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Evaluation of pre-released *kharif* grain sorghum genotypes to different fertility levels under deep clay soils of Gujarat

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Abstract
A field experiment was conducted at All India Coordinated Research Project on Sorghum (AICRP on Sorghum) centre, Surat, Gujarat in a deep clay soil during kharif 2020 to study the evaluation of pre-released kharif grain sorghum genotypes to different fertility levels under south Gujarat Condition. Soil of experimental field was deep clay in nature. It was medium in available nitrogen (250 kg/ha), high in available phosphorus (51 kg/ha) and available potassium (251 kg/ha). The experiment consisted of 32 treatment combinations comprising eight genotypes (three hybrids: SPH 1888, SPH 1914, SPH 1912 and two varieties: SPV 2568, SPV 2569) along with three checks (two hybrids: CSH 25, CSH 30 and one variety: CSV 20) were evaluated for their grain production potential across three fertility levels (50% RDF, 100% RDF and 150% RDF along with control). The experiment was laid out in Split Plot Design with 2 replications at Surat. Results showed that among different fertility levels, the differences in grain yield and stover yield was found significant. The highest grain yield (4160.1 kg/ha) and stover yield (13057.2 kg/ha) was recorded by F_4: 150% RDF (120:60:60 NPK kg/ha), which was followed with F_3: 100% RDF (80:40:40 NPK kg/ha) (3467.8 kg/ha grain yield and 10886.8 kg/ha stover yield). Among different genotypes G_6: CSH 25 recorded significantly highest grain and stover yield (4080.4 and 12063.4 kg/ha) and which was followed by G_3: SPH 1912 (3562.0 kg/ha grain yield). While in case of stover yield, it was being remained at par with G_4: SPV 2568. (11389.9 kg/ha).

Keywords: Yield, yield attributes, fertility levels, grain sorghum

Introduction
Sorghum [*Sorghum bicolor* (L.) Moench], belonging to family poaceae, is an important Kharif season crop which is grown mainly for grain both as food and as animal feed. It is the king of millets and fourth important crop in the country after rice, wheat and maize. Grain sorghum is also called "milo" and is a major feed grain for cattle. It is popularly known in India as “jowar”, is often cross pollinated crop. It is an important food, feed and fodder for humanity, poultry and cattle. It’s grains have about 9.35% protein, 3.35% fat, 72.41% carbohydrate and 10.66% moisture content (Adebiyi *et al.*, 2005) [1]. In India, the area under sorghum is approximately 4100 thousands hectares with an annual production of about 4740 thousand metric tonnes and an average productivity of 1.2 metric tons per hectare (India-Area, Yield and Production by United States Department of Agriculture-2020-21) [2]. In Gujarat State, the area covered in *kharif* sorghum is approximately 29470 hectares with an annual production of about 41930 tonnes and an average productivity of 1422 kg per hectare. (Anno. 2020) [3] Sorghum is mainly grown in Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh, Gujarat and Rajasthan. The production can be increased by adopting improved package including suitable genotype, optimum plant geometry and appropriate fertilization. Optimum dose of nitrogen, phosphorous and potassium is dependent on several factors like soils, crop, environment and crop growing situations, further genotype plays an important role in increasing crop production but information on the response of newly evolved genotypes/ varieties to nitrogen, phosphorous and potassium levels is meager. The development of elite genotype is a continuous process and currently many genotypes of different maturity groups have been evolved. Therefore, it is important to assess the response of fertility levels to these elite genotypes. Keeping in view of above consideration, present study was conducted during *kharif* season of 2020.

Material and Methods
The experiment was conducted at Main Sorghum Research Station, Navsari Agricultural

University, Navsari (Gujarat). The soil of experimental site was deep clay in nature, having slightly alkaline reaction (pH 7.9), medium in available nitrogen (250 kg/ha), high in available phosphorus (51 kg/ha) and available potassium (251 kg/ha). 32 treatment combinations comprising eight genotypes (three hybrids: SPH 1888, SPH 1914, SPH 1912 and two varieties: SPV 2568, SPV 2569) along with three checks (two hybrids: CSH 25, CSH 30 and one variety: CSV 20) were evaluated for their grain production potential across three fertility levels (50% RDF, 100% RDF and 150% RDF along with control). The experiment was laid out in split plot design and replicated two. Sorghum genotypes were sown on 30th June, 2020 using 10 kg/ha seed rate having 45 cm row to row distance and maintain plant to plant spacing of 15 cm. Fertilizer application was made as per the treatment. Full dose of phosphorus, potash and half dose of nitrogen were applied at the time of sowing through SSP, MOP and Urea as a basal application. The remaining dose of nitrogen was supplied by placement through urea at 30 DAS. Number of panicles metre-2 were counted before harvesting. Five representative panicles were taken from each plot and weighed after sun drying. The average weight of grain panicle-1 was recorded in gram. Weight of 1000 grains from bulk yield of each plot was also recorded in gram. After thorough sun drying of the harvested bundles of each net plot was collected and then their weight were taken for biological yield and then calculated in terms of kg/ha. Grain yield of each net plot was recorded separately and finally calculated in terms of kg/ha. From total biological yield grain yield was subtracted in each net plot and then stover yield was expressed in terms of kg/ha. Harvest index was calculated by using the formula given by Donald and Hamblin (1976) [6].

Harvest Index (%) = Economic Yield (kg/ha)/Biological Yield (kg/ha) × 100

Result and Discussion

The grain and stover yield differences due to genotypes and various levels of fertility was found significant. The interaction effect between fertility levels and sorghum genotypes was found non significant for grain and stover yield.

Effect of Fertility Levels on Growth Attributes

The results revealed that different fertility levels showed that significant influence on growth attributes viz days to 50% flowering, days to physiological maturity and plant height. In Table 1, application of 150% RDF (120:60:60 NPK kg/ha) recorded significant maximum plant height at harvest (183.70 cm) which was at par with application of 100% RDF (80:40:40 NPK kg/ha). Whereas, the lowest plant height recorded under Control treatment (152.60 cm).

Fertility levels with the application of 150% RDF (120:60:60 NPK kg/ha) recorded significantly less for 50% flowering, (76.30 days) but which was statistically at par with application of 100% RDF (80:40:40 NPK kg/ha). Days to physiological maturity was also taken significantly less days for maturity (110.1 days) in the 150% RDF (120:60:60 NPK kg/ha) which was followed by 100% RDF. Whereas, significantly more number of days and days to maturity were recorded under the control treatment.

Effect of Genotypes on Growth Attributes

Significant variation was recorded in days to 50% flowering, days to physiological maturity and plant height at harvest stages of sorghum with different genotypes. Genotype CSH 30 recorded significantly less days for 50% flowering (70.9 days), which was at par with all the genotypes, whereas CSH 25 genotype noted significantly more number of days was 86.1 days. While in case of days to maturity of sorghum was not influence due to different genotypes of sorghum. With respect to plant height, Genotype CSV 20 attained significantly higher plant height at harvest compare to rest of genotypes (Table 1).

Effect of Fertility Levels on Yield and Yield Attributes

No. of panicles per m2, 1000 Seed Weight (g) and harvest index were not influenced significantly due to various levels of fertility. Among the different fertility levels examined, application of 150% RDF (120:60:60 NPK kg/ha) noted significantly higher grain yield of sorghum was 4160.1 kg/ha which was followed by application of 100% RDF (80:40:40 NPK kg/ha). However, Control treatment produced the lowest sorghum grain yield (2251.4 kg/ha). It was observed that the grain yield of sorghum increased with increase in the level of RDF. The percent increase in grain yield of sorghum under the application of 50% RDF, 100% RDF and 150% RDF to the tune of 31.15%, 54.0% and 84.77%, respectively over control.

Same trends was observed in dry fodder yield and biological yield. Stover yield data indicate that application of 50% RDF, 100% RDF and 150% RDF significantly increase Stover yield to the tune of 31.30%, 54.08% and 84.80% over control, respectively. (Table 2)

Effect of Genotypes on Yield and Yield Attributes

No. of panicles per m2, 1000 Seed Weight (g) and harvest index were found influenced significantly due to various genotypes. Significantly maximum No. of panicles per m2 and harvest index were recorded under the SPH 1888 genotype. Whereas SPV 2569 genotype obtained highest 1000 Seed Weight (g). Significantly highest grain yield, stover yield and biological yield of 4080.4, 12063.4 and 16143.8 kg/ha were obtained with genotype CSH 25, respectively. With respect to grain yield, which was followed by SPH 1912.In case of dry fodder yield, it remained at par with SPV 2568. While in case of biological yield, it was followed with SPV 2568. (Table 2)

Above results are in close conformity with findings of (Singh and Sumeriya, 2004 and Dixit *et al.*, 2005) [9, 5]. Such close association ship of grain yield with different yield components was also observed by Mishra *et al.* (2015) Kaushal Kishor *et al.*, (2017) and Bhutada *et al.*, (2020) [8, 7, 4].

Interaction effects

The interaction effect among different levels of fertility and genotypes was failed to reach up to the level of significant (Table 1 and 2).

Table 1: Growth parameters of kharif sorghum genotypes as affected by various levels of fertility (Grain Sorghum)

Treatments	Days to 50% flowering	Days to physiological maturity	Plant height (cm)
Fertility Levels			
F1 (Control)	86.3	124.4	152.6
F2 (50% RDF)	84.2	121.2	158.4
F3 (100% RDF)	81.6	117.9	173.1
F4 (150% RDF)	76.3	110.1	183.7
S.Em.± (F)	1.1	1.2	2.5
C.D. at 5% (F)	5.0	5.3	11.2
C.V. %	5.4	4.0	6.0
Genotypes			
G1 (SPH 1888)	84.0	114.9	151.0
G2 (SPH 1914)	84.5	120.4	103.6
G3 (SPH 1912)	82.0	117.9	146.4
G4 (SPV 2568)	80.6	119.1	180.9
G5 (SPV 2569)	84.8	122.6	203.3
G6 (CSH 25)	86.1	122.1	163.5
G7 (CSH 30)	70.9	111.0	153.9
G8 (CSV 20)	84.0	119.1	233.3
S.Em.± (G)	2.4	3.1	5.4
C.D. at 5% (G)	7.0	NS	15.7
S.Em.± (F X G)	4.8	6.1	10.9
C.D. at 5% (F X G)	NS	NS	NS
C.V. %	8.3	7.3	9.2

Table 2: Yield and Yield Attributes of *kharif* sorghum genotypes as affected by various levels of fertility (Grain Sorghum)

Treatments	No. of panicles per m2	1000 Seed Weight (g)	Grain Yield (Kg/ha)	Stover Yield (Kg/ha)	Biological Yield (Kg/ha)	Harvest Index (%)
Fertility Levels						
F1 (Control)	7.2	31.6	2251.4	7065.3	9316.8	24.2
F2 (50% RDF)	7.4	32.1	2952.8	9276.8	12229.6	24.2
F3 (100% RDF)	7.9	32.4	3467.8	10886.8	14354.6	24.2
F4 (150% RDF)	8.4	32.4	4160.1	13057.2	17217.3	24.2
S.Em.± (F)	0.2	0.7	33.9	289.0	283.0	0.6
C.D. at 5% (F)	NS	NS	152.7	1300.5	1273.3	NS
C.V. %	10.0	8.3	4.2	11.5	8.5	9.2
Genotypes						
G1 (SPH 1888)	8.8	32.4	3303.9	9226.4	12530.3	26.4
G2 (SPH 1914)	7.8	22.9	2931.3	8394.6	11325.9	25.9
G3 (SPH 1912)	7.9	35.3	3562.0	10854.5	14416.5	24.8
G4 (SPV 2568)	7.8	34.3	3429.0	11389.9	14818.9	23.2
G5 (SPV 2569)	7.3	39.6	2664.4	8367.8	11032.1	24.2
G6 (CSH 25)	7.9	30.3	4080.4	12063.4	16143.8	25.2
G7 (CSH 30)	7.4	35.6	2520.4	9586.5	12106.9	20.9
G8 (CSV 20)	7.3	26.8	3172.9	10689.3	13862.1	22.9
S.Em.± (G)	0.3	1.3	134.3	379.2	436.1	0.8
C.D. at 5% (G)	0.8	3.8	389.0	1098.3	1263.0	2.3
S.Em.± (F X G)	0.6	2.7	268.6	758.4	872.1	1.6
C.D. at 5% (F X G)	NS	NS	NS	NS	NS	NS
C.V. %	10.5	11.7	11.8	10.7	9.3	9.4

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