Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(5): 898-900
Received: 09-07-2018
Accepted: 10-08-2018

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Effect of various levels of nitrogen on growth, yield and quality of fodder maize

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Abstract
A field experiment was conducted in the Research farm Faculty of Agricultural Science, Janta Mahavidiyalaya Ajeetmal, Auraiya (C.S.J.M. University, Kanpur) during 2015, to evaluate the effect of various levels of nitrogen on growth, yield and quality of fodder maize. 3 treatments were taken up (*viz.*, T_1 75, T_2 100 and T_3 125 kg nitrogen ha^{-1} along with control (T_0). Plant height, dry matter accumulations (t ha^{-1}), forage yield (t ha^{-1}) increased with increasing levels of nitrogen, while stem diameters (cm), leaf area (cm^2), fresh weight (g), crude protein percent decreased with increasing levels of nitrogen.

Keywords: Maize, nitrogen, dry matter, crude protein

Introduction
Maize (*Zea mays* L.) is locally known as makai belonging to family Poaceae and is grown as a food, feed and fodder crop in India. Maize as a covered for 2/3 rd of the total area in kharif season during 2013 (Anonymous, 2014) [1]. It is largely grown in Northern India. Uttar Pradesh, Rajasthan, Madhya Pradesh, Bihar, Himanchal Pradesh, Punjab and Jammu & Kashmir are main maize growing states. Uttar Pradesh accounts for 12.11 percent of the total area and 8.14 percent total production of maize in country. Maize crop provides the heavy tonnage of fodder and can be grown trough out the year. Fodder Maize has low protein contents (3.0-3.5%), yet it is relished by animals due to being succulent and palatable (Patel, 2005) [11]. It is a cash crop for growers around cities; it is widely grown for sale as green fodder.

Low yield of fodder maize is due to many constraints but fertilizer application is considered one of the major factors, which can increase fodder production on per unit area basis. The application of nitrogen not only affects the forage yield of maize but also improves its quality especially its protein contents (Bhoya, 2014) [4]. Similarly Kumar *et al.* (2013) [8] reported that application of nitrogen to maize increases the fodder nutrition value by increasing the crude protein and by reducing the ash and fiber contents. Mohammed *et al.* (2011) [10] obtained the maximum biological yield of two maize varieties when nitrogen was applied at the rate of 120 kg ha^{-1} whereas; Asish and Banjara (2014) [3] reported that the application 250 kg N ha^{-1} gave significant results in maize. In irrigated areas of Punjab maize is grown as a fodder crop alone or in mixture with sorghum or millet etc., while Cox (1997) [6] reported that average plant densities for effect of nitrogen levels on maize corn silage exceeded 36000 plants per acre in 1992 and 32523 in 1993. The present study was taken up to evaluate the influence of various levels of nitrogen on the yield and the nutritive value of fodder maize

Materials and Methods
A field experiment was conducted in the Research farm Faculty of Agricultural Science, Janta Mahavidiyalaya Ajeetmal, Auraiya (C.S.J.M. University, Kanpur) during 2015 to evaluate the effect of various levels of nitrogen on the growth, forage yield and quality of maize by adopting split plot design, with three replications; having a net plot size of 2.4 m x 7.0 m with row to row distance of 30 cm. Treatments of various levels of nitrogen were as follows:
T_0 =0 kg N_2 ha^{-1} (control)
T_1=75 kg N_2 ha^{-1}
T_2 =100 kg N_2 ha^{-1}
and T_3=125 kg N_2 ha^{-1}

The crop was sown during the third week of June 2014, in the pattern of 30 cm spaced in the lines using seed rate 75 kg^{-1}. Half of nitrogen along with full dose of phosphorous (60 Kg^{-1})

and potash (40 kg^{-1}) was applied at the time of sowing, while remaining half of nitrogen was applied at knee height. All agronomic practices were kept uniform for all the treatments. All the observations *viz.* plant height (cm), stem diameter (cm), leaf area per plant (cm^2), fresh weight per plant (g), dry matter yield (t ha^{-1}), green forage yield (t ha^{-1}) and crude protein (%)) were recorded during the course of study by using the standard methods. The crop was harvested in August, 2014. The collected data were statistically analyzed by using Fisher's analysis of variance technique and the treatment means were compared by least significant difference (LSD) test at 0.05% level of probability (Steel *et al.*, 1997) [13].

Results and Discussion

Plant height is directly linked with the fodder yields of crops and it is affected by the nitrogen application. A significant difference among the various levels of nitrogen treatments were reported 166.27cm at 0 kg N ha^{-1}, 181.61 cm at 75 kg N ha^{-1}, 196.53 cm at 100 kg N ha^{-1} and 209.66 cm at 125 kg N ha^{-1} (Table 1). The plants fertilized with 125 kg N ha^{-1} were significantly taller than those fertilized with 100, 75 kg N ha^{-1} and control. The minimum plant height of 166.27 cm was recorded in control plants. The plant height by 125 kg N ha $^{-1}$ was 26.09% more than control, 15.44% more than 100 kg N ha^{-1} and 6.68% more than 75 kg N ha^{-1}. Similar finding was also reported by Tariq, 1998 [14] in maize and Kumar *et al.* 2013 [8] in rice.

The averages of stem diameters were 1.32, 1.24, 1.17 and 1.06 cm under treatments of nitrogen and control. The application of nitrogen at the rate of 125 kg N ha^{-1} produced thickest. The stem diameter under the effect of 125 kg N ha^{-1} (1.32 cm) was 6.2% more than 100 kg N ha^{-1}(1.24 cm), 13.01% more than 75 kg N ha^{-1} (1.17 cm) and 24.29% more than control. It is evident from the data that stem diameter of maize plant increased with increasing levels of nitrogen. Similar result has been reported by Tariq (1998) [14].

Effect of nitrogen levels on number of leaves showed significant result. The maximum number of leaves was produced by 125 kg N ha^{-1} (13.40) which was 0.22% more than 100 kg N ha^{-1}, 0.90% more than 75 kg N ha^{-1} and 4% more than control, (13.40 vs. 13.37, 13.28 and 12.88, respectively. This finding also confirmed by Tariq (1998) [14].

Leaf area of any crop plant is directly related to the yield of that crop. If the leaf area increased the rate of photosynthesis also increased. The averages of leaf area per plant reported by the application of various levels of nitrogen and control (T_0) are 1780.39, 2107.48, 2286.29, 2407.47 cm^2 (Table 1). It shows that the maximum leaf area was 2407.47 cm^2 in receiving maximum nitrogen rate (125 kg N ha^{-1}) and minimum was 1780.39 cm^{-2} under control condition. The leaf area per plant at the rate of 125 kg N ha^{-1} was 5.29% more than that of 100 kg N ha^{-1}, 14.23% more than that of 75 kg N ha^{-1} and 35.22% more than that of control. These results are also supported by the finding of Tariq (1998) [14].

The data regarding the fresh weight per plant of maize crop shows that it was positively linked to the nitrogen application. More application of nitrogen resulted in more production of fresh weight per plant (Table 1). The maximum fresh weight per plant was noted with the application of 125 kg N ha^{-1} (353.01 g) which was 3.5% more than fresh weight per plant produced by application of 100 kg N ha^{-1} (340.98 g), 9.4% more than that of 75 kg N ha^{-1} (322.66 g) and 23.1% more than that of control (286.75 g).

Dry weight was also significantly affected by application of nitrogen. The dry weight (15.14 t. ha $^{-1}$) produced by 125 kg N ha^{-1} was 4.49% more than 100 kg N ha^{-1} dry matter yield (14.49 t. ha^{-1}), 8.50% more than 75 kg N ha^{-1} dry matter yield (13.96 t. ha $^{-1}$) and 18.14% more than control as given in Table 1. The significant effect of nitrogen application on dry matter yield has also been reported by Chaudhary *et al.* (1999) [5] and Kumar *et al.* (2010) [9].

The averages of green fodder yield were 35.948, 41.536, 47.156, and 52.213 t ha^{-1} which were significantly different from each other (Table 1). The maximum green fodder yield produced by 125 kg N ha^{-1} gave 10.72% more yield than 100 kg N ha^{-1} yield, 25.70% more yield than 75 kg N ha^{-1} yield and 45.24% more than control.

It is shown from the Table 1 that the maximum protein contents (9.138%) were produced by 125 kg N ha^{-1} while the minimum (6.541%) were produced by the control. The protein content (9.138%) produced by 125 kg N ha^{-1} was 39.70% more than the protein content of control, 11.45% more than 100 kg N ha^{-1} protein (8.199%) and 17.34% more than 75 kg N ha^{-1} protein content. The increase in crude protein content of maize fodder with nitrogen application has been reported by Ali *et al*., (1999) [2].

The maximum crude fiber (31.412%) was produced by 125 kg N ha^{-1} being 1.33% more than 100 kg N ha^{-1} crude fiber, 4.81% more than 75 kg N ha^{-1} crude fiber and 10.37% more than control crude fiber content (Table 1). The reason for having more crude fiber percentage at higher levels of nitrogen may be attributed to thicker stem diameter and taller plant height. Similar results were reported by Tariq (1998) [14].

Table 1: Effect of various levels of nitrogen on growth, yield and quality of fodder maize.

Treatments	Plant Height (cm)	Stem diameters (cm)	Leaf area plant^{-1}(cm^2)	Number of leaves	Fresh weight plant^{-1} (g)	Dry weight (t ha^{-1})	Forage yield (t ha^{-1})	Crude protein (%)	Crude fibers (%)
T_0 control	166.27	1.06	1780.39	12.88	286.75	12.82	35.95	6.45	28.460
T_1 50 kg ha^{-1}	181.61	1.17	2107.48	13.40	322.66	13.96	41.54	7.78	29.952
T_2 100 kg ha^{-1}	196.53	1.24	2286.29	13.28	340.98	14.49	47.16	8.20	30.997
T_3 150 Kg ha^{-1}	209.66	1.32	4207.47	13.37	353.01	15.15	52.21	9.14	31.412
LSD at 5% Probability level	3.38	0.04	120.20	0.48	17.38	0.49	1.97	0.18	1.93

* Significantly at 5% probability level. NS= Non-significant

Conclusion

The assessment of the effect of various levels of nitrogen on growth, yield and quality of fodder maize lead to conclude that all the considered parameters were significantly affected by nitrogen. Increasing levels of nitrogen up to 125 ka ha^{-1} produced higher fodder yield and improved its crude protein and fiber content, while control treatment gave poor performance in this regards.

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