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Effect of fertility levels on Yield and Yield attribute of different Sorghum [*Sorghum bicolar* (L.) Moench] genotypes

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Abstract
A field experiment was conducted at Udaipur in calcareous soil during *kharif* 2016 to study the effect of fertility levels on the yield and yield attributes of grain sorghum genotypes. Soil of experimental field was calcareous in nature. It was medium in available nitrogen (296.50 kg ha^{-1}), phosphorus (20.80 kg ha^{-1}) and high in available potassium (355.60 kg ha^{-1}). The experiment consisted of 15 treatment combinations comprising five genotypes (SPV 2293, SPV 2308, SPV 2307, CSV 17 and CSH 14 with three levels of fertility (75, 100 and 125 % RDF) laid out in factorial randomized block design and replicated thrice. Results showed that among the fertility levels 125 % and 100 % RDF significantly enhanced the grain weight $panicle^{-1}$ over 75 % RDF. However, 100 % and 125 % fertility levels were found at par with each other. Fertility levels failed to show any significant variation in number of panicles m^{-2}. Application of 125 % RDF provided significantly higher 1000-grain weight, grain, stover and biological yields over 75 % and 100 % RDF. However, harvest index was found non- significant to different fertility level. The genotypes did not show significant variation in number of panicle m^{-2}. CSH 14 recorded maximum grain weight $panicle^{-1}$ (34.05 g) which was statistically superior over rest of the genotypes but at par with CSV 17. CSH 14 recorded maximum 1000-grain weight which was significantly superior over SPV 2293 and SPV 2307 but found at par with CSV 17 and SPV 2308. csh 14 exhibited significant superiority in terms of grain yield (4230 kg ha^{-1}) and harvest index (32.53 %) was reported higher in CSV 17, however highest stover yield (12707 kg ha^{-1}) and biological yield (15940 kg ha^{-1}) were recorded in SPV 2293.

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 5.30 million hectares with an annual production of about 5.05 million tonnes and an average productivity of 953 kg ha^{-1} (Agriculture - statistical year book India, 2016). 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 *2016*.

Material and Methods
The experiment was conducted at Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur. The soil of experimental site was clay loam in texture, having slightly alkaline reaction (pH 7.9), medium in available

nitrogen (295.8 kg ha^{-1}) and phosphorus (19.5 kg ha^{-1}) and high in available potassium (346.2 kg ha^{-1}) (Table 1). The experiment comprised 15 treatment combinations, which consists of five grain sorghum genotypes (SPV 2293, SPV 2308, SPV 2307, CSV 17 and CSH 14) and three fertility levels 75 %, 100% (80 kg N ha^{-1}+40 kg P_2O_5 ha^{-1}+40 kg K_2O ha^{-1}) and 125 % RDF(Recommended dose of fertilizer). The experiment was laid out in a factorial randomized block design with factorial concept and replicated thrice. Sorghum varieties were sown on 8th July, 2016 using 10 kg ha^{-1} 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 Di-ammonium phosphate, Murraite of potash and Urea as a basal application. The quantity of nitrogen supplied through DAP was adjusted with urea. 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^{-1}. Grain yield of each net plot was recorded separately and finally calculated in terms of kg ha^{-1}. From total biological yield grain yield was subtracted in each net plot and then stover yield was expressed in terms of kg ha^{-1}. Harvest index was calculated by using the formula given by Donald and Hamblin (1976).

$$\text{Harvest index (HI)} = \frac{\text{Economic yield (kg ha}^{-1}\text{)}}{\text{Biological yield (kg ha}^{-1}\text{)}} \times 100$$

Result and Discussion

Effect on yield attributes

Number of ear heads (m^{-2}) was not influenced significantly either due to various levels of fertility or genotypes. CSH 14 recorded significantly higher weight of grain $panicle^{-1}$ as compare to rest of genotype but found at par with CSV 17. However, fertility levels significantly enhanced the weight of grain $panicle^{-1}$. Application of 125% RDF significantly increased weight of grain $panicle^{-1}$ to the tune of 22.02 and 7.15 per cent over 75% and 100% RDF, respectively. CSH 14 recorded significantly higher 1000 grain weight over rest of genotype except SPV 2308. Whereas with increase in the level of RDF significantly increased 1000 grain weight. The increase due to 125 % RDF was 9.81 and 3.61 per cent over 75 % & 100 % RDF, respectively. These results are in close conformity with findings of (Singh and Sumeriya, 2004 and Dixit *et al*., 2005) [9] [5].

Effect on yields

CSH 14 recorded significantly higher grain yield (4230 kg ha^{-1}) as compared to rest of genotypes. The CSH 14 produced 39.7, 34.0, 30.8 and 27.5 per cent higher grain yield over SPV 2307, SPV 2308, SPV 2293 and CSV 17**,** respectively. However with application of 100 % and 125 % RDF significantly increased the grain yield over 75 %. However, 100 % and 125 % RDF found at par with each other in respect to grain yield. The increase in grain yield due to 100 % and 125 % RDF was 16.2 and 22.3 per cent over 75 % RDF, respectively. Sujathamma *et al.* 2015 also reported longer panicles and higher number of grains $panicle^{-1}$, highest test weight and yield with application of RDF.

SPV 2293 recorded maximum stover yield (12706 kg ha^{-1}) which was statistically significant over CSV 17 and CSH 14 but at par with genotypes SPV 2308 and SPV 2307. Increased stover yield by 84.64 and 10.29 per cent was recorded with SPV 2293 over CSV 17 and CSH 14, respectively. Whereas, with application of 100 % and 125 % RDF significantly increased stover yield to the tune of 12.99 and 22.86 per cent over 75 % RDF, respectively. However, 100 % and 125 % RDF found at par with each other. The profound influence of fertilizer on biological yield seems to be an account of its influence on vegetative and reproductive aspects of crop growth. The results of present investigation are in close agreement with the findings of Singh and Sumeriya (2006) [9].

SPV 2293 recorded the maximum biological yield. Genotype SPV 2293, SPV 2308, CSH 14 and SPV 2307 recorded significantly higher biological yield by 56.27, 55.34, 54.42 and 50.36 per cent over CSV 17, respectively. However, they were found at par with each other. Among fertility levels 100 % and 125 % RDF recorded significantly higher biological yield by 13.72 and 22.72 per cent over 75% RDF, respectively. However, both these 100 % and 125 % RDF were found at par with each other. Every unit increase in this parameter *viz.*, weight $panicle^{-1}$, grain weight $panicle^{-1}$ and 1000-grain weight increased grain yield of sorghum by 3.026, 90.605 and 204.991 units, respectively. Such close associationship of grain yield with different yield components was also observed by Mishra *et al*. (2015). Genotype CSV 17 recorded maximum harvest index (32.53 %) followed by CSH 14 (26.85 %), SPV 2293 (20.29 %), SPV 2308(19.91 %) and SPV 2307 (19.74 %). However, fertility levels failed to bring any significant change in the harvest index.

Table 1: Chemical properties of the soil of the experimental field

Particulars	Value	Method of analysis	Reference
Organic carbon (%)	0.74	Rapid titration method	Walkley and Black (1934)
Available N (kg ha^{-1})	296.50	Alkaline $KMnO_4$ method	Subbiah and Asija (1956)
Available P (kg ha^{-1})	20.80	Olsen's method	Olsen *et al*., 1954
Available K (kg ha^{-1})	355.60	Flame photometer	Jackson (1967)
pH (1:2.5 soil water suspension)	8.00	pH meter	Richards (1968)
Electrical conductivity (dSm^{-1} at 25°C)	0.84	Using solubridge	Richards (1968)

Table 2: Effect of sorghum genotypes and different fertility leve

Treatments	Yield attributes			Yield (kg ha^{-1})			Harvest index (%)
	Number of panicle m^{-2}	Grain weight panicle^{-1} (g)	1000grain weight (g)	Grain	Stover	Biological	
Genotypes							
SPV 2293	12.99	31.92	26.80	3234	12707	15940	20.29
SPV 2308	13.65	31.82	28.42	3156	12690	15845	19.91
SPV 2307	13.60	31.32	25.90	3028	12310	15337	19.74
CSV 17	13.60	33.06	28.12	3318	6882	10200	32.53
CSH 14	13.14	34.05	28.87	4230	11521	15751	26.85
SEm±	0.34	0.67	0.35	92.2	407.7	443.8	0.76
CD (P= 0.05)	NS	1.93	1.00	267.1	1181.1	1285.6	2.20
Fertility levels (% of RDF)							
75	13.38	28.97	27.12	3007	10024	13031	23.08
100	13.11	32.99	27.37	3494	11326	14819	23.57
125	13.69	35.35	28.36	3678	12316	15993	22.99
SEm±	0.27	0.52	0.27	71.74	315.8	343.8	0.59
CD (P= 0.05)	NS	1.50	0.77	206.9	914.8	995.9	NS

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