Research Article

Evaluation of Spacing and Fertilizer Doses for Multicut Forage Sorghum under Irrigated Condition

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Abstract

A field experiment was conducted to evaluate the spacings and fertilizer doses on multicut forage sorghum (SPV 2242) under irrigated condition at Tamil Nadu Agricultural University, Coimbatore during July-December, 2016. The experiment was laid out in split plot design replicated thrice using SPV 2242 as the test variety. The treatments consisted of four different spacings (30 x 10 cm, 30 x 15 cm, 30 x 20 cm and 30 x 25 cm) along with three fertilizer doses (75% RDF, 100% RDF and 125% RDF). In addition, recommended application of FYM @ 12.5 t/ha was followed. The results revealed that increased plant population with highest rate of fertilizer application increases the green and dry forage yield and improved the fodder quality. Higher level of green and dry forage yield were recorded under 30 x 10 cm spacing with 125% RDF (38.9 and 20.3 t ha^{-1}, respectively) (Table 1 and figure 1, 2). Economic analysis showed that the higher gross return (₹86850/ha), net return (₹116007/ha) and B:C ratio of 1.72 were recorded with 30 x 10 cm spacing with 125% RDF.

Keywords: Forage sorghum, green forage yield, dry forage yield, crude protein, fertilizer dose

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Introduction

Global trend in animal production indicates a rapid increase in the consumption of livestock products. India supports nearly 20 per cent of the world livestock population on a land area of only 2.3 per cent. It is a leader in cattle (16 per cent) and buffalo (55 per cent) population and has world's second largest goat (20 per cent) and fourth largest sheep (5 per cent) 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 MT (390 MT green and 443 MT dry). In Tamil Nadu, the area under fodder crops is 1.72 lakh ha producing 340 lakh tonnes of fodder annually as against the requirement of 486 lakh tonnes (Season and Crop Report, 2013-14). It is estimated that the deficit will increase over 64.2 and 24.8 per cent of green and dry fodder, respectively by 2020 [1].

Amongst the annual forage crops, sorghum occupies nearly 2.5 m ha area. Cultivation of sorghum over other forage crops is widely practiced due to its high tolerance and suitability to wide variation in soil and climatic conditions and having many advantages like quick growth, high biomass accumulation, high dry matter content and wide adaptability besides drought withstanding ability. It is also suitable for silage and hay making. The green fodder availability from single cut sorghum is seasonal while multi-cut sorghum helps to supply green fodder throughout the year. Multi-cut forage having shorter cutting interval of 40-45 days, requires adequate nutrients in available form to produce sufficient foliage in a limited period of time.

For higher yields, an adequate plant population is a pre-requisite. This is again decided by the fertility of soil and the space required for the plant to develop healthily. The present study was taken up to find out the optimum population with optimum fertilizer doses for increasing the forage yield.

Materials and Methods

The experiment was conducted at, Tamil Nadu Agricultural University, Coimbatore during July-December 2016. The experiment was laid out in split plot design having three replications. The study area is geographically situated at 11˚N latitude and 77˚E longitude with an altitude of 426.7 m above mean sea level. The pH and EC of the soil was 8.01 0.32 dSm^{-1}, respectively. The net plot size of 5.0 x 2.4 m was used. The experiment comprised of four different spacing along with three different fertilizer doses *viz.*, 30 10 cm, 30 x 15 cm, 30 x 20 cm, 30 x 25 cm and 75% RDF,

100% RDF and 125% RDF. The variety used was SPV 2242. The seeds were dibbled at 2-3 seeds/hill in each main plot depending upon the spacing of respective treatments imposed. The seeds were sown on the two sides of ridge formed 60 cm apart to achieve 30 cm spacing between the rows. The recommended dose of N, P_2O_5, and K_2O kg/ha was applied treatment wise. Fifty percent of the recommended dose of nitrogen and full dose of P_2O_5 and K_2O were applied at the time of sowing. Remaining fifty percent dose of nitrogen was top dressed at 30 DAS. After each cut of 45 kg N/ha was applied. The data were statistically analyzed using "Analysis of variance test". The critical difference at 5% level of significance was calculated to find out the significance of different treatments over each other [2].

Treatment details

Main Plot: Spacings	Sub Plot: Fertilizer Levels
M_1 - 30 x 10 cm (3, 33,000 plants /ha)	**S_1** - 75% RDF (67.5:30:30 Kg NPK/ha)
M_2 - 30 x 15 cm (2, 22,000 plants /ha)	**S_2** - 100% RDF (90:40:40 Kg NPK/ha)
M_3 - 30 x 20 cm (1, 66,000 plants /ha)	**S_3** -125%RDF (112.5:50:50 kg NPK/ha)
M_4 - 30 x 25 cm (1, 33,333 plants /ha) (Recommended spacing: 30 x 10-15 cm)	

Results and Discussion

Green forage yield and Dry forage yield

Forage yield is a function of growth parameters, *viz.*, plant population, plant height, leaf to stem ratio, leaf area, and leaf area index. Forage yield is a function of genetic as well as environmental factors which plays a vital role in plant growth and development. Plant population had significant influence on green and dry forage yield. Higher the plant population higher was the yield. This might be attributed to nutrient supply, which increased all the growth parameters like plant height and leaf stem ratio of the crop and the enhanced growth reflected on yield.

The green forage and dry forage yield was significantly influenced by different spacings during first, second and third cut of forage sorghum. The narrow spacing of 30 x 10 cm recorded significantly higher green forage yield of 40.8 t/ha, 35.9 t/ha and 23.9 t/ha, (Table 1 and figure 1), respectively at first, second and third cut.

Higher dry forage yield was recorded with the treatment combination of 30 x 10 cm spacing with fertilizer dose of 125% RDF during first, second and third cut of forage sorghum (Table 1 and figure 2). This might be attributed to the low plant density at wider plant spacing and high plant density at narrow plant spacing. This result is in agreement with [3]. The higher yield was obtained from the highest seed rate and narrow row spacing [4] and increased row spacing reduced yield [5].

Table 1 Effect of spacing and fertilizer doses on green and dry forage yield (t/ha) at first, second and third cut

Treatments	Green and dry forage yield (t/ha)					
	First cut		Second cut		Third cut	
	Green forage yield	Dry forage yield	Green forage yield	Dry forage yield	Green forage yield	Dry forage yield
Spacing						
M_1 (30 x 10 cm)	40.8	22.9	35.9	21.8	23.9	13.2
M_2 (30 x 15 cm)	38.6	20.0	33.5	19.6	21.9	11.2
M_3 (30 x 20 cm)	37.8	18.2	30.8	16.5	21.6	10.6
M_4 (30 x 25 cm)	34.4	16.7	28.5	14.4	19.8	9.8
SEd	0.7	0.5	1.2	0.9	0.8	0.4
CD (P=0.05)	1.8	1.3	2.9	2.1	1.9	0.9
Fertilizer doses						
F_1 (75% RDF)	36.9	18.4	30.3	16.5	21.2	10.5
F_2 (100% RDF)	37.9	19.6	31.4	18.4	21.8	11.3
F_3 (125% RDF)	38.9	20.3	34.2	19.3	22.5	11.9
SEd	0.7	0.3	1.1	0.6	0.4	0.3
CD (P=0.05)	1.4	0.6	2.3	1.3	0.9	0.7
Interaction (MXF)						
SEd	1.3	0.7	2.2	1.3	1.0	0.7
CD (P=0.05)	NS	NS	NS	NS	NS	NS

With respect to fertilizer doses, highest fertilizer dose (125% RDF) recorded higher green forage yield of 38.9 t/ha, 34.2 t/ha and 22.5 t/ha at first, second and third cut, respectively. Higher dose of fertilizer resulted in higher availability of N and accelerating the process of cell division, enlargement and elongation. This in turn showed luxuriant vegetative growth and resulted in higher green forage yield. Similar results were also obtained by [6] and [7].

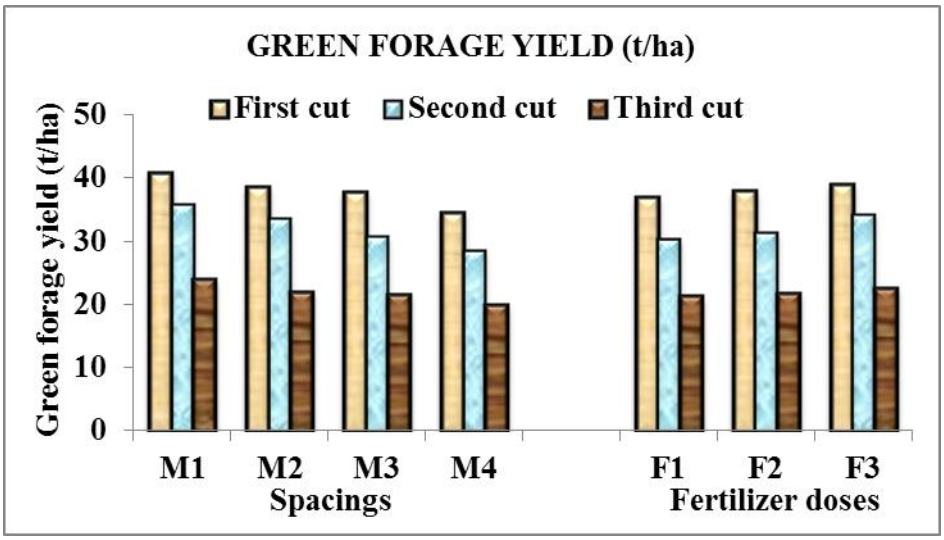

Figure 1 Effect of spacings and fertilizer doses on green forage yield (t/ha) - first, second and third cut

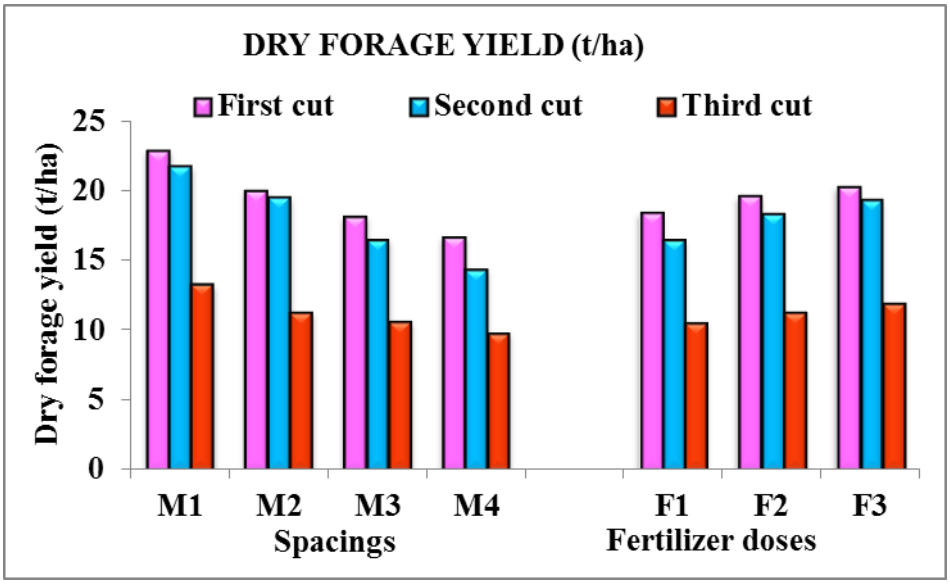

Figure 2 Effect of spacings and fertilizer doses on dry forage yield (t/ha) - first, second and third cut

Crude protein

Crude protein is a significant determinant for forage quality. Forage containing high crude protein content is considered as good quality forage. The palatability and digestibility are greater in the forage containing high crude protein contents. The positive effect of nitrogen on the crude protein content was reported by [8].

The narrow spacing of 30 x 10 cm recorded more crude protein (9.10, 8.99 and 8.29 % at first, second and third cut, respectively). With regard to fertilizer doses, application of higher fertilizer dose of 125% RDF increases the crude protein content at first (8.51%), second (8.48%) and third cut (8.31%) of forage sorghum (Table 2 and figure 3). Fertilizer dose of 125% RDF recorded significantly higher crude protein content, which might be due to increases in N fertilizer dose. These results are in conformity with the earlier findings of [9]. The increase in protein contents with increase in nitrogen level might be due to the reason that nitrogen application has enhanced the amino acid formation and in turn increased the protein contents [10].

Table 2 Effect of spacings and fertilizer doses on crude protein (%) at first, second and third cut

Treatments	Crude protein yield (%)		
	First cut	Second cut	Third cut
Spacing			
M_1 (30 x 10 cm)	9.10	8.99	8.29
M_2 (30 x 15 cm)	8.45	8.34	8.04
M_3 (30 x 20 cm)	8.02	8.00	7.84
M_4 (30 x 25 cm)	7.38	7.25	7.23
SEd	0.22	0.22	0.24
CD (P=0.05)	0.55	0.53	0.60
Fertilizer doses			
F_1 (75% RDF)	8.05	7.85	7.44
F_2 (100% RDF)	8.16	8.07	7.80
F_3 (125% RDF)	8.51	8.51	8.31
SEd	0.17	0.20	0.21
CD (P=0.05)	0.35	0.43	0.46
Interaction (MXF)			
SEd	0.35	0.40	0.44
CD (P=0.05)	NS	NS	NS

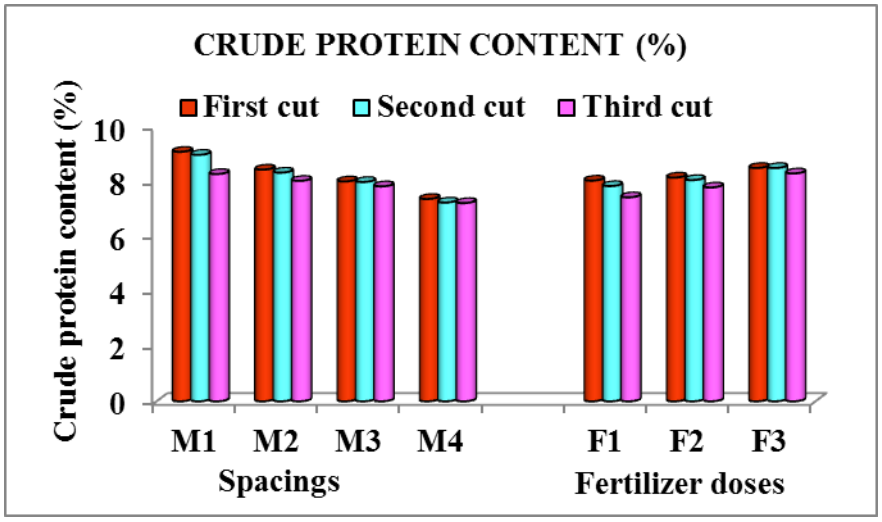

Figure 3 Effect of Spacings and fertilizer doses on crude protein content (%) - first, second and third cut

Conclusion

It could be concluded that 30 x 10 cm spacing along with 125% RDF (112.5:50:50 kg NPK/ha) produced higher green and dry forage yield with higher crude protein content in multicut forage sorghum.

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Publication History
Received 27th Sep 2017
Revised 15th Oct 2017
Accepted 18th Oct 2017
Online 30th Oct 2017