

RESPONSE OF FORAGE SORGHUM (*Sorghum bicolor*) TO DIFFERENT LEVELS OF FERTILIZER AND SEED RATE IN DRY FARMING CONDITION.

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ABSTRACT

A field experiment was conducted at Dry Farming Research Station, Junagadh Agricultural University, Targhadia (Dist: Rajkot, Gujarat) during kharif seasons of 2009-2012 to determine the effect of seed rate (three levels: 40, 50 and 60 kg/ha) and fertilizer levels (three: 60:30, 80:40 and 100:50 NP kg/ha) fertilizer dose for getting maximum fodder yield of sorghum CSV-21F. Increasing seed rate significantly decreased the number of leaves per plant, length of leaves and leaves breadth. Green and dry fodder yield increased significantly with increase in seed rate (40 to 60 kg/ha). Plant height, number of leaves per plant, length of leaves and leaves breadth as well as green and dry fodder yield recorded marked increase with increased in fertilizer levels from 60:30, 80:40 and 100:50 NP kg/ha. The results revealed that seed rate of 40 kg/ha and application of 100:50 NP kg/ha may be used for realizing palatable and higher yield of kharif fodder sorghum.

KEY WORDS: Economics, fertilizer, fodder yield, seed rate, growth parameters, sorghum

INTRODUCTION

Sorghum (*Sorghum bicolor* L.) locally known as Jawar or Chari is an important *kharif* season crop which is grown both for fodder and grains. Sorghum fodder is considered one of the essential feeds for livestock if properly cured as silage with a little supplement of protein, can maintain cattle in good health conditions during the winter with little or no grain supplement. Sorghum fodder contains more than 50 per cent digestible nutrients with 8 per cent protein, 2.5 per cent fat and 45 per cent nitrogen-free extract (NFE). Its nutritional value is equivalent to that of corn that is why animals relish well due to its

palatability and succulent nature (Wheeler, 1950).

Fertilizer application is one of the principle factors that markedly increase the fodder yield. An adequate supply of nutrients at each growth stage is essential for optimum growth and development of fodder sorghum. Nutrients are an important from essential nutrient physiological, growth and yield point of view (Alloway, 2008), but at the same time establishment of an optimum plant stand is equally important to get maximum yield (Reddy *et. al.*, 2010). Therefore, there is a need to evaluate the effect of seed rates and fertilizer levels on the growth and yield of *kharif* forage sorghum.

MATERIALS AND METHODS

The field experiment was conducted on forage sorghum [*Sorghum bicolor* (L) Moench] in the *kharif* seasons from 2009 to 2012 at Main Dry Farming Research Station, Junagadh Agricultural University, Targadia (Dist: Rajkot), Gujarat to determine the effect of seed rates and fertilizer level s on growth and yield of fodder sorghum under rainfed condition. The soil of experimental field was clayey in texture, moderately alkaline (pH 2.5-7.98), non-saline (EC 2.5-0.36 dS/m), low in organic carbon (4.76 g /kg), P₂O₅ 15.6 mg/kg¹ and high in K₂O, 151 mg/kg. The experiment was laid out with nine treatment combinations comprised: three seed rate (S) levels (40, 50 and 60 kg seed /ha) and three fertilizer (F) levels (60:30, 80:40 and 100:50 NP kg/ha in factorial randomized block design with three replications using forage sorghum variety CSV 21F. The net plot size measured 5.4×3 m². The crop was sown at 30cm row to row distances using bullock drawn seed drill. Urea and diammonium phosphate were used as fertilizer source. Full amounts of phosphorus was applied at the time of sowing, while half of the N quantity was applied at the time of sowing and the remaining half was as top dressed at 30 days after sowing. Recommended agricultural practices were maintained throughout the crop seasons. The crop was harvested at 50 per cent heading and green fodder yield was recorded. Dry fodder yield was recorded after 15 days of sun drying. The data were statistically analyzed as per procedure outline by Panse and Sukhatme (1985). Treatment means were compared at 5 per cent levels of significance using least significant difference (LSD). Economics was calculated based on price of green forage prevailing in the market.

RESULTS AND DISCUSSION

Rainfall features

Rainfall was varied from 404.5 to 1144.5 mm in rainy days of 17 to 38 with standard deviation of -36.6 to + 91.3 per cent (Table 1). Distribution of rainfall was uneven during year 2009 and 2012 and that of equal in years 2010 and 2011. Onset of monsoon was varied from 22th to 27th standard week, while withdrawal of monsoon was recorded from 35th to 41st Standard week. Long dry spells was recorded during years 2009 and 2012. Heavy rain storms of 112, 200 and 300 mm were recorded during year 2009, 2011 and 2012, respectively. Thus, there was wide variation in yearly and monthly rainfall amount which affected the fodder yield sorghum, so that in pooled results, year effect was found significant.

Growth parameters

Plant height was increased with increasing in rates of seed (S₄₀, S₅₀ and S₆₀) irrespective of the fertilizer levels and maximum value of 172 cm was recorded with seed rate @ of 60 kg/ha (Table 2). However, number of leaves per plant, length of leaves and leaves breath were decreased with increasing in rates of seed (S₄₀, S₅₀ and S₆₀) irrespective of the fertilizer levels. Higher values for these growth parameters were recorded with lower rates of seed i.e. 40 kg/ha. As per the average across the seed rates, plant height, number of leaves per plant, length of leaves and leaves breath were increased significantly with increasing in levels of fertilizers. Significantly the higher values of all the growth parameters were observed with higher level of fertilizer (F₃:100:50 NP kg/ha), which was statistically at par in case of number of leaves per plant and length of leaves with fertilizer level (F₂). Significant increase has already been observed in plant height, stem diameter

and number of leaves per plant by Khalid *et.al.* (2003).

Green fodder yield

The results showed that irrespective of the fertilizer levels, green fodder yield of sorghum was significantly differed due to rates of seed during all four years of study and in pooled results (Table 3). Data further indicated that the green fodder yield of sorghum was increased with increasing rates of seed (S_{40} , S_{50} and S_{60}). Maximum value of green fodder yield of sorghum 28829 kg/ha was recorded with seed rate @ of 40 kg/ha in pooled results might be due to higher values of growth parameters viz. ,number of leaves per plant, length of leaves and leaves breath. Singh *et al.* (2012) also reported that green fodder yield increased significantly with increased in seed rate 40 to 45 kg/ha compared to 30 and 35 kg/ha. Significant differences were also observed among different combinations NP fertilizers application during all the four years of study and in pooled results. It was observed that there was gradual increased in green fodder yield with N and P application. The application of NP fertilizers at the rate of 100:50 kg/ha (F_3) resulted in maximum grain fodder yield (30137. 35103, 31735, 16597 and 28393 kg/ha) in all four years and pooled, respectively, while the minimum green fodder yield was obtained in F_1 (60:30 kg/ha) in all the years and also in pooled. The increase in green fodder yield with fertilizer application may be due to greater plant height, number of leaves per plant, length of leaves and leaves breath.

Dry fodder yield

Dry fodder yield of was significantly differed due to rates of seed during all the four years of study and in pooled results with irrespective of the fertilizer levels (Table 4). Dry

fodder yield was decreased with increasing rates of seed (S_{40} , S_{50} and S_{60}). Higher values of dry fodder yield of sorghum was obtained with seed rate @ of 40 kg/ha in all the years and in pooled. Dry fodder yield was significantly differed due to levels of fertilizer application during all four years of study and in pooled results. In pooled results, 13.1 and 21.2 per cent higher dry fodder yield was recorded due to F_3 (100:50 NP kg/ha) in comparison to F_2 (80:40 NP kg/ha) and F_1 (60:30 NP kg/ha), respectively. Significant effect of N and P application on dry matter was also reported by Malik *et al.* (1992) and Rathod *et al.* (2002). The higher yields could be accredited to positive contribution of a combination of fodder yield components like number of leaves per plant, plant height, length of leaves and leaves breath, which were improved with fertilizer application.

Economics

A treatment combination of 40 kg seed/ha and 100 kg N and 50 kg P_2O_5 /ha recorded significantly higher green fodder yield (31395 kg/ha), gross returns (Rs. 62790 /ha), net returns (Rs. 43985 /ha) and B:C ratio (2.34) as compared to other treatment combinations.

CONCLUSION

Based on the results and Discussion, it can be concluded that seed rate of 40 kg/ha and application of 100:50 NP kg/ha is recommended/used for realizing palatable and higher yield of *kharif* fodder sorghum.

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Table 1 : Rainfall features during experimentation period

Year	Seasonal Rainfall (mm)	Rainy Days	Deviation to Normal (%)	Onset of Monsoon	Rainfall Distribution	Dry Spell	Withdrawn of Monsoon	Event
2009	458.2(-)*	17	-26.1	25th Std. week	Uneven	27th July to 29th August)	35th Std. week	Heavy rainfall on 18th July 112.0 mm
2010	1144.5 (60)	46	+91.3	22th Std. week	Even	-	37th Std. week	-
2011	1044.3 (18.0)	33	+79.7	27th std. week	Even	-	39th std. week	Heavy rainfall on 9th 145 mm & 18th July 200 mm
2012	404.5 (-)	21	-36.6	24th Std. week	Uneven	18th June to 2nd July and 14th July to 24th August	38th Std. week	-

**Figure in parenthesis indicated pre or post seasonal rainfall*

Table 2: Effect of seed rates and fertilizer doses on growth parameters of forage sorghum

Treatments	Plant Height cm	No. of Leaves/Plant	Length of Leaves (cm)	Leaves Breath (cm)
Seed Rates (kg/ha) (S)				
S ₁	152	9.12	21.27	6.46
S ₂	170	8.62	20.41	5.49
S ₃	170	8.01	18.97	5.23
S.Em.±	3.7	0.16	0.48	0.13
CD @ 5%	12.7	0.44	1.44	0.39
Fertility Levels (NPK kg/ha) (F)				
F ₁	155	8.08	19.06	5.51
F ₂	166	8.59	20.23	5.57
F ₃	173	9.09	21.36	6.10
S.Em.±	3.7	0.16	0.48	0.13
CD @ 5%	12.7	0.44	1.44	0.39
Interaction (S x F)				
S.Em.±	4.1	0.19	0.83	0.22
CD @ 5%	NS	NS	2.51	0.67

Table 3: Effect of seed rates and fertilizer doses on green fodder yield (kg/ha) of forage sorghum

Treatments	2009	2010	2011	2012	Pooled
Seed Rates (kg/ha) (S)					
S ₁	33594	34945	30403	16374	28829
S ₂	27551	33299	29881	16689	26855
S ₃	22257	31502	27757	15949	24366
S.Em.±	372	577	590	430	1114
CD @ 5%	1115	1729	1768	1289	3856
Fertility Levels (NPK kg/ha) (F)					
F ₁	26475	31310	24590	15331	24426
F ₂	26790	33333	31716	17084	27231
F ₃	30137	35103	31735	16597	28393
S.Em.±	372	577	590	430	860
CD @ 5%	1115	1729	1768	1289	3856
Interaction (S x F)					
S.Em.±	644	999	1021	745	-
CD @ 5%	1930	2995	NS	NS	-
	Y	Y x S	Y x F	S x F	Y x S x F
S.Em.±	1287	501	501	1883	868
C.D. at 5%	4453	1416	1416	NS	2452

Table 4: Effect of seed rates and fertilizer doses on dry fodder yield (kg/ha) of forage sorghum

Treatments	2009	2010	2011	2012	Pooled
Seed Rates (kg/ha) (S)					
S ₁	14863	13882	13889	9454	12603
S ₂	14171	13059	12654	9239	12281
S ₃	11109	12743	12211	8865	11652
S.Em.±	282	268	287	360	352
CD @ 5%	846	803	860	1081	1219
Fertility Levels (NPK kg/ha) (F)					
F ₁	12617	12051	10810	7169	10662
F ₂	12826	13128	13819	9599	12343
F ₃	14700	14506	14125	10789	13530
S.Em.±	282	268	287	360	326
CD @ 5%	846	803	860	1081	1219
Interaction (S x F)					
S.Em.±	488	464	496	624	
CD @ 5%	1465.00	1391.00	NS	NS	
	Y	Y x S	Y x F	S x F	Y x S x F
S.Em.±	407	301	301	335	522
C.D.at 5%	1408	852	852	NS	1476

Table 5: Economics of spacing and fertilizer treatment combinations (Pooled basis)

Treatments	Green Fodder Yield (kg/ha)	Gross Return (Rs./ha)	Cost of Cultivation (Rs./ha)	Net Return (Rs./ha)	BC Ratio
S ₁ F ₁	25393	50786	17521	33265	1.90
S ₁ F ₂	30264	60529	18163	42366	2.33
S ₁ F ₃	31395	62790	18805	43985	2.34
S ₂ F ₁	26425	52850	18088	34762	1.92
S ₂ F ₂	27597	55193	18730	36463	1.95
S ₂ F ₃	26390	52780	19371	33409	1.72
S ₃ F ₁	21461	42922	18654	24268	1.30
S ₃ F ₂	23831	47663	19296	28367	1.47
S ₃ F ₃	27395	54789	19938	34851	1.75

[MS received: May 16, 2016]

[MS accepted: June 26, 2016]