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Effect of planting geometry and different levels of nitrogen on growth, yield and quality of multicut fodder sorghum (*Sorghum bicolor* (L.) Monech)

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Abstract
A field experiment was conducted during the "Zaid" season 2016 at the Crop Research Farm Department of Agronomy, Naini Agriculture Institute, SHUATS, Allahabad (U.P.) This area is situated on the right side of the river Yamuna and by the opposite side of Allahabad cityThe soil of the experimental field was sandy loam in texture, slightly saline in reaction (pH 7.4), medium in available nitrogen (185.5 kg/ha) and phosphorus (36.0 kg/ha) potassium (98.0 kg/ha). The experiment consisted of 12 treatment combinations comprising one multi-cut forage sorghum genotype (CSH-20) and four nitrogen levels viz., 60, 80, 100 and120N kg/ha. To evaluate the effect of planting geometry and different levels of nitrogen on growth, yield and quality of multicut fodder sorghum [*Sorghum bicolor* (L.) Monech] laid out in Randomized Block Design with twelve treatments replicated thrice. The treatment combinations of spacing of *30cm×10cm with 120 kg nitrogen* ha^{-1}(T_8) recorded maximum higher plant height, number of leaves, dry weight, green fodder yield, leaf: stem ratio, fodder quality net return and benefit cost ratio followed by that recorded treatment spacing of *30cm×10cm with 100 kg nitrogen* ha^{-1}(T_7).

Keywords: Forage Sorghum, Plant Geometry, Nitrogen Levels, Green Forage Yield

Introduction

Sorghum is one of the gifted grass genera of the tropics. It provides food, feed, stover and fuel to millions of poor farm families and their livestock in the arid and semi-arid tropical region of the world. India is a notable for its huge livestock population and its economic integration with farm production, particularly under the less mechanized dry land agriculture. Sorghum is very important crop to resource poor farmers for nutritional and livelihood security. India supports 512.05 million of livestock, which includes 37.28 per cent cattle, 21.23per cent buffalo, 12.71 percent sheep, 26.40 per cent goat and 2.01 per cent pig (DAHD & F, 2012). India supports nearly 20 per cent of the world's livestock being the leader in cattle (16%) and buffalo (5.5%) population. Deficiency in feed and fodder has been identified as one of the major components in achieving the desired level of livestock production. The shortage in dry fodder is 21.8 per cent compared with requirement of 560 million tonnes for the current livestock populations (Rana *et al.*, 2013) [16]. Proper and adequate fertilization and suitable genotypes are one among the major factors limiting fodder sorghum production in our country. Identification of good quality sorghum genotypes and development of location specific production technology offer an excellent opportunity to provide fodder for better nutrition to bovine population (Pushpendra and Sumeriya, 2012) [15]. Nitrogen application has significant importance regarding the fodder yield. Nitrogen application increases the green fodder yield, dry matter yield and quality of oat as reported by Iqbal *et al.* (2009) [12]. Furthermore, Saleem *et al.*, (2009) [17] reported that yield of different maize hybrids is significantly affected by time and methods of nitrogen application. Among the various agronomic factors, proper manuring and appropriate planting geometry are of prime importance in getting higher forage yield of better quality.

Materials and Method

The experiment was conducted in the year of 2016 during the summer season at the plot no. 16 B of the Crop Research Farm, Department of Agronomy, Sam Higginbottom Institute of Agriculture, Technology and Science Deemed to-be- University, Allahabad (U.P.). The Crop Research Farm is situated at 250 57' N latitude, 870 19' E longitude and 98 m altitude from the sea level. This area is situated on the right side of the river Yamuna and by the opposite side of Allahabad cityThe soil of the experimental field was sandy loam in texture, slightly saline in reaction (pH 7.4), medium in available nitrogen (185.5 kg/ha) and phosphorus

(36.0 kg/ha) potassium (98.0 kg/ha). The experiment consisted of 12 treatment combinations comprising one multi-cut forage sorghum genotype (CSH-20) and four nitrogen levels viz., 60, 80, 100 and120N kg/ha. Recommended dose of phosphorus and potassium fertilizer (40 kg P2O5+40 kg K2O/ha). These treatments were tested in randomized block design with three replications. As per treatment, full dose of phosphorus and potassium and half dose of nitrogen were applied at the time of sowing. Remaining nitrogen dose was applied at 30 days after first cutting. The sorghum genotype as per treatment were sown on 29 April 2016 in opened furrows at 20, 30 and 40 cm apart using seed rate of 40 kg/ha. A plant to plant distance of 10 cm was maintained by thinning and gap filling operation at 15 DAS. The crop was irrigated at 15 days interval as per need during summer. Other agronomic and plant protection measures were adopted as and when crop needed. After the first cut at (60DAS), the nitrogen was applied as per treatment for each cut. Fodder sorghum harvested when crop attained full flowering which is considered to be ideal stage for quality fodder. Four 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. Second cut was done 45DAS. The data of all two cuts were pooled and statistically analyzed for interpretation of results.

Result and Discussion

Plant Height (cm): Nitrogen levels and sowing method, significantly higher mean plant height was recorded with 30 cm apart sowing method and 120 kg nitrogen/ha in both cuttings respectively (234.23 cm and 162.08) as compared to that with 40 cm line sowing 120 kg nitrogen/ha (225.58 cm and156.65) and minimum plant height recorded with 20 cm line with 60 kg nitrogen/ha (189.58 and 130.08 cm). The higher plant height in 30 cm line sowing was mainly due to reduced competition within the intra-row spacing as compared to 20 cm line sowing and lower nitrogen applied. The findings of Singh *et al*. (2005) confirmed the results. 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 there by resulting in luxuriant growth. The findings of Agarwal *et al*. (2005) [1] and Tiwana and Puri (2005) [22] confirmed the results.

Number of leaves per plant (No.): Leaves plays an important role in manufacturing and supply food material synthesized during photosynthesis. Thus an increase or decrease in number of leaves per plant has a direct effect on the green forage yield of forage crops. The effect of N levels and sowing methods was significant regarding number of leaves per plant of forage sorghum at harvest (table 1). The interactive effect of both nitrogen and sowing methods was significant in both cutting. Maximum number of leaves per plant (15.33 and 11) were recorded in T8 (30 cm line sowing) as compared to other. Whereas, the minimum numbers of leaves per plant were found in 20 cm apart sowing and 60 kg N applied T1(12.75 and 9.33). in two cuttings, respectively. Interactive results showed that nitrogen levels (30 cm apart rows and 120kg N/ha) showed better results in 1stand 2rd cutting. These result conformity with Olanite *et al*. (2010) [14], Samia *et al*. (2010) [18], Akram *et al*., (2010) [3]**.**

Dry Weight of Plant (g): The data reflected in table (1) showed that the effect of nitrogen and sowing methods on dry weight per plant was highly significant. Maximum dry weight per plant (66.07and 22.09g) was found in T8 (120 kg N/ha with 30 cm line sowing) while minimum dry weight per plant was found in T1 (60 kg N/ha with 20 cm line sowing) having dry weight per plant (30.31and 7.84 g)in both cutting. Samia *et al*. (2010) [18] and Khalid *et al*., (2010) [13] who found significant variations regarding dry weight per plant and total dry matter yield due to increase in nitrogen application. Lewis and Cherney (2004) [10] and Turgut *et al.* (2005) [23] who found significant variations among different genotypes regarding dry weight per plant and total dry matter yield.

Crop Growth Rate (gm^{-1}day^{-1}): Nitrogen levels and sowing method, significantly higher mean crop growth rate was recorded in 30 cm apart sowing method and 120 kg nitrogen/ha T_8 (1.93 and 1.05) as compared to minimum with 20 cm line sowing 60 kg nitrogen/ha T_1 (1.30 and 0.35) in both cuttings.

Relative growth rate (g g^{-1}day^{-1}) : Nitrogen levels and sowing method, significantly higher mean crop growth rate was recorded in 30 cm apart sowing method and 120 kg nitrogen/ha T_8 (0.033 and 0.043) as compared to minimum with 20 cm line sowing 60 kg nitrogen/ha T_4 (0.024 and 0.025) in both cuttings

Green Forage Yield (t/ha): Green fodder yield was significantly influenced by sowing method and nitrogen levels (Table 2). 30 cm line sowing with 120 kg N/ha recorded significantly higher green fodder yield T_8 (36.90 and 19.70 t/ha) as compared to that with 30 cm line sowing with 100 kg N/ha (33.69 and 19.03 t/ha) and minimum with (20 cm line sowing with 60 kg N/ha (27.86 and 13.47 t/ha) in both cuttings. The higher green fodder yield in 30 cm spacing was mainly due to higher plant height, number of leaves, plant population per meter 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 20 cm spacing. Among nitrogen levels mainly attributed to improved growth and yield parameters viz., plant height, number of number of leaves, plant population per meter, 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) [8], Sharma and Verma (2005) and Sheoran and Rana (2006).

Leaf: Stem Ratio-spacing of 30 cm with 120 kg N/ha recorded maximum leaf: stem ratio T_8(0.55 and 0.53) followed by 20 cm spacing with 120 kg N/ha(0.53and 0.51) and minimum with 20 cm spacing with 60 kg N/ha (0.46 and 0.44) in both cuttings. The higher leaf: stem ratio with spacing of 30 cm was due to increased leaf size and decreased stem girth. In with 20 cm spacing because of more population per unit area leds to grassy shoot appearance. At 40 cm spacing, 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) [21, 24]. In pooled analysis, among the nitrogen levels application of 120 kg N/ha recorded significantly higher leaf: stem ratio as compared to that with 60 kg N/ha and was on par with 100 and 80 kg N/ha. 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 meristemtic 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 inconformity with the findings of Singh and Gill (1976) [20].

HCN Content (ppm): HCN content was significantly influenced by nitrogen levels and non-significantly by spacing. HCN content was increased with increasing nitrogen levels in both cuttings became higher at 120 kg nitrogen/ha (82.5 and 82.81 ppm). HCN content increased from 74.15 to 82.25 ppm of fresh weight with increasing nitrogen levels, from 60 kg of to 120kg N/ha). It was mainly due to increase in nitrogen absorption by plants which was used for the synthesis of HCN. Arora *et al.* (1971) also observed increase in HCN content with high level of nitrogen fertilizer and low phosphorus content. Hydrocyanic acid content is heritable and subjected to modification through selection and breeding, as well as by climate, stage of maturity, stunting of plant, type of soil and fertilizer (Khatri *et al.,* 1997). Nitrogen application is considered essential for growth and regrowth during growing season. However, higher level of nitrogen application may increase HCN content of forage sorghum.

Proximate analysis- In the proximate analysis crude protein, crude fiber and mineral ash was significantly influenced by nitrogen levels. In the bot cuts maximum production of CP,CF and MA was recorded in 30 cm spacing with 120 kg N/ha(7.85, 33.12, 7.40 and 7.76,33.92, 7.32) respectively as compare with 80 kg N/ha (7.46, 32.48, 7.25 and 7.38, 33.26, 7.16) respectively and on par with 100 kg N/ha(7.82, 32.84, 7.32 and 7.72, 33.84, 7.32). Crude protein content increase in fodder due to enhancement of amino acid by nitrogen levels (Mahmud *et al* 2003) [11].The increase or decrease in ash contents (%) may be due to increase or decrease in dry matter production These results are in accordance with the findings of Ayub *et al.* (2003) [4, 11] who reported significant effect of nitrogen levels on total ash contents (9.29 %). The increase in ash contents with increased nitrogen levels was also reported by Nadeem *et al.* (2009) [12], Ayub *et al*. (2007) [5] and Iqbal *et al* (2006) [12].

Economics- total cost of cultivation having varied with spacing and levels of nitrogen. Maximum cost came in 120 kg N/ha applying treatments (24388.40) tan minimum with 60 kg N/ha (23608.46) on par with 100 kg N/ha (24130.34). Highest net return and B:C ratio in T_8 with 30 cm spacing and 120 kg N/ha followed by (T_7) 30 cm with 100 kg N/ha. Minimum net return and B: C ratio (T_1) 20 cm with 60 kg N/ha.

Table 1: Influence of plant geometry and nitrogen levels on growth attributes of multicut forage sorghum

First cut						Second cut				
Treatments	**Plant height**	**No. of leaves per plant**	**Dry wt. of plant**	**CGR**	**RGR**	**Plant height**	**No. of leaves per plant**	**Dry wt. of plant**	**CGR**	**RGR**
20cm+60 Kg N ha^{-1}	189.58	12.75	30.31	1.30	0.024	130.08	9.33	7.84	0.35	0.027
20cm+80 Kg N ha^{-1}	197.75	13.00	32.34	1.37	0.026	138.33	9.50	8.36	0.36	0.028
20cm+100 Kg Nha^{-1}	211.58	13.25	34.41	1.48	0.027	144.30	10.00	9.79	0.38	0.030
20cm+120 Kg Nha^{-1}	220.08	13.75	37.12	1.56	0.028	150.25	10.33	10.14	0.39	0.031
30cm+60 Kg Nha^{-1}	202.13	13.50	57.68	1.74	0.031	140.17	10.00	13.69	0.70	0.039
30cm+80 Kg Nha^{-1}	211.08	14.25	61.30	1.80	0.028	147.58	10.50	16.77	0.78	0.040
30cm+100 Kg Nha^{-1}	220.32	15.00	63.26	1.89	0.025	154.3	10.75	18.76	0.80	0.041
30cm+120 Kg Nha^{-1}	234.23	15.33	66.07	1.93	0.033	162.08	11.0	22.9	1.05	0.043
40cm+60 Kg Nha^{-1}	191.58	13.75	54.28	1.63	0.025	134.25	9.50	12.56	0.68	0.038
40cm+80 Kg Nha^{-1}	203.00	14.25	56.10	1.69	0.027	141.52	10.00	14.83	0.73	0.033
40cm+100 Kg Nha^{-1}	212.08	15.25	58.87	1.74	0.030	150.45	10.25	17.75	0.76	0.037
40cm+120 Kg Nha^{-1}	225.58	15.25	60.34	1.82	0.030	156.65	10.56	19.44	0.78	0.039
F-test	S	S	S	S	NS	S	S	S	S	NS
S. Ed.(±)	0.35	0.07	0.09	0.11	0.01	0.16	0.05	0.20	0.07	0.03
C.D. (P= 0.05)	0.72	0.14	0.18	0.23	0.02	0.39	0.10	0.42	0.15	0.07

Table: 2 Influence of plant geometry and nitrogen levels on yield and quality attributes of multicut forage sorghum

First cut							Second cut					
Treatments	**Green forage yield (t/ha)**	**L:S ratio**	**HCN (ppm)**	**CP**	**CF**	**MA**	**Green forage yield (t/ha)**	**L:S ratio**	**HCN (ppm)**	**CP**	**CF**	**MA**
20cm+60 Kg N ha^{-1}	27.86	0.46	74.15	6.28	32.07	7.16	13.45	0.44	75.67	6.21	32.55	7.09
20cm+80 Kg N ha^{-1}	30.34	0.50	76.75	744	32.52	7.26	14.91	0.47	77.33	7.33	33.22	7.16
20cm+100 Kg Nha^{-1}	31.77	0.51	76.28	7.77	32.64	7.26	17.06	0.49	76.35	7.71	33.63	7.25
20cm+120 Kg Nha^{-1}	34.33	0.50	82.21	7.82	33.08	7.37	18.37	0.51	83.01	7.73	33.85	7.31
30cm+60 Kg Nha^{-1}	29.70	0.49	74.52	6.28	32.09	7.17	15.46	0.47	75.23	6.24	32.57	7.12
30cm+80 Kg Nha^{-1}	30.98	0.51	76.63	7.46	32.48	7.25	16.56	0.49	77.67	7.38	33.26	7.16
30cm+100 Kg Nha^{-1}	33.69	0.53	79.75	7.82	32.84	7.32	19.03	0.52	80.47	7.72	33.63	7.28
30cm+120 Kg Nha^{-1}	36.90	0.55	82.25	7.85	33.12	7.40	19.70	0.53	82.81	7.76	33.92	7.32
40cm+60 Kg Nha^{-1}	26.16	0.47	74.28	6.27	32.08	7.15	13.18	0.45	74.61	6.21	32.56	7.09
40cm+80 Kg Nha^{-1}	26.88	0.49	76.40	7.43	32.47	7.22	14.69	0.46	76.48	7.36	33.38	7.15
40cm+100 Kg Nha^{-1}	28.96	0.50	79.50	7.76	32.89	7.30	16.56	0.48	79.72	7.70	33.61	7.21
40cm+120 Kg Nha^{-1}	31.24	0.52	82.10	7.80	33.05	7.36	17.13	0.50	82.27	7.39	33.90	7.29
F-test	S	S	S	S	S	S	S	S	S	S	S	S
S. Ed.(±)	0.39	0.05	0.05	0.01	0.09	0.01	0.7	0.11	0.24	0.07	0.04	0.01
C.D. (P= 0.05)	0.81	0.10	0.11	0.02	0.18	0.02	0.15	0.23	0.52	0.15	0.09	0.02

Table 3: Influence of plant geometry and nitrogen levels on economics attributes of multicut forage sorghum

Treatments	Green forage yield (t/ha) IstCut	Green forage yield (t/ha) IInd Cut	Gross return (₹/ ha)	Total cost of cultivation (₹/ ha)	Net return (₹ / ha)	Benefit cost ratio
1	27.86	13.45	61965	23608.58	38086.42	2.62
2	30.34	14.91	67875	23869.46	44005.54	2.84
3	31.77	17.06	73245	24130.34	49114.66	2.96
4	34.33	18.37	79050	24388.40	54661.60	3.24
5	29.70	15.46	67740	23608.58	44132.42	2.86
6	30.98	16.56	71310	23869.46	47441.54	2.98
7	33.69	19.03	79080	24130.34	54950.66	3.27
8	36.90	19.70	84900	24388.40	60512.60	3.48
9	26.16	13.18	59010	23608.58	35402.42	2.49
10	26.88	14.69	62355	23869.46	38486.54	2.61
11	28.96	16.56	68280	24130.34	38150.66	2.80
12	31.24	17.13	72555	24388.40	48167.60	2.97

References

1. Agarwal SB, Shukla VK, Sisodia HPS, Ranji Tomar, Arti Shrivastava. Effect of inoculation and nitrogen levels on growth, yield and quality of fodder sorghum [*Sorghum bicolor* (L.) Moench] varieties. Forage Res., 2005; 31:106-108.
2. AOAC. Official Methods of Analysis.15 th Ed. Association of Official Analytical Chemists, Inc., Virginia, USA, 1990, 770-771.
3. Akram M, Ashraf MY, Waraich EA, Hussain M, Mallahil AR. Performance of autumn planted maize (*Zea mays* L.) hybrids at various nitrogen levels under salt affected soils. Soil and Environ. 2010; 29(1):23-32.
4. Ayub, M, Nadeem MA, Ahmad R, Javaid F, Response of maize fodder to different nitrogen levels and harvesting times. Pakistan. J. Life Soc. Sci. 2003; 1:45-47.
5. Ayub M, Nadeem MA, Sharar MS, Mahmood N. Response of maize (zeamaysl.) fodder to different levels of nitrogen andphosphorus. Asian J. Plant Sci. 2007; 4(1):352-354.
6. Bosch L, Casanas F, Sanchez E, Almirall A, Nuez F. Performance of five generations of selection for increased stalk diameter in the Lancaster variety of maize (*Zea mays L.*), crossed with B73 inbred. Maydica. 2001; 46(4):221- 226.
7. DAHD F. 19th Livestock Census, Department of Animal Husbandry, Dairying and Fisheries, Government of India. 2012. http:// dahd.nic.in/dahd/ WriteReadData/Livestock.pdf.
8. Dudhat MS, Savalia MG, Ramdevputra MV. Response of forage maize to nitrogen and phosphorus levels. *Forage Res*., 2004; 30: 34-35.
9. Iqbal A, Ayub M, Zaman H, Ahmad R. Impact of nutrient management and legumes association on agro qualitative traits of maize forage. Pakistan. J. Bot. 2006; 38:1079-1084.
10. Lewis AL, Cherney WJH. Hybrid, maturity and cutting height interaction on corn forage yield and quality. Agron. J. 2004; 96(10):267-274.
11. Mahmud Khalid, Ijaz Ahmad, Ayub Muhammad. Effect of nitrogen and phosphorus on the fodder yield and quality of two sorghum cultivars (*Sorghum bicolor* L.). *Int. J. Agri. Biol*., 2003; 5: 61-63.
12. Nadeem MA, Iqbal Z, Ayub M, Mubeen and KM. Ibrahim Effect of nitrogen application on forage yield and quality of maize sown alone and in mixture with legumes. Pakistan. J. Life Soc. Sci. 2009; 7(2):161-167.
13. Khalid M, Ahmad I, Ayub M. Effect of Nitrogen and Phosphorus on the Fodder Yield and Quality of Two Sorghum Cultivars (*Sorghum bicolor* L). Int. J. Agri. Biol. 2010; 5(1):61-63.
14. Olanite JA, Anele UY, Arigbede OM, Jolaosho AO, Onifade OS. Effect of plant spacing and nitrogen fertilizer levels on the growth, dry-matter yield and nutritive quality of Columbus grass (*Sorghum almum* stapf) in southwest Nigeria. Grass and Forage Science, 2010; 65(4):369-375.
15. Pushpendra Singh, Sumeriya HK. Effect of nitrogen on yield, economics and quality of fodder sorghum genotypes. Ann. Pl. Soil Res., 2012; 14:133-135.
16. Rana DS, Singh B, Gupta K, Dhaka AK, Pahuja SK, Effect of fertility levels on growth, yield and quality of multi-cut forage sorghum (*Sorghum bicolor* L.) genotypes. Forage Res., 2013; 39: 36-38.
17. Saleem MF, Randhawa MS, Hussain S, Wahid MA, Anjum SA, Nitrogen management studies in autumn planted maize (zea mays L.) hybrids. The J. Anim. and Plant Sciences. 2009; 19(3):140-143.
18. Samia OY, Abdelsalam AK, Effect of nitrogen and seed rates on growth and yield of forage sorghum (*Sorghum bicolor* L Moenchcv. Abusabien). J. Sci. Tech. 2010; 11(2):123-136.
19. Sheoran, R. S., and D. S. Rana, Relative efficiency of *Azotobacter* and nitrogen fertilizer in forage sorghum (*Sorghum bicolor* L.) under semi-arid conditions. *Forage Res.*, 2006; 32:65-68.
20. Singh K, Gill PS, Effect of preceding crops on nitrogen and phosphorus requirement of forage sorghum. Forage Res., 1976; 2:49-54.
21. Singh VP, Verma SS, Chandra. Effect of fertility levels with bio-fertilizer and cutting management on seed yield of oats. Forage Res. 2005; 31:57-58.
22. Tiwana US, Puri KP, Effect of nitrogen levelson the fodder yield and quality of pearl millet varieties under rainfed conditions. *Forage Res*., 2005; 31:142-143.
23. Turgut I, Duman A, Bilgili U, Acikgoz E, Alternate roe spacing and plant density effects on forage and dry matter yield of maize hybrids (*Zea mays* L.) Crop Sci. 2005; 91(5):146-151.
24. Verma SS, Navneet Singh YP, Joshi, Vijay Deprari. Effect of nitrogen and zinc on growth characters, herbage yield, nutrient uptake and quality of fodder sorghum (*Sorghum bicolor*). Forage Res., 2005; 50:167-169.