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SHORT COMMUNICATION

QUALITY OF FODDER MAIZE IN RELATION TO FARM YARD MANURE AND NITROGEN LEVELS

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SUMMARY

A field experiment was conducted at the Research Farm of the Department of Agronomy, Punjab Agricultural University, Ludhiana during the summer season of 2011. The soil was loamy sand in texture, slightly alkaline in soil reaction (8.0), low in organic carbon (0.33%) and available N (130 kg/ha), high in available P (28.5 kg/ha) and medium in available K (240 kg/ha). The experiment comprising 12 treatment combinations viz., three main plots (farm yard manure at 0, 12.5 and 25 t/ha) and four nitrogen levels in sub-plots (0, 40, 80 and 120 kg/ha) was laid out in split plot design with four replications. Quality components such as moisture content, crude protein, IVDMD and ash content were improved by application of farm yard manure 25 t/ha over 12.5 t/ha untreated and control. Interaction effects were also recorded at harvest stage of fodder crop in quality parameters such as moisture content, crude protein and IVDMD. Application of chemical fertilizers also improved the different quality parameters with increasing level of nitrogen up to the highest level (N_{120}).

Key words : Maize fodder, nitrogen, farm yard manure, green fodder, dry matter, quality

Maize is the most nutritious, succulent and palatable fodder crop among cereals grown from March to September. Being a source of human and animal feed, it also provides a raw material for several industrial products like hull and maize oil, etc. Its starch is used in textile industry, paper industry, oil well drilling, batteries, leather and food material. Due to several advantages offered by maize, it is greatly favoured by the farmers during lean month of fodder availability. In recent years, a large number of varieties with different growth habits have been recommended for grain and fodder production. However, information on the quality fodder production in relation to nitrogen and farm yard manure is lacking in Punjab conditions. Therefore, an experiment was conducted to work out the effect of FYM and nitrogen of quality of fodder maize.

The field experiment was conducted at Punjab Agricultural University, Ludhiana during the summer season of 2011. The soil was loamy sand in texture, slightly alkaline in soil reaction (8.0), low in organic carbon (0.33%) and available N (130 kg/ha), high in available P (28.5 kg/ha) and medium in available K (240 kg/ha). The field experiment comprised 12 treatment combinations viz., three main plots (farm yard manure @ 0, 12.5 and 25 t/ha) and four nitrogen levels in sub-plots (0, 40, 80 and 120 kg/ha). The experiment was laid out in split plot design with four replications. The rainfall received during the crop season of summer 2011 was 641 mm. Maize composite variety J-1006 was sown by *kera* method on 11 April 2011 by using 75 kg seed/ha and row distance was maintained at 30 cm apart. Seed treatment was done with bavistin @ 3 g/kg seed before sowing. Phosphorus and potassic fertilizers were applied @ 24 kg P_2O_5/ha and 12 kg K_2O/ha. Calculated dose of nitrogen was applied in the form of urea in two equal splits. Half nitrogen and full dose of phosphorus as single super phosphate and potassium as muriate of potash were applied at the time of sowing by drilling in furrows. Second dose of nitrogen was applied 30 days after sowing of crop. Farm yard manure contained P or P_2O_5. Calculated dose of the farm yard manure was applied to crop before sowing. Total 12 irrigations were applied during the crop growth season. The crop attained harvestable stage on different dates in response to N and FYM levels, therefore, crop was harvested on June 27 and July 6, 2011 as the crop reached harvest maturity.

Fresh weight of fodder was recorded immediately after harvesting and plant samples were oven-dried for working out quality parameters.

Moisture Content

The data (Table 1) revealed that both the levels of farm yard manure produced more moisture content (succulent) than control (F_0). Though F_{25} produced fodder which had 1.72 per cent more moisture than that produced with $F_{12.5}$ but the differences were non-significant. The moisture content of maize tended to increase with increasing nitrogen levels from control (N_0) to N_{120}. Each level of nitrogen application produced fodder with significantly higher moisture content than its lower level. Nitrogen application tends to produce succulence, which is an index of quality in fodder crops. Increasing level of nitrogen increased the moisture content in fodder maize, hence produced the succulent fodder and higher palatability of fodder crop. Adequate nitrogen supply favours the growth of crop, which increases the protein formation from manufactured carbohydrates. Consequently, less carbohydrates are deposited in vegetative cells and more the protoplasm will be formed. As protoplasm is highly hydrated which leads to more succulence (Tisdale and Nelson, 2004).

Crude Protein Content

Application of FYM levels significantly affected the crude protein content of fodder maize. Each level of FYM produced significantly higher crude protein content than its lower levels. Application of F_{25} produced highest crude protein, which was 1.98 and 0.99 per cent higher than F_0 and $F_{12.5}$, respectively. The higher crude protein content under $F_{12.5}$ and F_{25} might be due to more availability of nitrogen, which ultimately led to more nitrogen uptake and nitrogen content accumulated in plants and extended benefit with congenial biochemical reactions at higher FYM levels as reported by Kamalakumari and Singaram (1996). Increase in protein content with increase in FYM levels was also reported by Nimjhe and Seth (1998) and Balyan *et al.* (2008).

Application of 120 kg N/ha resulted in crude protein content of 10.72 per cent which was significantly higher than 80, 40 kg N/ha and control which produced fodder with crude protein of 10.15, 9.74 and 9.35 per cent, respectively. At higher nitrogen levels, more crude protein content was because of more uptake of nitrogen which is constituent of protein, amino acids and amides (Keshwa and Yadav, 1989; Bhillare, 2007). Increase in crude protein content with increase in nitrogen level is also associated with cell division and cell elongation. Nitrogen supply also increased the formation of nucleotide and coenzyme of which nitrogen is constituent which therefore, facilitates cell elongation (Verma and Singh, 1987). Similar results were reported by Kakol *et al.* (2003).

Interaction of FYM and nitrogen levels on crude protein was significant (Table 2). Application of F_{25} alone

TABLE 1

Effect of farm yard manure and nitrogen on the moisture content, crude protein, IVDMD ash content, crude fibre and nitrate nitrogen content of maize fodder

Treatment	Moisture content (%)	Crude protein (%)	IVDMD (%)	Ash content (%)	Crude fibre (%)	Nitrate nitrogen content (ppm)	
						Days after sowing	
						30	45
FYM (t/ha)							
F_0	74.07	9.00	60.46	6.65	34.54	331.16	114.75
$F_{12.5}$	79.23	9.99	62.09	7.35	34.40	357.00	135.75
F_{25}	80.95	10.98	63.59	8.24	33.31	476.00	155.55
C. D. (P=0.05)	1.31	0.27	0.53	0.31	NS	50.629	9.03
Nitrogen (kg/ha)							
N_0	74.79	9.35	60.83	7.07	34.94	339.88	113.16
N_{40}	77.21	9.74	61.66	7.36	34.15	379.11	128.50
N_{80}	79.08	10.15	62.37	7.44	33.99	423.11	142.00
N_{120}	81.26	10.72	63.33	7.89	33.53	526.77	157.66
C. D. (P=0.05)	2.01	0.12	0.31	0.24	0.54	79.72	17.00

TABLE 2
Interaction effects of farm yard manure and nitrogen on crude protein (%) of fodder maize

Treatment	Farm yard manure (t/ha)			Mean
	F_0	$F_{12.5}$	F_{25}	
Nitrogen (kg/ha)				
N_0	8.76	9.00	10.30	9.35
N_{40}	8.88	9.50	10.85	9.74
N_{80}	8.97	10.25	11.22	10.15
N_{120}	9.40	11.22	11.56	10.72
Mean	9.0	9.99	10.98	

C. D. (P=0.05) : FYM =0.27, Nitrogen=0.12 and FYM x N=0.21.

produced significantly higher crude protein content than all the levels of nitrogen alone. Similarly, $F_{12.5}$ alone was at par with N_{80} (8.97%) alone. Application of 40 kg N/ha in conjunction with $F_{12.5}$ produced equivalent crude protein with 120 kg N/ha alone (9.40%). F_{25} alone produced crude protein equivalent to N_{80} in combination with $F_{12.5}$ (10.25%).

This might be due to use of organic manure like FYM and inorganic fertilizer known to have synergistic effect. Sometimes the organic manure has supplementary and complimentary effect with inorganic fertilizer. FYM in combination with inorganic fertilizer increases the availability of macro and micro-nutrients. Hence, it increases the quality of plants (Manohar *et al.*, 1992). Similar response was reported by Patel and Vihol (1992).

In vitro Dry Matter Digestibility (IVDMD)

The data for IVDMD are presented in Table 1. A perusal of data revealed that IVDMD of fodder maize was significantly affected by FYM and nitrogen levels. Farm yard manure @ 25 t/ha produced 63.59 per cent IVDMD, which was significantly higher than lower level of $F_{12.5}$ (62.09%) and control (60.46%). Similarly, $F_{12.5}$ produced 1.63 per cent higher IVDMD over control. Higher IVDMD per cent under $F_{12.5}$ and F_{25} over control might be due to more production and translocation of assimilates in vegetative phase of plant which increased the amino acids and ultimately protein content of fodder maize. The increase in IVDMD per cent with the addition of FYM might be due to cumulative effect of increase in crude protein content, moisture content, ash content and decrease in crude fibre. Similar results were reported by Singh and Nepalia (2009).

Application of nitrogen levels significantly affected the IVDMD per cent of fodder maize. Increase in nitrogen levels produced significantly higher IVDMD than lower level. The magnitude of increase with application of 120 kg N/ha was 9.6 per cent over control. With nitrogen application, the increase in IVDMD content might be due to increase in leaf : stem ratio, LAI, etc. as the leaves contained more protein and soluble carbohydrates than stem than lower levels. Increase in nitrogen application increased the IVDMD over control as was reported by Sindhu *et al.* (2006).

The interaction effect of FYM and nitrogen on IVDMD per cent was significant (Table 3). The application of 25 t/ha produced fodder having significantly higher IVDMD per cent than all the levels of nitrogen alone but on a par with 80 kg N/ha in the presence of FYM @ 12.5 t/ha. Similarly, FYM @ 12.5 t/ha was on a par with 80 kg N/ha alone; however, the same quantity of FYM ($F_{12.5}$) in conjunction with N_{40} resulted in IVDMD which was on a par with N_{120}. The increase in IVDMD was due to the cumulative effect of FYM and N on the various quality traits such as crude protein, succulence, reduction in the crude fibre, more ash content, etc.

TABLE 3
Interaction effects of farm yard manure and nitrogen on IVDMD (%) of maize fodder

Treatment	Farm yard manure (t/ha)			Mean
	F_0	$F_{12.5}$	F_{25}	
Nitrogen (kg/ha)				
N_0	59.37	60.50	62.62	60.83
N_{40}	60.25	61.62	63.12	61.66
N_{80}	60.87	62.25	64.00	62.37
N_{120}	61.37	64.00	64.62	63.33
Mean	60.46	62.09	63.59	

C. D. (P=0.05) : FYM =0.53, Nitrogen=0.31 and FYM x N=0.54.

Ash Content

The data presented (Table 1) revealed that both FYM and nitrogen levels significantly affected the ash content of fodder maize. Application of FYM @ 25 t/ha produced 8.24 per cent ash content, which was significantly higher than $F_{12.5}$ (7.35%) and control (6.65%). The difference between the mineral matter with $F_{12.5}$ and control was 0.70 per cent. Addition of more FYM (F_{25}) further improved the mineral matter contents

to 1.59 per cent over control (6.65%).

Nitrogen application improved the ash content up to the highest level of nitrogen (N_{120}). The application of N_{120} produced 7.89 per cent ash content which was significantly higher than the lower nitrogen levels of 80, 40 kg N/ha and control which resulted in 7.44, 7.36 and 7.07 per cent ash content, respectively. However, N_{80} produced ash content on a par with N_{40}. Nitrogen is known to promote vegetative growth of above ground and plant parts. This increase might be due to synergistic effect of nitrogen on most of other minerals and indirectly by increasing root surface area i. e nitrogen application increased the availability and uptake of other nutrients. Similar results were reported by Jadhao *et al.* (1995) and Sindhu *et al.* (2006).

Crude Fibre Content

The data revealed that application of both FYM and nitrogen levels lowered the crude fibre content of fodder maize. Though the effect of FYM was non-significant and that of nitrogen was significant. However, application of F_{25} and $F_{12.5}$ produced fodder which contained 1.23 and 0.14 per cent less crude fibre than control (F_0).

All levels of nitrogen significantly lowered crude fibre content from control (N_0). However, they were significant over the next lower level. Less nitrogen supply causes carbohydrates to deposit into the cells. Higher nitrogen application accelerates the protein formation from manufactured carbohydrates and also helps in reduced rate of lignifications thereby maintaining the fodder quality. Nitrogen application increased the protein synthesis and decreased pectin, cellulose and hemicellolose contents, which are major constituents of crude fibre (Tiwana *et al.*, 2003).

Nitrate Nitrogen Content

The nitrogen taken up by the plant from the soil as nitrates is converted into ammonia via nitrite and then quickly into protein. Nitrate as such is not toxic to animals but nitrite form is toxic.

Though nitrate nitrogen content of the 30 days old crop was the highest (527 ppm) which was below the maximum permissible limit i. e. 2000 ppm (Table 1). The nitrate nitrogen content decreased with age of the plant and fell below detectable limit. This might be due to full utilization of the applied nitrogen either through urea or FYM. The initial soil fertility status showed that soil of the experimental field had 0.33 per cent organic carbon, which was very low, hence, applied nitrogen did not amount to excessive dose. The decreasing trend of nitrate nitrogen with age might be due to its dilution effect caused by the increased growth with age.

CONCLUSION

Farm yard manure improved the quality of fodder maize. Fodder produced by application of 25 t FYM had 7.00 per cent higher moisture content over control. FYM @ 25 t/ha produced 1.98 and 0.99 per cent more crude protein than control and lower dose of FYM. Higher level of FYM resulted in significantly higher IVDMD per cent and ash contents over lower levels.

Increase in nitrogen application produced more succulent fodder. Application of 120 kg N/ha improved the crude protein. IVDMD per cent crude fiber (%) decreased with increasing nitrogen levels. Application of F_{25} alone produced significantly higher crude protein and IVDMD (%) than lower level of FYM and all the levels of nitrogen alone.

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