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AGRONOMIC EVALUATION OF FODDER MAIZE GENOTYPES AT VARIED NITROGEN LEVELS

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SUMMARY

A field experiment was conducted at CCS Haryana Agricultural University, Hisar (Haryana), India to test the impact of three graded levels of nitrogen (80, 120 and 160 kg/ha) on yield, quality and economics of seven fodder maize (*Zea mays* L.) genotypes (four test entries *viz*. DFH-2, HQPM-28, PFM-13, AFH-7 and three checks *viz*. African Tall, J-1006 and COHM-8) during *kharif* (rainy) season of 2022 using factorial RBD design in three replicates. Results revealed that check entry 'DFH-2' with highest green and dry fodder yields *i.e*. 603.34 and 160.56 t/ha excelled over all the other test entries and checks. Even significantly highest per day productivity of green fodder and dry matter yields (9.28 and 2.48 q/ha/day) were also recorded in DFH-2. Among genotypes, maximum crude protein content (10.85 %) was estimated with COHM-8 which was on a par with DFH-2 and African Tall. However, maximum crude protein yield (17.21 q/ha) was recorded in DFH-2 which was significantly superior over rest of the genotypes. Among N levels, significant improvement was seen in leaf to stem ratio values from 80 kg N to 120 kg N but no significant increase was observed from 120 to 160 kg N/ha. It was concluded that fodder maize genotype DFH-2 was exclusively promising and application of 120 kg N/ha was recommended nitrogen dose to ensure the higher fodder yield, quality and to fetch better remunerations.

Key Words: Fodder maize, genotypes, nitrogen levels, fodder yield, crude protein and BC ratio

Maize (*Zea mays* L.) is known as queen of cereals because of its highest genetic yield potential among the cereals. With an average grain yield of 58.7 q/ha, it was cultivated on an area of 205.87 mha worldwide. In India, with an average productivity of 31.3 q/ha grain and 350.5 q/ha of green fodder, acreage under maize is 9.9 mha for grain (FAO, 2021) and 0.9 mha for fodder, respectively. In Haryana, area under grain maize in *kharif* season is only about 6200 ha with average productivity of 27.4 q/ha (Anonymous 2020). Being a C_4 plant, maize requires less water than other C_3 cereals. Maize gives higher fodder productivity even in a shorter period than any other cereal fodder crop. Besides this, being a day-neutral crop, it can be grown in any season. It is one of the popular dual purpose crop, grown widely for grain as well as for fodder in India. Production potential of fodder maize can be improved with suitable agronomic practices *viz*., selection of a location specific genotype, nutrient management, crop geometry etc.

Fertilizer management directly influences the fodder yield and quality. Further, an optimum supply of nutrients at critical growth stages is essential for realizing higher fodder yield. On dry matter basis, fodder maize removed huge quantity of primary nutrients (16.3-5.6-34.2 kg N-P_2O_5-K_2O NPK per tonne dry matter produced) (Janjal *et al.,* 2021). Such a high nutrient removal calls for adequate nutrient supply through native soil fertility and fertilizer and/or manure application. Most of the Indian soils are already deficit in primary nutrients. Soil test data of 500 districts indicated that 51 & 40% and 9 & 42% district are low and medium for available P and K, respectively (Muralidharudu *et al.,* 2011). The nutrient status of the soils is further declining under intensive cultivation. Decline in macronutrient availability and soil organic matter content in the Indo-Gangetic Plains (IGP) is leading to lower productivity (Bhandari *et al.,* 2002). Among the nutrients essential for plant growth, N plays a dominant role in plant growth as it is required for chlorophyll production, as a constituent of enzymes, proteins, nucleic acids and cell walls (Marschner, 1986; Schrader, 1984). Nitrogen is also constituent of low molecular weight plant compounds including nucleotides, amides and amines. Consequently, sufficient N is a prerequisite. Moreover, maize is also a nitro-positive crop which needs heavy doses of nitrogenous fertilizer to achieve optimal production (Khan *et al*., 2011).

All India Coordinated Research Project on Forage Crops & Utilization (AICRP on FCU), continuous striving to improve quality and productivity of fodder crops. For this, new promising genotypes of breeding program (AVT-II) are agronomic evaluated against the check cultivars (African Tall, J-1006 and COHM-8). This trial was conducted to evaluate the response of new fodder maize genotypes at differing nitrogen levels. Keeping in view, the increasing crop requirements and depleting soil supplies and reduced fertilizer use. It is in this context, the present study was made to assess the response of new fodder maize genotypes (including the checks) to varying nitrogen levels.

MATERIALS AND METHODS

A field experiment was conducted during rainy (*kharif*) season of 2022 at Forage Section Research Area, Department of Genetics & Plant Breeding, CCS Haryana Agricultural University, Hisar (29°10' N of 75°46' E, at an average elevation of 215.2 m above mean sea level) having semi-arid and sub-tropical climate with hot dry summer and severe cold winters and receives 450 mm precipitation per annum. A rainfall of 353.7 mm was received during crop duration. Weekly weather parameters *i.e.* temperature (°C), relative humidity (%) and rainfall (mm) during the crop duration are given Fig 1. Just before the start of the study, the soil samples were drawn from the plough layer of the experimental site; and as per test report, the sandy-loam soil with pH 7.6 was rated as low for organic carbon (0.46%), available N (116.0 kg/ha), and medium for available P and K (11.8 and 240.5 kg/ha). 21 treatments formed by combination of seven fodder maize genotypes (four test entries *viz*. DFH-2, HQPM-28, PFM-13, AFH-7 and three checks *viz*. African Tall, J-1006 and COHM-8) and three Nitrogen levels (80, 120 and 160 kg N/ha) were evaluated in Factorial randomized block design with three replications. Entire recommended dose of P and K along with $^1/_2$ N dose of the treatment was applied basal at the time of sowing in last ploughing and

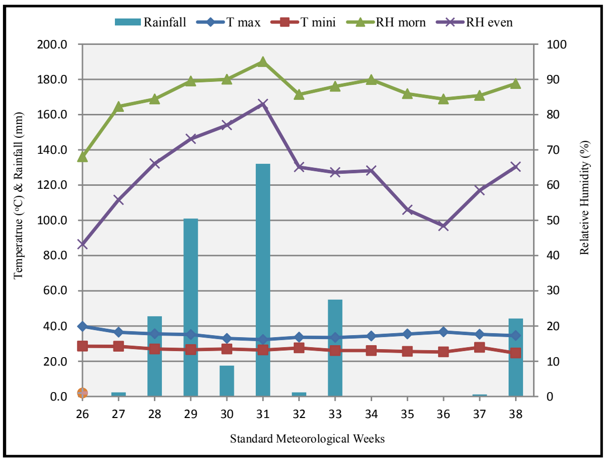

Fig. 1 Weekly weather data during the study period.

remaining $^1/_2$ N was top dressed at 30 days after sowing (DAS). The trial was sown manually on July 7, 2022 in soiled rows at 30 cm apart and harvested at 65 DAS. Nitrogen content (AOAC, 1995) was estimated for dried and grinded samples (2 mm sieve size) collected at 65 DAS. Crude protein content (CPC) was calculated by multiplying the nitrogen content (%) with 6.25. Crude protein yield (q/ha) was calculated by multiplication of CPC with dry matter yield (q/ha), respectively. Data were analyzed by using OPSTAT software available at CCS Haryana Agricultural University website (Sheoran *et al*., 1998). The results are presented at five per cent level of significance (p=0.05) for making comparison between treatments.

RESULTS AND DISCUSSION

Genotypes

Data (Table 1) reveals that among genotypes, significantly highest plant height was recorded with DFH-2. Maximum leaf to stem ratio (0.54) was recorded with J-1006 which was on a par with DFH-2 and PFM-13. However the plant stand per m row length was not affected significantly among genotypes. Maximum fresh weight and dry weight per plant (451.78 and 160.56 g/plant, respectively) were recorded in DFH-2 which was on a par with COHM-8, African Tall and PFM-13. Maximum green fodder and dry matter yield (603.34 and 160.56 q/ha, respectively) were recorded with DFH-2 which was significantly superior over all other genotypes. The differential values of the genotypes could be ascribed to their genetic makeup (Meena *et al*., 2012 and Satpal *et al*., 2022). Perusal of the data from Table 2 revealed that maximum per day productivity of green fodder and dry matter yield (9.28 and 2.48 q/ha/day) was

TABLE 1
Yield attributes and yields of fodder maize genotypes at different nitrogen levels

Treatment	Plant stand/mrl	Plant height (cm)	L:S ratio	Fresh wt/ plant (g)	Dry matter/ plant (g)	Green fodder yield (q/ha)	Dry matter yield (q/ha)
Genotypes							
DFH-2	10.00	254.47	0.50	451.78	119.73	603.34	160.56
COHM-8	9.48	176.16	0.39	366.11	106.00	403.70	117.92
HQPM-28	9.70	145.15	0.42	253.33	80.33	322.41	101.96
J-1006	9.74	178.02	0.54	268.33	90.22	310.37	104.80
African Tall	9.70	160.31	0.43	353.33	100.22	292.13	84.87
AFH-7	9.74	167.27	0.42	309.56	90.56	298.70	91.47
PFM-13	9.52	223.30	0.45	407.78	117.94	423.24	123.72
SEm±	0.30	4.02	0.02	19.25	4.67	9.09	3.50
CD (P=0.05)	NS	11.52	0.06	55.22	13.39	26.08	10.04
N Levels							
80	9.71	173.61	0.43	306.95	88.14	333.53	96.85
120	9.62	189.34	0.46	354.62	105.29	393.57	118.02
160	9.76	196.20	0.46	371.38	108.72	410.28	121.68
SEm±	0.20	2.63	0.01	12.60	3.06	5.95	2.29
CD (P=0.05)	NS	7.54	NS	36.15	8.76	17.07	6.57
G X N							
SEm±	0.52	6.96	0.03	33.34	8.08	15.74	6.06
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS
CV %	9.27	6.47	12.17	16.77	13.90	7.19	9.36

TABLE 2
Per day productivity, quality parameters and N uptake of fodder maize as influenced by nitrogen levels

Treatment	Per day productivity		Crude protein		Nitrogen	
	Green fodder (q/ha)	Dry matter (q/ha)	Content (%)	Yield (q/ha)	Content (%)	Uptake (kg/ha)
Genotypes						
DFH-2	9.28	2.48	10.68	17.21	1.71	275.30
COHM-8	6.21	1.81	10.85	12.91	1.74	206.59
HQPM-28	4.96	1.58	10.06	10.26	1.61	164.15
J-1006	4.79	1.62	10.39	10.95	1.66	175.25
African Tall	4.49	1.30	10.66	9.18	1.70	146.90
AFH-7	4.60	1.40	9.87	9.07	1.58	145.09
PFM-13	6.50	1.91	10.36	12.84	1.66	205.37
SEm±	0.14	0.05	0.11	0.39	0.02	6.22
CD (P=0.05)	0.40	0.15	0.33	1.12	0.05	17.85
N Levels						
80	5.12	1.50	9.53	9.29	1.52	148.67
120	6.06	1.82	10.77	12.71	1.72	203.32
160	6.32	1.87	10.93	13.32	1.75	213.14
SEm±	0.09	0.04	0.08	0.25	0.01	4.08
CD (P=0.05)	0.26	0.10	0.22	0.73	0.03	11.68
G X N						
SEm±	0.24	0.09	0.20	0.67	0.03	10.78
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV %	7.22	9.32	3.30	9.90	3.28	9.92

TABLE 3
Economics of promising genotypes of fodder maize as influenced by nitrogen levels

Treatment	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net Returns (Rs./ha)	B : C ratio
Genotypes (G)				
DFH-2	43107	120667	77561	2.80
COHM-8	43107	80741	37634	1.87
HQPM-28	43107	64481	21375	1.50
J-1006	43107	62074	18967	1.44
African Tall	43107	58426	15319	1.36
AFH-7	43107	59741	16634	1.38
PFM-13	43107	84648	41541	1.96
SEm±	-	1818	1818	0.04
CD (P=0.05)	-	5215	5215	0.12
Nitrogen Levels (N)				
80	42626	66706	24080	1.57
120	43108	78715	35606	1.83
160	43586	82056	38470	1.88
SEm±	-	1190	1190	0.03
CD (P=0.05)	-	3414	3414	0.08

recorded in DFH-2 which was significantly superior over all other genotypes.

Quality parameters data was presented in Table 2. Genotypes differed for crude protein contents and it ranged from 9.87 to 10.85%. Maximum CPC (10.85 per cent) was estimated in COHM-8 which was on a par with DFH-2 and African Tall. However, maximum CPY (17.21 q/ha) recorded with DFH-2 which was significantly superior over all other genotypes. Maximum nitrogen content (1.74 per cent) was estimated in COHM-8 which was on a par with DFH-2 and African Tall. Maximum nitrogen uptake (275.30 kg/ha) was estimated by DFH-2 which was significantly superior over all other genotypes.

Nitrogen levels

Perusal of the data of nitrogen levels (Table 1) revealed that maximum plant height was reported with the application of 160 kg N/ha but it was on a par with 120 kg N/ha. The plant stand per meter row length and leaf to stem ratio were not affected significantly among nitrogen levels. Except plant height, fresh weight and dry weight per plant, no other growth parameter improved significantly due to enhanced nitrogen levels and thus production improved significantly due to enhanced nitrogen levels over lower nitrogen doses. Maximum green fodder and dry matter yields (410.28 and 121.68 q/ha, respectively) were recorded with the application of 160 kg N/ha which was on a par with 120 kg N/ha. Perusal of the data from Table 2 revealed that maximum per day productivity of green fodder and dry matter yield (6.32 and 1.87 q/ha/day) was recorded with the application of 160 kg N/ha which was on a par with 120 kg N/ha. Maximum crude protein content and crude protein yield (10.93 per cent and 13.32 q/ha, respectively) were recorded with the application of 160 kg N/ha which was on a par with 120 kg N/ha but significantly superior over 80 kg N/ha. It was obvious that crude protein content was increased with increase in level of nitrogen application. Similar results were reported by Souza *et al*. (2019) and Guo *et al*. (2021).

Economics

Perusal of the data from Table 3 revealed that maximum net returns and BC ratio (Rs. 77561 per ha and 2.80, respectively) were fetched with DFH-2. Among nitrogen levels, maximum net returns and BC ratio (Rs. 38470 per ha and 1.88, respectively) were fetched with 160 kg N/ha nitrogen dose which was on a par with 120 kg/ha (Net returns Rs. 35606/ha and benefit cost ratio 1.83).

CONCLUSION

It is concluded from the study that for fodder maize genotype DFH-2 recorded significantly highest green fodder and dry matter yields. Among nitrogen levels, maximum green fodder (410.28 q/ha) and dry matter (121.68 q/ha) yield were recorded with 160 kg

N/ha which were on a par with 120 kg N/ha but significantly superior to lower level.

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