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Nitrogen and Sulphur Nutrition for Enhancing the Growth and Yield of Quality Protein Maize (QPM)

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ABSTRACT

A field experiment was conducted during *rabi,* 2014-15 at S.V. Agricultural College Farm, Tirupati to find out the response of quality protein maize hybrid (HQPM-1) to various N and S levels. The treatments consisted of four nitrogen levels (60, 120, 180, 240 kg N ha^{-1}) in combination with three sulphur levels (15, 30, 45 kg S ha^{-1}). The results of the experiment revealed that among the four nitrogen levels, application of 240 kg N ha^{-1} recorded the maximum plant height (185.6 cm), leaf area index (2.64), dry matter production (10903 kg ha^{-1}), grain yield (5101 kg ha^{-1}) and stover yield (5569 kg ha^{-1}) followed by 180, 120 and 60 kg N ha^{-1}. Similarly, application of 45 kg S ha^{-1} resulted in significantly more plant height (162.9 cm), leaf area index (1.87), dry matter production (8117 kg ha^{-1}), grain yield (3679 kg ha^{-1}) and stover yield (4029 kg ha^{-1}) followed by lower levels of sulphur. Hence N and S can be applied at the rate of 240 kg ha^{-1} and 45 kg ha^{-1}, respectively to obtain higher yield.

Key words: *Growth, Nutrition, Quality protein maize.*

Maize (*Zea mays* L.) is an important cereal crop which ranks third after wheat and rice in the world. Maize grains are used for both human and livestock consumption. Maize grain is the major cereal used for animal feed. Because of its expanded use in the agro- based industries it is considered as a leading commercial crop of great agro-economic value. Globally maize is cultivated in an area of 170.39 Million ha with a production of 883.46 Million tonnes and 5.18 Million tonnes ha^{-1} productivity (FAO, 2012). In India, grown in an area of 8.55 Million ha with a production of 21.73 Million tonnes and an average productivity of 2540 kg ha^{-1}. In Andhra Pradesh it covers an area of 0.82 Million ha with a production of 4.51 Million tonnes at an average productivity of 5317 kg ha^{-1} (CMIE, 2011). Unfortunately maize lacks the full range of amino acids, namely lysine and tryptophan, needed to produce proteins leading to poor net protein utilization, malnutrition and low biological value. Quality Protein Maize, is exactly similar to normal maize in grain texture, taste, colour but possesses double the level of lysine (4%) and tryptophan (0.8%), produces high yields and tolerates biotic and abiotic stresses. Such balanced condition of amino acids in the endosperm resulted to its higher biological value ensuring more availability of protein to human and animals than normal maize (Jena *et al.,* 2013). Hence, for better dissemination and adoption of QPM hybrids there is a need to understand the performance of QPM with various agronomic management practices among which nutrient management is a major one. Therefore, a field study was undertaken to study the effect of nitrogen and sulphur on growth and yield of QPM.

MATERIAL AND METHODS

A field experiment was carried out during *rabi,* 2014-15 at S.V. Agricultural College Farm, Tirupati. The experimental soil was sandy loam in texture, neutral in reaction (pH 6.9), low in organic carbon (0.43 per cent) and available nitrogen (125.4 kg ha^{-1}), high in available phosphorus (43.7 kg ha^{-1}), medium in potassium (146 kg ha^{-1}) and sufficient in sulphur (18.5 kg ha^{-1}). The experiment was laid out in randomized block design with factorial concept with twelve treatment combinations and replicated thrice. The treatments comprised of four nitrogen levels (60, 120, 180, 240 kg N ha^{-1}) in combination with three sulphur levels (15, 30, 45 kg S ha^{-1}).Quality Protein Maize hybrid (HQPM-1) was sown on 15th November 2014 with a seed rate of 20 kg ha^{-1} at a spacing of 60 × 25 cm. A basal dose of 80 kg P_2O_5 and 80 kg K_2O was applied uniformly to all the treatments. Sulphur is applied as basal as per the treatments. The scheduled nitrogen was applied in three equal splits *viz.,* first half at the

time of sowing as basal, 1/4 as top dressing at knee high stage and remaining 1/4 as top dressing at tasseling stage.

RESULTS AND DISCUSSION

Plant Height

The data on plant height revealed that, as the crop stage advanced from 30 to 90 DAS, the plant height increased progressively with varied levels of N and S, but showed a diminishing rate of increase at harvest. The four levels of N and three levels of S significantly influenced the plant height at 30, 60, 90 DAS and at harvest. Interaction effect between N and S was found non-significant on the plant height of QPM hybrid at all stages of crop growth.

Maximum plant height of 97.5 cm, 152.7 cm, 185.5 cm and 185. 6 cm at 30, 60, 90 DAS and at harvest, respectively was observed with 240 kg N ha^{-1} (N_4) which was significantly superior over the other levels tried .With regard to sulphur the taller plants were produced with 45 kg S ha^{-1} (S_3) (85.8 cm, 134.2 cm, 162.7 cm, 162.9 cm at 30, 60, 90 DAS and at harvest, respectively) while the application of 15 kg S ha^{-1} (S_1) resulted in the shortest plants (Table-1).

Increase in plant height with increasing levels of N and S could be attributed to the fact that nitrogen and sulphur helps in higher photosynthetic activity, cell and internodal elongation and maintenance of higher auxin levels, which might have resulted in the plants of taller stature. Similar results of increase in plant height with increasing levels of N and S application were reported by Mukhtar *et al.* (2011), Ravi *et al*. (2012) and Chaudhary *et al.* (2013).

Leaf Area Index

The data on LAI of quality protein maize at different crop growth stages was influenced by varied N and S levels while the interaction effect of N and S levels on LAI was not statistically measurable. There was a gradual increase in LAI of maize up to 90 DAS and tended to decline towards harvest.

Maximum LAI (2.64) was observed with 240 kg N ha^{-1} (N_4) at 90 DAS followed by 180, 120 and 60 kg N ha^{-1} with significant differences among them. LAI increased due to incremental increase of Sulphur from 15 to 45 kg S ha^{-1} and was found to be higher with 45 kg S ha^{-1} (S_3) (1.87) at 90 DAS followed by 30 kg S ha^{-1} (S_2) (1.77) and 15 kg S ha^{-1} (S_1) (1.55) (Table-1).

The increase in LAI could be attributed to favourable effect of nitrogen and sulphur on nitrogen metabolism, cell division and enlargement, manifesting the leaf tissues to grow better, producing larger leaf area and there by improved the quality of vegetative growth due to applied N and S fertilizers, which corroborate with the results of Ramu (2005) and Jeet *et al.* (2012).

Dry Matter Production

Dry matter production of maize increased progressively with the advance in age of the crop up to harvest. Dry matter production of maize estimated at different growth stages *i.e,* 30, 60, 90 DAS and at harvest differed significantly due to different levels of nitrogen and sulphur. Interaction effect of nitrogen and sulphur levels at all the stages was found to be non-significant.

The higher dry matter production was recorded with 240 kg N ha^{-1} (N_4) (10903 kg ha^{-1}), followed by 180 kg N ha^{-1} (N_3) (8539 kg ha^{-1}) followed by 120 kg N ha^{-1} (N_2) (5894 kg ha^{-1}) and 60 kg N ha^{-1} (N_1) (3800 kg ha^{-1}) at harvest. Dry matter production of maize at harvest was found to be significantly higher with 45 kg S ha^{-1} (S_3) (8117 kg ha^{-1}) than all other sulphur levels tried. This was followed by 30 kg S ha^{-1} (S_2) (7079 kg ha^{-1}) and 15 kg S ha^{-1} (S_1) (6657 kg ha^{-1}) with significant difference between them (Table-1).

The increased absorption of nitrogen under adequate S nutrition increases leaf area and photosynthetic rate and ultimately results in higher biomass production. Enhanced dry matter production with adequate supply of nitrogen and sulphur, as evidenced in this investigation corroborates the findings of Kumar (2008) and Sutar (2012).

Yield

Quality protein maize fertilized with 240 kg N ha^{-1} had resulted in higher grain yield (5101 kg ha^{-1}) and stover yield (5569 kg ha^{-1}). The percentage increase in grain yield with 120, 180 and 240 kg N ha^{-1} over 60 kg N ha^{-1} was 39.42 per cent, 60.9 per cent and 69.39 per cent, respectively. Similarly, the highest grain yield (3679 kg ha^{-1}) and stover yield (4029 kg ha^{-1}) were recorded with application of 45 kg S ha^{-1} followed by other lower levels (Table-2).

Table 1. Plant height (cm), Leaf Area Index and Dry matter production (kg ha^{-1}) of quality protein maize at different growth stages as influenced by levels of nitrogen and sulphur.

Treatments	Plant height (cm)				Leaf Area Index				Dry matter production (kg ha^{-1})			
	30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	At Harvest
Nitrogen levels (kg ha^{-1})												
N_1 (60)	66.7	100.7	128.4	129.2	0.08	0.89	0.93	0.91	104	1392	3792	3800
N_2 (120)	77.7	127.7	147.0	147.2	0.18	1.36	1.51	1.44	184	2440	5784	5894
N_3 (180)	87.4	142.4	166.4	166.5	0.69	1.77	1.84	1.79	244	3024	8525	8539
N_4 (240)	97.5	152.7	185.5	185.6	0.85	2.33	2.64	2.59	545	4395	10704	10903
S.Em±	1.0	0.8	1.2	1.2	0.01	0.02	0.08	0.02	9	76	116	100
CD (P=0.05)	2.9	2.3	3.6	3.4	0.02	0.07	0.25	0.06	26	223	339	292
Sulphur levels (kg ha^{-1})												
S_1 (15)	79.8	127.7	151.0	151.3	0.42	1.49	1.55	1.54	241	2515	6532	6657
S_2 (30)	81.5	130.6	156.8	157.2	0.45	1.57	1.77	1.68	268	2788	7059	7079
S_3 (45)	85.8	134.2	162.7	162.9	0.47	1.71	1.87	1.83	298	3136	8013	8117
S.Em±	0.9	0.7	1.1	1.0	0.01	0.02	0.07	0.02	8	66	100	86
CD (P=0.05)	2.6	2.0	3.1	3.0	0.02	0.06	0.22	0.06	22	193	294	253
Interaction												
S.Em±	1.7	1.3	2.1	2.0	0.01	0.04	0.15	0.04	15	132	200	173
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Effect of nitrogen and sulphur levels on grain yield and stover yield of QPM.

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Nitrogen levels (kg ha^{-1})		
N_1 (60)	1561	2006
N_2 (120)	2577	2835
N_3 (180)	3993	4269
N_4 (240)	5101	5569
S.Em±	50	72
CD (P=0.05)	147	210
Sulphur levels (kg ha^{-1})		
S_1 (15)	2997	3390
S_2 (30)	3247	3591
S_3 (45)	3679	4029
S.Em±	44	62
CD (P=0.05)	128	182
Interaction		
S.Em±	87	124
CD (P=0.05)	NS	NS

Higher rates of N and S had beneficial effect on physiological processes, plant metabolism, dry matter production, growth etc. there by leading to higher grain and stover yield. Similar results were reported by Meena *et al.* (2011) and Jena *et al.* (2013).

LITERATURE CITED

Chaudhary R, Singh D and NepaliaV 2013 Productivity and economics of quality protein maize (*Zea mays*) as influenced by nitrogen levels, its scheduling and sulphur application. *Indian Journal of Agronomy,* 58(3): 340-343.

Jeet S, Singh J P, Kumar R, Prasad R K, Kumar P, Kumari A and Prakash P 2012 Effect of nitrogen and sulphur levels on yield, economics and quality of QPM hybrids under dryland condition of Eastern Uttar Pradesh, India. *Journal of Agricultural Sciences*, 4 (9): 31-38.

Jena N, Vani K P, Rao P, Srinivas A and Sankar S 2013 Performance of quality protein maize (QPM) on quality, yield and yield components as influenced by nutrient management. *Journal of Progressive Agriculture,* 4 (2): 72-74.

Kumar A 2008 Productivity, economics and nitrogen use efficiency of speciality corn (*Zea mays*) as influenced by planting density and nitrogen fertilization. *Indian Journal of Agronomy*, 53 (4): 306-309.

Meena K N, Kumar A, Rana D S and Meena M C 2011 Productivity and nutrient uptake of maize (*Zea mays*)-wheat (*Triticum aestivum)* cropping system under different bio-sources and nitrogen levels. *Indian Journal of Agronomy*, 56(3): 182-188.

Mukhtar T, Arif M, Hussain S, Tariq M and Mehmood K 2011 Effect of different rates of nitrogen and phosphorus fertilizers on growth and yield of maize. *Journal of Agricultural Research,* 49 (3): 333-339.

Ramu R Y 2005 Agrotechniques for enhancing productivity and quality of hybrid maize (*Zea mays* L.). *Ph.D Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Ravi N, Basavarajappa R, Chandrashekar C P, Harlapur S I, Hosamani M H and Manjunatha M V 2012 Effect of integrated nutrient management on growth and yield of quality protein maize. *Karnataka Journal of Agricultural Sciences*, 25 (3): 395-396.

Sutar K R 2012 Response of maize to different sources and levels of sulphur. *M.Sc. (Ag.) Thesis.* University of Agricultural Sciences, Dharwad.

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