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Effect of Seedrates and Nitrogen and Phosphorus Levels on Forage Maize (*Zea mays* L.) Varieties

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ABSTRACT

A field experiment was conducted during *rabi* seasons of 1993-94 and 1994-95 on sandy loam soil to study the effect of seedrates, nitrogen and phosphorus levels on forage maize varieties. Maize variety African tall recorded significantly higher dry matter yield than Gujarat Maize-1, however both the varieties had no appreciable influence on green forage and crude protein yields. Gujarat Maize-1 was found superior in quality than African tall. Maize crop sown with 80 kg seed/ha was found advantageous in increasing net return and produced higher forage production with better quality than 40 and 80 kg seed/ha. Each successive increase in nitrogen level from 80 to 200 kg N/ha significantly increased the forage production of maize and increased the crude protein yield. Application of 200 kg N/ha also recorded the maximum values of crude protein content, leaf : stem ratio and net realization. Application of phosphorus had no influence on forage yield and quality of maize crop.

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INTRODUCTION

Maize (*Zea mays*, L.) is an ideal cereal forage crop adapted to varying soil and climatic conditions. It can be successfully grown during *rabi* season, since hybrid Napier, sorghum and *bajra* produce low forage yields. Optimum seedrate determines the yield potentiality of any crop, while the chemical fertilizers play an important role in increasing forage production of maize with better nutritive value. Gujarat Maize-1 variety recently released by Gujarat Agricultural University, requires shorter period for forage production. Hence, a field experiment was conducted to study the forage production potential of Gujarat Maize-1 alongwith African tall under different levels of seedrate and nitrogen and phosphorus fertilization under middle Gujarat conditions.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* seasons of 1993-94 and 1994-95 on sandy loam soil, low in total nitrogen (0.03%), medium in available phosphorus (43.5 kg/ha) and high in available in potash (261.4 kg/ha). Thirty six treatments comprising combinations of two maize varieties (African tall and Gujarat Maize-1) and three seedrates (40, 60 and 80 kg/ha) in main plots and combinations of three levels of nitrogen (80, 140 and 200 kg N/ha)

and two levels of phosphorus (0 and 40 kg P_2O_5/ha) in sub plots were tested in split plot design with four replications. Half of the nitrogen and entire quantity of phosphorus in the form of ammonium sulphate and single superphosphate, respectively were applied as per treatments at the time of sowing, whereas remaining half of nitrogen was topdressed one month after sowing. The harvesting of each treatment was done at milking stage. Nitrogen content of plant was estimated by modified Kjeldahl's method and crude protein content was worked out on dry weight basis (Jackson, 1973).

RESULTS AND DISCUSSION

Effect of varieties

The variety Gujarat Maize-1 produced significantly higher green forage yield than African tall during 1994-95, however the differences were not significant during 1993-94 and in pooled results (Table 1). African tall recorded significantly higher plant height and produced significantly higher dry matter yield than Gujarat Maize-1 during both the years as well as in pooled results. There was no appreciable influence on crude protein yield due to different varieties, however Gujarat Maize-1 recorded higher crude protein content than African tall during both the years (Table 2). The variety Gujarat Maize-1 also registered significantly lower Neutral Detergent Fibre (NDF) content, stem thickness and leaf : stem ratio than African tall during 1993-94 (Table 2). This might be due to varying genetic potentiality of two varieties. The results are in accordance with those reported by Desai and Deore (1980).

Effect of seedrates

During 1994-95 and in pooled results, the seedrates of 60 and 80 kg/ha produced equally higher green forage and dry matter yields and were found significantly superior than the treatment of 40 kg seed/ha (Table 1). The seed rate of 80 kg/ha recorded the maximum crude protein yield during both the years (Table 1). Different seedrates did not influence appreciably the plant height and crude protein content of maize. However, the seedrate of 80 kg/ha recorded significantly lower NDF content than 60 kg seed/ha and gave significantly higher leaf stem ratio than 40 kg seed/ha during 1993-94, while each increment in seedrate from 40 to 80 kg seed/ha significantly decreased stem thickness of maize crop (Table 2). The crop sown with 80 kg seeds/ha also gave the highest net returns of Rs. 16300.50 (Table 4). The findings confirm the results of Nehra *et al.* (1981).

Effect of nitrogen

Each increment in nitrogen from 80 to 200 kg N/ha significantly increased the green forage and dry matter yields of maize crop during both the years as well as in pooled results (Table 1). The crude protein yield was also increased due to increase in nitrogen application upto the highest level of 200 kg N/ha during both the years. The higher forage production under higher levels of nitrogen was attributed to significant increase in plant height of maize during both the years, while higher crude protein yield was attributed to increase in dry matter yield and crude protein content of forage maize (Table 2). The increase in nitrogenous fertilization enhanced rapid expansion of dark green foliage and increased the growth as it has fulfilled the requirement of nitrogen at various stage of crop growth. Similar results were also reported by Desai and Deore (1983), while Singh *et al.* (1981) reported that increase in nitrogen application resulted in increased crude protein content only.

TABLE 1

Influence of seedrates, nitrogen and phosphorus levels on green forage, dry matter and crude protein yields of maize varieties.

Treatment	Green forage yield (q/ha)			Dry matter yield (q/ha)			Crude protein. yield (q/ha)		
	1993-94	1994-95	Pooled	1993-94	1994-95	Pooled	1993-94	1994-95	Mean
Varieties									
African tall	684	514	599	166.2	114.4	140.3	10.18	5.77	7.98
Gujarat Maize-1	640	587	613	137.5	103.3	120.4	9.45	6.30	7.88
S. Em. ±	15	14	13	3.3	2.9	2.8	—	—	—
C. D. at 5%	NS	41	NS	10.1	8.7	8.3	—	—	—
Seedrates (kg/ha)									
40	644	490	567	147.3	95.7	121.5	9.84	5.20	7.52
60	650	560	605	150.0	112.0	131.0	9.72	6.36	8.04
80	693	600	647	158.2	118.7	138.5	10.00	6.54	8.27
S. Em. ±	18	17	16	4.1	3.5	3.4	—	—	—
C. D. at 5%	NS	50	47	NS	10.7	10.2	—	—	—
C V %	18.94	20.87	25.20	18.64	22.56	25.46	—	—	—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Nitrogen (kg/ha)									
80	595	469	532	136.8	93.9	115.3	7.67	4.49	6.08
140	675	573	624	152.5	111.8	132.2	10.56	6.20	8.38
200	717	608	663	166.1	120.8	143.5	11.33	7.41	9.37
S. Em. ±	8	7	5	2.4	1.4	1.4	—	—	—
C. D. at 5%	24	19	15	6.7	3.9	4.0	—	—	—
Phosphorus (kg/ha)									
0	659	546	602	150.5	108.7	129.6	9.91	6.05	7.98
40	666	555	610	153.1	108.9	131.0	9.80	6.01	7.91
S. Em. ±	7	5	4	1.9	1.1	1.1	—	—	—
C. D. at 5%	NS	NS	NS	NS	NS	NS	—	—	—
C. V. %	8.76	8.36	8.69	10.85	8.75	10.57	—	—	—

TABLE 2

Crude protein content and other ancillary observations of forage maize as influenced by different treatments.

Treatment	Av. plant height (cm)		Crude protein content (%)		NDF (%) 1993-94	Stem thickness (cm) 1993-94	Leaf : stem ratio 1993-94
	1993-94	1994-95	1993-94	1994-95			
Varieties							
African tall	313.7	206.2	5.83	4.98	68.7	2.02	0.39
Gujarat Maize-1	218.0	197.2	7.35	6.04	66.1	1.47	0.35
S. Em. ±	2.9	2.3	—	—	0.7	0.02	0.01
C. D. at 5%	8.8	7.0	—	—	2.2	0.07	0.03
Seedrates (kg/ha)							
40	271.0	197.8	6.77	5.39	65.6	1.90	0.33
60	261.4	201.7	6.55	5.65	70.1	1.70	0.40
80	265.1	205.5	6.46	5.49	66.5	1.62	0.39
S. Em. ±	3.6	2.8	—	—	0.9	0.03	0.01
C. D. at 5%	NS	NS	—	—	2.7	0.08	0.04
C. V %	9.31	9.77	—	—	9.2	10.73	24.55

1.	2.	3.	4.	5.	6.	7.	8.
Nitrogen (kg/ha)							
80	259.3	196.5	5.70	4.77	66.3	1.69	0.34
140	268.6	202.4	7.04	5.60	67.9	1.74	0.35
200	269.7	206.1	7.04	6.16	68.1	1.79	0.43
S. Em. ±	2.2	1.7	—	—	0.2	0.03	0.01
C. D. at 5%	6.1	4.8	—	—	0.6	0.07	0.03
Phosphorus (kg/ha)							
0	266.9	201.8	6.68	5.53	67.4	1.75	0.37
40	268.8	201.6	6.50	5.49	67.4	1.74	0.37
S. Em. ±	1.8	1.4	—	—	0.1	0.02	0.01
C. D. at 5%	NS	NS	—	—	NS	NS	NS
C. V. %	5.62	5.90	—	—	2.44	10.01	20.40

TABLE 3

Interaction effect of seedrates and nitrogen levels on green forage and dry matter yields (pooled data).

Treatment	*Nitrogen (kg/ha)*		
	80	*140*	*200*
	Green forage yield (q/ha)		
Seedrates (kg/ha)			
40	498	564	639
60	526	635	655
80	573	672	694
S. Em. ±		9.3	
C. D. at 5%		26.2	
	Dry matter yield (q/ha)		
Seedrates (kg/ha)			
40	108.7	116.7	139.2
60	115.9	137.2	139.9
80	121.5	142.5	151.4
S. Em. ±		2.4	
C. D. at 5%		6.9	

The highest level of 200 kg N/ha also recorded significantly higher values of stem thickness than 80 kg N/ha and leaf : stem ratio than 80 and 140 kg N/ha, while application of 80 kg N/ha registered significantly lower NDF content than 140 and 200 kg N/ha during 1993-94 (Table 2). The increase in NDF content with the application of higher doses of nitrogen might be due to the formation of more amount of complex carbohydrates. The economics of nitrogenous fertilization revealed that the application of 200 kg N/ha recorded the highest net realization of Rs. 15,914.50 on hectare basis (Table 4).

Effect of phosphorus

Application of phosphorus @ 40 kg P_2O_5/ha did not exert significant influence on green forage and dry matter yields during both the years and also in pooled results (Table 1). Similar was the case with plant height, stem thickness and leaf : stem ratio of fodder maize and quality characters like crude protein yield, crude protein content and NDF content (Table 2). The findings confirm the results of Sharma *et al.* (1976).

TABLE 4

Economics of forage maize as influenced by seedrates and nitrogen levels.

Treatment	*Pooled green forage yield (q/ha)*	*Gross realization (Rs./ha)*	*Cost of cultivation (Rs./ha)*	*Net realization (Rs/ha)*
Seedrates (kg/ha)				
40	567	21262	7534	13728
60	605	22687	7748	14939
80	647	24262	7962	16300
Nitrogen (kg/ha)				
80	532	19950	6548	13402
140	624	23400	7748	15652
200	663	24862	8948	15914

Selling price of green forage = Rs. 37.50/q.
Cost of nitrogen (Ammonium sulphate) = Rs. 20/kg.
Cost of phosphorus (single superphosphate) = Rs. 13.75/kg.
Cost of seeds = Rs. 10.70/kg.
Labour charges = Rs. 25/day.

Interaction effects

Maize crop sown with 80 kg seeds/ha and fertilized with 200 kg N/ha gave the maximum green forage yield but at par with 140 kg/ha and produced significantly higher dry matter yield than rest of the treatment combinations (Table 3). Treatment combinations of 40 kg seed/ha and 80 kg N/ha produced significantly the lowest green forage and dry matter yields indicating synergistic effects of both the inputs on forage production.

Conclusion

The results suggest that maize variety Gujarat Maize-1 be sown with 80 kg seeds/ha and fertilized with 200 kg N/ha for maximum dry matter and 140 kg N/ha for green forage production with better nutritive value.

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