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Response of *Rabi* maize (*Zea mays* L.) varieties to different levels of nitrogen for green forage yield under middle Gujarat conditions

■ D.J. VYAS, M.R. PATEL[1], H.K. PATEL[1] AND P.M. PATEL[1]

AUTHORS' INFO
Associated Co-author :
[1]Department of Agronomy, B.A. College of Agriculture, Anand Agricultural University, ANAND (GUJARAT) INDIA

Author for correspondence:
D.J. VYAS
Department of Agronomy, B.A. College of Agriculture, Anand Agricultural University, ANAND (GUJARAT) INDIA

ABSTRACT : A field experiment was conducted at the College Agronomy Farm, Anand Agricultural University, Anand to find out the response of *Rabi* maize (*Zea mays* L.) varieties to different levels of nitrogen for green forage yield under middle Gujarat conditions during *Rabi* season of 2012-13. The experiment consisted of twelve treatment combinations comprised of three varieties (African tall, GM-3 and GM-4) and four nitrogen levels (80, 100, 120 and 140 kg N ha^{-1}). Significantly the highest green forage (543.62 q ha^{-1}), dry matter (125.29 q ha^{-1}) and crude protein (6.56 q ha^{-1}) yields of forage maize were recorded by African tall variety over the variety GM-3 and GM-4. The green forage, dry matter and crude protein yields were significantly influenced by nitrogen levels. Application of nitrogen at 140 kg ha^{-1} produced significantly higher green forage (543.40 q ha^{-1}), dry matter (113.53 q ha^{-1}) and crude protein (6.25 q ha^{-1}) yields as well as crude protein content (5.53 %).The higher net realization of 21282 Rs. ha^{-1} and higher B.C.R. value of 1.09 were recorded in variety African tall. Among different nitrogen levels, application of 140 kg N ha^{-1} resulted in higher net realization (Rs. 19129 ha^{-1}) with B.C.R. of 1.05.

KEY WORDS : *Rabi* maize, Nitrogen, Green forage

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Maize (*Zea mays* L.) is an important food cum forage crop in India. The crop has an edge over other cultivated fodder crops due to its better adaptability, succulency, excellent fodder quality and usage in the form of silage in a short time. With the possibility of growing maize round the year it offers an importance sources of green forage for the milch cattle. It has high production potential ability, wider adoptability and multy used. The forage of maize is succulent, sweet, palatable, nutritious and free from toxicants and it can be safely fed to animals at any stage of crop growth.

Various agronomic management techniques have been developed to enhance the green as well as dry fodder yield of maize, among them the application of nitrogen and varieties have been found to be the most important towards boosting fodder yield.

The main constraint of low production and productivity of forage maize crop is their cultivation in poor and marginal lands under rainfed conditions with no or little use of fertilizers. Fertilizer management is one of

the most important agronomic factors that affect the yield of forage crops. Nitrogen is most important major nutrient element for a maize plant as it increase the vegetative growth of plants and green matter production which are the twin desirable qualities of an ideal fodder yield of maize. Where whole plant is of economic importance. Nitrogen application increases the crude protein content and metabilizable energy besides improving succulency and palatability of fodder yield. It is the important constituent of chlorophyll and protein. It imparts dark green colour to the plants, promotes vegetative growth and rapid early growth. It improves the quality by increasing the protein content of fodder crops and governs to a considerable degree, the utilization of protein, phosphorus and other elements. Maize crop absorbs nutrients in large amount throughout the growth period and nitrogen is the major limiting factors for dry matter production and quality improvement.

The purpose of investigation was to study the effects of varieties and nitrogen fertilization practices on growth, forage production and nutritive value of fodder maize.

RESEARCH PROCEDURE

A field experiment was conducted at the College Agronomy Farm, Anand Agricultural University, Anand to find out the response of *Rabi* maize (*Zea mays* L.) varieties to different levels of nitrogen for green forage yield under middle Gujarat conditions during *Rabi* season of 2012-13. The experiment consisted of twelve treatment combinations comprised of three varieties (African tall, GM-3 and GM-4) and four nitrogen levels (80, 100, 120 and 140 kg N ha^{-1}).The field experiment was laid out in RBD (Factorial) with four replications. The soil of experimental site was loamy sand in texture having good drainage capacity with pH 7.15, it was low in organic carbon (0.43 %) and available nitrogen (242.50 kg ha^{-1}), medium in available phosphorus (32.56kg ha^{-1}) and available potash (216.20 kg ha^{-1}). The maize varieties were sown as a spacing of 30 cm using seed rate of 80 kg ha^{-1}. The economics was worked out on current market price basis. Nitrogen was given as per treatments in the form of urea. The full dose of phosphorus from SSP and half dose of nitrogen were applied as a basal does at the time of sowing, whereas remaining half of nitrogen was top dressed after one month of sowing. The harvesting of each treatment was done at silking and tasseling stage. The crude protein content (%) was estimated from the powder of representative oven dried samples using near-infrared spectroscopy method (NIR analyzer). The values of "F'' was worked out and compared with the value of table F at 5 per cent level of significance. The values of S.E. ± C.D. and C.V. per cent were also calculated (Cochran and Cox, 1967).

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

Effect of varieties :

The data presented in Table 1 showed that, among the varieties, variety African tall (V_1) recorded significantly the highest green forage yield (543.62 q ha^{-1}) than varieties GM-3 and GM-4 (460.94 and 503.91 q ha^{-1}). Increase in green forage yield of African tall variety was to the extent of 17.94 and 7.88 per cent over GM-3 and GM-4 varieties, respectively. The variation in green forage yield of varieties might be related to inherent differences and high vigour in growth parameters *i.e.*, plant height and leaf: stem ratio. The highest plant height (210.41 cm) at harvest and maximum leaf: stem ratio (0.69) was recorded with African tall and GM-4 varieties, respectively. Variety GM-4 (V_3) recorded 18.96 per cent higher leaf: stem ratio over GM-3. Plant height generally depends on genetically make up of a particular variety. The results corroborate with the finding of Pandey and Tomer (1989), Sood *et al.* (1994), Patel *et al*. (1997) and Suthar *et al*. (2012).

Significantly the highest dry matter (125.29 q ha^{-1}) and crude protein (6.56 q ha^{-1}) yields were recorded in variety African tall among all other variety. The significant increase in dry matter yield and crude protein yield under V_1 variety was 49.92, 47.38 per cent and 44.49, 41.37 per cent as compared to the GM-3and GM-4 (V_2andV_3), respectively. Significantly higher crude protein content (5.44 %) was recorded in variety GM-4 while the highe neutral detergent fibre content (79.78 %) was recorded in variety African tall.

Effect of nitrogen level :

There was progressive increase of green fodder yield in response to increasing N supply. Nitrogen fertilization had significantly effect on green fodder yield (543.40 kg ha^{-1}) with 140 kg N ha^{-1}. Sheraz *et al.* (2010) also observed liner increase in green fodder yield of forage maize with

increased nitrogen levels. The increase in leafy part due to nitrogen application might have ultimately resulted in higher photosynthetic activities and also in production of more photosynthates. This readily supplied food growing parts might have helped in improvement of growth and yield attribute like plant height and leaf: stem ratio. Nitrogen fertilization significantly influenced on plant height and leaf: stem ratio (Table 1). Application of 140 kg N ha^{-1} recorded significantly higher plant height at harvest (204.71 cm) and leaf: stem ratio (0.74) than other lower levels of nitrogen. Nitrogen is the main component of the protoplasm involves in various metabolic processes *viz.*, photosynthesis (Coris, 1995), stimulation of cell division and elongation. As a result of which, nitrogen yielded better response on forage yield similar results were also observed by Dudhat *et al*. (2004), Joshi and Kumar (2007), Puri and Tiwana (2008).

Dry matter and crude protein yields showed a significant variation by the application of different levels of nitrogen (Table 1). The highest dry matter (113.53 q ha^{-1}) and crude protein (6.25 q ha^{-1}) yields were found when nitrogen was applied @ 140 kg N ha^{-1}. The dry matter yield followed the same trend as observed in green forage yield due to application of nitrogen. Nitrogen is used largely in synthesis of protein, but structurally it is a constituent of chlorophyll molecule combined with carbohydrates and fatty acids. It helps in formation of protoplasm, which is the physical base of a life of the plant. Thus, more production of dry matter can be explained at higher nitrogen rates. The higher dry matter yield with higher nitrogen rates was also reported by Gour *et al*. (2006), Joshi and Kumar (2007), Puri and Tiwana (2008) and Sheraz Mehdi *et al*. (2010). This increase in crude protein yield with higher level of nitrogen could be ascribed to additive effect of increased dry matter yield.

Data presented in Table 1 revealed that application of 140 kg N ha^{-1} recorded significantly the highest crude protein content (5.53 %). The increase in crude protein content of forage maize with increasing level of nitrogen is attributed to increased nitrogen absorption by forage maize. N is main constituent of protein and it is involved in the synthesis of amino acids and accumulation of protein in plants. These results are in accordance with those of Sindhu *et al*. (2006), Gour *et al*. (2006) and Puri and Tiwana (2008). The reduction in NDF content was observed with increase in the level of nitrogen might be due to increase in succulence *i.e.*, leaf: stem ratio (Table 1) of plant by reducing formation of polysaccharides *viz.*,

Table 1 : Green forage, dry matter and crude protein yields, growth attributes and quality parameters as influenced by different varieties and levels of nitrogen

Treatments	Green forage yield (q ha^{-1})	Dry matter yield (q ha^{-1})	Crude protein yield (q ha^{-1})	Crude protein content (%)	NDF (%)	Plant height at harvest (cm)	Leaf : stem ratio	Gross realization (Rs. ha^{-1})	Total cost of cultivation (Rs. ha^{-1})	Net realization (Rs. ha^{-1})	BCR
Varieties (V)											
African tall (V_1)	543.62	125.29	6.56	5.31	79.78	210.41	0.58	40771	19489	21282	1.09
GM-3(V_2)	460.94	83.57	4.54	5.43	78.66	183.35	0.68	34570	19489	15081	0.77
GM-4(V_3)	503.91	85.01	4.64	5.44	77.95	193.43	0.69	37793	19489	18304	0.94
S.E. ±	13.62	2.74	0.15	0.03	0.50	3.13	0.02	–	–	–	–
C.D. (P=0.05)	39.21	7.88	0.43	0.09	1.44	9.02	0.05	–	–	–	–
Nitrogen levels (kg ha^{-1}) (N)											
80 (N_1)	467.01	82.50	4.36	5.29	80.24	184.48	0.58	35026	19069	18287	0.84
100(N_2)	483.51	92.55	4.93	5.34	79.28	194.44	0.60	36263	19349	18568	0.87
120(N_3)	517.36	103.26	5.58	5.41	78.38	197.29	0.68	38802	19629	18852	0.98
140(N_4)	543.40	113.53	6.25	5.53	77.28	204.71	0.74	40755	19910	19129	1.05
S.E. ±	15.73	3.16	0.17	0.04	0.58	3.62	0.02	–	–	–	–
C.D. (P=0.05)	45.28	9.10	0.49	0.10	1.66	10.42	0.06	–	–	–	–
Interaction											
V × N	NS	NS	NS	NS	NS	NS	NS	–	–	–	–
C.V. %	6.40	10.54	10.83	11.18	11.23	4.32	4.54	–	–	–	–

Note : Selling price of Green forage – 0.75 `kg^{-1} NS=Non-significant

cellulose, hemi-cellulose and lignin, which generally account for content of NDF in the plant. These results are in accordance with those of Patel *et al*. (1997) and Gour *et al*. (2006).

Economics of different treatments :

Economics play an important role in deciding the adoption of particular treatment by the farmers. Therefore, the gross realization, net realization and benefit cost ratio (B.C.R.) were calculated for varieties and nitrogen levels (Table 1).

Effect of varieties :

The data on economics (Table 1) revealed that variety African tall (V_1) recorded maximum gross and net realization of 40771 and 21282 Rs. ha^{-1}, respectively, African tall variety recorded higher B.C.R. value of 1.09.

Effect of nitrogen levels :

Among the different nitrogen levels, application of 140 kg N ha^{-1} (N_4) recorded the highest net realization (Rs.19129 ha^{-1}) and B.C.R. (1.05) values.

Conclusion :

In light of the results obtained from this investigation, it is concluded that for securing maximum forage production with good quality and for getting higher net return, forage maize variety African tall should be fertilized at 140 kg N ha^{-1} (50 % as basal and 50 % at 30 DAS) in sandy loam soils under middle Gujarat conditions (Basal dose 50 kg P_2O_5 and 25 kg $ZnSO_4$/ ha).

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