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Response of single-cut fodder sorghum genotypes to fertility levels under rainfed conditions of Rajasthan

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■ **ABSTRACT :** The objectives were to study the appropriate sorghum fodder variety for this zone, work out the optimum fertility level for test genotypes and to study the economically viable treatment. Soil of experimental field was calcareous in nature, medium in available nitrogen (272.00), phosphorus (21.69) and high in available potassium (284.60). The experiment consisted of 24 treatment combinations comprising four levels of fertility (50, 75, 100 and 125% RDF) and six varieties (SPV-2185, SPV-2191, CSV-21F, HC- 308, CSV-30F and PC-1080) laid out in Factorial Randomized Block Design and replicated thrice. The result showed that among the genotypes, SPV-2185 produced maximum plant height, DMA at 25, 50DAS and at harvest, stem girth and number of leaves plant^{-1} at harvest, green and dry fodder yield, crude protein, ether extract, crude fibre mineral ash content and TDN in fodder. This genotype also estimated significantly gross and net returns over rest of the genotypes. However, maximum HCN content at 25 and 50DAS, organic carbon, available P and K status in soil after harvest with variety SPV-2191. Genotype CSV-21F produced maximum nitrogen status in soil. An application of 125% RDF recorded maximum plant height, stem girth, number of leaves at harvest, dry matter accumulation at various growth stages, green fodder and dry fodder yield, crude protein, crude fibre, ether extract, mineral ash content, TDN, HCN at 25 and 50 DAS, available organic carbon nitrogen phosphorus and potassium in soil after harvest over lower doses in all the above parameters. Highest nitrogen free extract were obtained under 50% RDF while, the lowest being recorded fewer than 125% RDF. In case of gross return, net return and B:C ratio with application of 125% RDF recorded significantly higher over 50% RDF, 75% RDF and 100% RDF.

■ **KEY WORDS :** DMA, TDN, HCN, SPV-2191, CSV-21F

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In Indian agriculture, livestock plays a vital role in the development and progress of mankind with crop production programme as a complementary enterprise. India is basically an agricultural country and about 70% of its people live in villages. Their livelihood is dependent mainly on agriculture and animal husbandry. India has a huge livestock population of 512.1 million (Agriculture Statistics, 2016). Yet, the productivity of milk and other livestock products is about the lowest in the world because of huge gap between demand and supply of all kind of feed and fodders. The projected shortages of dry and green fodder are 23.46 and 62.76% compared with the requirement of 589 and 1061 million tonnes for the current livestock population, respectively (ICAR, 2012). The available fodder can meet the demand of only 47% total livestock population. Hence, all our efforts should be focused for achieving higher fodder yield. Fodder based cheaper feeding strategies are required to reduce the cost of quality livestock product as the feed alone constitutes 70 per cent of the milk production cost. There is tremendous pressure of livestock on available total feed and fodder, as land available for fodder production has been decreasing. To meet the current requirement of livestock production and also its annual growth as a result of increase in population, the deficit in all components of fodder, dry crop residues and feed has to be met either from increasing productivity, utilizing untapped feed resources or through imports. In animal feed supply, coarse cereals have a major role and four major cereals *viz.*, maize, barley, sorghum and pearl millet account for about 44% of the total feed. Production of these cereals is stagnating at around 30 million tonnes thus there is an urgent need to narrow down the gap between demand and supply of good quality feed and fodder and to improve health and productivity of vast livestock population in India by enhancing productivity of fodder crops. The total area under cultivated fodders is about 8.3 million ha, sorghum amongst the *Kharif* crops (2.6 million ha) and berseem (Egyptian clover) amongst the *Rabi* crops (1.9 million ha) occupy about 54% of the total cultivated fodder cropped area. Sorghum is major fodder crop in *Kharif*, meets 60% demand of livestock in India, which is not only a staple food but it also fulfills the fodder requirements of cattle in order to make animal husbandry sector more viable. In last 15 years, area under grain sorghum has been decreasing in favour of other crops. Forage sorghum forms a specialized production system to cater need of commercial dairy farms, which are largely confined to northern India and it is mostly preferred over maize for its less input requirement and drought tolerance. Its single cut is preferred over multicuts in *Kharif* season as it suitably fits in sorghum–wheat crop sequence. Sorghum stover is the main feed resource in the semiarid regions of Tamil Nadu, Karnataka, Andhra Pradesh, Maharastra, Gujarat, Rajasthan and UP. It also holds a good promise as a fodder crop in low and uncertain rainfall areas, especially in Rajasthan because of its high tolerance to high temperature, great adaptability to environments from wet to drought, resistance to lodging and a very remarkable ability to recover from short interval of drought. It is estimated that sorghum stover constitutes 20-45% of total dry weight of roughage used for dairy livestock during normal monsoon year and upto 60% during drought year in the semiarid regions. There is a great need to maintain regular and well balanced supply of more nutritious feed and fodder for stall feeding animals as well as productive milch herds, which would accelerate the growth of milk production in the state. Amongst the crop growth factors, adequate fertilizers specially, nitrogenous, phosphatic and potashic are considered to be of prime importance due to their profound impact on various aspects of growth and development of the crop. Fertilizers are rich source of plant nutrients required for increasing crop productivity. The balanced use of fertilizers can help in providing much needed nutrients to the soil, thereby increasing crop yields, improving quality of fodder and reducing damage to the environment. It also plays a key role in the modernization of Indian agriculture and in making the country sufficient in fodder production for animals. Results of the research carried out at different part of the country also showed that the sorghum genotypes are only able to express their inherent genetic production potential when they are supplemented with need based fertilizers. Similarly, looking to the response to recommended doses of fertilizers, there is needed to assess the effect of higher levels of nitrogen, phosphorus and potassium to break the yield plateau. During the last few years a number of high yielding varieties of fodder sorghum have been developed. Genotype of a crop plays an important role in increasing crop production, but information on the response of newly evolved genotypes/varieties to various fertility levels is the meagre. So, it is reasonable to assess the relative performance of different sorghum genotypes with different levels of fertilizer under the agro climatic situation of southern Rajasthan. Keeping the above facts in view, it is considered appropriate to carry out the investigation entitled "response of single-cut fodder forghum genotypes to fertility levels under rainfed conditions of Southern Rajasthan" with following objectives:- (i) To study comparative performance of selected single-cut fodder sorghum genotypes for growth, productivity and quality of fodder. (ii) To evaluate the effect of fertility levels on productivity and quality of fodder. (iii) To work out economic evaluation of treatments.

METHODOLOGY

The details of materials used, experimental techniques followed and criteria adopted for treatment evaluation during the course of investigation are presented in this chapter under appropriate heads.

Physico-chemical characteristics of the soil :

Soil samples were taken from different spots of the experimental field upto a depth of 15cm and then a composite sample was prepared. This representative soil sample was then subjected to physical and chemical analysis to ascertain the physico-chemical properties and availability of major elements in the soil of the experimental field prior to experimentation. The results of the analysis along with methods used are presented in Table A. The data indicate that the soils of the experimental field was clay loam in texture, slightly alkaline in reaction, low in available nitrogen, medium in available phosphorus and high potassium as well as high in calcium carbonate.

Experimental details :

In present investigation six genotypes were evaluated at four fertility levels. The 24 combinations were as follows (Table B and C).

Brief description of varieties tested:

CSV-21F :

It is a sweet sorghum single cut fodder variety released from Navsari in 2006. The variety has attained

Table A : Mechanical and physico-chemical properties of soil of the experimental soil

Particulars	Value	Method	Reference
Mechanical analysis			
Sand (%)	34.60	Bouyoucos Hydrometer	Landor (1991)
Silt (%)	30.90	Bouyoucos Hydrometer	Landor (1991)
Clay (%)	34.10	Bouyoucos Hydrometer	Landor (1991)
Textural class	Clay loam	Triangular diagram	Brady and Weil (2002)
Physical analysis			
Bulk density (Mg M^{-3})	1.47	Core sampler method	Black (1965)
Particle density (Mg M^{-3})	2.60	Pycnometer	Bowles (1992)
Porosity (%)	42.52		Black (1965)
Chemical analysis			
Organic carbon (%)	0.78	Rapid titration method	Walkley and Black (1947)
Organic matter (%)	1.34	By factor (1.724)	
Available N (Kg ha^{-1})	272.00	Modified Kjeldahl distillation method	Subbiah and Asija (1956)
Available P (Kg ha^{-1})	21.69	Olsen's method	Olsen *et al.* (1954)
Available K (Kg ha^{-1})	284.60	Flame emission spectrophotometer	Jackson (1967)
pH (1:2 soil water suspension)	8.1	Method No. 21 (b), USDA Hand book No. 60	Richards (1954)
Electrical conductivity (1:2 Soil water suspension) (dSm^{-1} at 25^0C)	0.82	Method No. 4, USDA Hand book No. 60	Richards (1954)

Table B : Treatments

Varieties	Symbol	Varieties	Symbol	Fertility levels	Fertility levels
SPV-2185	G_1	CSV-21F	G_4	50% RDF- F_1	125% RDF- F_4
SPV-2191	G_2	CSV-30F	G_5	75% RDF- F_2	(100% RDF=80 kg N+40 kg
HC-308	G_3	PC-1080	G_6	100% RDF- F_3	P_2O_5 +40 kg K_2O ha^{-1})

Table C : Treatment combinations

V_1F_1	V_2F_1	V_3F_1	V_4F_1	V_5F_1	V_6F_1
V_1F_2	V_2F_2	V_3F_2	V_4F_2	V_5F_2	V_6F_2
V_1F_3	V_2F_3	V_3F_3	V_4F_3	V_5F_3	V_6F_3
V_1F_4	V_2F_4	V_3F_4	V_4F_4	V_5F_4	V_6F_4

220-270cm plant height and flowered in 70-76 days after sowing. The yield potential of variety ranges from 375-410qha^{-1} as green fodder and 112 to 125qha^{-1} dry fodder. The variety has broad and long leaves resistant to stem borer and having very low HCN content

PC-1080 :

It is a early single cut forage sorghum variety released from Udaipur. The variety flowered in 60-65 days after sowing. The yield potential of this variety ranges 300-400q ha^{-1} as green fodder and 125-135q ha^{-1} dry fodder. It has superior quality fodder with 6.8% protein and 54.80% *in vitro* digestible dry matter

CSV-2185 :

This variety was developed by NRC Sorghum, Hyderabad and released in 1992 as a dual purpose variety for the whole country. It is a single cut variety with 120 t ha^{-1} of green fodder and 36q seed yield. Its stems are tall, sweet and juicy. At 50% flowering it provided 350-450q green and 120-130 q ha^{-1} dry fodder. It is resistant to leaf diseases and drought as well as tolerant to shoot fly and stem borer.

HC-308 :

This variety was released from Haryana and recommended for whole northern part of India as single cut forage. It is tall (220-230cm), leafy with green mid rib, and taken 70-74 days to flower initiation, having stem sweet and juicy. The yield potential of the variety ranges between 410-420 q ha^{-1} as green fodder and 125-130q ha^{-1} dry fodder.

SPV-2191 :

SPV 2191 is the most promising genotype for fodder yield, per day productivity and quality. SPV 2191 had good level of resistance to shoot fly, stem borer and leaf diseases.

CSV-30F :

CSV-30F genotype developed by MPKV Rahuri in maharastra. It is a single cut genotype with 120 t ha^{-1} of green fodder and 36 q seed yield. Its stems are tall, sweet and juicy. If harvest at 50% flowering provided 350-450q green and 120-130q ha^{-1} dry fodder. It is resistant to leaf diseases and drought as well as tolerant to shoot fly and stem borer.

Details of crop rising :

The details of the operation done during the experimentation are given as under:

Fertilizer application :

Crop was fertilized with following doses of nitrogen *i.e.*, 40, 60 and 80 along with 20, 30, and 40kg of both P_2O_5 and K_2O ha^{-1}. Nitrogen was supplied through urea and DAP and phosphorus was given through DAP, whereas, potassium was supplied through MOP. Full dose of phosphorus and potassium and half dose of nitrogen of each level were applied at the time of sowing as basal dose. Remaining half dose of N was top dressed in standing crop after 40 days of sowing.

Sowing :

Sorghum was shown on 19th July, 2016 in rows, keeping row to row distance 30cm and 10cm plant to plant with recommended seed rate (40kg ha^{-1}). The number of rows were 15 in 4.5m x 5m plot size.

Plant protection:

Phorate 10G was applied @ 20kg ha^{-1} in furrow at sowing to minimize the infestation of shoot fly, stem borer and other soil borne insects. The crop remained diseases free during the season of experimentation. To control all types of weeds in initial stage of crop growth 0.5kg ha^{-1} atrazine was sprayed as pre emergence application.

Fodder harvesting :

Crop was harvested on 04-10-2016. Two border rows from each side and half meter from either sides of the plot were harvested first to mitigate the border effect and bulked together. Then, crop was harvested from net plot area individually, tagged and weighed plot wise and expressed in kg ha^{-1} as green fodder yield.

Treatment evaluation :

The treatments were evaluated on the basis of following observations.

Plant height :

Height of five plants was recorded from ground level to the top of the main shoot at harvest in each plot. The mean plant height for each treatment was worked out in cm.

Stem girth :

Randomly selected five plants were used for stem girth and it was recorded at middle portion of the plant in cm by using a Varnier calipers. It was recorded at harvest.

Number of leaves plant^{-1} :

Total numbers of leaves for five randomly selected plants were counted at harvest from each experimental unit. These were averaged and expressed as number of leaves plant^{-1}.

Leaf to stem ratio :

Weight of leaf and stem were taken of five randomly selected plants from experimental unit at harvest. The average and then ratio of both expressed as leaf stem ratio.

Dry matter accumulation plant^{-1} :

The periodic changes in dry matter accumulation plant^{-1} were recorded at 25, 50DAS and at harvest by taking randomly selected five plants from inner border rows of each treatment. The samples were chopped, air dried for few days and then oven dried at 65ºC for 72 hours to obtain a constant. These were weighed to estimate dry matter plant^{-1} at respective stage and expressed in g plant^{1}.

Green fodder yield:

Crop was harvested at about 74DAS for green fodder. Two border rows from each side of the individual plot and half meter from either side, as border were harvested first. Then green fodder crop was harvested from each net plot, tagged, weighed to estimate green fodder yield q ha^{-1}.

Dry fodder yield :

The sample bundles of green fodder from each net plot were initially weighed and left for 30 days to sun drying. After sun drying these bundles were again weighed and calculated to dry fodder yield in q ha^{-1}.

Plant analysis :

Quality parameters :

Oven dried samples were ground in a "Willey Mill" and passed through a screen containing 16 mesh cm^{-2} and then elements of fodder quality were estimated on dry weight basis. These elements along with methods used for analysis are as follows:

Crude protein content and production :

Crude protein content was determined by multiplying the nitrogen content of fodder in percentage with factor 6.25 as described by AOAC (2012). Crude protein content (%) = Nitrogen content (%) x 6.25

$$\text{Crude protein} = \frac{\text{Crude protein content (\%) x Dry matter yield (kg ha}^{-1})}{\text{Production (kg ha}^{-1})\ 100}$$

Crude fibre content and production:

The crude fibre content was determined by the method described by AOAC (2012). The percentage of this ingredient was calculated as under.

$$\text{Crude fibre (\%)} = \frac{\text{(Wt. of crucible + dry residue) - (Wt. of crucible + Ash)}}{\text{Amount of substance taken}} \text{x100}$$

$$\text{Crude fibre production (kg ha}^{-1}) = \frac{\text{Crude fibre content (\%) x Dry matter yield (kg ha}^{-1})}{100}$$

Ether extract content and production:

The ether extract content was determined by Soxhlet apparatus using petroleum ether (B.P. 40-60^{0}C) as described by AOAC (2012). The percentage of this ingredient was calculated as follows:-

$$\text{Ether extract content (\%)} = \frac{\text{Wt. of oil flasks with extract - Wt. of oil flask}}{\text{Amount of substances taken}} \text{x100}$$

$$\text{EE production (kg ha}^{-1}) = \frac{\text{Ether extracts content (\%) x Dry matter yield (kg ha}^{-1})}{100}$$

Mineral ash content and production:

The mineral matter content was determined by using Muffle furnace method as described by AOAC (2012). The percentage of mineral matter was calculated as under:

$$\text{Mineral ash content (\%)} = \frac{\text{Wt. of crucible with ash - Wt. of crucible}}{\text{Amount of substances taken}} \text{x100}$$

$$\text{M.A. production (kg ha}^{-1}) = \frac{\text{Mineral ash (\%) x DM yield (kg ha}^{-1})}{100}$$

Total digestible nutrient (%) content and production :

For calculating TDN content in percentage, digestible value of various components *viz.*, crude protein, crude fibre, ether extract and nitrogen free extract were computed by using digestible co-efficient as given in Table D.

Table D : Digestible co-efficient of various nutritional components used for the estimation of TDN content (%)

Crop	Digestibility co-efficient			
	CP	EE	CF	NFE
Sorghum	44	44	59	60

Ranjan (1983)

Total digestible nutrients in percentage were calculated by the formula given by Moore *et al.* (1953). TDN content (%) = Digestible crude protein (%) + Digestible crude fibre (%) +Digestible NFE (%) + [Digestible ether extract (%) x 2.25*]* Digestible fat was multiplied by 2.25 as fat contains 2.25 times more energy than carbohydrate and protein.

$$\text{TDN production (kg ha}^{-1}) = \frac{\text{TDN content (\%) x Dry matter yield (kg ha}^{-1})}{100}$$

Nitrogen free extract content and production :

It was calculated by adding together the percentage crude protein, ether extract, crude fibre and mineral matter and subtracting the total of these values from 100 as described by Knowles and Watkins (1960)

NFE content (%) =100 – [Crude protein (%) + Ether extract (%) + Crude fiber (%)+ Mineral matter (%)]

$$\text{NFE production (kg ha}^{-1}) = \frac{\text{NFE content (\%) x Dry matter yield (kg ha}^{-1})}{100}$$

HCN estimation:

The HCN content was determined by the picric acid method of Hogg and Ahlgreen (1942) at 25 and 50DAS. Collect five representative plants from each treatment, cut and remove the root portion. Wash the plants in tap water to remove any insect/pest, dust present on stem or leaves. Dry the plants in folds of blotting paper. Then chop each part of plant (including leaves and stem but not roots) separately into as small pieces as possible. Mix the sample and take a representative sample of 1g in duplicate from each plot. Then finally chopped samples of weight 1g were kept in separate 15 ml capacity glass test tubes. Add 0.2 ml of chloroform to it suspend a filter paper strip (Whatman No. 1 of size 1cm width and 10 cm long) dipped in alkaline picric acid along with a cork(bar cork). Keep this test tube with chopped plant sample (1g) and filter paper strip for 24 hours. After 24 hours take out the filter paper strip and put this strip inside 10 ml of distilled water (measured with a pipette) in another set of 15 ml capacity glass test tubes. Immerse this strip completely in the 100 ml distilled water with the help of a glass rod. Then mix the strip in side carefully by vortexing it using a test tube vortex mixer until all colour of strip is dissolved in the distilled. Two or three time vortexing is enough. Then remove the filter paper strip from the distilled water. Take optical density of the coloured distilled water in a colorimeter at 515 nm wavelength. In the chopped plant samples (1g) remained in the sample, again add 0.2ml of chloroform and place another fresh filter paper strip dipped in picric acid with the help of the cork as done before. Allow it to retain for another 24 hours. Then, after the second 24 hours, repeat the same procedure. In this way we will have two optical densities (24 hours and 48 hours) for each sample. Simultaneously also prepare a standard curve using KCN. The amount of HCN in ppm on dry weight basis is calculated by calibrating the absorbance with KCN (5-40 ppm) in water as standard (Gilchrist *et al.,* 1967).

$$\text{Dry matter factor for estimation of HCN} = \frac{X - Y}{Y}$$

where, X = Weight of fresh chopped plant sample, Y = Weight of oven dried plant sample.

Therefor $\text{HCN} = \frac{R}{\text{Dry matter factor}}$

R = Reading taken from automatic HCN analyzer

Soil analysis :

Available nitrogen :

The available nitrogen content of soil samples was determined by Modified Kjeldahl distillation method described by Subbiah and Asija (1956) and expressed in kg ha^{-1}.

Available phosphorus :

Available phosphorus content of soil samples was estimated by Olsen method (Olsen *et al.,* 1954) and expressed in kg ha^{-1}.

Available potassium :

Available potassium was estimated by flame photometer from the extract of neutral normal ammonium acetate (Jackson, 1967) and expressed in kg ha^{-1}.

Organic carbon :

Organic carbon content of soil samples was estimated by Walkley and Black method (1947) and expressed in per cent.

Economics :

To ascertain the most remunerative treatment, economics of different treatments were worked out in terms of net returns Rs. ha^{-1}, which was computed by deducting cost of cultivation from income per ha fetched by the respective treatment. Further, to ascertain profitability per rupee investment, benefit: cost ratio was calculated by using following formula:

$$\text{BC ratio} = \frac{\text{Net returns (Rs. ha}^{-1})}{\text{Total cost (Cost of cultivation + cost of treatments) (Rs. ha}^{-1})}$$

RESULTS AND DISCUSSION

Data pertaining to the effect of different treatments were properly tabulated and the result of all the main effect have been described invariable while only significant interaction effect have been presented with succeeding paragraph.

Growth parameters :

Plant stand at 30DAS :

A reference to data presented in Table 1 revealed that neither genotypes nor fertility levels significantly affected the plant stand at 30DAS.

Plant height at harvest :

Genotypes:

Data on plant height at harvest presented in Table 1 indicated that SPV-2185 obtained maximum plant height followed by SPV-2191.The variety SPV-2185 was found significantly superior over rest of the varieties except SPV-2191. Further data revealed SPV-2191 were at par in plant height at harvest.

Fertility levels :

The maximum plant height was observed when the crop was fertilized with 125% RDF, however its effect was at par with that of 100% RDF but significantly superior over that of 50% RDF and 75%RDF. Application of 125% RDF to sorghum genotypes accounted for an increase of 11.03, 8.24 and 3.73% height of crop plant over 50% RDF, 75% RDF and 100% RDF, respectively.

Days to 50% flowering:

Genotypes :

A critical examination of data revealed that single-cut forage sorghum genotypes differed significantly with respect to develop days to 50% flowering. Genotype SPV-2185 attained days to 50% flowering earlier by 1.09, 1.34, 1.51, 1.54 and 2.35 days compared to genotypes CSV-21F, PC-1080, SPV-2191, CSV-30F and HC-308, respectively. Further genotypes SPV-2191, CSV-21F,

Table 1 : Effect of genotypes and fertility levels on plant stand, plant height and days to 50% flowering of sorghum

Treatments	Plant stand (no. of plants m^{-2}) at 30DAS	Plant height (cm) at harvest	Days to 50% flowering
Genotypes			
SPV-2185	31.60	217.35	74.67
SPV-2191	31.49	209.41	76.18
HC-308	31.48	199.46	77.02
CSV-21F	31.69	197.06	75.76
PC-1080	31.47	199.79	76.01
CSV-30F	31.68	201.06	76.21
S.E. ±	0.34	4.95	0.44
C.D. (P = 0.05)	NS	14.11	1.27
Fertility levels			
50% RDF	31.41	194.01	77.99
75% RDF	31.63	199.01	76.27
100% RDF*	31.56	207.65	75.05
125% RDF	31.67	215.41	74.60
S.E. ±	0.28	4.04	0.36
C.D. (P = 0.05)	NS	11.52	1.04

NS=Non-significant

CSV-30F and PC-1080 were statistically at par with each other in this respect.

Fertility levels :

It is explicit from the data that fertility levels had significant effect to develop sorghum plants on days to 50% flowering. Application of 125% RDF took minimum days to 50% flowering as compared to 50% RDF and 75% RDF and 100% RDF. The magnitude of increase in days to 50% flowering under application of 50% RDF and 75% RDF and 100% RDF were 4.54, 2.23 and 0.60% as compared to 125% RDF

Number of leaves plant^{-1} at harvest:

Genotypes :

It is evident from data presented in Table 2 that variety SPV-2185 provided maximum number of leaves plant^{-1} at harvest which was significantly superior over all other genotypes under test. Remaining varieties were statistically at par with each other except HC-308 which was lowest in number of leaves plant^{-1}.

Fertility levels:

It can be inferred from the data presented in Table 2 that maximum number of leaves plant^{-1} were observed with application of 125% RDF which was statistically superior over 50% RDF, 75% RDF and 100% RDF by 15.82, 6.56 and 5.97%, respectively. However, application of 100% RDF was at par with 75% RDF.

Stem girth at harvest:

Genotypes :

Data presented in Table 2 revealed that variety CSV-30F show maximum stem girth which was significantly higher over all other varieties at harvest. Second maximum stem girth was shown by SPV-2185 which was significantly higher over HC-308, CSV-21F and PC-1080 but statically at par with SPV-2191.

Fertility levels :

A reference to data presented in Table 2 showed that application of 125% RDF significantly increased the stem girth at harvest over lower fertility levels. The magnitude of increase in stem girth by 125% RDF was 1.56, 1.53 and 1.41cm dues 100%, 75% and 50% RDF.

Leaf to stem ratio at harvest :

Genotypes :

A perusal of data presented in Table 2 revealed that sorghum genotypes significantly influenced the leaf to stem ratio at harvest. Among tested genotypes, highest leaf to stem ratio was recorded with CSV-21F followed by SPV-2191. CSV-21F was observed significantly superior over all other tested genotypes. However, it was statically at par with SPV-2191 and SPV-2185.

Table 2: Effect of genotypes and fertility levels on number of leaves plant^{-1}, stem girth and leaf to stem ratio at harvest of sorghum

Treatments	Number of leaves plant^{-1}	Stem girth (cm)	Leaf to stem ratio
Genotypes			
SPV-2185	13.55	1.60	24.63
SPV-2191	12.83	1.55	24.78
HC-308	11.87	1.48	21.59
CSV-21F	12.42	1.49	26.57
PC-1080	12.30	1.47	23.95
CSV-30F	12.69	1.67	24.11
S.E. ±	0.23	0.02	0.70
C.D. (P = 0.05)	0.67	0.06	2.01
Fertility levels			
50% RDF	11.63	1.41	23.89
75% RDF	12.64	1.53	23.89
100% RDF*	12.71	1.56	23.65
125%RDF	13.47	1.67	25.65
S.E. ±	0.19	0.01	0.57
C.D. (P = 0.05)	0.54	0.05	NS

NS=Non-significant

Fertility levels :

Application of fertility levels failed to exhibit any significant influence on leaf to stem ratio at harvest (Table 2).

Dry matter accumulation plant^{-1}:

At 25DAS:

Genotypes:

Data on dry matter accumulation plant^{-1} at 25DAS presented in Table 3 indicate that variety SPV-2185 provided significantly higher dry matter accumulation plant^{-1} at 25 DAS over remaining varieties except SPV-2191 and CSV-30F. Variety SPV-2191 found second best in this manner. The per cent increases in dry matter accumulation plant^{-1} recorded under variety SPV-2185 were by 9.42, 9.98 and 12.06% over the varieties CSV-21F, PC-1080 and HC-308, respectively at harvest.

Fertility levels:

It is clear from the data presented in Table 3 that application of 125% RDF recorded significantly higher dry matter accumulation plant^{-1} over 50% RDF but at par with 75% RDF and 100% RDF. It was recorded that 100% RDF failed to show any significant variation over 75% RDF at 25DAS.

At 50 DAS :

Genotypes:

A reference to data indicated that variety SPV-2185 brought about maximum dry matter accumulation plant^{-1} followed by SPV- 2191 at 50 DAS. Variety SPV-2185 was found significantly superior over remaining tested varieties except SPV- 2191.

Fertility levels:

Application of 125% RDF provided significantly maximum dry matter accumulation plant^{-1} (54.60g plant^{-1}) at 50DAS over 50% RDF and 75% RDF. However, it was statically at par with 100% RDF. Application of 100% RDF also proved significantly superior over 50% RDF. The corresponding per cent increase with application of 125% RDF were by 19.15 and 8.03% over 50% RDF and 75% RDF, respectively.

At harvest :

Genotypes :

Data on dry matter accumulation per plant of sorghum at harvest presented in Table 3 shows that dry matter accumulation plant^{-1} at harvest was significantly influenced by genotypes. Maximum dry matter plant^{-1} was recorded with genotypes SPV-2185. These genotypes brought about significantly higher dry matter accumulation at harvest over remaining varieties but at par with SPV- 2191.

Fertility levels :

Data in Table 3 reveals that application of 125%

Table 3 : Effect of genotypes and fertility levels on dry matter accumulation at different growth stages of sorghum

Treatments	Dry matter accumulation (g plant^{-1})		
	25 DAS	50 DAS	At harvest
Genotypes			
SPV-2185	6.50	54.64	94.87
SPV-2191	6.17	51.57	89.27
HC-308	5.80	48.71	83.12
CSV-21F	5.94	49.66	84.42
PC-1080	5.91	48.62	82.99
CSV-30F	6.08	47.47	81.33
S.E. ±	0.15	1.24	2.09
C.D. (P = 0.05)	0.44	3.53	5.95
Fertility levels			
50% RDF	5.61	45.15	74.25
75% RDF	6.05	49.80	87.37
100% RDF*	6.19	51.69	89.43
125%RDF	6.41	53.80	92.96
S.E. ±	0.15	1.01	1.70
C.D. (P = 0.05)	0.44	2.88	4.86

RDF accumulated significantly maximum dry matter plant^{-1}at harvest over 50% RDF and 75% RDF. However, it was statistically equivalent with 100% RDF. Application of 100% RDF also proved significantly superior over 50% RDF in accumulation of dry matter plant^{-1} at harvest. The corresponding per cent increase with 125% RDF were by 25.19 and 6.39, over 50% RDF and 75% RDF, respectively.

Fodder yield :

Green fodder yield :

Genotypes:

Data presented in revealed Table 4 that among the genotypes, SPV-2185 brought about significantly maximum green fodder production over rest of the tested genotypes. It was observed that genotype SPV-2185 produced 6.71 t ha^{-1} greener fodder yields in comparison to second high yielded variety SPV-2191 which was 18.84 per cent higher over this genotype. It was also noted that variety SPV-2185 provided 42.73, 43.31, 43.84 and 55.24% higher green fodder yield over CSV-30F, PC-1080, HC-308 and CSV-21F, respectively. There was minimum green fodder yield recoded with CSV-21F.

Fertility levels :

Application of nutrients from 75% RDF to 125% RDF significantly increased the green forage yield of sorghum; however, the increase with 75% RDF over 50% RDF was no significant. The increase was in order of 8.68, 45.08 and 65.29 per cent, respectably with application of 75% RDF and 100% RDF and 125% RDF over 50% RDF (24.89 t ha^{-1}). Data further show that significant increase by 13.93% was observed in green forage yield when crop was fertilized with 125% RDF over 100% RDF.

Interaction effect of genotypes and fertility levels:

The interactive effect of sorghum genotypes with fertility levels on green forage yield (Table 4a) revel that sorghum genotypes SPV-2185 and SPV-2191 produced significantly higher green fodder yield than HC-308, CSV-21F, PC-1080 by and CSV-30F at all the four fertility levels. Maximum green fodder yield obtained genotype SPV-2185 along with application of 125% RDF, which is statistically equivalent to that obtained by application of 100% RDF with SPV-2185. Data further show that it is statistically superior over rest of the combinations.

Dry fodder yield:

Genotypes:

It is evident from data that among the tested genotypes, SPV-2185 produced significantly maximum dry fodder yield over rest of the tested genotypes. It was observed that variety SPV-2185 produced 3.53t ha^{-1} more dry fodder yield as compared to second high yielded genotype SPV-2191 which was 30.35 per cent higher

Table 4 : Effect of genotypes and fertility levels on green and dry fodder yield of sorghum

Treatments	Green fodder yield (t ha^{-1})	Dry fodder yield (t ha^{-1})
Genotypes		
SPV-2185	42.32	15.16
SPV-2191	35.61	11.63
HC-308	29.42	10.34
CSV-21F	27.26	9.69
PC-1080	29.53	10.44
CSV-30F	29.65	10.56
S.E. ±	0.96	0.24
C.D. (P = 0.05)	2.76	0.69
Fertility levels		
50% RDF	24.89	9.63
75% RDF	27.05	10.47
100% RDF*	36.11	11.96
125%RDF	41.14	13.16
S.E. ±	0.79	0.19
C.D. (P = 0.05)	2.25	0.57

over SPV-2191. It was also observed that genotype SPV-2185 provided 43.56, 45.21, 46.61 and 56.44% higher green fodder yield over CSV-30F, PC-1080, HC-308 and CSV-21F, respectively.

Fertility levels :

The data revealed that every increase in fertility levels from 50 to 125% RDF significantly increased dry fodder yield. Maximum dry fodder yield (13.16 t ha^{-1}) was obtained with the application of 125% RDF which was 36.65, 25.69 and 10.03% higher over 50% RDF, 75% RDF and 100% RDF, respectively. Data further show that significant increase by 9.12% was observed in dry fodder yield when crop was fertilized with 125% RDF over 100% RDF.

Interaction effect of genotypes and fertility levels:

Data presented in Table 4b reveal that genotypes SPV-2185 produced significantly higher dry fodder yield at all the four levels of fertility than other test genotypes. Genotypes HC-308, SPV-2191 and CSV-21F gave yield advantage with nutrient application upto 100% RDF, while SPV-2185, PC-1080 and CSV-30F produced statistically higher yield with application of nutrient at 125% RDF over 100% RDF. Maximum dry forage yield produced by genotypes SPV-2185 with super optimal nutrients dose *i.e.* 125% RDF, However, the dry forage yield obtained by this genotype with 100% RDF was significantly superior over other genotypes with 100% RDF or 125% RDF.

Fodder quality parameters at harvest:

Crude protein content :

Genotypes:

Data Table 5 revealed that variety SPV-2185 recorded maximum crude protein content in fodder over PC-1080, HC-308, CSV-30F and CSV-21F but it was at par with genotypes SPV-2191. Genotypes CSV-30F proved its superiority over PC-1080, HC-308 and CSV-21F in this respect.

Fertility levels:

Data further illustrate that application of 125% RDF recorded significantly higher crude protein content over 50% RDF and 75% RDF, but statically at par with 100% RDF. The increase in crude protein with 125% RDF was by 23.40, 58.07% over 50% RDF and 75% RDF, respectively.

Crude fibre content :

Genotypes:

A critical examination of the data indicated that maximum crude fibre content was noted with variety SPV-2185 which was at par with varieties SPV-2191 and PC-1080 and these were analytically superior over varieties CSV-21F, CSV-30F, and HC-308. Further, CSV-

Table 4a: Interaction effect of genotypes and fertility levels on green fodder yield (t ha^{-1}) of sorghum

Fertility levels	Genotypes					
	SPV-2185	SPV-2191	HC-308	CSV-21F	PC-1080	CSV-30F
50% RDF	31.23	29.47	24.32	21.02	21.57	21.74
75% RDF	33.94	32.03	26.43	22.85	23.44	23.63
100% RDF*	51.13	38.81	30.78	32.17	31.88	31.90
125% RDF	52.97	42.15	36.15	33.01	41.23	41.35
S.E. ±	1.93					
C.D. (P = 0.05)	5.51					

Table 4b : Interaction effect of genotypes and fertility levels on dry fodder yield (t ha^{-1}) of sorghum

Fertility levels	Genotypes					
	SPV-2185	SPV-2191	HC-308	CSV-21F	PC-1080	CSV-30F
50% RDF	12.83	10.11	9.29	8.35	8.52	8.69
75% RDF	13.94	10.99	10.10	9.08	9.26	9.45
100% RDF*	15.59	12.49	10.51	11.11	11.02	11.03
125% RDF	18.30	12.94	11.46	10.24	12.95	13.07
S.E. ±	0.48					
C.D. (P = 0.05)	1.38					

30F also produced significantly more crude fibre content over HC-308 and CSV-21F.

Fertility levels :

A critical assessment of data revealed that application of 125% RDF significantly increased fibre content over 50% RDF and 75% RDF but it was statistically at par with 100% RDF.

Ether extract:

Genotypes:

Data presented in the Table 5 reveals that variety SPV-2185 obtained maximum ether extract but it was statistically at par with varieties SPV-2191, CSV-21F and PC-1080 at harvest and all these varieties proved superior over "HC-308" and "CSV-30F" in ether extract.

Fertility levels :

In case of ether extract, application of 125% RDF recorded significantly higher content over 50% RDF and 75% RDF. However, application of 100% RDF proved its superiority over 50% RDF and 75% RDF in this respect.

Mineral ash :

Genotypes:

It is apparent from the data that variety SPV-2185 recorded maximum mineral ash content in fodder which was at par with varieties SPV-2191, CSV-21F and all these were superior over HC-308 and CSV-30F, respectively

Fertility levels:

Perusal of data indicated content of sorghum forage that increases in fertility levels from 50 to 125% RDF increased the mineral ash content of sorghum forage. The maximum mineral ash was recorded by applying 125% RDF which was at par with 100% RDF and significantly superior over 75% and 50% RDF, respectively.

Nitrogen free extract :

Genotypes :

Amongst varieties, CSV21F obtained maximum nitrogen free extract which, was at par with HC-308 and both were superior over rest of the genotypes tested.

Fertility levels :

Data showed that application of 125% RDF recorded minimum nitrogen free extract over in dry matter which was statistically at par with 100% RDF and both the higher doses were lower in nitrogen free extract content of sorghum forage over 50% RDF and 75% RDF.

Total digestible nutrient :

Genotypes :

Table 5 : Effect of genotypes and fertility levels on quality parameters of sorghum

Treatments	Crude protein (%)	Crude fibre (%)	Ether extract (%)	Mineral ash (%)	Nitrogen free extract (%)	Total digestible nutrient (%)	HCN content (ppm)	
							25 DAS	50 DAS
Genotypes								
SPV-2185	6.70	31.54	1.68	6.89	53.20	27.35	277.39	173.52
SPV-2191	6.56	31.25	1.66	6.87	53.65	27.10	283.20	177.68
HC-308	6.07	30.42	1.66	6.70	55.14	26.29	279.14	174.80
CSV-21F	6.49	29.85	1.66	6.84	55.16	26.22	280.08	175.47
PC-1080	6.51	31.48	1.67	6.79	53.55	27.17	271.94	169.72
CSV-30F	6.53	30.95	1.65	6.67	54.20	26.77	267.72	166.74
S.E. ±	0.05	0.13	0.01	0.02	0.14	0.08	2.98	1.92
C.D. (P = 0.05)	0.17	0.37	0.02	0.08	0.40	0.23	8.50	5.48
Fertility levels								
50% RDF	4.77	27.82	1.54	5.60	60.27	23.40	261.29	162.15
75% RDF	6.11	31.57	1.64	7.09	53.58	27.20	272.41	170.05
100% RDF*	7.49	32.07	1.72	7.23	51.48	28.27	282.57	177.24
125%RDF	7.54	32.19	1.75	7.25	51.26	28.40	290.05	182.52
S.E. ±	0.04	0.10	0.01	0.02	0.11	0.06	2.43	1.57
C.D. (P = 0.05)	0.14	0.30	0.05	0.06	0.33	0.19	6.94	4.47

A keen investigation of data indicated that minimum total digestible nutrients were brought about with genotype CSV-21F which was at par with HC-308. Genotype SPV-2185 provides maximum total digestible nutrient content and it was statistically higher over rest of the genotypes tested except PC-1080.

Fertility levels :

Data evaluated in Table 5 shows that increasing fertility levels from 50 to 125% RDF significantly increase total digestible nutrient in sorghum forage.

HCN content at 25DAS :

Genotypes :

An examination of data indicated that variety SPV-2191 recorded significantly higher HCN content over PC-1080 and CSV-30F at 25DAS. SPV-2191 genotypes statically at par with genotypes CSV-21F, SPV-2185 and HC-308. The magnitude increases in HCN content of sorghum plant at 25DAS with genotype SPV-2191 were by 6.56 and 4.69% over varieties CSV-30F and PC-1080, respectively.

Fertility levels:

Data presented in Table 5 showed that fertility level 125% RDF produced maximum HCN content in sorghum plant at 25DAS which was significantly higher over 50% RDF, 75% RDF and 100% RDF. Application of 50% RDF recorded lowest doses HCN content in sorghum plant at 25DAS in comparison to higher levels of nutrient application.

HCN content at 50 DAS :

Genotypes:

An examination of data showed that HCN content in sorghum plant at 50DAS was significantly affected with the genotypes. Maximum HCN content was recorded by genotype SPV-2191 which was at par with SPV-2185, CSV-21F and HC-308, further data indicate that genotypes PC-1080 and CSV-30F recorded significantly lower HCN content then SPV-2191 at 50DAS, the magnitude of decrease in HCN concentration by PC-1080 and CSV-30F was 4.69 and 6.56%, respectively over SPV-2191.

Fertility levels :

Data presented in Table 5 revealed that fertility level 125% RDF provided maximum HCN content in leaves at 50 DAS which was significantly higher over 50% RDF, 75% RDF and 100% RDF. Application of 50% RDF was recorded lowest HCN content in leaves.

Nutrient status of soil (at harvest of crop):

Available nitrogen :

Genotypes:

A perusal of the data revealed that different genotypes under test significantly affect the available N status of soil at harvest of sorghum. Genotypes CSV-21F had highest status of available N which was at par with HC-308, PC-1080 and CSV-30F. Genotypes SPV-2185 cultivated soil has lowest available N status at harvest, however, it was at par with SPV-2191 and CSV-30F cultivated soil.

Fertility levels:

A reference to data indicated that plots fertilized with highest level of fertilizer *i.e.* 125% RDF had significantly higher available nitrogen status of soil at harvest by 20.62 and 5.98%, respectively over 50% RDF and 75% RDF. However, 100% RDF was failed to bring about significantly reduction in available N status of soil over application of 125% RDF.

Available phosphorus:

Genotypes :

A perusal of the data revealed that cultivation of genotypes SPV-2191 bring a significant improvement in higher available phosphorus content of soil at harvest of crop over CSV-21F, CSV-30F, PC-1080 and SPV-2185 which was at par with HC-308.

Fertility levels :

An assessment of data showed that plots fertilized with highest level of fertilizer *i.e.* 125% RDF had significantly higher available phosphorus content over 50% RDF and 75% RDF but statistically equivalent with 100% RDF status, which was significantly higher over 50% RDF.

Available potassium:

Genotypes:

Data brought in Table 6 showed that amongst genotypes SPV-2191 significantly higher available potassium content bring of soil after harvest of crop over

CSV-21F and CSV-30F but at par with SPV-2185, PC-1080 and HC-308 test varieties, in this manner.

Fertility levels :

Application of 125% RDF retained higher potassium content of soil at harvest of the crop, which was significantly higher over 50% RDF, 75% RDF and 100% RDF by 22.73, 7.92 and 3.90%, respectively.

Available organic carbon :

Genotypes :

A reference to data presented in Table 6 revealed that genotypes failed to exhibit any significant influence on organic carbon in soil at harvest of sorghum.

Fertility levels:

An examination of data revealed that application of nutrients at 125% RDF retained higher status of organic carbon of soil at harvest of crop, which was significantly superior over 50% RDF, 75% RDF and 100% RDF by 12.28, 6.66 and 3.22%, respectively.

Economic evaluation:

Gross returns :

Genotypes :

It is clear from the data presented in Table 7 that genotype SPV-2185 (Rs. 63473) provided maximum gross returns followed by SPV-2191 (Rs. 53420). Further it was observed that SPV-2185 found significantly superior over rest of the tested genotype. The per cent increase with SPV-2185 were to the tune of 18.81, 42.64, 43.28, 43.83 and 55.22 over genotypes SPV-2191, CSV-30F, PC-1080, HC-308 and CSV-21F, respectively. Further, genotype SPV-2191 also proved it's superiority over CSV-21F, PC-1080, HC-308 and CSV-30F. Genotype CSV-21F provided minimum gross return (Rs. 40892) which was at par with genotype. HC-308, PC-1080 and CSV-30F.

Fertility levels:

An examination of data Table 7 revealed that a significant response was noted in gross return with application of 125% RDF over 50% RDF, 75% RDF and 100% RDF by 65.30, 52.08 and 13.93 per cent, respectively. However, it was observed that 100% RDF showed significant increases over 50% RDF and 75% RDF.

Interaction effect of genotypes and fertility levels:

Data presented in Table 7a reveal that maximum gross return (Rs. 79457.03) was recorded with the treatment combination of 125% RDF along with SPV-2185 which was significantly superior over rest of the combinations except SPV-2185 along with 100% RDF (Rs. 76688.34). There was minimum gross return (Rs. 31529) was obtained with genotype "CSV-21F" along

Table 6 : Effect of genotypes and fertility levels on status of available of N, P, K (kg ha^{-1}) and organic (%) carbon in soil at harvest

Treatments	Organic carbon (%)	Nitrogen	Phosphorus	Potassium
Genotypes				
SPV-2185	0.617	236.61	19.59	345.74
SPV-2191	0.613	238.95	20.92	349.10
HC-308	0.601	250.03	20.69	347.76
CSV-21F	0.604	250.41	20.10	338.61
PC-1080	0.612	247.65	19.72	346.56
CSV-30F	0.600	243.49	19.40	340.73
S.E. ±	0.005	3.39	0.19	2.46
C.D. (P = 0.05)	NS	9.64	0.56	7.02
Fertility levels				
50% RDF	0.574	215.27	17.79	303.35
75% RDF	0.607	245.02	20.14	345.00
100% RDF*	0.623	258.13	21.05	358.33
125%RDF	0.642	259.67	21.29	372.33
S.E. ±	0.002	2.76	0.16	2.01
C.D. (P = 0.05)	0.006	7.87	0.45	5.73

NS=Non-significant

with 50% RDF.

Net returns :

Genotypes:

Data presented in Table 7 revealed that genotypes significantly influenced the net return and recorded maximum return with genotype SPV-2185 (Rs. 43753) followed by SPV-2191 (Rs. 33700). It was also observed that SPV-2185 recorded significantly superior over rest of the tested genotypes. The per cent increase in returns with SPV-2185 were in order of 29.83, 76.70, 78.02, 79.24 and 106.65 over genotypes SPV-2191, CSV-30F, PC-1080, HC-308 and CSV-21F, respectively. Further, genotype SPV-2191 also proved it's superiority over CSV-21F, PC-1080, HC-308 and CSV-30F. Variety CSV-21F provided minimum net return (Rs. 21172).

Fertility levels:

An examination of data Table 7 reveal that a

Table 7 : Effect of genotypes and fertility levels on gross returns, net returns and BC ratio

Treatments	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	BC ratio
Genotypes			
SPV-2185	63473	43753	2.35
SPV-2191	53420	33700	2.19
HC-308	44130	24410	1.70
CSV-21F	40892	21172	1.06
PC-1080	44298	24577	1.22
CSV-30F	44482	24761	1.23
S.E. ±	1453	1453	0.07
C.D. (P = 0.05)	4137	4137	0.21
Fertility levels			
50% RDF	37334	18908	1.03
75% RDF	40580	21291	1.10
100% RDF*	54167	34015	1.69
125%RDF	61715	40700	1.94
S.E. ±	1187	1187	0.06
C.D. (P = 0.05)	3378	3378	0.17

Table 7a : Interaction effect of genotypes and fertility levels on gross returns

Fertility levels	Genotypes					
	SPV-2185	SPV-2191	HC-308	CSV-21F	PC-1080	CSV-30F
50% RDF	46838	44200	36476	31529	32356	32610
75% RDF	50911	48043	39648	34271	35167	35443
100% RDF*	76688	58213	46171	48258	47827	47847
125% RDF	79457	63225	54225	49511	61844	62027
S.E. ±	2907					
C.D. (P = 0.05)	8274					

Table 7b : Interaction effect of genotypes and fertility levels on gross returns

Fertility levels	Genotypes					
	SPV-2185	SPV-2191	HC-308	CSV-21F	PC-1080	CSV-30F
50% RDF	46838	44200	36476	31529	32356	32610
75% RDF	50911	48043	39648	34271	35167	35443
100% RDF*	76688	58213	46171	48258	47827	47847
125% RDF	79457	63225	54225	49511	61844	62027
S.E. ±	2907					
C.D. (P = 0.05)	8274					

significant response was noted in net return with application of 125% RDF over lower fertility levels. The 50% RDF, 75% RDF and 100% RDF by 115.24, 91.95 and 19.65%, respectively. However, it was observed that application of nutrients at 100% RDF showed significant increase in net returns over 50% RDF and 75% RDF.

Interaction effect of genotypes and fertility levels on gross returns :

Data presented in Table 7 b reveal that interaction effect found with genotypes and fertility levels. Maximum net return (Rs. 58442) was recorded with the treatment combination of 125% RDF along with SPV-2185 which was significantly superior over rest of the combinations except with some genotype SPV-2185 along with 100% RDF (Rs. 56536). There was minimum net returns (Rs. 13103) was obtained with genotype CSV-21F along with 50% RDF.

BC ratio:

Genotypes:

A perusal of data presented in Table 7 revealed that genotypes significantly influenced BC ratio. The maximum BC ratio was registered with genotype SPV-2185 genotype (2.35) followed by SPV-2191. It was also observed that SPV-2185 recorded significantly superior over rest of the tested genotypes except SPV-2191. The per cent increases with SPV-2185 were in order of 38.23, 91.05, 92.62 and 121.69 over genotypes HC-308, CSV-30F, PC-1080 and CSV-21F, respectively. Further, genotype SPV-2191 also proved it's superiority over CSV-21F, PC-1080, HC-308 and CSV-30F. Genotype CSV-21F accounted minimum B-C ratio.

Fertility levels:

An examination of data Table 7 reveals that a significant response was noted in BC ratio with application of 125% RDF over 50% RDF, 75% RDF and 100% RDF by 88.34, 76.36 and 14.79%, respectively. However, it was observed that 100% RDF registered it's superiority over 50% RDF and 75% RDF.

Conclusion :

The results of field experiment entitled "response of single-cut fodder sorghum genotypes to fertility levels under rainfed conditions of Southern Rajasthan" presented and discussed in the preceding chapters are summarized as under.

Effect of varieties :

Growth parameters :

(i) Amongst genotypes, SPV-2185 produced highest plant height at harvest which was at par with SPV-2191. CSV-21F lowest plant height at harvest was recording by CSV-21F. (ii) Genotypes SPV-2185 took minimum days to 50% flowering which was significantly lower among all genotypes under treatment, whereas, at par with CSV-21F. (iii) Amongst genotypes, revealed that neither genotypes nor fertility levels significantly affected the plant stand at 30DAS. (iv) Stem girth total number of leaves plant^{-1} and at harvest were recorded maximum under genotypes SPV-2185. Whereas, CSV-21F recorded maximum leaf to stem ratio at harvest. Genotypes HC-308 was poorest performer under test at all the above said parameters. (v) Marked improvement in growth components of crop under the influence SPV-2185 led to produce significantly higher biomass per plant at 25, 50DAS and at harvest. It recorded highest biomass 6.50, 54.64 and 94.87(g plant^{-1}) at 25, 50DAS and at harvest over all the tested varieties.

Yield:

Genotypes SPV-2185 recorded significantly higher green as well as dry fodder yield over genotypes SPV-2191, CSV-21F, PC-1080, CSV-30F and HC-308. Genotypes PC-1080, CSV-30F and HC-308 were statistically at par with each other and superior over CSV-21F in these parameters.

Fodder quality parameters:

Variety SPV-2185 recorded significantly maximum crude protein content which was at par with SPV-2191. Variety SPV-2185 also attained maximum crude fibre content and ether extract over rest of the varieties, while variety CSV-21F recorded maximum nitrogen free extract whereas maximum TDN and mineral ash were recorded in SPV-2185 over the other test varieties.

HCN content:

Genotypes SPV-2191 recorded maximum HCN content (ppm) at 25DAS and 50DAS. It varies from 283.20 and 177.68ppm within varieties under test. Whereas, variety CSV-30F analysed minimum HCN content at 25 and 50DAS.

Available N, P, K and OC in soil after harvest:

The soils of experiment was analyzed after harvest of test crop, maximum available nitrogen content obtained with the soil with variety CSV-21F whereas, SPV-2191 cultivated soil all data maximum available organic carbon and available phosphorus available potassium content in soil after harvest of crop.

Monetary returns:

Variety SPV-2185 recorded maximum net returns (Rs. 43753 ha^{-1}) and B:C (2.35) whereas, lowest net returns (Rs. 21172 ha^{-1}) and B:C (1.06) was obtained under cultivar CSV-21F.

Effect of fertility levels:

Growth parameters:

(i) Fertility levels failed to record any significant response in respect to plant stand at 30DAS. (ii) An application of 125% RDF to sorghum recorded significantly higher plant height at harvests over 50% RDF and 75% RDF except 100% RDF which was at par with 125% RDF. At harvest 100% RDF was statistically superior over 50% RDF and 75% RDF in respect to plant height of sorghum plant. (iii) An application of 125% RDF recorded earliest days to 50% flowering which was significantly earlier over rest of fertility levels. Whereas, 50% RDF was taken maximum days to attend 50% flowering in sorghum plant. (iv) An application of 125% RDF recorded significantly higher dry matter accumulation at 25DAS, 50DAS and at harvest over 50% RDF and 75% RDF except 100% RDF which was at par with 125% RDF. (v) An application of 125% RDF recorded significantly maximum stem girth and number of leaves at harvest over 50% RDF, 75% RDF and 100% RDF in respect to both the above cited parameters. However, fertility levels failed to record any significant response in case of leaf to stem ratio.

Yields:

Application of 100% RDF recorded significantly higher green fodder as well as dry fodder yield over both the lower doses. However, application of 75% RDF also proved significantly superior over 50% RDF in this respect.

Fodder quality parameters:

Enriching fertility level upto 100% RDF gave significantly higher ether extract and mineral ash content. While, application of 75% RDF obtained significantly greater crude protein and crude fibre content over 50% RDF, further increase in fertility level did not produce any significant variation. Highest TDN and nitrogen free extract were obtained under 50% RDF while, the lowest being recorded fewer than 100% RDF.

Fodder quality parameters production:

An application of 100% RDF produced significantly higher crude protein, crude fibre, ether extract, nitrogen free extract, mineral ash and TDN production over 50% RDF and 75% RDF.

HCN content:

The increasing fertility levels upto 100% RDF correspondingly increases in HCN content (ppm) in sorghum fodder at 25 and 50DAS over both the lower fertility levels. The highest HCN content being recorded with 100% RDF which was significantly higher over 50% RDF but at par 75% RDF.

Available N, P, K and OC in soil after harvest:

After harvest of crop, available nitrogen and phosphorus contents of soil under application of 100% RDF were significantly higher over 50% RDF, but at par with 75% RDF whereas, available potassium and organic carbon retained in soil under application of 100% RDF were significantly higher over both the lower doses in this, respect.

Monetary returns:

An application of 125% RDF recorded significantly higher net returns and BC ratio over 50% RDF, 75% RDF and 100% RDF by (Rs. 43753 ha^{-1}) and BC ratio. Further increase with fertility level marginally improved net returns and BC ratio.

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■ REFERENCES

A.O.A.C. (2012). *Official methods of analysis*. 19th Ed. Association of Official Analytical Chemist, Washington D.C.

Black, C.A. (1965). *Methods of soil analysis.* American Society of Agronomy, Inc. Madison, Wisconsin.

Bowles, J.E. (1992). *Engineering properties of soils and their measurements*, 4th Ed., McGraw-Hill, USA.

Brady, N.C. and Weil, R.R. (2002). *The nature and properties of soils.* 12th Ed.. Pearson Education Pvt. Ltd. pp. 622-627.

Gilchrist, D.G., Luechen, W.E. and Hittle, C.N. (1967). Revised method for preparation of standards in the sodium picrate assay of HCN. *Crop Sci.,* **7**(3): 267-268.

Hogg, P.G. and Ahlgreen, H.L. (1942). A rapid method for determining HCN content of single plant of Sudangrass. *J. American Soc. Agron.,* **34** (2): 199-200.

Jackson, M.L. (1967). *Soil chemical analysis*, Prentice-Hall of India, New Delhi.

Knowles, F. and Watkins, J.E. (1960). *A practical course in agricultural chemistry*. Mac Millan and Co., London, pp. 93-94.

Landor, J. R. (1991). Brooker tropical soil manual. A handbook for soil survey in the tropics and subtropics. (pp. 106-144). England: Longman Group.

Moore, L.A., Irwin, H.M. and Show, J.C. (1953). Relationship between TDN and energy values of feeds. *J. Dairy Sci.,* **36**(2): 93-97.

Olsen, S.R., Cole, C.V., Wantnable, F.S. and Dean, L.A. (1954). Estimation of available phosphorus in soil by extraction with HNO3. In: Diagnosis and improvement of saline and alkaline soils. USDA Handbook No 60.

Ranjan, S.K. (1983). *Animal and feeding practices.* 3rd Revised edition. pp: 93-104.

Richards, L.A. (1954). Diagnosis and improvement of saline and alkaline soils, USDA Hand book No. 60, Oxford and IBH Pub. Co., New Delhi.

Sheoran, R.S. and Rana, D.S. (2006). Relative efficiency of azotobacter and nitrogen fertilizer in forage sorghum (*Sorghum bicolor* L.) under semi-arid conditions. *Forage Res.,* **32** (2) : : 65-68

Subbiah, B.V. and Asija, G.L. (1956). A rapid procedure for available nitrogen in soil. *Curr. Sci.,* **25**(8): 259-260.

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