Forage Res., **40** (4) : pp. 247-250 (2015) **http://forageresearch.in**

GROWTH, YIELD AND ECONOMICS OF MULTICUT FODDER SORGHUM (*SORGHUM SUDANENSE* L.) AS INFLUENCED BY DIFFERENT SEED RATES AND NITROGEN LEVELS

K. S. SOMASHEKAR*, B. G. SHEKARA, K. N. KALYANAMURTHY AND H. C. LOHITHASWA

Department of Agronomy
University of Agricultural Sciences, GKVK,
Bangalore (Karnataka), India
(e-mail : somashekar.ks18@gmail.com)

(Received : 15 January 2015; Accepted : 16 February 2015)

SUMMARY

A field experiment was conducted at Zonal Agricultural Research Station, Visweswaraiah Canal Farm, Mandya (Karnataka) during **kharif** seasons of 2011-12 to study the response of multicut fodder sorghum to different seed rates and nitrogen levels under protective irrigated condition. The experiment consisting 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 with the application of 30 kg N/ha recorded significantly higher green fodder (79.88 and 76.46 t/ha, respectively) and dry matter yield (18.51 and 17.04 t/ha, respectively) and growth parameters like plant height (153.34 and 149.45 cm), number of tillers/m row length (77.51 and 72.28, respectively), leaf : stem ratio (0.26 and 0.25, respectively), net returns (Rs. 35018 and 31285/ha, respectively) and B : C ratio (2.40 and 2.20, respectively).

Key words : Fodder sorghum, green forage yield, dry matter yield, plant height

Forages are the backbone of livestock 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 tonnes (390 mt green and 443 mt dry fodders). Whereas the annual forage requirement is 1594 million tonnes (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 and 21.9% of green and dry fodder) (Anonymous, 1999). 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.

MATERIALS AND METHODS

A field experiment was conducted during **kharif** seasons of 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), phosphorus (34.20 kg/ha) and potassium (34.20 kg/ha). 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, 7.5 and 10 kg/ha) and four levels of nitrogen (15, 30, 45 and 60 kg N/ha for each cut). Equal quantity of farm yard manure at the rate of 10 t/ha 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 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 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 into hectare basis and expressed in tonnes. The samples were first dried under shade and then in electric oven at a temperature of 60^0C till attained constant, on the basis of weight of these samples, the green fodder yield was converted into dry matter yield. The data of all four cuts were pooled and statistically analyzed for interpretation of results.

RESULTS AND DISCUSSION

Green Fodder Yield

Green fodder yield was significantly influenced by seed rates and nitrogen levels (Table 1). Seed rate of 7.5 kg/ha recorded significantly higher green fodder yield (79.88 t/ha) as compared to that with seed rate of 5 kg/ha (67.99 t/ha) and was on par with seed rate of 10 kg/ha (76.51 t/ha). The higher green fodder yield in seed rate of 7.5 kg/ha was mainly due to higher plant height, number of tillers per metre row length and leaf : stem ratio. Apart from this, the over burden of the plant population which might compete for light and nutrients leads to lanky growth and grassy shoot appearance resulted in lower green fodder yield in seed rate of 10 kg/ha. These results are in conformity with the findings of Mishra *et al.* (1994), Gaurkar and Bharad (1998) and Naganagouda (2002). Among nitrogen levels, application of 30 kg N/ha recoded significantly higher green fodder yield (76.46 t/ha) as compared to that with 15 kg N/ha (65.19 t/ha) and was

TABLE 1

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

Treatment	Green fodder yield (t/ha)	Dry matter yield (t/ha)	Plant height (cm)	No. of tillers/m row length	Leaf : stem ratio
Seed rates (kg/ha)					
S_1–5	67.99	14.09	150.39	66.34	0.24
S_2–7.5	79.88	18.51	153.34	77.51	0.26
S_3–10	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)					
N_{15}–15	65.19	13.80	135.67	62.79	0.23
N_{30}–30	76.46	17.04	149.45	72.28	0.25
N_{45}–45	77.27	17.60	151.48	75.58	0.26
N_{60}–60	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

NS–Not Significant.

on par with 45 and 60 kg N/ha (77.27 and 80.26 t/ha) on mean data basis. This may be mainly attributed to improved growth and yield parameters viz., plant height, number of tillers/m 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) and 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 recorded significantly higher dry matter yield (18.51 t/ha) as compared to that with seed rate of 5 kg/ha (14.09 t/ha) and was on par with seed rate of 10 kg/ha (17.40 t/ha). Among nitrogen levels, application of 30 kg N/ha recoded significantly higher green fodder yield (17.04 t/ha) as compared to that with 15 kg N/ha (13.80 t/ha) and was on par with 45 and 60 kg N/ha (17.60 and 18.23 t/ha, respectively) on mean data basis.

Plant Height

Irrespective of N levels, significantly higher mean plant height was recorded with seed rate of 7.5 kg/ha (153.34 cm) as compared to that with seed rate of 5 kg/ha (150.39 cm) and was on par with seed rate of 10 kg/ha (141.69 cm). The higher plant height in seed rate of 7.5 kg/ha 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 for each cut recorded significantly higher plant height (157.29 cm) than 15 kg N/ha (135.67 cm) which was on par with 45 and 30 kg N/ha for each cut (151.48 and 149.45 cm, respectively). The higher plant height on higher levels of nitrogen was 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 thereby resulting in luxuriant growth. The findings of Agarwal *et al*. (2005) and Tiwana and Puri (2005) confirmed the results.

Leaf : Stem Ratio

Seed rate of 7.5 kg/ha recorded significantly higher leaf : stem ratio (0.26) than seed rate of 5 kg/ha (0.24) and was on par with seed rate of 10 kg/ha (0.25) from the pooled mean. The higher leaf : stem ratio with the seed rate of 7.5 kg/ha was due to increased leaf size and decreased stem girth. In higher seed rate because of more population per unit area led to grassy shoot appearance. At lower seed rate, more space was available for crop growth which resulted in higher stem girth which led to lower leaf : stem ratio in both higher and lower seed rates, respectively. The similar kinds of results were reported by Verma *et al*. (2005). In pooled analysis, among the nitrogen levels application of 60 kg N/ha recorded significantly higher leaf : stem ratio (0.27) as compared to that with 15 kg N/ha (0.23) and was on par with 45 and 30 kg N/ha (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 favourable 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) and Gardner Franklin *et al.* (1988).

Number of Tillers/m Row Length

Tillers/m row length increased significantly with increase in seed rate. Irrespective of N levels significantly mean higher number of tillers per metre row length was obtained with the seed rate of 7.5 kg/ha (77.51) as compared to that with seed rate of 5 kg/ha (66.34) and was on par with seed rate of 10 kg/ha (72.97). This was mainly attributed to lesser competition for space within the plant row due to moderate plant population resulting in better root growth and expansion which led to profuse tillering in seed rate of 7.5 kg/ha. In higher seed rate of 10 kg/ha, more number of tillers was obtained per metre 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 for each cut recorded significantly higher number of tillers/m row length (78.44) than 15 kg N/ha (62.79) and was on par with 45 and 30 kg N/ha (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), net returns (Rs. 35018/ha) and B : C ratio (2.40) were obtained with the seed rate of 7.5 kg/ha as compared to that with seed rate of 10 and 5 kg/ha (Table 2). This was mainly due to higher green forage yield and less cost of production as compared to 5 and 10 kg seeds per hectare. Among nitrogen levels, significantly higher gross returns (Rs. 59987/ha) and net returns (Rs. 32550/ha) were obtained with 60 kg N/ha which were on par with application of 30 kg N/ha for each cut (Rs. 57350 and 31285/ha, respectively). However, significantly higher B : C ratio was obtained with 30 kg N/ha for each cut (2.20). This was due to higher green fodder yield with minimum incremental nitrogen level and lower cost of cultivation.

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

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

Treatment	Gross returns	Net returns (Rs./ha)	B : C ratio
Seed rates (kg/ha)			
S_1–5	50993	26600	2.09
S_2–7.5	59911	35018	2.40
S_3–10	57380	31987	2.25
S. Em±	880	880	0.03
C. D. (P=0.05)	2582	2582	0.10
Nitrogen levels (kg/ha)			
N_{15}–15	48894	23415	1.91
N_{30}–30	57350	31285	2.20
N_{45}–45	57747	30896	2.15
N_{60}–60	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

NS–Not Significant.

REFERENCES

Agarwal, S. B., V. K. Shukla, H. P. S. Sisodia, Ranji Tomar, and Arti Shrivastava. 2005 : Effect of inoculation and nitrogen levels on growth, yield and quality of fodder sorghum [*Sorghum bicolor* (L.) Moench] varieties. *Forage Res.*, **31** : 106-108.

Anonymous. 1999 : *Economic Survey 1998-99*. Government of Karnataka, Bangalore.

Chaurasia, M., D. R. Chauhan, and Jagdev Singh. 2006 : Effect of irrigation, nitrogen and phosphorous levels on fodder production of bajri (*Pennisetum glaucum* L.)–A local race of bajra. *Forage Res*., **32** : 128-129.

Dudhat, M. S., M. G. Savalia, and M. V. Ramdevputra. 2004 : Response of forage maize to nitrogen and phosphorus levels. *Forage Res.*, **30** : 34-35.

Gardner Franklin, P., R. Brent Peaarce, and L. Mitchell Roger. 1988 : *Physiology of Crop Plants*. Scientific Publishers, Jodhpur. pp. 1-302.

Gaurkar, S. G., and G. M. Bharad. 1998 : Effect of plant population and nitrogen levels on growth and yield of maize (*Zea mays* L.). *PKV Res. J.* **22** : 136-137.

Mishra, B. N., R. S. Yadav, R. L. Rajput, and S. M. Pandey, 1994 : Effect of plant geometry and nitrogen application on yield and quality of winter maize (*Zea mays* L.). *Indian J. Agron.*, **39** : 468-469.

Naganagouda. 2002 : Potentiality of sorghum [*Sorghum bicolor* (L.) Moench] genotypes under fodder-food production system in northern transition zone. M. Sc. (Agri.) thesis, Univ. Agric. Sci., Dharwad, Karnataka (India).

Sharma, K. C., and R. S. Verma. 2005 : Effect of N and P and bio-fertilizers on the yield, marginal rate of return, energy relationship, economics and residual effect on soil in fodder oats (*Avena sativa* L.). *Forage Res*., **31** : 118-112.

Sheoran, R. S., and D. S. Rana, 2006 : Relative efficiency of *Azotobacter* and nitrogen fertilizer in forage sorghum (*Sorghum bicolor* L.) under semi-arid conditions. *Forage Res.*, **32** : 65-68.

Singh, K., and P. S. Gill. 1976 : Effect of preceding crops on nitrogen and phosphorus requirement of forage sorghum. *Forage Res.*, **2** : 49-54.

Singh, V. P., S. S. Verma, and Chandra. 2005 : Effect of fertility levels with bio-fertilizer and cutting management on seed yield of oats. *Forage Res.*, **31** : 57-58.

Tiwana, U. S., and K. P. Puri, 2005 : Effect of nitrogen levels on the fodder yield and quality of pearl millet varieties under rainfed conditions. *Forage Res.*, **31** : 142-143.

Verma, S. S., Navneet Singh, Y. P. Joshi, and Vijay Deprari. 2005 : Effect of nitrogen and zinc on growth characters, herbage yield, nutrient uptake and quality of fodder sorghum (*Sorghum bicolor*). *Forage Res.*, **50** : 167-169.