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# Influence of Inter Row Spacing and Fertilizer Levels on Seed Production and its Economic Benefits in Perennial Fodder Sorghum cv. CoFS-29

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**ABSTRACT:** Maintenance of optimum number of plants per unit area and nutrient management are considered as important management practice for enhancing the seed and fodder productivity in forage crops. Keeping this in view, a field experiment was conducted during *kharif* 2012 and 2013 at University of Agricultural Sciences, Dharwad to assess the seed yield and economic benefit in perennial fodder sorghum with suitable row spacing and fertilizer levels. The evaluation was conducted with three row spacings (30 cm, 45cm and 60 cm) and four fertilizer levels (100:40:40, 100:60:40, 150:40:40 and 150:60:40 NPK kg $ha^{-1}$) for two years. The results revealed that 30 cm spacing recorded about 22 per cent more seed yield (657.6 kg $ha^{-1}$), 10 per cent more dry fodder yield (126.7 q $ha^{-1}$) and higher gross returns (Rs. 80967 $ha^{-1}$), net returns (Rs. 50855 $ha^{-1}$) and B:C ratio (1.69), as compared to 45 and 60 cm spacings. Among the fertilizer levels, the plants grown at 150:60:40 kg NPK $ha^{-1}$ have out yielded other doses with more seed yield (641.6 kg $ha^{-1}$), more dry fodder yield (125.6 q $ha^{-1}$), increased gross returns (Rs. 79234 $ha^{-1}$), net returns (Rs.548726 $ha^{-1}$) and B:C ratio (1.60). From this study, it can be concluded that application of 150:60:40 kg NPK $ha^{-1}$ with 30 cm row spacing is more economical for seed production of multicut fodder sorghum cv. CoFS-29.

**Key words:** Row spacing, Fertilizer levels, Fodder sorghum, Seed yield, Net returns, B: C ratio

The importance of sorghum as a commercial forage crop is growing in many regions of the world due to its high productivity and efficient utilization of water even under drought conditions. In India, it is principally grown as an important *kharif* crop since it is highly palatable and digestible as far as the nutritional quality is concerned. The present feed and fodder production can meet only 48 per cent of the livestock requirement. Non-availability of quality seeds of improved forage varieties and lack of improved cultivation techniques for enhancing the average commercial forage and seed yields are one of the reasons for this deficit.

Seed production is maximized at an optimum plant density (row spacing), with both very low and very high densities reducing seed yield in forages. However, the realization of higher seed yield from different plant densities is dependent on fertility status of the soil and the fertilizer applied [1]. Providing differential plant geometry may alter the plant canopy architecture affecting light interception and carbon dioxide assimilation and ultimately resulting in variable seed yield and quality. Fertilizer is the most critical input required for intensive cultivation of fodder sorghum crop and its profitability depends mainly on its seed and fodder yielding ability *vis-a-vis* agronomic practices and input management [2 and 3]. Therefore, the ideal planting geometry with appropriate fertilizer dose is necessary for getting not only higher fodder yield, but also the seed yield. In view of the above considerations, we examined the effect of row spacing and

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fertilizer level (N and P) on seed production of perennial fodder sorghum.

## MATERIAL AND METHODS

The experiment was carried out in split plot design with 12 treatment combinations involving three inter row spacings as main plot *viz.* 30 cm ($S_1$), 45 cm ($S_2$) and 60 cm ($S_3$) and four fertilizer levels as sub plot *viz.*, 100:40:40 ($F_1$), 100:60:40 ($F_2$), 150:40:40 ($F_3$) and 150:60:40 NPK ha$^{-1}$ ($F_4$) in three replications at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during *kharif* 2012 and 2013. The soil of the experimental site was medium deep black with medium fertility. The seeds of multicut fodder sorghum cv. CoFS-29 procured from the Indian Grassland and Fodder Research Institute (IGFRI), Southern Regional Research Station, Dharwad were sown by hand dibbling 2-3 seeds per hill at 1 to 2 cm depth, as per the treatments. The crop was incorporated with well decomposed FYM @ 10 t ha$^{-1}$ three weeks prior to sowing of the crop. The calculated quantities of fertilizers were applied as per treatments in the two splits using Urea, Single Superphosphate and Muriate of Potash. The half dose of N and entire dose of $P_2O_5$ and Potash were applied at the time of sowing and the remaining half dose of N was applied to soil at 30 DAS. Furadon 3G granules @ 10 kg per hectare were also applied to prevent shoot fly incidence. The crop was provided with protective irrigations looking into the critical moisture condition of the soil. All the other crop management practices were followed as per recommended package of practices.

The crop was harvested from net plot area manually, as per treatment, soon after attainment of physiological maturity i.e., when the panicles turned straw coloured. The harvested plants were sundried for few days and threshed manually by beating with pliable wooden mallet for easy separation of seeds. The seeds were cleaned and dried in shade to around 10 per cent moisture content.

The observations on yield parameters were recorded after physiological maturity of the crop. Economic parameters were calculated on the basis of prevailing market prices. The data collected in respect of various parameters of seed yield, fodder yield and economics of seed production was analyzed statistically as described by [4].

## RESULTS AND DISCUSSION

Seed yield and its various attributes were affected significantly by both row spacing and fertilizer levels in the pooled data and also in the two individual year of experiment. Among the seed yield components, panicle length and number of panicles per plant were significantly and consistently higher (51.62 cm and 12.02 respectively) in the 60 cm row spacing as against the other two spacings (30 cm and 45 cm) (Table 1). The higher seed yield and its components noticed in the wider row spacing might be due to less plant population density which resulted in better growth of plants by enhancing the source to sink relationship due to availability of adequate nutrients, light, space and moisture unlike those grown at narrow spacing. Similar results were also reported by [5] in maize, [6] in buffel grass and [7] in forage crops. It was also seen from the results that although the seed yield attributes were less in 30 cm row spacing, it registered significantly more seed yield per hectare, dry fodder yield per hectare and harvest index (657.6 kg, 126.7 q and 5.19 %, respectively) as compared to 45 cm and 60 cm (538.8 kg, 114.7 q and 4.68 %, respectively) (Table 1). On an average, it recorded about 22 per cent more seed yield and 10 per cent more dry fodder yield over 60 cm row and it may be probably related to 50 per cent more plant population (3, 33,333 plants ha$^{-1}$) per unit area noticed in the narrow inter row spacing despite showing less yield components compared to the wider row spacing (1, 66,666 plants ha$^{-1}$) as seen from the results of the present study. These results were supported by the findings of [7] in forage crops, [8] in aerobic rice and [9] in sweet corn.

The pooled data revealed significantly higher panicle length (52.64 cm), number of panicles per plant (11.44), seed yield hectare (641.6 kg), dry fodder yield per hectare (125.6 q) and harvest index (5.11 %) in 150:60:40 kg NPK ha$^{-1}$ level as against 100:40:40 kg NPK ha$^{-1}$ level (47.27 cm, 46.74 cm, 10.86, 1.18 g, 12.88 g, 564.0 kg, 56, and 116.2 q, respectively). The next higher seed yield

**Table 1. Seed yield and its parameters as influenced by inter row spacings and fertilizer levels in perennial fodder sorghum cv. CoFS-29 (Pooled data of 2012-13 and 2013-14)**

| Treatments | Panicle length (cm) | Number of panicles $plant^{-1}$ | Seed yield $hectare^{-1}$ (kg) | Dry fodder yield $hectare^{-1}$ (q) | Harvest index (%) |
|---|---|---|---|---|---|
| Inter row spacing (S) | | | | | |
| $S_1$ : 30 cm | 48.24 | 10.34 | 657.6 | 126.7 | 5.19 |
| $S_2$ : 45 cm | 50.12 | 11.09 | 610.3 | 120.7 | 5.05 |
| $S_3$ : 60 cm | 51.62 | 12.02 | 538.8 | 114.7 | 4.68 |
| S.Em± | 0.10 | 0.04 | 6.2 | 0.7 | 0.06 |
| C.D. (P=0.05) | 0.40 | 0.18 | 24.2 | 2.8 | 0.22 |
| Fertilizer levels (F) | | | | | |
| $F_1$ : 100:40:40 NPK kg $ha^{-1}$ | 47.27 | 10.86 | 564.0 | 116.2 | 4.83 |
| $F_2$ : 100:60:40 NPK kg $ha^{-1}$ | 47.97 | 11.00 | 582.5 | 117.9 | 4.93 |
| $F_3$ : 150:40:40 NPK kg $ha^{-1}$ | 52.09 | 11.31 | 620.7 | 123.2 | 5.04 |
| $F_4$ : 150:60:40 NPK kg $ha^{-1}$ | 52.64 | 11.44 | 641.6 | 125.6 | 5.11 |
| S.Em± | 0.10 | 0.03 | 7.4 | 0.7 | 0.07 |
| C.D. (P=0.05) | 0.28 | 0.10 | 21.9 | 2.2 | NS |
| Interactions (S x F) | | | | | |
| $S_1F_1$ | 45.87 | 10.09 | 644.6 | 122.0 | 5.29 |
| $S_1F_2$ | 46.58 | 10.27 | 652.6 | 124.0 | 5.26 |
| $S_1F_3$ | 49.83 | 10.44 | 662.1 | 129.0 | 5.14 |
| $S_1F_4$ | 50.67 | 10.57 | 671.0 | 131.9 | 5.09 |
| $S_2F_1$ | 47.37 | 10.85 | 584.4 | 116.8 | 5.00 |
| $S_2F_2$ | 48.02 | 11.02 | 593.0 | 117.9 | 5.03 |
| $S_2F_3$ | 52.37 | 11.20 | 625.7 | 123.5 | 5.07 |
| $S_2F_4$ | 52.73 | 11.30 | 638.0 | 124.6 | 5.12 |
| $S_3F_1$ | 48.58 | 11.64 | 462.8 | 109.7 | 4.21 |
| $S_3F_2$ | 49.30 | 11.70 | 502.0 | 111.6 | 4.49 |
| $S_3F_3$ | 54.07 | 12.27 | 574.4 | 117.2 | 4.91 |
| $S_3F_4$ | 54.53 | 12.45 | 615.8 | 120.3 | 5.13 |
| Mean | 49.99 | 11.15 | 602.2 | 120.7 | 4.98 |
| S.Em± | 0.17 | 0.07 | 12.7 | 1.3 | 0.12 |
| C.D. (P=0.05) | 0.58 | 0.22 | 40.5 | NS | 0.37 |
| Interactions (F x S) | | | | | |
| S.Em± | 0.16 | 0.06 | 12.8 | 1.3 | 0.12 |
| C.D. (P=0.05) | 0.49 | 0.17 | 38.0 | NS | 0.35 |

*NS : Non significant

**Table 2.** Economics of the seed production as influenced by inter row spacing and fertilizer levels in perennial fodder sorghum cv. CoFS-29. (Pooled data of 2012-13 and 2013-14)

| Treatments | Gross returns (Rs. $ha^{-1}$) | Net returns (Rs. $ha^{-1}$) | B:C ratio |
|---|---|---|---|
| Inter row spacing (S) | | | |
| $S_1$ : 30 cm | 80967 | 50855 | 1.69 |
| $S_2$ : 45 cm | 75513 | 45526 | 1.52 |
| $S_3$ : 60 cm | 67640 | 37778 | 1.26 |
| S.Em± | 626 | 626 | 0.02 |
| C.D. (P=0.05) | 2459 | 2459 | 0.08 |
| Fertilizer levels (F) | | | |
| $F_1$ : 100:40:40 NPK kg $ha^{-1}$ | 70340 | 40874 | 1.39 |
| $F_2$ : 100:60:40 NPK kg $ha^{-1}$ | 72396 | 42477 | 1.42 |
| $F_3$ : 150:40:40 NPK kg $ha^{-1}$ | 76857 | 46802 | 1.56 |
| $F_4$ : 150:60:40 NPK kg $ha^{-1}$ | 79234 | 48726 | 1.60 |
| S.Em± | 750 | 750 | 0.03 |
| C.D. (P=0.05) | 2229 | 2229 | 0.07 |
| Interactions (S x F) | | | |
| $S_1F_1$ | 79107 | 49516 | 1.67 |
| $S_1F_2$ | 80139 | 50095 | 1.67 |
| $S_1F_3$ | 81687 | 51507 | 1.71 |
| $S_1F_4$ | 82937 | 52304 | 1.71 |
| $S_2F_1$ | 72465 | 42999 | 1.46 |
| $S_2F_2$ | 73457 | 43538 | 1.45 |
| $S_2F_3$ | 77381 | 47326 | 1.57 |
| $S_2F_4$ | 78748 | 48240 | 1.58 |
| $S_3F_1$ | 59449 | 30108 | 1.03 |
| $S_3F_2$ | 63591 | 33797 | 1.13 |
| $S_3F_3$ | 71503 | 41573 | 1.39 |
| $S_3F_4$ | 76017 | 45634 | 1.50 |
| Mean | 74707 | 44720 | 1.49 |
| S.Em± | 1288 | 1288 | 0.04 |
| C.D. (P=0.05) | 4117 | 4117 | 0.14 |
| Interactions (F x S) | | | |
| S.Em± | 1299 | 1299 | 0.04 |
| C.D. (P=0.05) | 3861 | 3861 | 0.13 |

per hectare (620.7 and 582.5 kg) was seen in the 150:40:40 kg NPK ha$^{-1}$ and 100:60:40 kg NPK ha$^{-1}$ fertilizer levels (Table 1). On an average, the plants grown at 150:60:40 kg NPK ha$^{-1}$ have out yielded by showing 13.75 per cent more seed yield and 8.08 per cent more dry fodder yield as against those at 100:40:40 kg NPK ha$^{-1}$. The marked increase in seed yield per hectare noticed in the higher fertilizer level might be attributed to its increased availability of essential nutrients to the plants, thereby favouring higher crop growth and flowering parameters. These results are in agreement with those of [10] in *Stylosanthes*, [11] in buffel grass and [12], [13] in oat.

With regard to economics of seed production, the row spacing of 30 cm recorded significantly higher gross returns (Rs. 80967 ha$^{-1}$), net returns (Rs. 50855 ha$^{-1}$) and B: C ratio (1.69) as compared to other row spacing's (Table 2). This was mainly due to significantly higher seed yield and dry fodder yield recorded with 30 cm row spacing, as compared to 45 and 60 cm spacings. Increase in fertilizer level of 150:60:40 kg NPK ha$^{-1}$ significantly increased gross returns (Rs. 79234 ha$^{-1}$), net returns (Rs. 48726 ha$^{-1}$) and benefit cost ratio (1.60) (Table 2). This could be attributed with seed and dry fodder yield. These findings are in agreement with [14] in baby corn, [9] in sweet corn and [15] in fodder sorghum. Less spacing with higher dose of fertilizers were found to be economical for seed production of multicut fodder sorghum.

## REFERENCES


1. BOONMAN JG (1972). Experimental studies on seed production of tropical grasses in Kenya. 3. The effect of nitrogenand row width on seed crops of *Setaria sphacelata* cv. Nandi II. *Netherlands J. Agric. Sci.*, **20**, 22-34.
2. SIDDIQUE N (1989) Yield and quality of maize fodder as influenced by different stages of harvesting and nitrogen rates. *M. Sc. (Agri.) Thesis*, Univ. Agric., Faisalabad, Pakistan.
3. RAHEJA PC (1996). Soil productivity and growth, Asia Publising House, New Delhi, India.
4. GOMEZ KA AND AA GOMEZ (1984). Analysis of data from a series of experiments. *Statistical Proc. for Agril. Res.*, John Wiley and Sons, New York, pp. 168.
5. DESAI BK (1987). Effect of plant population and hydrophilic polymer on the performance of short duration maize. *M. Sc. (Agri.) Thesis*, Uni. Agric. Sci, Dharwad, Karnataka, India.
6. KUMAR D, GK DWIVEDI AND SN SINGH (2005). Seed yield and quality of buffel grass (*Cenchrus ciliaris*) as influenced by row spacing and fertilizer level. *Trop. Grassl.*, **39**: 107-111.
7. SUNITHA DEVI KB AND V SATYANARAYANA RAO (2007). Effect of spacing and varieties on seed yield of forage cowpea. *Forage Res.*, **33**(3): 161-163.
8. SRIDHARA CJ, BK RAMACHANDRAPPA, HV NANJAPPA AND NS MAVARKAR (2011). Effect of genotype, planting geometry and methods of establishment on growth and yield of aerobic rice. *Mysore J. Agric. Sci.*, **45**(3): 501-505.
9. SINGH U, AA SAAD, T RAM, L CHAND, SA MIR AND FA AGA (2012). Productivity, economics and nitrogen-use efficiency of sweet corn (*Zea mays saccharata*) as influenced by planting geometry and nitrogen fertilization. *Indian J. Agron.*, **57**(1): 43-48.
10. BHATTACHARYA S, MK NANDA AND AK MUKHERJEE (2004). Effect of phosphorus and cutting on biomass and seed production of *Stylosanthes* cultivars. *Forage Res.*, **30**(2): 96-98
11. SHARMA SK, MS YADAV AND MP RAJORA (2002). Effect of row spacing and fertilizers on growth and seed yield in buffel grass (*Cenchrus ciliaris* Linn.) var. CAZRI 75. *Seed Res.*, **30**(1): 56-59.
12. PATEL AS, TN BAREVADIA, MR PATEL, AC SADHU AND HP PARMAR (2007). Effect of nitrogen and different management practices on growth and seed production of oat (*Avena Sativa* L.). *Forage Res.*, **32**(4): 264-266.
13. DEVI U, KP SINGH, SURESHKUMAR AND M SEWHAG (2014). Effect of nitrogen levels, organic manures and *Azotobacter* inoculation on yield and economics of multi-cut oats. *Forage Res.*, **40**(1): 36-43.
14. THAKUR DR, OMPRAKASH, PC KHARWA AND SK BHALLA (1998). Effect of nitrogen and plant spacing on yield, nitrogen uptake and economics in baby corn (*Zea mays* L.). *Indian J. Agron.*, **43** (4): 668-671.
15. MANJUNATHA SB, VV ANGADI, YB PALLED, SV HOSAMANI, HB BABALAD, MH HOSAMANI, DH MUDAKAVI AND HT CHANNAL (2013). Response of multicut fodder sorghum (CoFS-29) to row spacings and nitrogen levels under irrigated condition. *Karnataka J. Agric. Sci.*, **26**(4): 511-513.