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# Yield, Productivity and Economics as Influenced by Different Fertility Levels and Genotypes in Single Cut Forage Sorghum under Rainfed Environment of the Northern Gujarat

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**Abstract:** A field experiment was conducted at Sorghum Research Station, SDAU, Deesa during kharif season in 2016 with six single cut forage sorghum genotypes (SPH 1794, SPH 1797, SPV 2317, SPH 1752, CSH 13 and CSV 21F) grown at three fertility levels {75% recommended dose of fertilizer (RDF), 100% RDF (80 kg N + 40 kg $P_2O_5$ $ha^{-1}$) and 125% RDF}. Results showed that application of 100% RDF markedly increased yield attributes like plant height, stem diameter, green and dry fodder yields, fodder productivity and profit in single cut forage sorghum. Genotypes SPH 1794, SPH 1797, SPV 2317 and SPH 1752 were promising as single cut forage sorghum under rain-fed environment of Northern Gujarat as they performed well in terms of growth, yields and productivity with higher remuneration than other genotypes.

**Key words:** Fertility levels, forage sorghum, genotypes, yield, north Gujarat.

India has one of the largest livestock sectors in the world with a holding of 11.6% of world livestock population**.** However, the country is facing acute shortage of feed and fodder thereby severely affecting the dairy economy. At present only 4.4% of total cropped area is devoted towards fodder cultivation due to which there is a net deficit of 23.56%, 63.50% and 51% in dry fodder, green fodder and concentrates availability, respectively (Anonymous, 2015). If concrete efforts are not directed timely to bridge this huge demand-supply gap, then India may have to import milk by 2021.

Sorghum is one of the important fodder crops which is fast growing, adaptive to varying environmental condition and palatable to the animals. It is being cultivated across the country in both kharif and rabi season. The productivity of sorghum genotypes is low because of poor management and low resource allocation. Both deficient and excess application of fertilizers hinders crop performance and pollutes environment. Hence, optimum nutrient supply is a key factor for obtaining higher yield and profits besides sustaining environment. However, response of genotypes may differ to different levels of fertility in a particular region. So, it becomes imperative to find out the performance of genotypes under various levels of fertilizer dose and also assess their economics. The present investigation was conducted to find out the optimum fertilizers level for different genotypes of single cut forage sorghum under rainfed environment.

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## Materials and Methods

A field experiment was conducted at Sorghum Research Station, SDAU, Deesa (Gujarat) during kharif season in 2016. The soil of the experimental site was loamy sand in texture, low in organic carbon (0.28%), pH (7.81), available nitrogen (158.12 kg N $ha^{-1}$), medium in available phosphorus (28.18 kg $P_2O_5$ $ha^{-1}$) and available potassium (273.30 kg $K_2O$ $ha^{-1}$). The site has semi-arid and sub-tropical climate with hot dry summer and cold winter. A total rainfall of 452 mm with 24 rainy days was recorded with maximum distribution in July and August in 2016 (Fig. 1). The experiment comprised of 18 treatment combinations with three fertility levels i.e. 75% recommended dose of fertilizer (RDF), 100% RDF and 125% RDF and six single-cut forage sorghum genotypes i.e. SPH 1794, SPH 1797, SPV 2317, SPH 1752, CSH 13 and CSV 21F. These treatments were laid out in factorial randomized block design and replicated thrice. Recommended dose of

fertilizers for forage sorghum was 80:40:0 kg N: $P_2O_5$:$K_2O$ ha$^{-1}$. Half dose of N and full doses of P were applied basally during final land preparation and the remaining dose of nitrogen was applied at 30 days after sowing. Seeds were sown on 19$^{th}$ July, 2016 at the rate of 20 kg ha$^{-1}$ with row spacing of 30 cm. Sources of nitrogen and phosphorus were urea and single super phosphate. Recommended package of practices were followed for raising the crop. One life saving irrigation (50 mm) was given during its entire cropping period. The crop was harvested at 75 days after sowing. Yield attributes of forage sorghum like plant height and stem diameter at harvest were recorded. Green and dry fodder yields of sorghum were recorded from net plot and then expressed in tons ha$^{-1}$.

Green and dry fodder productivity were calculated by using formula:

$$\text{Green/dry fodder productivity (kg ha}^{-1}\text{ day}^{-1}\text{)} = \frac{\text{Total green/dry fodder yield (kg ha}^{-1}\text{)}}{\text{Total crop duration (days)}}$$

Economics like cost of cultivation and net return were worked out by using prevailing market prices of inputs during the period of investigation. Net return was estimated by subtracting total cost of cultivation from gross return. Benefit-cost ratio (BCR) was worked out by using the formula:

$$\text{BCR} = \frac{\text{Net return (Rs. ha}^{-1}\text{)}}{\text{Total cost of cultivation (Rs. ha}^{-1}\text{)}}$$

Return per day of forage sorghum was evaluated by using the formula:

$$\text{Return per day (Rs. ha}^{-1}\text{ day}^{-1}\text{)} = \frac{\text{Net return (Rs. ha}^{-1}\text{)}}{\text{Crop duration (days)}}$$

Data of the experiment were statistically analysed using OPSTAT software designed by HAU, Hisar.

## Results and Discussion

### *Fertility levels*

Growth characters such as plant height and stem diameter increased significantly with increasing fertility level up to 100% RDF (Table 1). However, highest values of these characters i.e. plant height (218.28 cm) and stem diameter (4.26 cm) being registered under 125% RDF. Similarly, green fodder yield responded significantly up to 100% RDF (57.08 t ha$^{-1}$) though significantly highest value was noted under 125% RDF (25.92 t ha$^{-1}$). Sufficient supply of nitrogen might have enhanced synthesis of amino acids, proteins and growth promoting substances, which led to accelerated cell division and elongation, and ultimately resulted in luxuriant vegetative growth in terms of plant height, stem diameter and dry matter (Singh *et al*., 2015). In addition, phosphorus being responsible for energy transfer, could have

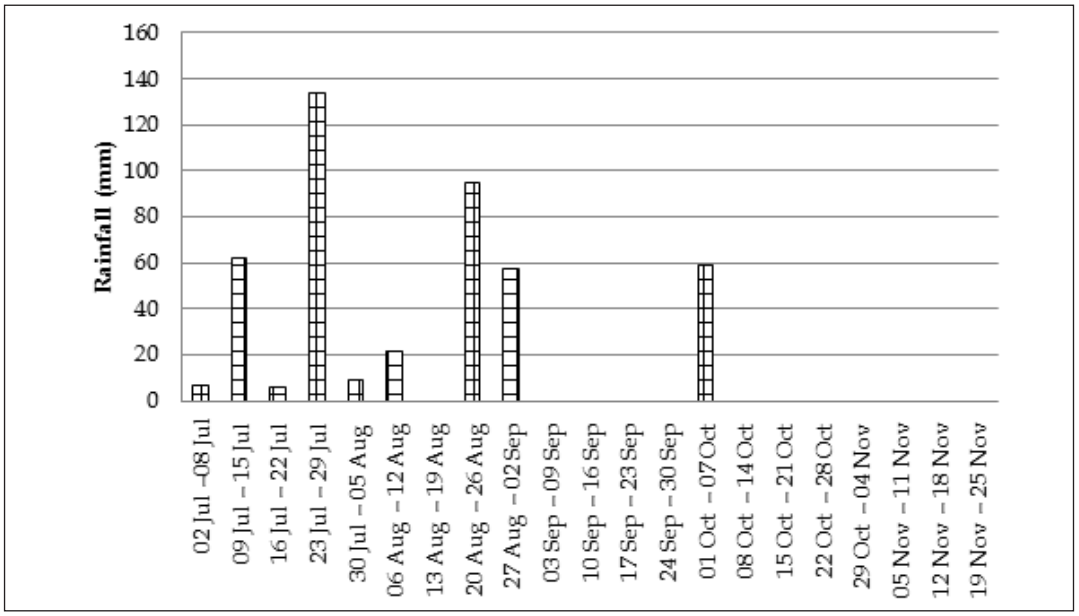


*Fig. 1. Weekly rainfall distribution during kharif season 2016.*

*Table 1. Yield attributes, yields, productivity and economics of various genotypes of sorghum as influenced by different fertility levels*

| Treatment | Plant height at harvest (cm) | Stem diameter at harvest (cm) | Green fodder yield (t ha$^{-1}$) | Dry fodder yield (t ha$^{-1}$) | Green fodder productivity (kg ha$^{-1}$ day$^{-1}$) | Dry fodder productivity (kg ha$^{-1}$ day$^{-1}$) | Net return ($10^3$ x Rs. ha$^{-1}$) | BCR | Return per day (Rs. ha$^{-1}$ day$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| Fertility levels (F) | | | | | | | | | |
| 75% RDF | 204.39 | 3.99 | 51.79 | 21.33 | 690.57 | 28.45 | 105.52 | 4.40 | 1406.87 |
| 100% RDF | 213.16 | 4.20 | 57.08 | 24.08 | 761.01 | 32.10 | 117.96 | 4.77 | 1572.84 |
| 125% RDF | 218.28 | 4.26 | 59.80 | 25.92 | 797.29 | 34.56 | 124.01 | 4.86 | 1653.40 |
| SEd | 3.24 | 0.06 | 1.65 | 0.70 | 22.03 | 0.93 | 4.13 | 0.17 | 55.07 |
| CD (P≤0.05) | 6.61 | 0.13 | 3.37 | 1.42 | 44.96 | 1.90 | 8.43 | 0.34 | 112.39 |
| Genotypes (G) | | | | | | | | | |
| SPH 1794 | 204.18 | 4.23 | 55.38 | 23.44 | 738.39 | 31.25 | 113.39 | 4.52 | 1511.83 |
| SPH 1797 | 207.60 | 4.35 | 59.21 | 24.90 | 789.45 | 33.19 | 122.96 | 4.90 | 1639.50 |
| SPV 2317 | 213.89 | 3.95 | 56.97 | 23.88 | 759.56 | 31.84 | 118.36 | 4.92 | 1578.09 |
| SPH 1752 | 230.33 | 4.31 | 59.56 | 25.29 | 794.17 | 33.72 | 123.85 | 4.93 | 1651.28 |
| CSH 13 | 207.36 | 4.31 | 53.71 | 22.76 | 716.13 | 30.35 | 109.21 | 4.36 | 1456.18 |
| CSV 21F | 208.29 | 3.76 | 52.50 | 22.40 | 700.05 | 29.86 | 107.20 | 4.45 | 1429.33 |
| SEd | 4.58 | 0.09 | 2.34 | 0.99 | 31.15 | 1.31 | 5.84 | 0.24 | 77.88 |
| CD (P≤0.05) | 9.35 | 0.18 | 4.77 | 2.01 | 63.58 | 2.68 | 11.92 | 0.48 | 158.95 |

significantly increased plant growth especially at early crop growth stage which was ultimately reflected in higher green fodder and dry matter yield. Similar findings were reported by Satpal *et al.* (2016) also.

Green fodder productivity improved statistically with increasing levels of fertility up to 100% RDF (761.01 ha$^{-1}$ day$^{-1}$). However, in case of dry fodder productivity, highest value was recorded in 125% RDF (34.56 ha$^{-1}$ day$^{-1}$). Application of 125% RDF also registered highest values of net return (Rs. 124.01 x $10^3$ ha$^{-1}$), BCR (4.86) and return per day (Rs.1653.40 ha$^{-1}$ day$^{-1}$), which was statistically at par with 100% RDF. This could be attributed to better growth and yield under high fertility level.

*Genotypes*

Amongst all genotypes, SPH 1752 registered significantly highest plant height (230.33 cm) which was followed by SPV 2317 (213.89 cm). However, in case of stem diameter genotype SPH 1797 had maximum value (4.35 cm) which was statistically at par with SPH 1794, SPH 1752 and CSH 13. Variation in genetic constituent of different genotypes could be the reason for their differential behaviours. Earlier findings of Rana *et al*. (2013) corroborated with our results. Highest green fodder yield (59.56 t ha$^{-1}$) and dry fodder yield (25.29 t ha$^{-1}$) were recorded under SPH 1752 which was statistically at par with SPH 1794, SPH 1797 and SPV 2317 and significantly better than rest of the genotypes. The increased fodder yield of SPH 1752, SPH 1794, SPH 1797 and SPV 2317 could mainly be attributed to comparatively higher plant height and stem diameter of these genotypes. Several workers have also recorded the variation among the genotypes of sorghum for forage yield and growth characteristics (Ibrahim, 1999; Hanuman *et al*., 2008; Satpal *et al*., 2016).

Highest green (794.17 kg ha$^{-1}$ day$^{-1}$) and dry (33.72 kg ha$^{-1}$ day$^{-1}$) fodder productivity was recorded in case of genotype SPH 1752, which was statistically at par with SPH 1794, SPH 1797 and SPV 2317 and it was significantly better than rest of genotypes. Similarly, SPH 1752 had maximum net return (Rs. 23.85 x $10^3$ ha$^{-1}$), BCR (4.93) and return per day (Rs. 1651.28 ha$^{-1}$ day$^{-1}$), which was statistically at par with genotypes SPH 1794, SPH 1797 and SPV 2317. The economic benefits accrued could be attributed to better growth and yield of these genotypes under high fertility level.

Based on above findings, it can be inferred that application of 100% RDF to genotypes SPH 1794, SPH 1797, SPV 2317 and SPH 1752 should be advocated for high yield, productivity and profitability for single cut forage sorghum production under rainfed environment of the Northern Gujarat.

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