



RESEARCH ARTICLE

NUTRIENT MANAGEMENT ON GROWTH, YIELD AND ECONOMICS OF QUALITY PROTEIN MAIZE (QPM)

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ABSTRACT

Response of quality protein maize hybrid (HQPM-1) to various N and P levels was studied at College Farm, College of Agriculture, Rajendranagar, Hyderabad during *kharif* 2012. Trail with four nitrogen levels (0, 120, 180 and 240 kg N ha⁻¹), four phosphorus levels (0, 60, 80 and 100 kg P₂O₅ ha⁻¹) was laid out in randomized block design in three replications with a plot size of 6m × 5m at spacing of 60 × 20 cm. Results showed that each incremental effect of nitrogen and phosphorus fertilizers significantly increased the yield (grain and stover) of HQPM-1 over control. Among four levels of nitrogen, application of 240 kg N ha⁻¹ gave maximum plant height (212.75 cm), LAI (3.89), dry matter production (13432 kg ha⁻¹), cob length (17.50 cm), grain yield (6383 kg ha⁻¹), protein content (11.35 %), net returns (46954 ₹ ha⁻¹) and B: C ratio (2.97) followed by 180, 120 kg N ha⁻¹ and control. Similarly, out of four levels of phosphorus highest dose i.e. 100 kg P₂O₅ ha⁻¹ resulted in taller plants (185.95 cm), high LAI (3.17), dry matter production (10572 kg ha⁻¹), cob length (16.25 cm), grain yield (5010 kg ha⁻¹), protein content (11.06 %) net returns (30996 ₹ ha⁻¹) and B: C ratio (2.22) followed by lower levels of phosphorus. Hence, QPM obtained good results at 240 kg N ha⁻¹ and 100 kg P₂O₅ ha⁻¹.

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INTRODUCTION

Maize (*Zea mays*) which means "that which sustains life". Maize, is an important world cereal crop after wheat and rice, which is referred as "Queen of Cereals", due to the high productiveness, easy to process, low cost than other cereals (Jaliya et al., 2008), provides nutrients for humans and animals, serves as basic raw materials for production of starch, oil, alcoholic beverages and more recently fuel (Punita, 2006). It is a good source of carbohydrates, fat, proteins, vitamins and minerals, however deficient in essential amino acids viz., lysine and tryptophan which reduce its biological value. The amount of these deficient amino acids has been increased by incorporating opaque-2 gene in quality protein maize (QPM). Hence, the cultivation of QPM provides an opportunity to the farmers to produce nutritionally superior maize grains. Growth and grain yield of maize is remarkably influenced by nutrient management, but inadequate use of major nutrients (N, P) is responsible for limiting maize yields. Hence proper nutrition of QPM hybrid is important to get high crop yields.

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Nitrogen is a component of protein and nucleic acid which determines plant growth and development (Onasanya et al., 2009). Phosphorus is needed for growth, utilization of sugar and starch, photosynthesis, metabolic process which leads to higher yield potential (Ayub et al., 2002). Maize with higher productive potential, being heavy feeder of nutrients requires continuous and assured nutrient supply throughout the growing period from germination to grain filling stages to realize good yields. Hence, for better dissemination and adaptation of QPM hybrids the present experiment on fertilizer management with nitrogen and phosphorus levels was initiated as an endeavor to make QPM a real potential use.

MATERIALS AND METHODS

A field experiment was conducted on Quality Protein Maize during *kharif* 2012, at College Farm, College of Agriculture, Rajendranagar, Hyderabad. The experiment consisted of four levels of N (0, 120, 180 and 240 kg ha⁻¹) and P (0, 60, 80 and 100 kg ha⁻¹) with three replications in Randomized Block Design. The soil was classified as sandy loam, neutral in soil reaction (pH 6), rich in organic carbon (0.43%), medium in available nitrogen (309 kg ha⁻¹), phosphorus (31.23 kg ha⁻¹)

and potassium (320 kg ha⁻¹). The annual rainfall of the region is 532.8 mm. A uniform basal dose of potassium (80 kg ha⁻¹) and graded levels of nitrogen and phosphorus as per treatments was applied basally. Quality Protein Maize hybrid (HQPM-1) was sown 9th July 2012 with a seed rate of 20 kg ha⁻¹ at a spacing of 60 × 20 cm. Crop was harvested on Oct 18th 2012.

RESULTS AND DISCUSSION

Growth parameters

The growth parameters like Plant height, LAI and dry matter production was significantly affected by the application of nitrogen and phosphorus (Table 1). Maize crop fertilized with 240 kg N ha⁻¹ had significantly resulted in long statured plants (212.75 cm), higher leaf area index (3.89) and maximum dry matter production (13432 kg ha⁻¹) compared to other nitrogen levels (180, 120 kg N ha⁻¹ and control) at harvest. Application of phosphorus @ 100 kg P₂O₅ ha⁻¹ produced significantly the taller plants (185.95 cm), maximum LAI (3.17) and higher dry matter production (10572 kg ha⁻¹) over other 'p' levels (60, 80 kg P₂O₅ ha⁻¹) and minimum with control. Increasing levels of nitrogen and phosphorus influences growth parameters by enhancing cell division, cell elongation and nucleus formation (Ali *et al.*, 2012).

Yield components

Among the yield components the cob length was significantly influenced by different levels of nitrogen and phosphorus (Table.1). The cob length of 17.5 cm increased linearly with 240 kg N ha⁻¹ significantly superior over 180 kg N ha⁻¹, 120 kg N ha⁻¹ and control by 10.22%, 25.42% and 48%. Maximum dose of phosphorus fertilizer (100 kg P₂O₅ ha⁻¹) has shown longer cobs (16.25 cm) significantly superior over control (11.47 cm) followed by 80 kg P₂O₅ ha⁻¹ (15.15 cm) and 60 kg P₂O₅ ha⁻¹ (13.99 cm). Number of cobs per plant was not significantly influenced by nitrogen and phosphorus. Nitrogen and Phosphorus are essential nutrients that promote higher photosynthetic activities leading to the production of higher sink components like cob length and number of cobs plant⁻¹ (Ravi *et al.*, 2012).

Grain yield and Protein content

QP maize fertilized with 240 kg N ha⁻¹ produced maximum yields (6383 kg ha⁻¹) significantly superior over 180 kg ha⁻¹ (12.50%), 120 kg ha⁻¹ (33.32%) and control (71.43%). Phosphorus @ 100 kg ha⁻¹ applied to QPM produced grain yield (5010 kg ha⁻¹) which was significantly higher by 798, 2127 and 4560 kg ha⁻¹ than the maize fertilized with 80, 60 kg P₂O₅ ha⁻¹ and control respectively (Table.2).

Table 1. Effect of nitrogen and phosphorus on growth and yield components of QPM

Treatment	Plant height (cm)	LAI	Dry matter production (kg ha ⁻¹)	Number of cob plant ⁻¹	Cob length (cm)
Nitrogen Levels (kg ha ⁻¹)					
0	116.04	1.33	4022	1.00	10.60
120	181.12	2.39	9176	1.00	13.05
180	202.94	3.59	11832	1.33	15.71
240	212.75	3.89	13432	1.33	17.50
SE m±	1.65	0.05	198	0.11	0.36
CD (P=0.5)	4.78	0.15	573	NS	1.05
Phosphorus Levels (kg ha ⁻¹)					
0	170.55	2.35	8176	1.16	11.47
60	175.43	2.74	9616	1.16	13.99
80	180.90	2.94	10098	1.16	15.15
100	185.95	3.17	10572	1.16	16.25
SE m±	1.65	0.05	198	0.11	0.36
CD (P=0.5)	4.78	0.15	573	NS	1.05
Interaction (N×P)					
SE m±	3.31	0.10	396	0.22	0.73
CD (P=0.5)	NS	NS	NS	NS	NS

Table 2. Effect of nitrogen and phosphorus on yield, protein content and economics of QPM

Treatment	Grain yield (kg ha ⁻¹)	Protein content (%)	Net return (₹ ha ⁻¹)	B:C ratio
Nitrogen Levels (kg ha ⁻¹)				
0	1823	9.14	-512	0.96
120	4256	9.96	25051	2.10
180	5585	10.67	38921	2.67
240	6383	11.35	46954	2.97
SE m±	93	0.22	1035	-
CD (P=0.5)	269	0.66	2990	-
Phosphorus Levels (kg ha ⁻¹)				
0	3798	9.68	22813	2.11
60	4490	9.88	27405	2.17
80	4749	10.49	29199	2.20
100	5010	11.06	30996	2.22
SE m±	93	0.22	1035	-
CD (P=0.5)	269	0.66	2990	-
Interaction (N×P)				
SE m±	186	0.45	2070	-
CD (P=0.5)	NS	NS	NS	-

High rates of nitrogen and phosphorus influences physiological process, plant metabolism, increasing yield components, there by leading to higher grain yield (Pokharel *et al.*, 2009). The protein content, which is the quality parameter of QPM, was significantly higher with 240 kg N ha⁻¹ (11.35 %) over other N levels and also maximum with 100 kg P₂O₅ ha⁻¹ (11.06 %) over other P levels. Nitrogen concentration in the grain is integral part of protein synthesis, accelerating the protein content (Jaliya *et al.*, 2013).

Economics

Quality Protein Maize with 240 kg N ha⁻¹ (₹ 46, 954 ha⁻¹) recorded highest net returns compared to other N levels and control. While 100 kg P₂O₅ ha⁻¹ also recorded higher net returns of ₹ 30, 996 ha⁻¹ over lower and no fertilizer treatments. Higher B: C ratio of 2.97 was recorded with 240 kg N ha⁻¹ compared to other N levels and 2.22 of B: C ratio was observed with 100 kg P₂O₅ ha⁻¹ while it was lower with 80 kg ha⁻¹ (0.90 %), 60 kg ha⁻¹ (2.25%) and control (4.95%) (Table.2). Adequate supply of N and P fertilizers is responsible for biomass accrual, efficient translocation of nutrients, elevated yield attributes, high yield resulting in higher monetary returns and B: C ratio (Naik *et al.*, 2012).

Conclusion

As the QPM is an improved version of normal maize with high levels of protein and amino acids especially Lysine and Tryptophan. Hence the research and development on different agronomic management practices can be evaluated to popularize QPM. Based on the above findings, the improved growth, yield parameters, and economics can be achieved with application of 240 kg N ha⁻¹ and 100 kg P₂O₅ ha⁻¹.

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