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**Growth and yield of cabbage var. Golden Acre as
affected by nitrogen, phosphorus and potassium
fertilizers under acid soil conditions**

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Abstract

An 'On Farm' experiment was carried out at Krishi Vigyan Kendra, Lohardaga during early winter seasons of year 2015 and 2016 to study the "Growth and yield of cabbage var. Golden Acre as affected by nitrogen, phosphorus and potassium fertilizers under acid soil conditions". Three types of fertilizers (nitrogen, phosphorus and potassium) in different combinations were tested in a Randomized Block Design with four replications. Cabbage plants were fertilized with different rates of chemical fertilizers *i.e.* nitrogen fertilizers N (120 kg ha⁻¹), single dose of phosphorus P (60 kg ha⁻¹) and potassium K (60 kg ha⁻¹). The highest plant height (cm), diameter of cabbage head (cm), weight of edible portion (g plant⁻¹) and total weight of cabbage head (g plant⁻¹) were obtained from the application of the recommended dose of nutrients *viz.*, 120 kg N + 60 kg P + 60 kg K/ha with FYM (25 t ha⁻¹). The results revealed that significantly the highest plant height, higher yield and yield attributing characters were recorded with the application of NPK *i.e.* 120 kg N ha⁻¹ along with 60 kg P ha⁻¹ and 60 kg K ha⁻¹ and FYM @ 25 t ha⁻¹. So, it may be suggested that application of NPK *i.e.* 120 kg N ha⁻¹ along with 60 kg P ha⁻¹ and 60 kg K ha⁻¹ and FYM 25 t ha⁻¹ can be suitable fertilizer package for cabbage var. Golden Acre production in the soils of Lohardaga district of Jharkhand.

Keywords: cabbage, phosphorus and potassium fertilizers, acid soil

Introduction

Increasing land use intensity, introduction of modern varieties of crop, minimum and unbalanced use of fertilizer and no practice of leaving crop residues, no addition of organic manure to soil have lead to a marked depletion of nutrient reserve in soils. Cabbage (*Brassica oleracea* L. var *Capitata*) is a popular vegetable in many parts of the world including Lohardaga District of Jharkhand. Cabbage is known for its nutritional importance, it is rich in minerals and vitamins like A, B1, B2 and C. It is also known for its cooling effect. Being an appetizer, it aids digestion thereby help preventing constipation. Cabbage is a cool-season vegetable flourish well in cool moist climate. It tolerates frost and extreme chilling. In plateau areas of Jharkhand, cabbage is grown all the year round, especially from October to March. It has been found that a crop of cabbage producing 70 tons per hectare consumes 370 Kg N, 85 Kg P₂O₅ and 480 Kg K₂O from soil. It needs nitrogen in optimum amount, excessive amount of nitrogen may cause loose head formation and internal decay if nitrogen is not in adequate amount it would not form heads. The demand for phosphorus increases manifold during head formation stage. While potassium deficiency can result in marginal necrosis and retards head quality but its excess cause the head to open. Cabbage can be grown on wide range of soil, from clayey to sandy loam soils, however the latter on suit best. Soil pH is an important parameter in site selection for its successful germination and growth. It should be grown on soil having pH less than 5.5. The cause behind lower yield of cabbage may be due to the unbalance and injudicious use of fertilizers. The judicious and balance use of fertilizer can nevertheless bring about a substantial increase in crop productivity (Anonymous, 1995) [1]. No efforts have seriously been done in this direction, despite the fact that of N₂, P₂O₅ and K₂O in optimum amount increase the total marketable yield of cabbage (Sharma and Lal, 1988; Khadir *et al.*, 1991; Singh and Naik, 1990; Khan *et al.*, 2002) [9, 5, 11, 6]. Thus, integrated

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nutrient management has become an accepted strategy to bring about improvement in soil fertility and protecting the environment. This strategy utilizes a judicious combination of fertilizers. According to Mishra and Singh (2006) [7], the relative growth rate of tomato increase sharply with increasing plant P concentration when the letter is below the critical level of adequacy. Results from recent research have indicated that foliar application of phosphorus in greenhouse tomato enhances the concentrations of chlorophyll, K, P, Mg and Fe in the leaves, accelerates fruit maturity and increases marketable yield and quality. A balanced nutrient regime is important to support rapid and consistent fruit growth (Snapp and Huang 2004) [12]. Hence the investigation was carried out to study the effect of integrated nutrient management on the growth, yield and yield attributes of cabbage. Their limited works had been done in this regard. From this point of view, the present research was undertaken to find out the optimum rate of nitrogen, phosphorus and potash for cabbage head yield in the soil of Lohardaga.

Materials and Methods

The 'On Farm' experiment entitled "Growth and yield of cabbage var. Golden Acre as affected by nitrogen, phosphorus and potassium fertilizers under acid soil conditions" was conducted during early winter seasons of year 2015 and 2016, at Krishi Vigyan Kendra, Lohardaga. The experiment was laid out in Randomized Block Design (RBD). There were 4 replications and 5 treatments. There were twenty plots and the area of each was 5.40 m². Plant to plant distances and row to row distances were kept at 30 cm and 60 cm, respectively. Planting was done on raised beds of about 45 cm high using transplanting of the available cabbage cultivar 'Golden Acre'. The basal doses of farm yard manure @ 25 t ha⁻¹, N @ 120 kg ha⁻¹, P @ 60 kg ha⁻¹ and K @ 60 kg ha⁻¹ were applied by using FYM, urea, single super phosphate (SSP) and potassium sulphate sources. FYM, P, K and half N were mixed with soil before transplantation, while the remaining N was applied after four weeks of transplantation. During the research, all other cultural activities like weeding, hoeing, irrigation were carried out at proper time. The soil of experimental field was sandy loam texture with pH 5.6. Data regarding plant height (cm), diameter of cabbage head (cm), weight of edible portion (g plant⁻¹) and total weight (g plant⁻¹) of selected 10 plants were measured and then calculated their mean. The data were pooled and analyzed statistically as per Gomez and Gomez, 1984. Getting the significant variation, the mean was further assessed for differences through critical difference (CD) test at 0.05% probability level.

Results and Discussion

Results presented in Table 1, indicated the significant differences among the kinds of inorganic fertilizers. The plant height, considered to be an important factor to judge the vigor was found increased to a significant level and inoculated plants resulting in accumulation of more dry matter, N, P and K in the stems and leaves (Nanthakumar and Veeraragavathatham, 2001) [8].

Similar to plant height, the diameter of cabbage head was increased due to the application of inorganic fertilizers. The diameter of cabbage head is of considerable importance and it has positive association with yield.

The diameter of cabbage head ranged from treatment T₅ (24.69 cm) to T₁ (15.22 cm). This parameter was boosted correspondingly with the addition of phosphoric and potassic fertilizers with nitrogen application of N (120kg ha⁻¹) which

caused 9.03% increase over the diameter recorded due to application only of nitrogenous fertilizer (22.46 cm).

The height of cabbage plants increased significantly with the addition of phosphoric and potassic fertilizers with nitrogen. It ranged from 26.05 to 21.24 cm under the different treatment combinations. Application of 120 kg N ha⁻¹ P(60 kg ha⁻¹) and K (60 kg ha⁻¹) with FYM (25 t ha⁻¹) produced (26.05 cm.) taller plants than the lowest dose i. e. no use of NPK and FYM. The plants under the lowest level (no NPK and FYM) or in other word no use of fertilizer remained significantly dwarf when compared with the rest of the treatments. The findings of the present investigation are in conformity with the reports of Baringer *et al.* (1999) as reported in tomato.

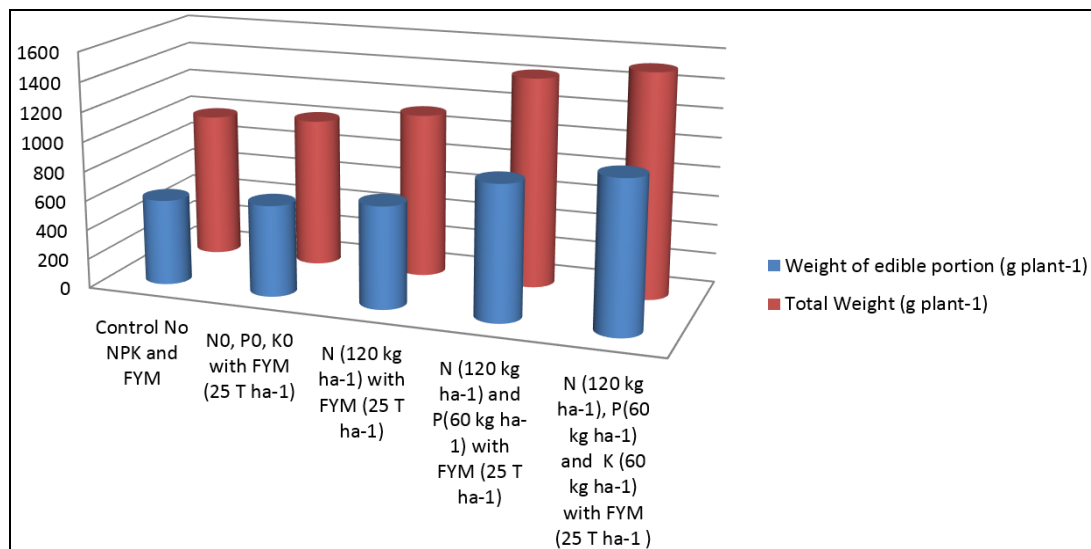
The diameter of cabbage head (24.69 cm) in T₅ i.e. due to application of 120 kg N ha⁻¹ P(60 kg ha⁻¹) and K (60 kg ha⁻¹) with FYM (25 t ha⁻¹), the parameter was boosted correspondingly with the addition of phosphorus and potash application (each of 60kg ha⁻¹) with nitrogen 120 kg N ha⁻¹ which increased for 38.36% in this attribute as compared to no use of N, P and K fertilizer (Mishra and Singh, 2006) [7], as reported in tomato. The diameter of cabbage head ranged from 15.22 – 24.69 cm under the different treatment combination of N, P and K with addition of FYM 25 t ha⁻¹. This parameter was boosted correspondingly with the addition of application of P and K (each of 60kg ha⁻¹) to nitrogen application of 120 kg N ha⁻¹. The height of cabbage plants increased correspondingly with the addition of phosphorus and potassium. It ranged from 26.05 to 21.24 cm under the different treatments.

Nitrogen treatment in combination of other inorganic fertilizers namely phosphorus and potash (each of 60 kg ha⁻¹) levels improved the yield and yield attributing characters. In the present investigation application of 120 kg N ha⁻¹ P (60 kg ha⁻¹) and K (60 kg ha⁻¹) with FYM (25 t ha⁻¹) produced the highest weight of edible portion per plant (1016 g) followed by the weight of edible portion per plant of 910 g recorded with the application of only nitrogen (120kg N ha⁻¹) and phosphorus (60 kg ha⁻¹) with FYM (25 t ha⁻¹). These findings are in line with the reports of Khan *et al.* (2002). Addition of phosphorus improved the yield and yield attributing characters. Addition of 60 kg P ha⁻¹ to nitrogen at 120 kg ha⁻¹ produced the second highest weight of edible portion per plant (910 g). These findings are in line with the reports of Mishra and Singh (2006) [7]. Addition of potassium (60 kg K ha⁻¹) also improved the yield and yield attributing characters. The maximum total weight of cabbage per plant (1516 g) was obtained with the application of 120kg N ha⁻¹ P (60 kg ha⁻¹) and K (60 kg ha⁻¹) with FYM (25 t ha⁻¹). The application of nitrogen, phosphorus and potash, all three along with FYM increases the total marketable cabbage head. In the present investigation addition of 60 kg K ha⁻¹ to the application of 120 kg N and 60 kg P ha⁻¹ produced the highest weight of edible portion per plant (1016 g) as well as highest weight of marketable cabbage head per plant (1516 g) which is on supported by the reports of Mishra and Singh (2006) [7]. These findings are in concurrent with the findings of Kang *et al.* (1989) [4] and Silva (1994) [10].

It is summarized from the two years study felt that application of NPK @ 120+60+60 kg ha⁻¹ with FYM @ 25 t ha⁻¹ improved the growth, yield and yield attributing characters of cabbage under Lohardaga condition. So, it may be suggested that application of NPK @ 120+50+50 kg ha⁻¹ and FYM 25 t ha⁻¹ can be suitable fertilizer package for cabbage var. Golden Acre production in the soils of Lohardaga district of Jharkhand.

Table 1: Plant growth and yield parameters of cabbage var. Golden Acre as influenced by application of nitrogen, phosphorus and potash.

Treatment	Plant height (cm)	Diameter of Head (cm)	Weight of edible portion (g plant ⁻¹)	Total Weight (g plant ⁻¹)
T ₁ – Control No NPK and FYM	21.24	15.22	581	985
T ₂ – N ₀ , P ₀ , K ₀ with FYM (25 t ha ⁻¹)	22.48	18.38	619	1015
T ₃ – N (120 kg ha ⁻¹) with FYM (25 t ha ⁻¹)	24.57	22.46	691	1115
T ₄ – N (120 kg ha ⁻¹) and P(60 kg ha ⁻¹) with FYM (25 t ha ⁻¹)	25.10	22.96	910	1422
T ₅ – N (120 kg ha ⁻¹), P(60 kg ha ⁻¹) and K (60 kg ha ⁻¹) with FYM (25 t ha ⁻¹)	26.05	24.69	1016	1516
S.E. Difference	0.31	0.54	31	33
CD _{0.05}	0.81	1.60	87	87

**Fig 1:** Effect of fertilizers on Yield of head (g plant⁻¹) of cabbage var. Golden Acre [*Brassica oleracea* L. var *Capitata*].

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