however, available nitrogen was noticed in G1 (224.45 kg/ha) at the fertility level F1 (N100P80K80). This finding was similar with Assefa *et al.* (2014), Yadav *et al.* (2007) in clove of garlic. The available phosphorous was highest in BRG-13(60.11 kg/ha.) at the fertility level F3 (N140P100K100), however, least available phosphorous was noticed in G1(47.93 kg/ha.) the fertility level F1 (N100P80K80). This finding was supported by the result of Assefa *et al.* (2014) in clove of garlic.The available potassium was highest in BRG-13(317.58 kg/ha.) at fertility level F3 (N140P100K100), however, least available potassium was noticed in G1 (300.52 kg/ha.) at fertilitylevel F1 (N100P80K80). This finding was supported by the result of Yadav *et al.* (2007) in clove of garlic. The available sulphur was highest in BRG-13(3.63 kg/ha.) at the fertility level F2 (N120P90K90), however, least available sulphur was noticed in BRG-1(3.08 kg/ha.) at the fertility level F1 (N100P80K80). This finding was supported by the results of Assefa *et al.* (2014) in clove ofgarlic.

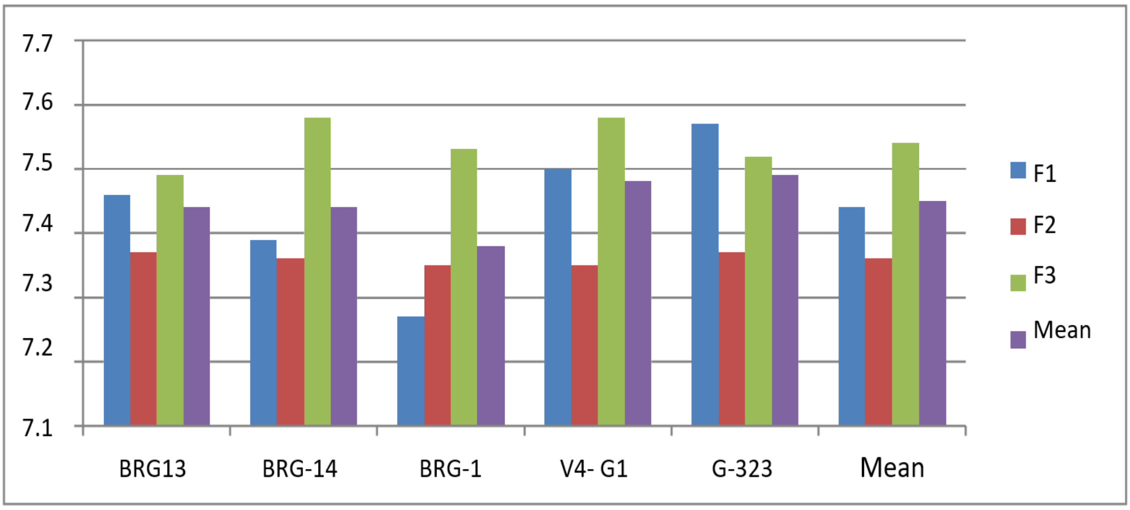

Fig. 1. Effect of different level of fertilizer (F1, F2 and F3) and variety on soil pH.

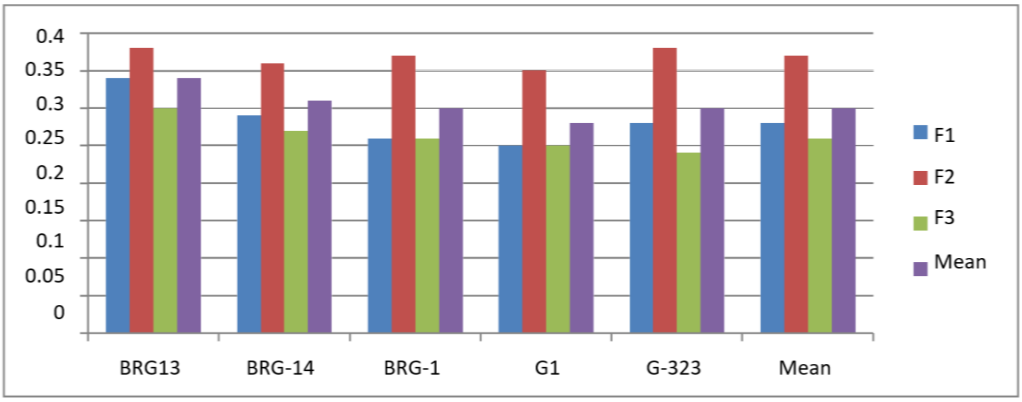

Fig. 2. Effect of different level of fertilizer (F1, F2 and F3:) and variety on Electrical Conductivity (dS m^{-1}).

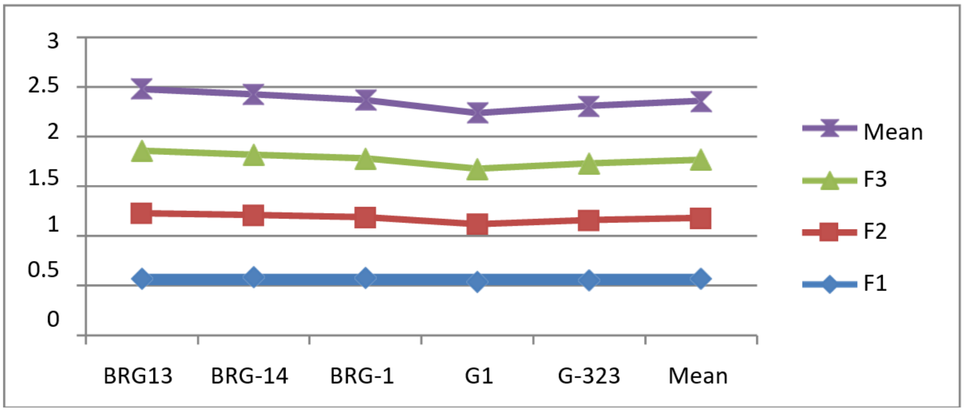

Fig. 3. Effect of different level of fertilizer (F1, F2 and F3) and variety on organic carbon (%).

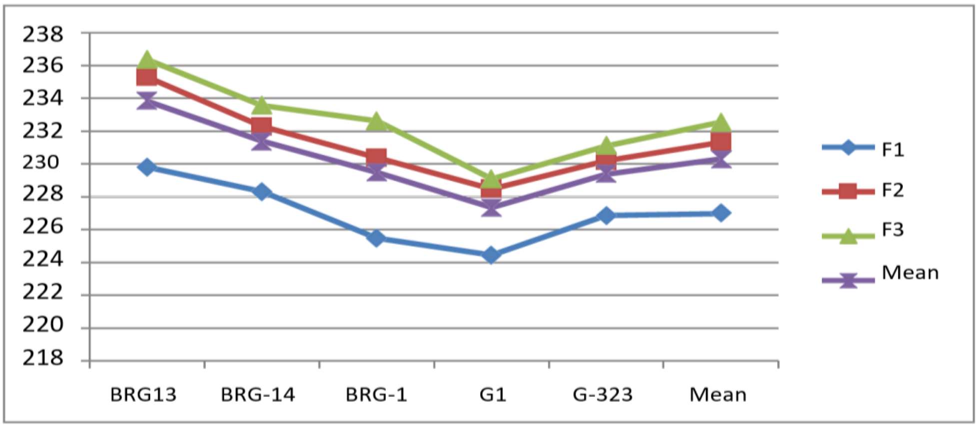

Fig. 4. Effect of different level of fertilizer (F1, F2 and F3) and variety on available nitrogen (kg/ha.).

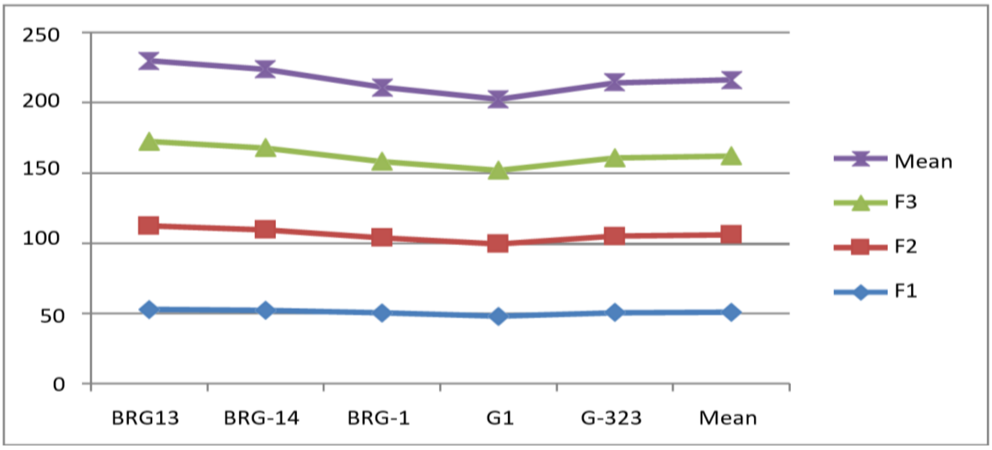

Fig. 5. Effect of different level of fertilizer (F1, F2 and F3) and variety on available phosphorus (kg/ha.).

Table 1: Effect of different level of fertilizer and variety on available potassium (kg/ha.).

	F1	F2	F3	Mean
V1	310.44	316.38	317.58	**314.80**
V2	308.08	313.53	315.76	**312.46**
V3	305.10	308.88	310.96	**308.32**
V4	300.52	307.59	309.35	**305.82**
V5	307.06	311.45	313.69	**310.74**
Mean	**306.24**	**311.57**	**313.47**	**310.43**

	Sem(±)	CD
F (Fertilizer)	3.45	NS
V(variety)	5.31	NS
V * F	9.20	NS
F *V	8.93	NS
C.V (%)	(a) 4.30	(b) 5.14

Table 2: Effect of different level of fertilizer and variety on available sulphur (kg/ha.).

	F1	F2	F3	Mean
V1	3.22	3.63	3.52	**3.46**
V2	3.25	3.59	3.50	**3.45**
V3	3.08	3.51	3.44	**3.34**
V4	3.12	3.40	3.37	**3.30**
V5- G-323	3.17	3.44	3.41	**3.34**
Mean	**3.17**	**3.51**	**3.45**	**3.38**

	Sem(±)	CD
F (Fertilizer)	0.05	0.21
V(variety)	0.06	NS
V * F	0.11	NS
F * V	0.11	NS
C.V (%)	(a) 6.00	(b) 5.58

CONCLUSIONS

This study shows that application of fertilizers is compulsory to improve the production and productivity of garlic in the study area since almost all parameters of garlic were significantly influenced by NPK fertilizer rates. According to this study most of parameters were significantly highest at BRG-13 genotypes. Due to the application of third level of fertilizer (N140P100K100) almost all the parameter was significantly affected. Therefore, based on this study, it could be recommended that the application of nitrogen 140kg ha^{-1}, phosphorus 100 kg ha^{-1} and potassium 100kg ha^{-1} could be recommended for garlic production.

FUTURE SCOPE

Effect of NPK fertilizer on physicochemical properties of garlic can be further studied. Also their effect on S-compound can be studied to check its effect on antimicrobial properties of garlic.

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