

Original Research Article

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Effect of Spacing and Fertility Levels on Yield and Productivity of Multi-cut Forage Sorghum [*Sorghum bicolor* (L.) Moench]

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ABSTRACT

Keywords

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A field experiment was conducted for Evaluation of Spacing and Fertility Levels for Multi-Cut Forage Sorghum. It was found that maximum increase in maximum increase in green and dry fodder yield was obtained with spacing 30 cm x 10 cm (54.77 and 15.91 t/ha, respectively) with the highest net returns (₹ 44881 /ha) and B-C ratio (1.41) and application of 125% RDF proved most economically as it recorded highest net returns (₹46607 /ha) and B C ratio (1.42) compared to 75% RDF and 100% RDF.

Introduction

India has very large population of livestock, the productivity of milk and other livestock product per animal is very low compared to other many countries in the world. One of the main reasons for the low productivity of our livestock is malnutrition, under-nutrition or both, beside the low genetic potential of the animals. The adequate supply of nutritive fodder and feed is a crucial factor impacting the productivity and performance of the animals. The country is highly deficient in respect of availability of green fodder, dry fodder and concentrates (Grover and Kumar, 2012). Feeding is the major component of

cost of milk production accounting for 55-60 per cent of the total cost of milk production. It is estimated that the world food requirement by the year 2050 will be double that of 2010. A significant part of this requirement will emanate from the developing countries, on account of increased human populations, disposable incomes and urbanization. For livestock products, about two-thirds of this increased demand will need to be met by improving the production efficiency of feed, both forages and concentrate feeds. However, in addition to shortage of feed, it is well documented worldwide that imbalanced nutrition is a major factor responsible for low livestock productivity (Tonapi *et al.*, 2011).

Globally, sorghum is cultivated on 41 million hectares to produce 64.20 million tonnes, with productivity hovering around 1.60 tonnes per hectare. With exceptions in some regions, it is mainly produced and consumed by poor farmers. India contributes about 16% of the world's sorghum production. It is the fifth most important cereal crop in the country. It is now recognized worldwide as a smart crop capable of providing food, feed, fodder and fuel especially under moderate inputs, especially in water-deficit environments in the low rainfall areas. It is grown as green forage (multi-cut) crop in north-Indian plains where irrigation is available and as single-cut forage mainly in drier parts of Western India (Tonapi *et al.*, 2011). Sorghum plants contain an alkaloid, which releases hydrocyanic, or prussic acid, when hydrolyzed. This can be toxic to livestock. During periods of drought or other stresses, sorghum tends to accumulate nitrates, which can be toxic to livestock. If retarded crop growth is observed, forage needs to be analyzed for excessive nitrates before feeding (Pandey and Roy, 2011). Plant density is one of the important factor determines growth, development and yield. Plant density selection to allow for expression of maximum yield is a management practice that would make sorghum production more economical (Zand and Shakiba, 2013).

The plant population and plant spacing has always been complex question for sorghum (Wylie, 2008). Maintenance of optimum planting density through appropriate geometry is always a big problem to the farmers. Substandard plant density result in high weeds infestation, poor radiation use efficiency and low yield, while dense plant population on the other hand cause lodging, poor light penetration in the canopy, reduce photosynthesis production due to shading of lower leaves and drastically reduce the yield. Agronomic traits such as plant maturity, stalk

strength and height were influenced little by varying row spacing (Schatz *et al.*, 1990).

The agronomic traits like total tillers number, total fresh forage, total forage dry matter, leaf dry matter, stem dry matter and leaf-stem ratio are significantly affected by altering plant density of sorghum (Bahrani and Deghani ghenateghestani, 2004). Keeping the above facts in view, the present investigation was undertaken to know the effect of fertility and spacing on yield of forage sorghum.

Materials and Methods

A field experiment was conducted at Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur during *Kharif*, 2016 season with the objectives to select suitable multi-cut forage sorghum spacing for this zone, work out optimum fertility level for test sorghum genotypes and to access the economically viable treatment. Soil of the experimental field was sandy clay loam in texture and was medium in available nitrogen (281.40 kg /ha), phosphorus (21.46 kg /ha) and high in available potassium (315.45 kg /ha). The experiment consisted of 27 treatment combinations comprising three levels of fertility (75, 100 and 125% RDF) and three spacing (30 cm x 10 cm, 30 cm x 15 cm and 45 cm x 15 cm) laid out in factorial randomized block design with three replications.

Yield attributes i.e., green forage, dry fodder yield and total fodder yield were recorded at 1st and 2nd time of harvest. THE economics analysis of each treatment was done on the basis of prevailing market rates of the inputs used and outputs obtained under each treatment. The crop was sown on 06 June 2016 and was harvested on 9 September and 20 October 2016 as 1st and 2nd cutting, respectively.

Results and Discussion

Effect of spacing

Green forage yield

The maximum green forage yield of multi-cut forage sorghum at 1st cutting was obtained by close spacing of 30 cm x 10 cm (30.50 t/ha). It was significantly superior (10.75 and 21.51 per cent) over wider spacing of 30 cm x 15 cm and 45 cm x 15 cm, respectively. The data explicated that increasing spacing was associated with significant reduction of green forage yield at 2nd cutting. The maximum yield (24.27 t/ha) was obtained when the crop was sown at closer spacing of 30 cm x 10 cm. It was reduced by 8.24 and 14.96 per cent by sowing the crop at wider spacing of 30 cm x 15 cm and 45 cm x 15 cm, respectively. In tune with 1st and 2nd cutting data, the highest total green forage yield (54.77 t/ha) of the multi-cut forage sorghum crop was recorded under closer spacing of 30 cm x 10 cm which was significantly higher (9.96 and 19.75 percent) over wider spacing of 30 cm x 15 cm and 45 cm x 15 cm, respectively (Table 1).

Dry fodder yield

There was a gradual and significant reduction in dry fodder yield at 1st cutting by increasing the spacing of crop. The maximum dry fodder yield (7.71 t/ha) was observed when the crop was closely spaced at 30 cm x 10 cm. Widening the spacing to 30 cm x 15 cm and 45 cm x 15 cm was associated with significant reduction of 9.08 and 19.72 per cent in dry fodder yield, respectively in comparison to close spacing of 30 cm x 10 cm. The maximum dry fodder yield at 2nd cutting (8.20 t/ha) was recorded by keeping a spacing of 30 cm x 10 cm. It reduced significantly (7.56 and 13.78 per cent) by widening the spacing to 30 cm x 15 cm and 45 cm x 15 cm, respectively. The maximum

total dry fodder yield (15.91 t/ha) was obtained by closer spacing of 30 cm x 10 cm. It was significantly reduced by 8.30 and 15.02 per cent by following wider spacing of 30 cm x 15 cm and 45 cm x 15 cm, respectively.

Effect of fertility levels

Green forage yield

An insight of data revealed that increasing fertility levels from 75 % up to 125 % RDF tended to increase the green forage yield of the crop at 1st cutting. Increase in level from 75 to 100 % RDF and from 100 to 125 % RDF gave 16.00 and 21.26 per cent forage yield enhancement. An examination of data revealed that fertility levels had significantly effect on green fodder yield at 2nd cutting. The crop under the influence of 125% RDF produced the highest green forage yield at (23.87 t/ha 2nd cutting, which was significantly higher over 75 % and 100 % RDF by 12.70 and 7.91 per cent, respectively. The total green forage yield was significantly influenced by fertility levels. The data revealed that the total green forage production was highest (56.66 t/ha) when soil was enriched with 125 % RDF. It was significantly superior (15.26 and 27.35 per cent) over 100 % and 75 % RDF, respectively.

Dry fodder yield

The maximum dry fodder yield at first cutting (6.02 t/ha) was observed by supplying 75 % RDF for crop raising. It was lifted to 6.90 t/ha by supplying 100 % RDF and to a maximum of 8.25 t/ha by supplying 125 % RDF which was significantly higher over preceding levels. Though the minimum dry fodder yield (7.24 t/ha) was recorded by supplying 75 % RDF but it was at par with yield obtained (7.53 t/ha) under 100 % RDF. The minimum dry fodder yield (8.08 t/ha) was harvested by

supplying 125 % RDF which was significantly higher over 100 and 75 % RDF. The total dry fodder yield of multi-cut fodder sorghum increased significantly by supplying nutrients at an increasing rate over a range of 75 to 125 % RDF. The maximum yield (16.33 t/ha) was observed by applying 125 % RDF

for crop raising which was significantly greater (13.17 and 23.15 per cent) over 100 and 75 % RDF, respectively. The positive response of multi-cut sorghum crop to balanced fertilization is in close agreement with the findings of Singh *et al.*, (2008), Singh *et al.*, (2010) and Singh *et al.*, (2014).

Table.1 Effect of spacing and fertility levels on yield of sorghum

Treatment	Yield (t/ha)					
	Green forage			Dry fodder		
	1 st Cutting	2 nd Cutting	Total	1 st Cutting	2 nd Cutting	Total
Spacing (cm x cm)						
30 × 10	30.50	24.27	54.77	7.71	8.20	15.91
30 × 15	27.54	22.27	49.81	7.01	7.58	14.59
45 × 15	25.10	20.64	45.74	6.44	7.07	13.52
S Em±	0.77	0.57	1.18	0.18	0.18	0.31
CD (P = 0.05)	2.31	1.70	3.53	0.54	0.53	0.94
Fertility levels						
75% RDF	23.31	21.18	44.49	6.02	7.24	13.26
100% RDF*	27.04	22.12	49.16	6.90	7.53	14.43
125% RDF	32.79	23.87	56.66	8.25	8.08	16.33
S Em±	0.77	0.57	1.18	0.18	0.18	0.31
CD (P = 0.05)	2.31	1.70	3.53	0.54	0.53	0.94

* 90 kg N+40 kg P₂O₅+40 kg K₂O /ha

Table.2 Effect of spacing and fertility levels on net return and BC ratio of sorghum

Treatments	Net return (₹ /ha)	B C ratio
Spacing (cm x cm)		
30 × 10	44881	1.41
30 × 15	37941	1.19
45 × 15	32541	1.03
S Em±	1650	0.05
CD (P = 0.05)	4947	0.16
Fertility levels		
75% RDF	31621	1.03
100% RDF*	37135	1.17
125% RDF	46607	1.42
S Em±	1650	0.05
CD (P = 0.05)	4947	0.16

* 90 kg N+40 kg P₂O₅+40 kg K₂O /ha

Economics

The data (Table 2) revealed that multi-cut sorghum spacing 30 cm x10 cm and 125 % RDF fetched the highest net return and B C ratio of ₹ 44881 /ha, 1.41 and ₹ 46607 /ha,1.42 respectively.

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