Growth, Yield and Economics of Multicut Fodder Sorghum (*Sorghum Sudanense* L.) as Influenced by Different Seed Rates and Nitrogen Levels

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ABSTRACT

A field experiment was conducted at Zonal Agricultural Research Station, Visweswaraiah Canal Farm, Mandya (Karnataka) during Kharif seasons of 2011 to study the response of multicut fodder sorghum to different seed rates and nitrogen levels under protective irrigated condition. The experiment consisted of 12 treatments was tested in randomized complete block design with factorial concept replicated three times. The mean of four cuts data indicated that seed rate of 7.5 kg ha^{-1} with the application of 30 kg N ha^{-1} recorded significantly higher green fodder (79.88 and 76.46 t ha^{-1}, respectively) and dry matter yield (18.51 and 17.04 t ha^{-1} respectively) and growth parameters like plant height (153.34 and 149.45 cm), number of tillers m^{-1} row length (77.51 and 72.28, respectively), leaf stem ratio (0.26 and 0.25, respectively), net returns (Rs. 35018 and Rs. 31285 ha^{-1} respectively) and B: C ratio (2.40 and 2.20, respectively).

Forages are the back bone of live stock industry. The mainstay of animal wealth and their production depends on availability of fodder. The scarcity of green forages and grazing resources in the country has made the livestock to suffer continuously with malnutrition resulting in their production potentiality at sub optimum level as compared to many developed nations. India is having the largest livestock population of 520 million heads, which is about 15 per cent of the world's livestock population, supporting 55, 16, 20 and 4 per cent of world's buffaloes, cattle, goats and sheep population, respectively. But, the country has only 4.4 per cent of the cultivated area under fodder crops with an annual total forage production of 833 million tons (390 mt green and 443 mt dry fodders). Whereas, the annual forage requirement is 1594 million tons (1025 mt green and 569 mt dry) to support the existing livestock population. The present feed and fodder resources of the country can meet only 48 per cent of the requirement, with a vast deficit of 52 per cent (61.1 per cent and 21.9 per cent of green and dry fodder) (Anon., 2009). The livestock breeds with higher milk yield potential are suffering from deficit of green and dry fodder availability in the country. To overcome this deficit, dairy farmers resort to the increased use of costly concentrate feeds, which increases the cost of production. The feed

cost alone accounts for 65 to 70 per cent of the total cost of milk production. Keeping these things in view the present investigation was carried out for achieving maximum production.

1. MATERIAL AND METHODS

A field experiment was conducted during Kharif seasons, 2011 and 2012 at Zonal Agricultural Research Station, Vishweswaraiah Canal Farm, Mandya (Karnataka) to assess the growth, yield and economics of multicut fodder sorghum as influenced by different seed rates and nitrogen levels. The soil of experimental field is red sandy loam with neutral soil pH (6.86), medium in available nitrogen (297.5 kg ha^{-1}), phosphorous (34.20 kg ha^{-1}) and potassium (34.20 kg ha^{-1}). The experiment was laid out in randomized complete block design with factorial concept with three replications. The experiment consisted of 12 treatment combinations viz., three levels of seed rates (5 kg, 7.5 kg and 10 kg $ha^{-1)}$ and four levels of nitrogen (15kg, 30kg, 45kg and 60 kg N for ha^{-1} each cut). Equal quantity of farm yard manure at the rate of 10 t ha^{-1} was applied to each plot three weeks prior to sowing**.** The recommended dose of 40 kg of nitrogen, 50 kg P_2O_5 and 40 kg K_2O ha^{-1} was applied uniformly as basal dose at the time of sowing in the form of urea, single super phosphate and muriate of potash, respectively. The remaining 45 kg of nitrogen was applied in two equal splits each at 30 DAS and 45 DAS in the form of urea for establishment of the crop. After the first cut the nitrogen was applied as per treatment for each cut. Fodder sorghum variety CoFS-29 was sown in line 30 cm apart. The crop was sown during last week of July and harvested when crop attained full flowering which is considered to be ideal stage for quality fodder. Five plants were randomly selected in each net plot area for taking observations on growth and yield attributing parameters. The crop in each net plot was harvested separately as per treatment and the values were converted in to hectare basis and expressed in tons. The samples were first dried under shade and then in electric oven at a temperature of 60^0 C till attain constant, on the basis of weight of these samples, the green fodder yield was converted in to dry matter yield. The data of all four cuts is pooled and statistically analyzed for interpretation of results.

2. RESULTS AND DISCUSSION

Green fodder yield

Green fodder yield was significantly influenced by seed rates and nitrogen levels. Seed rate of 7.5 kg ha^{-1} recorded significantly higher green fodder yield (79.88 t ha^{-1}) as compared to that with seed rate of 5 kg ha^{-1} (67.99 t ha^{-1}) and was on par with seed rate of 10 kg ha^{-1} (76.51 t ha^{-1}). The higher green fodder yield in seed rate of 7.5 kg ha^{-1} was mainly due to higher plant height, number of tillers per meter row length, and leaf stem ratio. Apart from this the over burden of the plant population which might compete for light and nutrients which leads to lanky growth and grassy shoot appearance resulted in lower green fodder yield in seed rate of 10 kg ha-^{1}. These results are in conformity with the findings of Mishra *et al.* (1994), Gaurkar and Bharad (1998), Naganagouda

(2002). Among nitrogen levels, application of 30 kg N ha^{-1} recoded significantly higher green fodder yield (76.46 t ha^{-1}) as compared to that with 15 kg N ha^{-1} (65.19 t ha^{-1})and was on par with 45 and 60 kg N ha^{-1} (77.27 and 80.26 t ha^{-1}) on mean data basis. This may be mainly attributed to improved growth and yield parameters, *viz.,* plant height, number of tillers m^{-1} row, leaf stem ratio and the beneficial effects of nitrogen on cell division and elongation, formation of nucleotides and Co-enzymes which resulted in increased meristematic activity and photosynthetic area and hence more production and accumulation of photosynthates, yielding higher green fodder and dry matter. These results are in conformity with the findings of, Dudhat *et al*. (2004), Sharma and Verma (2005), Sheoran and Rana (2006).

Dry matter yield:

Dry matter yield was significantly influenced by seed rates and nitrogen levels. Seed rate of 7.5 kg ha^{-1} recorded significantly higher dry matter yield (18.51 t ha^{-1}) as compared to that with seed rate of 5 kg ha^{-1} (14.09 t ha^{-1}) and was on par with seed rate of 10 kg ha^{-1} (17.40 t ha^{-1}). Among nitrogen levels, application of 30 kg N ha^{-1} recoded significantly higher green fodder yield (17.04 t ha^{-1}) as compared to that with 15 kg N ha^{-1} (13.80 t ha^{-1})and was on par with 45 and 60 kg N ha^{-1} (17.60 and 18.23 t ha^{-1}, respectively) on mean data basis.

Plant height:

Irrespective of N levels, significantly mean higher plant height was recorded with seed rate of 7.5 kg ha^{-1} (153.34 cm) as compared to that with seed rate of 5 kg ha^{-1} (150.39 cm) and was on par with seed rate of 10 kg ha^{-1} (141.69 cm). The higher plant height in seed rate of 7.5 kg ha^{-1} was mainly due to reduced competition within the intra row spacing as compared to higher seed rate. The findings of Singh *et al*. (2005) confirmed the results. The plant height increased significantly with increase in level of nitrogen. Application of 60 kg N ha^{-1} for each cut recorded significantly higher plant height (157.29 cm) than 15 kg N ha^{-1} (135.67 cm) which was on par with 45 kg and 30 kg N ha^{-1} for each cut (151.48 cm and 149.45 cm, respectively). The higher plant height on higher levels of nitrogen is mainly attributed to more availability and uptake of nitrogen by crop which resulted in more vegetative growth and increase in protoplasmic constituent and acceleration in the process of cell division, expansion and differentiation and there by resulting in luxuriant growth. The findings of Agarwal *et al*. (2005), Tiwana and Puri (2005) confirmed the results.

Leaf stem ratio:

Seed rate of 7.5 kg ha^{-1} recorded significantly higher leaf: stem ratio (0.26) than seed rate of 5 kg ha^{-1} (0.24) and was on par with seed rate of 10 kg ha^{-1} (0.25) from the pooled mean. The higher leaf stem ratio with the seed rate of 7.5 kg ha^{-1} is due to increased leaf size and decreased stem girth. In higher seed rate because of more population per unit area leads to grassy shoot appearance. At lower seed rate more space is available for crop growth resulted in higher stem girth which leads

lower leaf stem ratio in both higher and lower seed rate respectively. The similar kind of results was reported by Verma *et al*. (2005). In pooled analysis, among the nitrogen levels application of 60 kg N ha^{-1} recorded significantly higher leaf stem ratio (0.27) as compared to that with 15 kg N ha^{-1}(0.23) and was on par with 45 kg and 30 kg N ha^{-1} (0.26 and 0.25). The increase in leaf stem ratio with increasing levels of nitrogen was mainly due to rapid expansion of dark green foliage which could intercept and utilize the incident solar radiation in the production of photosynthates and eventually resulting in higher meristematic activity and increased leaf stem ratio of fodder sorghum. This might be also due to favorable influence of nitrogen on cell division and cell elongation, which could have produced more functional leaves for a longer period of time. These results are in conformity with the findings of Singh and Gill (1976), Gardner Franklin *et al.* 1988.

Number of tillers m^{-1} row length:

Tillers m^{-1} row length increased significantly with increase in seed rate. Irrespective of N levels significantly mean higher number of tillers per meter row length was obtained with the seed rate of 7.5 kg ha^{-1} (77.51) as compared to that with seed rate of 5 kg ha^{-1} (66.34) and was on par with seed rate of 10 kg ha^{-1} (72.97). This is mainly attributed to lesser competition for space with in the plant row due to moderate plant population resulted in better root growth and expansion which leads to profuse tillering in seed rate of 7.5 kg ha^{-1}. In higher seed rate of 10 kg ha^{-1} more number of tillers is obtained per meter row length in the first cut but later on due to more competition for space the mortality of tillers was noticed which resulted in lower number of tillers in subsequent cut. The results are in conformity with the findings of Verma *et al*. (2005). In pooled analysis, application of 60 kg N ha^{-1} for each cut recorded significantly higher number of tillers m^{-1} row length (78.44) than 15 kg N ha^{-1} (62.79) and was on par with 45 kg and 30 kg N ha^{-1} (75.58 and 72.27 respectively). This was mainly due to increased vegetative growth and capacity to produce more number of tillers under higher nitrogen levels. These results are in conformity with the findings of Chaurasia *et al*. (2006).

Economics:

Higher gross returns (Rs. 59911 ha^{-1}), net returns (Rs. 35018 ha^{-1}) and B: C ratio (2.40) was obtained with the seed rate of 7.5 kg ha^{-1} as compared to that with seed rate of 10 kg ha^{-1} and 5 kg ha^{-1}. This was mainly due to higher green forage yield and less cost of production as compared to 5 kg and 10 kg seeds per hectare. Among nitrogen levels, significantly higher gross returns (Rs. 59987 ha^{-1}) and net returns (Rs. 32550 ha^{-1}) were obtained with 60 kg N ha^{-1} which was on par with application of 30 kg N ha^{-1} for each cut (Rs. 57350 ha^{-1}, Rs. 31285 ha^{-1}, respectively). However, significantly higher B: C ratio was obtained with 30 kg N ha^{-1} for each cut (2.20). This is due to higher green fodder yield with minimum incremental nitrogen level and lower cost of cultivation.

Based on the result it can be inferred that seed rate of 7.5 kg ha^{-1} with 30 kg N ha^{-1} for each cut found optimum and economical which recorded higher green forage, dry matter yield and net returns and B:C ratio.

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Table 1: Growth and yield parameters of multicut fodder sorghum as influenced by different seed rates and nitrogen levels

Treatments	Green fodder yield (t ha^{-1})	Dry matter yield (t ha^{-1})	Plant height (cm)	Number of tillers m^{-1} row length	Leaf stem ratio
Seed rates (kg ha^{-1})					
S_1= 5 kg ha^{-1}	67.99	14.09	150.39	66.34	0.24
S_2= 7.5 kg ha^{-1}	79.88	18.51	153.34	77.51	0.26
S_3= 10 kg ha^{-1}	76.51	17.40	141.69	72.97	0.25
S.Em+	1.17	0.39	2.46	1.06	0.005
C.D. (P=0.05)	3.44	1.15	7.22	4.60	0.01
Nitrogen levels (kg ha^{-1})					
N_{15}= 15 kg ha^{-1}	65.19	13.80	135.67	62.79	0.23
N_{30}= 30 kg ha^{-1}	76.46	17.04	149.45	72.28	0.25
N_{45}= 45 kg ha^{-1}	77.27	17.60	151.48	75.58	0.26
N_{60}= 60 kg ha^{-1}	80.26	18.23	157.29	78.44	0.27
S.Em+	1.36	0.45	2.84	1.22	0.01
C.D. (P=0.05)	3.98	1.33	8.33	6.30	0.02
Treatment Combinations (S x N)					
S_1N_{15}	56.83	11.40	136.69	55.96	0.23
S_1N_{30}	69.98	14.37	150.69	68.25	0.24
S_1N_{45}	71.11	15.03	149.96	70.25	0.25
S_1N_{60}	74.05	15.58	164.20	70.92	0.24
S_2N_{15}	71.65	15.12	140.72	67.96	0.24
S_2N_{30}	80.98	19.01	152.97	76.92	0.26
S_2N_{45}	82.03	19.37	158.40	80.58	0.27
S_2N_{60}	84.87	20.52	161.28	84.58	0.29
S_3N_{15}	67.10	14.87	129.62	64.46	0.24
S_3N_{30}	78.45	17.75	144.68	71.67	0.25
S_3N_{45}	78.64	18.39	146.08	75.92	0.26
S_3N_{60}	81.84	18.59	146.38	79.83	0.27
S.Em+	2.35	0.79	4.92	2.11	0.01
C.D. (P=0.05)	NS	NS	NS	NS	NS

Table 2: Economics of multicut fodder sorghum as influenced by different seed rates and nitrogen levels

Treatments	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B: C ratio
Seed rates (kg ha^{-1})			
S_1= 5 kg ha^{-1}	50993	26600	2.09
S_2= 7.5 kg ha^{-1}	59911	35018	2.40
S_3= 10 kg ha^{-1}	57380	31987	2.25
S.Em+	880	880	0.03
C.D. (P=0.05)	2582	2582	0.10
Nitrogen levels (kg ha^{-1})			
N_{15}= 15 kg ha^{-1}	48894	23415	1.91
N_{30}= 30 kg ha^{-1}	57350	31285	2.20
N_{45}= 45 kg ha^{-1}	57747	30896	2.15
N_{60}= 60 kg ha^{-1}	59987	32550	2.18
S.Em+	1016	1017	0.04
C.D. (P=0.05)	2982	2983	0.11
Treatment Combinations (S x N)			
S_1N_{15}	42622	17643	1.70
S_1N_{30}	52485	26918	2.05
S_1N_{45}	53135	26781	1.96
S_1N_{60}	55337	28347	2.04
S_2N_{15}	53737	28258	2.10
S_2N_{30}	60732	34665	2.32
S_2N_{45}	61325	34471	2.28
S_2N_{60}	63450	36010	2.31
S_3N_{15}	50322	24343	1.93
S_3N_{30}	58837	32270	2.21
S_3N_{45}	58782	31428	2.14
S_3N_{60}	61177	33237	2.18
S.Em+	1761	1761	0.07
C.D. (P=0.05)	NS	NS	NS