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Effect of macro- nutrients (NPK) on quality and economic feasibility of garlic (*Allium sativum* L.)

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Abstract
The specific objective of this study was to effect of macro- nutrients (NPK) on quality and economic feasibility in five different garlic genotypes. The present experiment was conducted during winter (Rabi) season of 2018-19 at the research farm and the laboratory at Bihar Agricultural University Sabour Bhagalpur, Bihar. The experiment comprised of five genotypes of garlic namely, BRG-13, BRG-14, BRG-1, G-1 and G-323 and the treatment consists of three fertilizer levels, F1 (N100P80K80), F2 (N120P90K90), F3 (N140P100K100) and total numbers of treatment combinations were 15. The design of experiment was Split Plot Design and there were three replications. Observations were recorded treatment wise on quality parameter like total nitrogen, total phosphorus, total potassium, total Sulphur and economic feasibility of various treatment. The results showed that most of the treatments varied significantly with respect to different fertilizers and genotypes and also due to their interaction effect for quality parameters and that the genotype, BRG-14 was the best performer with respect to growth yield and quality when applied F2 (N120P90K90) and highest B:C ratio in BRG-13 with application of second level of fertilizer i.e.; N120P90K90.

Keywords: Garlic, genotypes, macronutrients

Introduction
Garlic (*Allium sativum* L.) is the second most widely used cultivated bulb crops after onion in Egypt and it is also important foreign exchange earner. Garlic originated in Central Asia where it was extended to the Mediterranean region in the prehistoric dates (Thompson and Kelly, 1957). The major garlic producing countries of the world are China, South Korea, Egypt, India, Spain, USA, Thailand and Turkey. Beside garlic, family Amaryllidaceae has 600 known species such as onion (*Allium cepa* L.), shallot (*Allium oscaninii* L.), leek (*Allium ampeloprasum* L.) and chive (*Allium schoenoprasum*). Garlic is a diploid species (2n=2x=16) of obligated apomixes, therefore its reproduction is vegetative (Ipek M, 2008) [7]. The crop consists of an underground bulb and above the ground vegetative part which consists of the leaves and flowers. In world total garlic production was 26,573,001 metric tons in 2016. China is the leading producer with 21,197,131 tons (FAO, 2016) [20]. In India garlic is grown in an area of 393 thousand hectares producing 3208 thousands metric tons with an average national productivity of 8.16 tons ha^{-1} (NHB 2021-22). Garlic has higher nutritive value than other bulbs crops (Abou El-Magd *et al*. 2012) [1]. Keeping in view of its medicinal value, especially Allicin of garlic which has antibacterial properties (Al-Otayk *et al.* 2009 and Sterling and Eagling, 1997) [2, 17], garlic is widely used in all households throughout the year. According to Amagase *et al.* (2001) [3] and Iciek *et al*. (2009) [6], the unique flavor and health-promoting functions of garlic are generally attributed to its rich content of sulfur-containing compounds, that is, alliin, g-glutamyl cysteine, and their derivatives. Garlic is grown worldwide in all temperate to subtropical and tropical hilly areas as an important spice and medicinal plant (Pandey, 2012) [11]. Clove sprouting and emergence are controlled mainly by temperature (Takagi H, 1990). Sowing time plays an important role on the growth and yield of garlic. Garlic is known to be thermos and photo-sensitive crop (Jones and Mann, 1963) [8] and its vegetative growth and bulb formation are greatly influenced by growing environment (Jones and Mann, 1963, Rahim and Fordham, 1988) [8, 14]. The early growth stage of garlic is suited by exposure of cloves to low temperature and planting in a cool growing period and this treatment is essential for proper development of shoot and good yield of bulb (Bhuiya MAK, 2003) [5]. Delay of a few weeks in the normal planting date led to several losses in yield (Rahman AKMM, and Talukder MR, 1986 and Rahman MM, 1981) [15, 16].

Garlic plant requires many different micronutrients which are essential for health, growth and reproduction and these are usually required in smaller amount than nitrogen, phosphorus and potassium and Sulphur. These nutrients are very important for growth and general health of the plant. Fast-growing crops take up nitrogen quickly, so they need a generous supply of nitrogen (Mengel *et al*. 2006) [9]. Sulphur is the fourth major essential nutrient particularly in garlic.

Materials and Method

The experiment was conducted during winter (Rabi) season of 2018-19 at the research farm and the laboratory at Bihar Agricultural University, Sabour, Bhagalpur, Bihar with a view to investigating the effect of macro-nutrient like nitrogen, phosphorus and potassium on the quality parameter like total nitrogen, total phosphorus, total potassium, total Sulphur. The soil of experimental plot was typically genetic alluvial in origin. The plant materials comprised of five genotypes of garlic namely, BRG-13, BRG-14, BRG-1, G-1 and G-323 denoted as (V1, V2, V3, V4 and V5 respectively in the treatment combination in the experiment). Nitrogen, phosphorous and potash 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 mutate of potash respectively. The garlic genotypes were sown on 10th October 2018. Thus, total numbers of treatment combinations were 15. The design of experiment was Split Plot Design and there were three replications. Planting was done at spacing of 15 cm from row to row and 10 cm from plant to plant. Observations were recorded treatment wise on five randomly selected plants for total nitrogen, total phosphorus, total potassium, total Sulphur and economic feasibility of various treatment. The data were analyzed statistically according to the method outlined by Panse and Sukhatme (1984) [12].

Results and Discussion

Effect of macro-nutrient (NPK)

The effect of NPK on total nitrogen (Fig:1), phosphorus (Fig:2), potassium (Fig:3) and Sulphur (Fig:4) content and economic feasibility (Table-1) in garlic genotypes. Results revealed that the nutrient content in the bulb of garlic, the maximum total nitrogen (%) was recorded in BRG-13 (1%) when was apply second and third level of fertilizer dose i.e., F2 (N120P90K90) and F3 (N140P100K100), however, minimum total nitrogen (%) was found in BRG-14 (0.74%) and G1 (0.74%) at the third level of fertilizer dose i.e. F3 (N140P100K100). The result indicates that genotypes, BRG-14 and G-1 were not responsive to increased fertilizer doses for Nitrogen percentage in bulb. This result was supported by the result of Naruka and Dhaka (2001) [10] in clove of garlic. The maximum total phosphorous (%) was observed in BRG-14 (0.23%) at the second level of fertilizer i.e., F2 (N120P90K90), however, minimum total phosphorous (%) was found in G1 (0.09%) and G-323 (0.09%) at the first and third level of fertilizer i.e., F1 (N100P80K80) and F3 (N140P100K100). This similar finding was observed by the result of Naruka and Dhaka (2001) [10] in clove of garlic. The maximum total potassium (%) was found in BRG-14 (0.22%) at the second level of fertilizer dose i.e., F2 (N120P90K90), however, minimum total potassium (%) was observed in G1 (0.13%) F3 (N140P100K100). This similar result was supported by the result of Otunola *et al*. (2010), Naruka and Dhaka (2001) [10] in clove of garlic. The maximum total Sulphur (%) was found in BRG-14(0.40%) at the fertility level F2 (N120P90K90), however, minimum total Sulphur (%) was noticed in G1 (0.25%) at the first level of fertilizer i.e., F1 (N100P80K80). This similar result was supported by the result of Naruka and Dhaka (2001) [10], Patidar *et al*. (2017), Bhandari et al. (2012) [4] in clove of garlic. These results could be explained by positive effect of fertilizer level at higher rates in improving nutritional status of soils that used by garlic plants. The interaction effect of nitrogen Phosphorus and Potassium had a synergistic effect on the production of dry matter. Nitrogen content of the bulb increased at increased levels of nitrogenous fertilizers as they supplied both N and S nutrients which might have interacted to increase the nutrient uptake and production of dry matter. A good supply of nitrogen stimulates root growth and development as well as the uptake of other nutrients and application of phosphorus improves the vegetables quality (Brady and Weil, 2002) [21]. The growth, yield and economic potential of garlic were increased in response to the combined application of 120 kg N + 90 kg P + 90 kg K ha-1 with a benefit cost ratio of 4.51on F2V1(F2-NPK-120:90:90+ BRG-13). It could thus be concluded that application of 120 kg N + 90 kg P + 90 kg K ha-1 for cultivation of BRG13 was optimum and economical to attain maximum productivity of the garlic. This finding was supported by the result of Shiferaw *et al.* (2015) [22] in garlic.

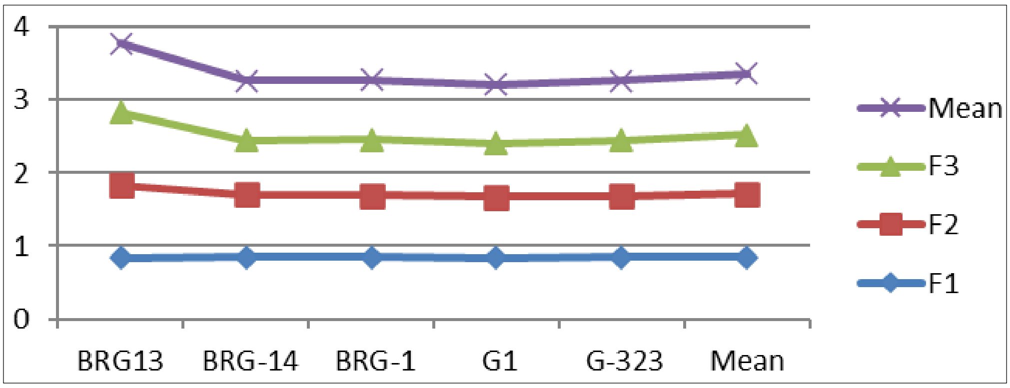

Fig 1: Effect of NPK fertilizer (F1: N100 P80 K80, F2: N120P90K90 and F3: N140P100K100) and variety on total nitrogen (%)

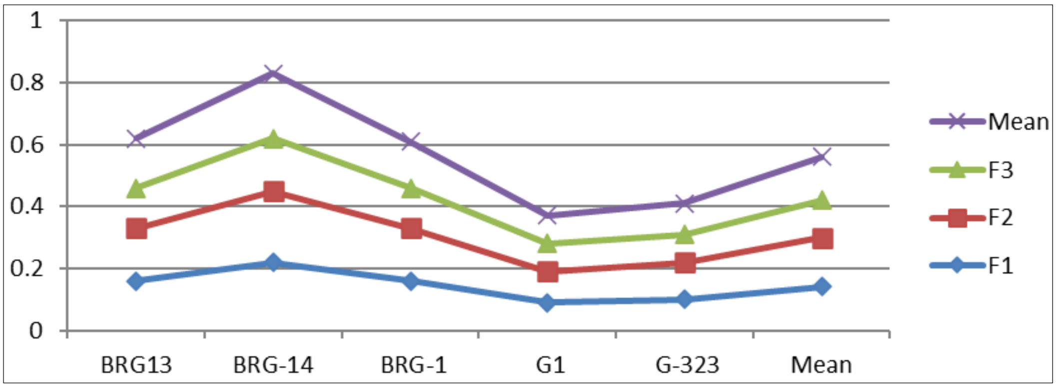

Fig 2: Effect of NPK fertilizer (F1: N100 P80 K80, F2: N120P90K90 and F3: N140P100K100) and variety on total phosphorus (%)

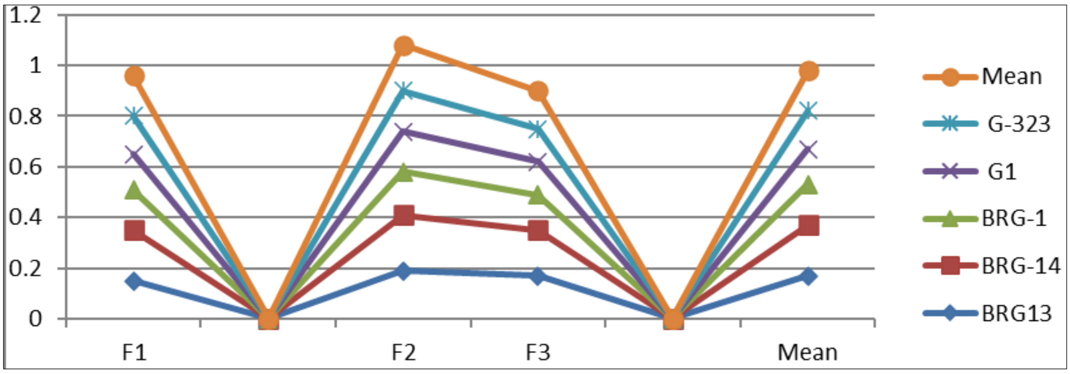

Fig 3: Effect of NPK fertilizer (F1: N100 P80 K80, F2: N120P90K90 and F3: N140P100K100) and variety on total potassium (%)

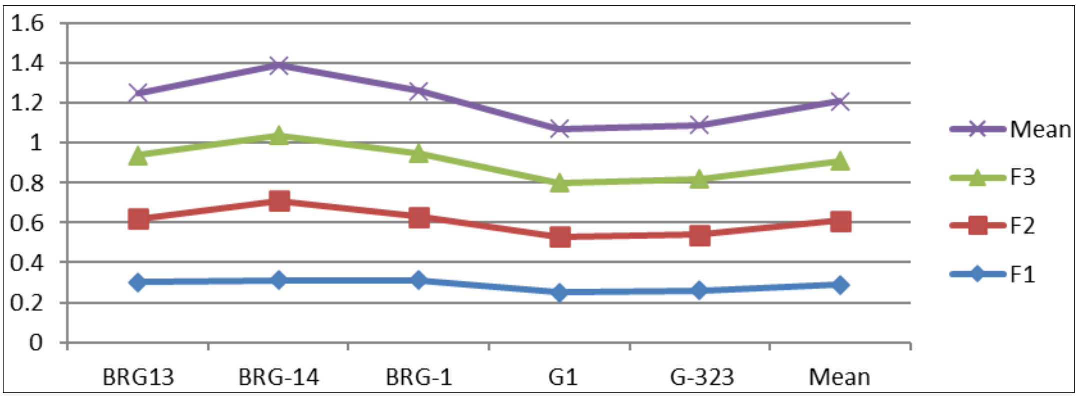

Fig 4: Effect of NPK fertilizer (F1: N100 P80 K80, F2: N120P90K90 and F3: N140P100K100) and variety on total sulphur (%)

Table 1: Effect of NPK fertilizer and variety on economics feasibility of various treatment

(A)	Field management/ha	
1.	Land preparation	
(a)	One disc king @ Rs. 1350.00/ha	1350.00
(b)	Two cross ploughing by cultivator followed by planking @ Rs.1350.00/each per hectare	2700.00
(c)	Levelling, dressing , preparation of plot and irrigation channel of land-60 laborer's @ Rs. 277.00/day	16620.00
2.	Cost of labors for planting - 80 labors @ Rs. 277.00/day	22160.00
3.	Cost of FYM -200 q/ha @ Rs. 150/q	30000.00
4.	Cost of FYM & fertilizers application – 10 labors @ Rs.277.00/day	2770.00
6.	Cost of seed -400 kg @ Rs. 100.00/kg	40000.00
7.	Cost of irrigation – 8 irrigations @ Rs. 1000.00/irrigation/ha	8000.00
8.	Laborer charges for 8 irrigation – 16 laborers @ Rs. 277.00/day	4432.00
9.	Two interculture, hoeing and weeding – 160 laborer @ Rs.277.00/day	44320.00
10.	Plant protection measures	
(a)	Three spraying of monostrophes @ 1.50 liter/ha. = 4.50 liter @ Rs. 600.00/liter	2700.00
(b)	Three spraying of Dithiane M-45 @ 2kg/ha. = 6.00kg @ Rs. 360.00/kg	2160.00
(c)	Laboure's charge for spraying-9 laborer @ Rs. 277.00/day	2493.00
9.	Harvesting, sorting, grading, carrying and selling-80 laborer @ Rs. 277.00/day	22160.00
10.	Watching cost for three months (1-labourers/ hectare/day for 30 days @ Rs. 277.00/day)	8310.00

11.	Miscellaneous expenditure	2000.00
	Grand Total	2,12,175

	Treatments	Common cost of cultivation (Rs.)	Variable cost of cultivation (Rs.)	Total cost of cultivation (Rs.)	Yield q/ha.	Rate (q/ha) Rs.	Gross Income Rs.	Net Income Rs.	B-C ratio
1.	F1V1	2,12,175	8902	2,21,077	157.22	7000	1,100,540	879,463	3.97
2.	F1V2	2,12,175	8902	2,21,077	142.31	7000	996,170	775,093	3.50
3.	F1V3	2,12,175	8902	2,21,077	129.22	7000	904,540	683,463	3.09
4.	F1V4	2,12,175	8902	2,21,077	111.03	7000	777,210	556,133	2.51
5.	F1V5	2,12,175	8902	2,21,077	120.03	7000	840,210	619,133	2.80
6.	F2V1	2,12,175	10160	2,22,335	175.01	7000	1,225,070	1,002,735	4.51
7.	F2V2	2,12,175	10160	2,22,335	168.31	7000	1,178,170	955,835	4.29
8.	F2V3	2,12,175	10160	2,22,335	156.49	7000	1,095,430	873,095	3.92
9.	F2V4	2,12,175	10160	2,22,335	147.84	7000	1,034,880	812,545	3.65
10.	F2V5	2,12,175	10160	2,22,335	156.88	7000	1,098,160	875,825	3.93
11.	F3V1	2,12,175	11350	2,23,525	147.35	7000	1,031,450	807,625	3.61
12.	F3V2	2,12,175	11350	2,23,525	141.19	7000	988,330	764,805	3.42
13.	F3V3	2,12,175	11350	2,23,525	120.96	7000	846,720	623,195	2.78
14.	F3V4	2,12,175	11350	2,23,525	129.75	7000	908,250	684,725	3.06
15.	F3V5	2,12,175	11350	2,23,525	140.41	7000	982,870	759,345	3.39

References

1. Abou EMM, El-Shourbagy MT, Shehata SM. A Comparative study on the Productivity of Four Egyptian Garlic Cultivars Grown Under Various Organic Material in Comparison to Conventional Chemical Fertilizer. Australian Journal Basic and Applied Science. 2012;6(3):415-421.
2. Al-Otayk SMI, Motawei MI, El-Shinawy MZ. Variation in productive characteristics and diversity assessment of garlic cultivars and lines using DNA markers. Journal of Meteorology Environment and Arid land Agriculture Sciences. 2009;20:1.
3. Amagase H, Petesch BL, Matsuura H, Kasuga S, Itakura Y. Intake of garlic and its bioactive components. Journal Nutrition. 2001;131:955-962.
4. Bhandari SA, Patel KS, Nehete DS. Effect of integrated nutrient management on growth, yield and quality of garlic (*Allium sativum* L.) cv. GUJARAT GARLIC–3. The Asian journal of Horticulture. 2012;7:48-51.
5. Bhuiya MAK, Rahim MA, Chowdhury MNA. Effect of planting time, mulch and irrigation on the growth and yield of garlic. Asian J Plant Sci. 2003;2:639-643.
6. Iciek M, Kwiecien I, Wlodek L. Biological properties of garlic and garlic-derived organo sulfur compounds. Environmental and molecular mutagenesis 2009;50:247-265.
7. Ipek M, Ipek A, Simon PW. Genetic characterization of *Allium tuncelianum*: An endemic edible *Allium* species with garlic odor. Sci Hortic. 2008;115:409-415.
8. Jones HA, Mann LK. Onions and Their Allies. Leonard Hill (Book) Limited, London; c1963. p. 286.
9. Mengel K, Hütsch B, Kane Y. Nitrogen fertilizer application rates on cereal crops according to available mineral and organic soil nitrogen. European Journal of Agronomy. 2006;24(4):34-348.
10. Naruka IS, Dhaka RS. Effect of row spacing and nitrogen fertilization on growth, yield and composition of bulb in garlic (*Allium sativum* L.) cultivars. Journal of Spices and Aromatic Crops. 2002;10(2):111-117.
11. Pandey UB. Garlic, Handbook of herbs and spices, Woodhead Publishing; c2012.
12. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi; c1984.
13. Patidar M, Shaktawat RPS, Naruka IS. Effect of Sulphur and Vermicompost on Growth, Yield and Quality of Garlic (*Allium sativum* L.). Journal of Krishi Vigyan. 2017;5(2):54-56.
14. Rahim MA, Fordham. Effects of storage temperature on the initiation and development of garlic cloves (*Allium sativum* L.). Scientia Horticulture. 1988;37(1-2):25-28.
15. Rahman AKMM, Talukder MR. Influence of date of planting and plant spacing on the growth and yield of garlic. Bangladesh J Agric. 1986;11:19-26.
16. Rahman MM. Effect of different dates of planting and plant spacing on the yield of garlic (*Allium sativum* L.). M.Sc. Thesis, Department of Horticulture, BAU, Mymensingh, Bangladesh; c1981.
17. Sterling SJ, Eagling DR. Agronomics and allicin yield of Australian grown garlic (*Allium sativum),* 2nd Int. Symp. on Edible Alliaceae. 1997;555:63-73.
18. Takagi H. Garlic (*Allium sativum* L.). In: H.D. Rabi- no witch and J.L. Brewster (eds.). Onions and allied crops. CRC Press, Boca Raton, Fla. 1990;3:109-146.
19. Thompson HC, Kelly WC. Vegetable crops. Mc Grew Hill Book Co, New York; c1957. p. 368-370.
20. [FAO] Food and Agriculture Organization of the United Nations, 2016, FAOSTAT Database, FAO. 1 December 2016.
21. Brady NC, Weil RR. Soil and the hydrologic cycle. The Nature and Properties of Soils, 2002, 2.
22. Shiferaw B, Kebede T, Kassie M, Fisher M. Market imperfections, access to information and technology adoption in Uganda: Challenges of overcoming multiple constraints. Agricultural economics. 2015 Jul;46(4):475-488.