

Original Research Article

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Effect of Integrated Nitrogen Management and Spacing on Yield, Quality and Economics of Fodder Maize (*Zea mays* L.) Var. Shiats Makka-2

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ABSTRACT

Keywords

Integrated nitrogen management, Vermicompost, *Azotobacter*, Spacing, Green fodder yield, Quality and economics

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A field experiment was conducted during the *rabi* season of 2017-18 on fodder maize crop (var. SHIATS Makka- 2) at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (U.P.). The soil of the experimental field was sandy loam with low organic carbon (0.45%) and a soil pH of 7.6. The experiment comprised of three planting geometry viz., 40 ×10 cm, 50× 10 cm, 60×10 cm and 2 nitrogen levels 90 kg N ha⁻¹ and 120 kg N ha⁻¹ respectively, with 18 treatments replicated thrice and laid out in Randomized Block Design. The experiment was conducted to evaluate the growth and yield of fodder maize (*Zea mays* L.). The result revealed that treatment T₁₇ [120 kg N ha⁻¹ + (50% N through vermicompost + 50%N through urea) + Seed inoculated with *Azotobacter* + 50×10cm] recorded higher crude protein (9.567), Ash (5.270%), Gross return (₹ 89120 ha⁻¹), Net Return (₹ 51351.6 ha⁻¹), B: C (2.36) ratio.

Introduction

Maize (*Zea mays* L.) is one of the most versatile and multi utility cereals and commonly known as queen of cereals due to its highest genetic yield potential and wider adaptability under diverse agro-ecological conditions. In India area under fodder crops is only 8.4 m ha which is static since last two decades.

At present, the country faces a net deficit of 61.1% green fodder, 21.9% dry crop residue and 64% feeds (Chaudhary *et al.*, 2012). Among cultivated forage crops, maize is most suitable crop for fodder as well as silage

because of its high yielding ability and excellent nutritional profile. Besides, it is served as source of food, feed and industrial raw material and provides enormous opportunity for crop diversification, value addition and employment generation. Worldwide, maize is an ideal fodder crop because of its quick growing nature, succulence, palatability and excellent quality without any anti-nutritional factor; when harvested at any stage of crop growth (Anonymous, 2013). Forage maize responds differently to plant densities under different environmental and cultural factors, which influence maize forage yield and quality (Carpici *et al.*, 2010).

Furthermore, the fertilizer management is one of the most important factors that influence the growth and yield of maize crop. In fact, organic manure not only provides plant nutrients but also improves or sustains the soil health. The micronutrient content in organic manure may be sufficient enough to meet the crop production requirement but problem of low soil fertility is one of the obstacles to maintain and sustain agricultural production and productivity. Integrated nutrient management (INM) is a judicious use of organic and inorganic sources of nutrients to crop field (Kannan *et al.*, 2013).

Nitrogen (N) sources and rates influence grain yield and profitability and total dry matter accumulation, agronomic N-use efficiency and harvest index in maize (*Zea mays* L.). Planting geometry directly influences the plant population /m² or the fodder production /m². Keeping this in view, the present experiment was undertaken to study the effect of planting geometry and integrated Nitrogen on quality and yield of fodder maize.

Materials and Methods

A field experiment was conducted during the rabi season of 2017 on fodder maize crop (var. SHIATS Makka-2) at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (U.P.), which is located at 25°24' 41.27" N latitude, 81° 51'3.42" E longitude and at an altitude of 98 m above the mean sea level. The soil of experimental field was sandy loam having pH of 7.2 with 0.45% organic carbon. The experiment consisted of 18 treatments with two levels of nitrogen i.e., levels 90 kg N ha⁻¹ and 120 kg N ha⁻¹ respectively, managed through three different sources viz. 50% N through vermicompost + 50% N through urea, 50% N through vermicompost + 50% N through urea in addition with seed inoculation with *Azotobacter*, which was compared with

100% N supplied through urea alone with three different row spacing i.e. 40cm, 50cm and 60cm at a plant to plant spacing of 10cm, laid out in Randomized Block Design and replicated thrice. Fodder maize (var. SHIATS Makka-2) was sown 6th of November 2017. The crop matured in 90 days and was harvested in first week of February. After harvesting, the data on yield attributes viz. green fodder yield (t h⁻¹), dry weight (g) and plant height (cm) are statistically analyzed and critical difference were calculated.

Results and Discussions

Green fodder yield

The data pertaining to green fodder yield and quality are presented in Table 1, which revealed that the integrated nitrogen management in fodder maize (var. SHIATS Makka-2), significantly increase the green fodder yield (44.56 t ha⁻¹) was observed statistically significant with treatment T₁₇ (120 kg N ha⁻¹ + 50% N through VC + 50% N through Urea + Seed inoculation with *Azotobacter* + 50 cm×10 cm), are significantly higher with T₁₇ This result are very close with the finding of Arif *et al.*, (2010) and Barik *et al.*, (2007).

Effect on quality

As given in Table 2, the quality viz. The maximum Crude protein (9.567%) and Ash (5.720%) were found in treatment T₁₇ (120 kg N ha⁻¹ + 50% N through VC + 50% N through Urea + Seed inoculation with *Azotobacter* + 50×10 cm). The results are in accordance with Joshi and Kumar (2007) who also reported significant increase in crude protein yield of maize with increase in levels of nitrogen up to 120 kg ha⁻¹. And the lower crude fiber (23.853%) was found under treatment T₆ (90 kg N ha⁻¹ + 50% N through VC + 50% N through Urea + 60×10 cm).

Table.1 Effect of integrated nitrogen management and spacing on yield and quality of fodder maize var. Shiats Makka-2

Treatments		Proximate Analysis			Green fodder yield (t ha ⁻¹)
		Crude protein (%)	Crude fibre (%)	Ash (%)	
T1	90 kg N ha ⁻¹ + 100% N through Urea + 40×10 cm	6.947	31.473	2.367	38.00
T2	90 kg N ha ⁻¹ + 100% N through Urea + 50×10 cm	7.537	31.920	2.427	34.00
T3	90 kg N ha ⁻¹ + 100% N through Urea + 60×10 cm	7.653	31.333	2.213	35.00
T4	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 40×10 cm	7.863	30.240	2.777	33.50
T5	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 50×10 cm	9.083	26.050	5.333	34.80
T6	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 60×10 cm	9.030	23.853	5.267	33.00
T7	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 40×10 cm	7.983	26.400	3.933	37.50
T8	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 50×10cm	8.110	31.567	5.497	39.00
T9	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 60×10cm	9.177	33.233	5.360	35.50
T10	120 kg N ha ⁻¹ +100% N through Urea + 40 ×10 cm	7.560	25.363	3.843	33.60
T11	120 kg N ha ⁻¹ +100% N through Urea + 50 ×10 cm	8.033	26.143	4.233	40.00
T12	120 kg N ha ⁻¹ +100% N through Urea + 60 ×10 cm	8.053	28.603	4.533	41.00
T13	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 40×10 cm	8.103	25.700	3.203	42.50
T14	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 50×10 cm	8.917	24.120	5.190	42.66
T15	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 60×10 cm	8.120	26.080	5.230	42.00
T16	120 kg N ha ⁻¹ +50% N through VC + 50 % N through Urea + <i>Azotobacter</i> (SI) + 40×10 cm	9.307	25.817	5.107	43.60
T17	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 50×10 cm	9.567	28.983	5.720	44.56
T18	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 60×10cm	9.363	26.400	5.643	44.00
	F- test	S	S	S	S
	S. Ed. (±)	0.542	1.203	0.406	1.018
	C. D. (P = 0.05)	1.118	2.483	0.838	2.102

VC-Vermicompost, SI- Seed Inoculation

Table.2 Effect of integrated nitrogen management and spacing on economics of fodder maize var. Shiats Makka-2

Treatments		Economics			
		Cost of Cultivation	Gross return (₹ ha ⁻¹)	Net Return (₹ ha ⁻¹)	B:C ratio
T1	90 kg N ha ⁻¹ + 100% N through Urea + 40×10 cm	38,339	76000	37661.1	1.98
T2	90 kg N ha ⁻¹ + 100% N through Urea + 50×10 cm	38,339	68000	29661.1	1.77
T3	90 kg N ha ⁻¹ + 100% N through Urea + 60×10 cm	38,339	70000	31661.1	1.83
T4	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 40×10 cm	37,453	67000	29546.8	1.79
T5	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 50×10 cm	37,453	69600	32146.8	1.86
T6	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 60×10 cm	37,453	66000	28546.8	1.76
T7	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 40×10 cm	37,453	75000	37546.8	2.00
T8	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 50×10cm	37,453	78000	40546.8	2.08
T9	90 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 60×10cm	37,453	71000	33546.8	1.90
T10	120 kg N ha ⁻¹ +100% N through Urea + 40 ×10 cm	38,949	67200	28250.6	1.73
T11	120 kg N ha ⁻¹ +100% N through Urea + 50 ×10 cm	38,949	80000	41050.6	2.05
T12	120 kg N ha ⁻¹ +100% N through Urea + 60 ×10 cm	38,949	82000	43050.6	2.11
T13	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 40×10 cm	37,768	85000	47231.6	2.25
T14	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 50×10 cm	37,768	85320	47551.6	2.26
T15	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + 60×10 cm	37,768	84000	46231.6	2.22
T16	120 kg N ha ⁻¹ +50% N through VC + 50 % N through Urea + <i>Azotobacter</i> (SI) + 40×10 cm	37,768	87200	49431.6	2.31
T17	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 50×10 cm	37,768	89120	51351.6	2.36
T18	120 kg N ha ⁻¹ + 50% N through VC + 50% N through Urea + <i>Azotobacter</i> (SI) + 60×10cm	37,768	88000	50231.6	2.33

VC-Vermicompost, SI- Seed Inoculation

The higher nitrogen doses result in higher protein synthesis and lower soluble carbohydrates which could be responsible for lower crude fiber content of the fodder maize. The results are in conformity with the findings of Almodares *et al.*, (2009), Sujata *et al.*, 2008 and Krishna *et al.*, 1998.

Effect on economics

The maximum gross return (89120 Rs. ha⁻¹), net return (51351.6 Rs. ha⁻¹) and benefit cost ratio (2.36) was recorded in treatment T₁₇ (120 kg N ha⁻¹ + 50% N through VC + 50% N through Urea + Seed inoculation with *Azotobacter* + 50×10 cm). The plant spacing of 50 cm × 10 cm gave the maximum green fodder yield then the other spacing. These results are in conformity with those of Kunjir (2004).

On the basis of the above findings, it can be concluded that for obtaining higher green fodder yield, better fodder quality and benefit cost ratio, SHAITs Makka-2, should be fertilizer with 120 kg/ha of nitrogen (N) as 50% N through vermicompost and 50% N through urea in addition to seed inoculation with *Azotobacter* and should be sown at a spacing of 50cm (row to row) ×10cm (plant to plant).

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