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Effect of nitrogen on yield, economics and quality of maize varieties

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Maize (*Zea mays*) belonging to the family Poaceae is one of the most popular coarse millet crops. It is very nutritious particularly cobs and delicious. Besides being a rich source of starch (80%), maize seed also contains 10% protein, 4.5% oil, 3.5% fiber and 2% minerals (Reddy and Reddy, 2003). In India, maize is grown in 8.50 m ha with a production of 21.5 mt and productivity 2520 kg ha^{-1}. In terms of national hectarage, it ranks next to rice, wheat, sorghum and pearl millet. In M.P., maize is grown in an area of 0.84 m ha with a production of 1.08 mt and productivity 1.30 t ha^{-1}.Among the different inputs, nutrients play vital role in crop productivity. The inadequate management of nitrogen is considered a major limiting factor for maize yield. Nitrogen is important for the plant metabolism as it participates in proteins and chlorophyll biosynthesis. It also participates in several major metabolic pathways of plant biochemistry and demonstrated that under appropriate levels of other nutrients in the soil, nitrogen provides the greatest increment to the maize yield (Singh *et al.*, 2017). As a thumb rule, it is assumed that for every 100 kg of grain yield, 1.8 kg N in the grain and 1.0 kg in the above ground parts of the plant are required and must be supplied to the soil. The actual N-requirement of some of the recently developed maize varieties at Chindwara (M.P.) is yet to be known for Satna region. Hence, the present research was taken up.

The experiment was conducted during rainy season of 2017 at the Instructional farm, A.K.S. University, Satna (M.P.). The soil of the experimental field was silty clay-loam having pH 7.5, electrical conductivity 0.26 dS m^{-1}, organic carbon 4.8 g kg^{-1}, available N 186 kg ha^{-1}, available P_2O_5 12.5 kg ha^{-1}, available K_2O 200 kg ha^{-1}. The total rainfall received during the cropping season (June to October 2017) was 760.8 mm. The treatments comprised four N levels (0, 60, 100 and 140 kg ha^{-1}) and three varieties (JW-216, JW-12 and improved local). Thus, the experiment was laid out in a factorial randomized block design keeping three replications. Maize varieties were sown @ 20 kg seed/ha in rows 30 cm apart on 6th July 2017. An uniform dose of 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} was applied as basal through single superphosphate and muriate of potash, respectively in all the treatments. The crop was harvested on 4th October 2017. The protein content in grain was determined by the procedure of A.O.A.C. (1997).

The increased supply of nitrogen up to N_{140} increased the number of cobs (1.29/plant), number of seeds (33.20/cob row), 100-seed weight (26.10 g) and grain weight (104.69 g/plant) up to maximum extent (Table 1). Such increment in yield-attributes may be as a result of greater accumulation of carbohydrates, protein and their translocation to the reproductive organs, which in turn, increased the number of cobs as well as other yield-components due to N_{100}. These results are in close agreement with the findings of Singh *et al.* (2013 a & b), Verma *et al.* (2014), Golada *et al.* (2017) and Singh *et al.* (2017). Similarly, JW-216 variety resulted in significantly highest cobs/plant (1.23) and grain weight (94.17g/plant). Whereas JW-12 recorded the 100-seed weight significantly highest (28.47 g). The improved local variety recorded the lowest yield attributes. The varietal differences on yield attributes was in accordance with their genetic make up as well as increased growth parameters and differences in dry matter production. Singh *et al.* (2016 a & b) also found that the maize varieties with higher dry matter production and its proper distribution towards reproductive organs brought about higher productivity. The improvement in the main yield-attributes due to JW-216 variety may be ascribed to the increased photosynthesis and improved vegetative growth as a result of increased supply of nitrogen. Similar results have been reported by Singh (2016), Synrem *et al.* (2016) and Bhiusal *et al* (2017).

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Table 1: Yield attributes, yield, quality and economics of maize as influenced by N levels and varieties

Treatments	Cobs/ plant	Seeds/ cob row	100-seed weight (g)	Grain weight/ plant (g)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)	Net income (Rs ha^{-1})	B:C ratio	Grain protein (%)
Varieties										
JW-216	1.23	30.75	23.75	94.17	35.29	74.71	31.90	64268	3.02	8.99
JW-12	1.19	31.73	28.47	86.00	33.65	70.54	32.11	59184	2.86	8.94
Improved local	0.85	30.12	24.40	83.71	28.46	58.00	33.11	45232	2.42	8.58
S.Em±	0.05	0.74	0.21	3.08	1.83	3.29	5.83	--	--	0.10
C.D. (P=0.05)	0.16	NS	0.63	9.27	5.44	9.65	NS	--	--	0.29
Nitrogen (kg ha^{-1})										
0	0.96	29.11	25.28	73.58	24.51	55.91	30.63	36425	2.20	7.11
60	1.18	30.13	25.35	85.71	31.59	64.32	33.15	53954	2.71	8.98
100	1.19	31.02	25.43	92.02	35.23	73.16	32.56	62569	2.90	8.85
140	1.29	33.20	26.10	104.69	39.20	77.62	33.16	71963	3.24	10.42
S.Em±	0.06	0.85	0.25	3.55	2.14	3.79	6.66	--	--	0.11
CD P=0.05)	0.19	2.50	NS	10.42	6.24	11.14	NS	--	--	0.33

Application of 140 kg N ha^{-1} resulted in the significantly higher grain and stover yields of maize as compared to higher or lower N-levels. The grain and stover yield was found higher by 14.69 and 21.71, respectively due to N_{140} over N_0. The increases in grain yield due to N_{140} were exactly in accordance with the similar increases in the yield-attributes. The results are in consistent with the findings of Verma *et al.* (2014), Golada *et al.* (2017) and Singh *et al.* (2017).The maize varieties were found to differ significantly with respect to grain and stover yield. However, the harvest index did not change. The varieties JW-216 and JW-12 were at par in grain production (33.65 to 35.29 q ha^{-1}) as well as in stover production (70.54 to 74.71 q ha^{-1}). Whereas the improved local gave significantly lowest grain (28.46 q ha^{-1}) and stover yield (58.0 q ha^{-1}). The varietal differences in grain and stover production were in accordance with their genetic make up and yield-attributes as a result of varied photosynthetic rate and dry matter production. It is a well-established phenomenon that the varieties with higher dry matter production and its proper distribution towards reproductive organs results in higher productivity. The findings corroborate with those of Singh (2016), Singh *et al.* (2016 a & b), Synrem *et al.* (2016) and Bhusal *et al.* (2017).

The nitrogen up to N_{140} gave the maximum net income (Rs.71963 h^{-1}) with 3.24 B:C ratio. It was higher by Rs.35538 ha^{-1} over control. The variety JW-216 resulted in maximum net income (Rs.64268 ha^{-1}) with 3.02 B:C ratio. It was higher by Rs.19036 ha^{-1} over the local variety.The maximum protein content (10.42%), was recorded under N_{100}, wheres the significantly lowest protein content (7.11%) was noted from the local variety. The response of N in improving seed protein may be attributed to its significant role in regulating the photosynthesis, root-enlargement, better mirobial activities and associated N-metabolism in plants. The seed protein was significantly higher (8.99%) in JW-216, followed by JW-12 (8.94%) and the lowest (8.58%) in the local variety. Such differences in seed protein were due to the variability in the genetic get up and protein synthesis among these varieties.

It may concluded from the results that 140 kg N ha^{-1} recorded the maximum grain yield (39.20 q ha^{-1}), net income (Rs.71963 ha^{-1}), B:C ratio (3.24) and seed protein (10.42%), The maize variety, JW-216 gave the maximum yield (35.29 q ha^{-1}), net income (Rs.64268 ha^{-1}), B:C ratio (3.02) and grain protein (8.99%). Thus, the most economical maize variety for Kymore plateau of M.P. is JW-216 grown with 140 kg N ha^{-1}.

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