Journal of AgriSearch **4**(1):27-30
An Open Access International Peer Reviewed Quarterly

ISSN : 2348-8808 (Print), 2348-8867 (Online)
http://dx.doi.org/10.21921/jas.v4i1.7415

Production Potential and Nutrient Uptake of Quality Protein Maize Hybrid as Influenced by Nitrogen and Sulphur Fertilization

SABHA JEET, JP SINGH[2] AND RAKESH KUMAR[3]*

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

ARTICLE INFO

Received on	:	09.12.2016
Accepted on	:	19.01.2017
Published online	:	01.03.2017

ABSTRACT

Field experiment was conducted during the two consecutive kharif season of 2009-10 and 2010-11 on sandy loam soil of Varanasi to assess the production potential and nutrient uptake of quality protein maize hybrid with the application of different levels of nitrogen and sulphur in dryland condition of Eastern Uttar Pradesh. The experiment was laid out in split-plot design and replicated thrice, in which main plot were allotted four nitrogen levels (0, 50, 100 and 150 kg N/ha) and two quality protein maize hybrid (Shaktiman 2 and Shaktiman 4) and three levels of sulphur (15, 30 and 45 kg S/ha) in sub-plots. Results revealed that growth, yield attributes, yield, and economics of quality protein maize hybrid was significantly increased with application of increasing levels of nitrogen and sulphur up to 150 kg N/ha. Application of 45 kg S/ha obtained highest grain yield during 1st and 2nd years, respectively over 15 kg S/ha. The highest gross return was also recorded under the same treatments. Hence, it may be concluded that quality protein hybrid Shaktiman 4 along with 150 kg N applied/ha with 45 kg S/ha recorded significantly highest yield and gross income under dryland conditions of EasternUttar Pradesh, India.

Keywords: QPM Maize, Grain yield, Gross returns, Nutrient uptake

INTRODUCTION

Maize (Zea mays L.) is the third most important cereal crop next to rice and wheat in India and a predominant cereal in global agricultural economy (Kumar *et al*., 2015). Out of total production of maize, 45% is consumed as staple food in various forms (Jeet *et al*., 2014). Beside this maize a main ration for poultry birds. Forage maize is used as fresh for dry matter. The most important goal for enhancing productivity of quality protein maize is to reduce the malnutrition through direct human consumption in tribal dominated area, where maize is a staple food (Baral *et al*., 2016). However, this is a wrong procedure because for correct development, maize requires not only nitrogen, phosphorus or potassium also but sulphur (Kumar *et al*., 2015 and Kumar *et al*., 2016). Sulphur, an essential for plant growth and development is considered a secondary nutrient because it is generally required in lower amounts than nitrogen, phosphorus and potassium (Jeet *et al*.,2014). High yield production systems that sustain soil organic matter content and fertilizer management practices, which replace sulphur and other nutrients removed in grain and stover, are critical to maintaining efficient cropping systems (Kumar *et al*., 2016). Being exhaustive crops, maize require huge amount of nutrients particularly nitrogen for producing more yields. The experiment results at various places indicated that highest grain yield was obtained with applied of 120 kg N/ha (Meena *et al*., 2011). In recent past high yielding single cross hybrid of quality protein maize were bread by additional of opaque-2 mutant gene, which improved the lysine and tryptophan and reduced lucine and isoleucine content and produced quality protein with balanced composition of amino acids The quality protein maize has widely adopted for cultivation in developing world to fight malnutrition. The hypothesis of undertaken experiment assumed that nitrogen and sulphur, whose deficits are found in majority of loamy sand soil, can exert an effect on yield (Kumar and Bohra 2014). In this view, the present studies were undertaken with objective of determining the effect of levels of nitrogen and sulphur application on production potential and nutrient uptake of quality protein maize hybrid under dryland condition of Eastern Uttar Pradesh.

MATERIAL AND METHODS

A field experiment on quality protein maize was carried out at research farm, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during two consecutive kharif seasons of2009-10 and 2010-11. Total rainfall received during the crop period was 484.2 and 722 mm, respectively during first and second year of the experimentation. The soil of the experimental plot is sandy loam having low in organic carbon (0.32%), available N (183 kg/ha), available K (228 kg/ha), medium in available P (21.02 kg/ha) and available S (14.32 kg/ha)with pH 7.6. Experiment was conducted in split plot design replicated thrice keeping four nitrogen levels (control, 50, 100 and 150 kg N/ha) in main plots, two quality protein maize hybrid (Shaktiman 2 and Shaktiman 4) and three levels of sulphur (15, 30 and 45 kg S/ha) in sub-plot. The nitrogen and sulphur were applied through urea and elemental sulphur as per treatment. While

[1]Subject Matter Specialist (Agronomy) KVK Patna,Bihar, India.
[2]Professor, Department of Agronomy, Institute of Agricultural Sciences, BHU Varanasi, Uttar Pradesh, India
[3]Scientist (Agronomy), Division of Crop Research, ICAR RC for Eastern Region, Patna, Bihar, India
*Corresponding Author Email : rakeshbhu08@gmail.com

recommended dose of phosphorus (60 kg P2O5/ha) and potassium (40 kg k/ha) were applied as basal through di-ammonium phosphate and muriate of potash. Quality protein maize hybrids Shaktiman 2 and 'Shaktiman 4 was sown on 12and 15th July in 2009 and 2010, respectively. Sowing of crop was done with tractor drawn bed maker-cum planter. Distance of 67.5 cm between centre to centre of bed the bed size including 37.5 cm bed top and 30 cm furrow one row per bed. One manually weeding was done at 35 days after sowing to control the initial flushes of weeds. Other management practices were adopted as per recommendations of crop. Growth parameters recorded as per standard procedure at harvest of the crops. All the chemical analysis of nutrients was carried out as per standard procedures and nutrient uptake was workout by multiplying yield with nutrient content. Economics was computed by prevalent market prices of input and outputs. To test the significance, the experimental data collected on various aspects were analyzed with the procedure described by Cochran and Cox (1967) and adopted by Cheema and Singh (1991) in statistical package CPCS 1.

RESULTS AND DISCUSSION

Growth and yield attributes

Taller plants with higher leaf area index and stem girth were recorded with150 kg N applied/ha over 100, 50 kg/ha and controls (Table 1).The plant height and leaf area index of the QPM hybrid Shaktiman-4 proved significantly taller than Shaktiman-2 at which no significant result of plant height was found during both the years. Plant height was increased significantly with increasing level of sulphur. The significantly highest plant height was recorded at 45 kg S ha^{-1} which followed by 30 and 15 kg S ha^{-1}. This significant improvement with increasing level of nitrogen might be due to higher uptake of N at higher level of N application (Kumar and Bohra 2014). Kumar *et al.*, 2016 reported that increasing nitrogen levels of 150 kg N/ha significantly increased growth and yield attributes of maize. Significantly highest stem girth was recorded at the 150 kg N ha^{-1} as compared to 50 kg N ha^{-1} and control but it was at par with 100 kg N ha^{-1}. The QPM hybrid Shaktiman-4 produced significantly higher stem girth compared to Shaktiman-2. The significantly higher stem girths were recorded at 45 kg S ha^{-1} compared to 15 kg S ha^{-1} (S1) but the differences were at par with 30 kg S ha^{-1}. Increasing levels of N up to 120 kg N/ha markedly improve the yield attributing characters viz., cob length of quality protein maize. The sink capacity of the plant is dependent mainly on vegetative growth and vigorous vegetative growth increased leaf area index and stem girth with application of higher doses of N consequently supply of photosynthesis for formation of yield component was enhanced. However, length of cob remained higher due to increasing levels of N application up to 150 kg N/ha. Shaktiman-4 recorded taller plants with maximum leaf area index compared to Shaktiman 2 (Table 1). Higher weight of cob length was recorded with Shaktiman-4 than Shaktiman-2. Quality protein maize hybrids viz., Shaktiman 4 resulted in maximum cob length than Shaktiman 2. Significantly taller plants with more leaf area index and stem girth was noticed with application of 45 kg S/ha. Similarly, length of cob was found to be significantly higher with application of S up to 45 kg S/ha. The improved physicochemical properties and availability of nutrients at slow rate for longer time with the use of different levels of sulphur might be responsible for better growth and yield attributes of quality protein maize hybrids (Kumar *et al.*, 2015). Further, sulphur involve in synthesis of S containing of amino acids viz. cysteine, cystene and methionine, various enzymatic process and various oxidation-reduction of the plant resulting in greater merismatic activities and apical growth thereby improved the overall growth and development of maize (Choudhary *et al.*, 2013). The effect of sulphur levels on growth and yield attributes of maize is thus quite comparable to results obtained by Shivran *et al.* (2013).

Yield parameters

In general, application of 150 kg N/harecorded significantly 43.5% higher grain yield, 33.3% higher stover yield and 9.7% higher harvest index over control in both the years of study. The enhancements in the grain, stover yield and harvest index

Table 1: Growth and yield attributes of QPM hybrids as influenced by nitrogen and sulphur fertilization

Treatment	Plant height (cm)		Stem girth (cm)		Leaf area index		Cob length (cm)		Grain yield (t/ha)		Straw yield (t/ha)		Harvest index (%)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Nitrogen levels (kg/ha)														
Control	137	140	2.10	2.14	3.31	4.09	10.1	11.0	4.12	4.23	7.33	7.69	35.99	35.50
50	164	167	2.31	2.53	4.45	5.25	14.9	15.3	5.71	5.83	9.74	10.26	36.95	36.25
100	178	180	2.44	2.58	5.50	6.29	16.1	16.3	6.58	6.68	10.04	10.23	39.59	39.50
150	189	193	2.478	2.62	6.39	7.27	18.0	17.5	7.35	7.48	11.16	11.46	39.72	39.52
...	2.38	3.2	0.05	0.05	0.23	0.37	0.2	0.38	1.97	2.05	3.50	4.18	0.52	0.49
CD (P=0.05)	5.82	7.9	0.13	0.13	0.57	0.92	0.6	0.94	0.48	0.50	0.85	1.02	1.29	1.22
QPM hybrids														
.....	164	168	2.29	2.39	4.72	5.57	14.6	14.9	5.79	5.94	9.53	9.90	37.57	37.50
'Shaktiman 4'	170	172	2.37	2.55	5.11	5.89	14.9	15.2	6.01	6.10	9.68	10.00	38.54	37.88
SE m±	1.6	1.7	0.02	0.03	0.10	0.13	0.06	0.10	0.54	0.56	0.39	0.64	0.17	0.09
CD (P=0.05)	3.2	3.5	0.05	0.06	0.21	0.27	0.13	0.22	0.11	0.11	0.08	0.13	0.36	0.20
Sulphur levels (kg/ha)														
15	160	164	2.27	2.41	4.75	5.41	14.6	14.4	5.59	5.68	9.51	9.78	37.03	36.76
30	168	171	2.32	2.49	4.87	5.73	14.7	15.1	5.85	6.04	9.47	9.92	38.20	37.85
45	172	175	2.40	2.50	5.12	6.04	14.9	15.7	6.27	6.33	9.83	10.14	38.94	38.45
SE m±	2.5	2.7	0.03	0.03	0.11	0.14	0.09	0.15	0.60	0.37	0.52	0.70	0.27	0.22
CD (P=0.05)	5.2	5.5	0.06	0.07	0.24	0.29	0.19	0.31	0.12	0.17	0.10	0.14	0.56	0.45

with each increase N levels were of significant level (Table 1). The beneficial effect of N application on growth, yield attributes, yield and their cumulative effect are responsible for enhancing productivity at higher levels of N application (Kumar and Bohra 2014and Jeet *et al*., 2014). Similar finding were also reported by Neupane et al.,2011. Shaktiman 4 recorded significantly 3.3% higher grain yield, 1.3%% higher stover yield and 2.4% higher harvest in 1st and 2nd years, respectively as compared to 'Shaktiman 2'. The improvement might be due to Shaktiman 4 had a better growth and yield attributing characters ability.

Application of 45 kg S/ha resulted significantly higher grain yield to the tune of 10.8%, 10.3% higher grain yield, 3.2%, 3.5% higher stover yield and 4.9%, 4.4% higher HI than 15 kg S/ha in 1st and 2nd years, respectively. The considerable improvement in grain yield, due to application of 45 kg S/ha might be attributed to fact that sulphur nutrients had positive effect on yield attributes and these are mainly responsible for higher yield parameters with 45 kg S/ha (Kumar *et al*., 2016). The findings are in close conformity to those of Shivran *et al*. (2013).

Nutrient uptake

Nitrogen, phosphorus, potassium and sulphur uptake by quality protein maize hybrids differed significantly due to varying nitrogen and sulphur levels (Fig. 1-4). Differences in total N, P, K and S uptake were influenced significantly with different levels of nitrogen applied. With each successive increase in N levels up to 150 kg N/ha, total uptake of N increased significantly. The results are in close conformity with those of the several workers. Total uptake of N, P, K and S was higher with Shaktiman 4 as compared to Shaktiman 2. Significantly higher N, P, Kand S uptake was recorded at 45 kg S/ha followed by 30 and 15 kg S/ha. The higher uptake of nutrients might be due to better root establishment which resulting in higher absorption of nutrient which lead to higher grain and straw yield. The nutrient uptake is the function of yield and nutrient concentration and yield is more deciding factor for higher nutrient uptake (Jeet *et al*., 2014). Shivran *et al*. (2013) reported application of 60 kg S/ha significantly improved yield attributes consequently productivity estimated in terms of grain and stover yield. The effect of sulphur fertilization appears to vigorous plant as it presence in plant suggest greater availability of metabolites and nutrients (Kumar and Bohra 2014).

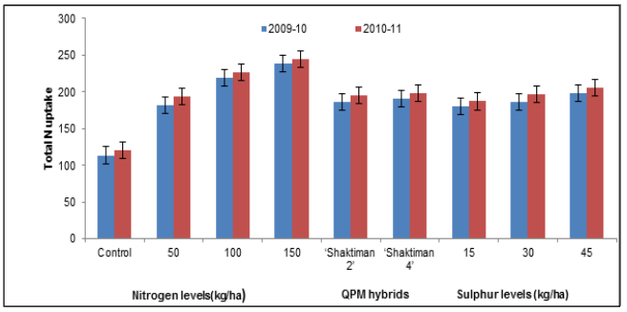

Fig. 1: Total N uptake of QPM hybrids as influenced by nitrogen and sulphur fertilization

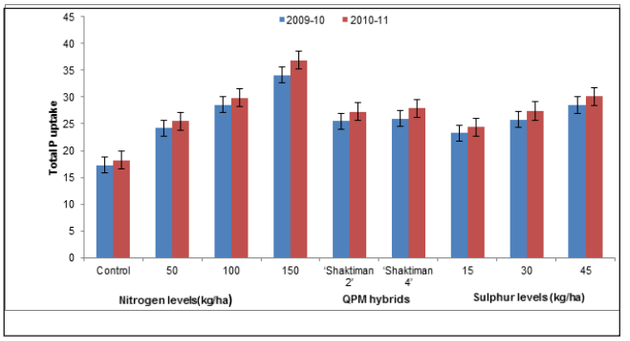

Fig. 2: Total P uptake of QPM hybrids as influenced by nitrogen and sulphur fertilization

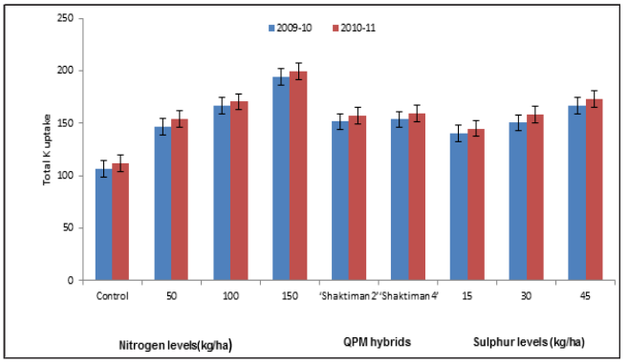

Fig. 3: Total K uptake of QPM hybrids as influenced by nitrogen and sulphur fertilization

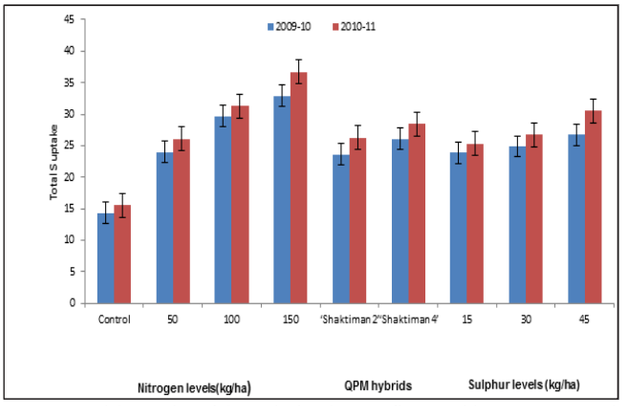

Fig. 4: Total S uptake of QPM hybrids as influenced by nitrogen and sulphur fertilization

Economics

The data of economics inferred that gross return (Rs.78, 817 and Rs.80,310 ha^{-1}), was found to be higher with application of 150 kg N/ha(Fig .5). The higher gross return was attributed to the higher grain yield. The results are in close conformity with that of Kumar and Bohra 2014 and Kumar *et al*.2016. Shaktiman4 proved economically beneficial with highest gross returns (Rs.65,968 ha^{-1}) over 'Shaktiman 2'. Each successive increment of sulphur levels from 15 to 45 kg S/haimproved net return. Application of sulphur 45 kg S/ha observed higher gross return` 68336 ha^{-1}). Choudhary *et al*.(2013) reported application of 40 kg S/ha affirmed potential role in enhancing productivity of quality protein maize under

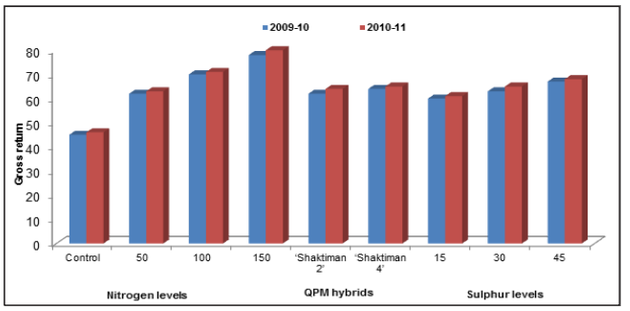

Fig. 5: Gross income of QPM hybrids as influenced by N and S fertilization

judicious use of N and S and proved economically profitable compared to control. This might be an account of higher productivity of maize (Shivran *et al*., 2013).

CONCLUSION

Based on above findings, it may be concluded that growing of quality protein maize hybrid Shaktiman 4 along with 150 kg N/ha + 45 kg S applied/ha recorded significantly higher yield and monetary return, nutrient uptake in dryland conditions of Varanasi in Eastern Uttar Pradesh.

REFERENCES

Baral BR, Adhikari P and Shrestha J. 2016.Productivity and economics of hybrid maize (*Zea mays* L.) under different fertilizer doses in the inner Terai Region of Nepal. *Journal of AgriSearch* **3** (1): 13-6.

Cheema H S and Singh B. 1991.Software Statistical Package CPCS-1. Department of Statistics, Punjab Agricultural University, Ludhiana.

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

Cochran W G and Cox G M. 1967.Experimental Designs. Asia Publishing House, New Delhi.

Jeet S, Singh JP, Kumar R and Om Hari.2014.Response of nitrogen and sulphur levels on productivity and profitability of QPM hybrid (*Zea mays*) under dryland condition of Eastern Uttar Pradesh. *Indian Journal of Agricultural Sciences* **84**(5): 589-94.

Kumar R and Bohra JS.2014.Effect of NPKS and Zn application on growth, yield, economics and quality of baby corn. Archives of *Agronomy and Soil Science* **60** (9):1193-206.doi:10.1080/03650340.2013.873122

Kumar R, Bohra JS, Kumawat N and Singh AK.2015.Fodder yield, nutrient uptake and quality of baby corn (*Zea mays* L.) as influenced by NPKS and Zn fertilization. *Res. on Crops* **16** (2): 243-9.doi : 10.5958/2348-7542.2015.00036.4

Kumar R, Bohra JS, Kumawat N, Kumar A, Kumari A and Singh AK.2016.Root growth, productivity and profitability of baby corn (*Zea mays* L.) as influenced by nutrition levels under irrigated ecosystem. *Res. on Crops* **17** (1): 41-6.doi: 10.5958/2348-7542.2016.00008.5

Meena KN, Kumar A, Rana DS and Meena MC. 2011. Productivity and nutrient uptake of maize (*Zea mays*)-wheat cropping system under different bio-sources and nitrogen levels. *Indian Journal of Agronomy* **56** (3): 182-8.

Neupane MP, Singh RK, Kumar R and Kumari A.2011.Quality and yield performance of baby corn (*Zea mays* L.) as influenced by nitrogen sources and row spacing. *Environment and Ecology* **29** (3A): 1215-8.

Shivran RK, Kumar R and Kumari A. 2013.Influence of sulphur, phosphorus and farm yard manure on yield attributes and productivity of maize (*Zea mays* L.) in humid *south eastern plains of Rajasthan Agric. Sci. Digest*. **33** (1): 9-14.

Citation:

Jeet S, Singh JP and Kumar R .2017.Production potential and nutrient uptake of quality protein maize hybrid as influenced by nitrogen and sulphur fertilization. *Journal of AgriSearch* **4**(1):27-30