

EFFECT OF DIFFERENT LEVELS OF NITROGEN ON THE GRAIN AND STOVER YIELD OF THREE VARIETIES OF SORGHUM (*SORGHUM BICOLOR L.*), DISEASE INCIDENCES AND ECONOMICS UNDER RAINFED CONDITIONS OF CENTRAL U.P.

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ABSTRACT

A field experiment was conducted during kharif season of 2003 and 2004 at Research Farm of M M P G Collage, Kalakankar, Pratapgarh (U. P.) to study the optimum level of nitrogen and best suitable variety of sorghum for grain as well as stover yield for rainfed areas of central Uttar Pradesh.. Sorghum hybrid variety MSH-51 proved significantly superior in respect of grain yield and variety Sundhia (Local) proved their superiority in respect of Stover yield over the other varieties included in the study. Account of all the treatments, highest net income (Rs. 22,057.60 and 25,125.43) observed in $T_4 (V_1 N_{60})$ treatment during both the year of experiment. The benefit-cost ratio was also superior with this treatment.

Key words: Sorghum, Nitrogen levels, Varieties, Diseases

INTRODUCTION

Sorghum (*Sorghum bicolor* L.) is the fifth most important cereal crop globally after wheat (*Triticum aestivum*), rice (*Oryza sativa*), maize (*Zea mays*) and barley (*Hordeum vulgare*) with multiple uses as food, feed, fodder and fuel. It is well known that the per hectare production of this crop is below to the productivity level, due to this crop is generally cultivated in dry land area. This belief is substantiated by the results of a large number of experiments conducted all over the country on different dryland crops during the recent past where adequate fertilization, particularly the nitrogen resulted in substantial increase in crop yield as reported by Gahlot *et al.* [1] and Nagre *et al.* [2]. There are several varieties of sorghum available for cultivation , but under rainfed condition of central Uttar Pradesh there was no enough work were carried out. The response of sorghum to nitrogen, however, would depend on the amount of available moisture particularly during the active growth period and the growing cultivars/ varieties. Hence present study was under taken to find out optimum dose of nitrogen to the sorghum variety which was suitable for rainfed areas of central Uttar Pradesh.

MATERIALS AND METHODS

A field experiment was conducted during rainy (*kharif*) season of 2003 and 2004 at Research Farm of M. M. P. G. Collage, Kalakankar, Pratapgarh (U.P.) to study the effect of different levels of fertilizer on the grain and stover yield of three varieties of Sorghum. The experiments during both the years consisted of 12 treatments, viz. $T_1 (V_1 N_1)$, $T_2 (V_1 N_2)$, $T_3 (V_1 N_3)$, $T_4 (V_1 N_4)$, $T_5 (V_2 N_1)$, $T_6 (V_2 N_2)$, $T_7 (V_2 N_3)$, $T_8 (V_2 N_4)$, $T_9 (V_3 N_1)$, $T_{10} (V_3 N_2)$, $T_{11} (V_3 N_3)$, $T_{12} (V_3 N_4)$.

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$T_3(N_1), T_{10}(V_1N_2), T_{11}(V_1N_3), T_{12}(V_1N_4)$. The soil was sandy-loam having pH 6.9 along with electrical conductivity of 0.04m mhos/cm at 25°C and organic carbon 0.32%. The experimental site soil having available nitrogen, phosphorous and potassium 147, 13 and 121 kg/ha. respectively. The treatments consist of three varieties like V_1 =MSH-51 hybrid, V_2 = BC-6 composite and V_3 =*Sundhia* Local and 4 levels of nitrogen viz; N_1 =0, N_2 =20, N_3 =40, N_4 = 60 kg/ha. All the twelve treatment combinations were laid out in a two factor factorial arranged in randomized block design with three replication. Sorghum was sown with a row spacing of 40 cm and 15 cm plant to plant with 60 kg P_2O_5 /ha through S. S. P. and 40kg K_2O /ha through Murate of Potash and half total of nitrogen through Urea were applied as basal and the remaining nitrogen was top dressed at 30 days after of sowing. The crop was sown on 13th and 15th July 2003 & 2004 and harvested 28th and 30th October 2003 & 2004 respectively.

Disease incidence was observed in each combination of treatments in both the cropping seasons (2003 and 2004). Infected and healthy plants were recorded at the time of harvesting and percent disease incidence was calculated adopting the formula:

$$\text{Percent Disease Incidence (PDI)} = \frac{\text{(No. of Infected Plants per Plot)}}{\text{(Total No. of Plants per plot)}} \times 100$$

RESULT AND DISCUSSION

Data (Table-1) revealed that nitrogen fertilization to the sorghum significantly increased the grain and stover yield with every increase in the level of nitrogen. The application of 60 kg N/ha gave maximum grain yield and Stover yields i.e. 32.71; 81.37 q/ha in 2003; 34.87; 85.90 q/ha in 2004, respectively which were significantly superior over 20kg N/ha. Hipra *et al.* [3] and Warsi [4], found the response of nitrogen on the grain yield of rainfed sorghum up to 60 kg N/ha. Application of nitrogen to the soil also improved the translocation of photosynthesis and dry matter pertaining of the crop, which ultimately increase the grain and stover yield.

Table 1: Effect of sorghum varieties and N levels on the plant population and yield of grain and stover

Treatment	Plant population		Grain yield(q/ha)		Stover yield(q/ha)	
	2003	2004	2003	2004	2003	2004
Varieties						
MSH-51	16.08	16.83	26.79	30.54	60.05	57.50
BC-6	15.50	17.17	25.24	26.87	68.28	69.15
Sundhia(Local)	16.50	16.08	23.26	23.47	77.79	86.52
CD (P=0.05)	NS	NS	1.03	1.67	0.94	1.80

Nitrogen levels (Kg/ha)						
0	16.22	16.33	16.60	17.51	51.00	48.25
20	15.44	16.66	22.15	24.21	66.11	68.92
40	16.33	16.67	28.93	31.20	76.33	81.15
60	16.11	17.11	32.71	34.87	81.37	85.90
CD (P=0.05	NS	NS	1.19	1.93	1.09	2.08

The data (Table-1) revealed that sorghum hybrid MSH-51 resulted in significantly higher grain yield 26.79 and 30.54 q/ha as compared to BC-6(composite) and Sundhia(local) during 2003 and 2004, respectively. The mean grain yield in V₁, V₂ and V₃ varieties was found to be 26.79, 25.24, 23.26 q/ha in 2003 and 30.54, 26.87 and 23.43 q/ha in 2004 respectively. There was significant difference in the grain yield of the three varieties in both the years. The maximum increase in the grain yield in V₁ variety occurred at 60 kg N /ha followed by V₂ and V₃, where as maximum increase in the stover yield V₃ variety gave at 60 kg N /ha i.e. 77.79 q/ha in 2003 and 86.53 q/ha in 2004 followed by V₂ and than V₁ respectively in both the years.

The interaction effect of sorghum varieties and nitrogen levels on the grain and stover yield was found significant in both the years. (Table-2) Data indicates that during both years MSH-51 gave maximum grain yield (36.44 q/ha) in 2003 and grain yield (40.73 q/ha) in 2004 with application of 60kg N/ha which were significantly superior over other combinations. However, in respect of stover yield Sundhia (local) proved significantly superior with the application of 60kg N/ha (92.30q/ha) in 2003 and (107.53 q/ha) in 2004, followed by application of 40 kg N/ha to Sundhia with the yield 85.93q of stover/ha in 2003 and 100.37q stover/ha in 2004. Mahakulkar *et al.* [5] also observed the same in respect of grain and stover yield of sorghum.

Table 2: Interaction effect of varieties and nitrogen levels on grain and stover yield during 2003 and 2004

Yield Type	Variety	N levels (kg/ha)							
		2003				2004			
		0	20	40	60	0	20	40	60
Grain Yield (q/ha)	MSH-51	15.15	23.03	32.55	36.44	18.98	26.18	36.29	40.73
	BC-6	16.71	22.07	29.08	33.11	16.50	23.59	31.43	35.95
	Sundhia	17.95	21.36	25.14	28.58	17.05	22.86	25.88	27.93
	CD at 5%	2.07				3.35			

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Stover yield (q/ha)	MSH-51	45.40	55.64	67.80	71.37	40.47	53.93	65.87	69.73
	BC-6	50.27	67.10	75.27	80.47	51.40	67.53	77.23	80.43
	Sundhia	57.33	75.60	85.93	92.30	52.90	85.30	100.37	107.53
	CD at 5%	1.89				3.60			

The grain smut of sorghum was important disease infecting the sorghum in this region. The data presented in (Table-3) referred that different varieties and nitrogen levels significantly influenced the incidence of grain smut of sorghum. The Hybrid variety of sorghum MSH-51 showed the highest disease incidence to the tune of 24.31% in 2003 and 26.85% in 2004. It was followed by composite and local variety of sorghum.

Different levels of nitrogen also significantly influenced the disease incidence. Maximum incidence of grain smut was recorded in 60 kg/ha nitrogen level in the tune of 23.53% in 2003 and 26.50% in 2004. It was followed by 40 kg nitrogen level. However, interaction between variety and nitrogen level showed in non-significant effect on disease incidence. The effect of nitrogen levels of grain smut of sorghum in Pratapgarh region corroborated with the findings of Pal *et al.* [6] and Chauhan *et.al.* [7], they reported that different fertilizers and its level influenced the disease incidence

Table 3: Effect of different varieties and nitrogen levels on grain smut of sorghum

Treatment	Disease incidence (%)	
	2003	2004
Varieties		
MSH-51	20.29	22.50
BC-6	18.11	19.73
Sundhia	13.70	16.58
CD (P=0.05)	1.98	2.0
Nitrogen levels (Kg/ha)		
0	14.43	16.80
20	16.87	19.20
40	19.99	21.70
40	23.53	26.50
CD (P=0.05)	2.28	2.3

Table-4: Economic Analysis of Effect of nitrogen levels on different varieties of sorghum crop

Treatment	Cost of cultivation (Rs./ha)		Gross income (Rs./ha)		Net income (Rs./ha)		Benefit: cost ratio	
	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05
T ₁	9526.62	10252.73	16281.25	19161.20	6754.63	8908.47	1:1.71	1:1.87
T ₂	10813.79	11317.31	23412.25	26221.80	12598.46	14904.49	1:2.17	1:2.32
T ₃	11218.68	13813.86	32014.17	35370.45	20795.49	21556.59	1:2.85	1:2.56
T ₄	13320.43	14110.62	35378.00	39236.05	22057.60	25125.43	1:2.65	1:2.78
T ₅	9603.61	10427.78	17977.25	18441.50	8373.64	8013.72	1:1.87	1:1.77
T ₆	10516.12	11010.45	23814.25	25710.55	13298.13	14700.10	1:2.26	1:2.33
T ₇	12061.31	12422.37	30064.00	32853.55	18002.69	20431.18	1:2.49	1:2.64
T ₈	13416.23	13334.65	33707.25	36708.55	20291.02	23373.90	1:2.51	1:2.75
T ₉	10172.83	10578.44	19652.00	19032.85	9479.17	8454.41	1:1.93	1:1.80
T ₁₀	11980.43	11217.22	24100.00	27099.50	12119.57	15882.28	1:2.01	1:2.41
T ₁₁	12210.28	11912.45	29076.56	31097.70	16866.22	19185.25	1:2.38	1:2.61

The table 4 shows the per hectare cost of cultivation, gross income and net income of sorghum crop in two years of experiment i.e. agricultural year 2003-04 and 2004-05. The per hectare cost of cultivation varies to Rs: 9,526.62 to 13,416.23 in year 2003-04. Similarly it varies to Rs: 10,252.73 to 14,110.62 in year 2004-05. The per hectare gross income worked out to Rs: 16,281.25 which is lower in treatment T1 while it is highest as Rs. 35,378.00 in treatment T4 in year 2003-04. In year 2004-05 per hectare gross income to highest in treatment T4 i.e. Rs. 39,236.05 and lowest in treatment T5 i.e. Rs. 18,441.50. The per hectare highest net income comes from treatment T4 i.e. Rs. 22,057.60 and Rs. 25,125.72 in year 2003-04 and 2004-05 respectively. The highest benefit-cost ratio comes to 1:2.85 in T3 in the year 2003-04, while it is highest in T4 in year 2004-05 i.e. 1:2.78.

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