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EFFECT OF FERTILITY LEVELS ON YIELD AND NUTRITIONAL STATUS OF SORGHUM [*SORGHUM BICOLOR* (L.) MOENCH] GENOTYPES

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ABSTRACT

The field experiment was conducted at Udaipur during *Kharif* season of 2013 to study the effect of fertility levels on yield and nutrient content and uptake of sorghum genotypes. Results showed that among the genotypes, maximum grain and dry fodder yield is obtained by SPH 1705 and CSV 23, respectively. Genotype SPH 1705 recorded maximum NPK content in grain and its uptake by grain, protein content and protein yield by grain and CSV 23 recorded maximum NPK uptake by fodder over rest of the genotypes tested. Among fertility levels, 100% RDF (80 kg N + 40 kg P_2O_5 + 40 kg K_2O ha^{-1}) recorded maximum grain, dry fodder and biological yield, NPK content in grain as well as in dry fodder and their uptake than rest of the fertility levels. Application of this level recorded 20.46, 23.95 and 23.34 per cent higher grain, dry fodder and biological yield than 50% RDF.

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INTRODUCTION

Sorghum is an important staple food as well as fodder crop with a greater emphasis on fodder not only in India but Semi-Arid Tropics also (Singh *et al.,* 2013). Among cereals, it occupies third position in respect of area and production. Its importance is ever increasing as the source of food for rural masses, food for teeming cattle population and raw material for the industries (Kumar, 2013). Rajasthan is a major sorghum producing state in the country but it is endowed with moderate to acute shortage of dry fodder in different parts almost round the year on account of highly aberrant and extremely variable rainfall pattern, lack of *in situ* conservation of rain water and several other production constraints (light soils, poor soil fertility and shallow soil depth; socio-economical backwardness etc). Major constraint in sustained higher productivity of sorghum dominantly grown for different purposes (grain, fodder and both) in Rajasthan mainly comprise of lack of suitable genotype in hands of farmers (traditional/ local varieties dominate), lack of proper geometry for different improved new genotypes and inadequate supply of major nutrients mainly the NPK (as sorghum is more nutrient exhaustive crop than other crops). Development of elite genotype is a continuous process and these genotypes widely differ in their growth habit, duration and resource mining potential particularly the nutrient and moisture and finally in yield potential (Singh and Sumeriya, 2004). Sorghum is dominantly grown in drought prone rain-fed production system of Rajasthan as well as in Udaipur region where farmers usually apply life saving irrigation on commencement of prolog droughts. There exists a wide gap between realizable sorghum yield and yield obtained by the farmers. The balanced fertilization has a substantial impact on growth, development and productivity of sorghum genotypes (Kumar *et al.,* 2008). In backdrop of meager studies on response of elite sorghum genotypes to different fertility levels in sub humid southern plains and Aravalli hills of Rajasthan (Zone IV A), this study was undertaken to optimize grain and dry fodder productivity of different sorghum genotypes as well as to work out economical feasibility for sorghum growers in the region.

MATERIALS AND METHODS

The experiment was conducted during *Kharif* season of the year 2013 at the Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan) which is situated at 24º35' N latitude, 73º42' E longitude and at an altitude of 582.17 metre above mean sea level. The soil of experimental site was clay loam in texture, having slightly alkaline reaction (pH 8.0), organic carbon content (0.74%), medium in available nitrogen (296.50 kg ha^{-1}) and phosphorus (20.80 kg ha^{-1}) and high in available potassium (355.60 kg ha^{-1}). The experiment comprises of 21 treatment combinations, consisted of three fertility levels [50, 75, 100 % RDF (80 kg N + 40 kg P_2O_5 + 40 Kg K_2O ha^{-1})] and seven genotypes (SPH 1703, SPH 1705, SPV 2110, SPV 2122, SPV 2061, CSH 16 and CSV 23). The experiment was carried out in Factorial Randomized Block Design with three replications. Sorghum genotypes were sown on 5th July, 2013 at 45 x 15 cm row to row and plant to plant spacing with a seed rate of 10 kg ha^{-1}. As per the treatment nitrogen and phosphorus were applied through urea and DAP and potassium through muriate of potash. One half of nitrogen and full dose of phosphorus and potassium were given as basal application. The remaining dose of nitrogen was top dressed at 30 DAS in standing crop. The crop received 736 mm well distributed rainfall during crop season. All the cultural and plant protection measures were followed as and when required to harvest a good crop. The crops were harvested according to their maturity.

RESULTS AND DISCUSSION

Data presented in Table 1 and 2 reveals that SPH 1705 recorded maximum grain and biological yield, N, P, K content in grain and fodder over rest of the genotypes tested. Significantly maximum protein content and its yield reported under SPH 1705 which was found significantly higher over SPV 2122. The differential behavior of these genotypes in respect to growth parameters could be explained solely by the variation in their genetic makeup (Mawliya, 2012). The variation in plant height of the genotypes might be related to their inherent and genotypic variations and higher vigor. SPH 1705 recorded maximum grain yield (2873 kg ha^{-1}) which was found remain at par with SPH 1703 (2726 kg ha^{-1}) and significantly superior over rest of the genotypes and this genotype registering 61.40, 68.75, 58.46, 32.51 and 64.41 per cent higher grain yield over SPV 2110, SPV 2122, SPV 2061, CSH 16 and CSV 23**,** respectively. Genotype CSV 23 recorded maximum dry fodder yield (10771 kg ha^{-1}) which was found statistically at par with genotypes SPH 1703, SPV 2110, SPV 2122 and CSH 16. SPH 1705 recorded maximum total nitrogen and phosphorous uptake which was found 23.19 and 21.15, 11.71 and 9.26 percent higher over SPV 2110 and SPV 2122. SPH 1705 recorded 66.65, 76.63, 63.18 and 70.27 percent higher in protein uptake by grain over SPV 2110, SPV 2122 SPV 2061 and CSV 23. Further data in Table 3 revealed that SPV 2122 reported maximum available soil N and P and SPV 2110 reported maximum available K in soil after harvest than rest of the genotypes tested. The higher grain yield by SPH 1705 and stover yield by CSV 23 were registered

Table 1: Effect of different fertility levels on yield and nutrient concentration of different elite sorghum genotypes

Treatments	Yield (kg ha^{-1}) Grain	Fodder	Biological	Nutrient content (%) Nitrogen Grain	Fodder	Phosphorus Grain	Potassium Fodder	Grain	Fodder	Protein content(%)
Genotypes										
SPH 1703	2726	9384	12111	1.650	0.486	0.267	0.173	0.496	1.649	10.31
SPH 1705	2873	9762	12634	1.654	0.493	0.281	0.177	0.506	1.662	10.34
SPV 2110	1780	10164	11944	1.603	0.481	0.279	0.174	0.482	1.587	10.02
SPV 2122	1702	10769	12471	1.592	0.483	0.275	0.172	0.484	1.579	9.95
SPV 2061	1813	9839	11652	1.611	0.485	0.276	0.173	0.492	1.633	10.07
CSH 16	2168	10076	12244	1.619	0.502	0.281	0.177	0.494	1.627	10.12
CSV 23	1747	10771	12518	1.609	0.481	0.280	0.176	0.485	1.599	10.06
SEm+	59.24	318.64	329.86	0.015	0.005	0.003	0.001	0.005	0.019	0.09
CD (P=0.05)	168.11	904.25	NS	0.042	0.013	0.009	0.004	0.014	0.053	0.26
Fertility levels (% RDF)										
50	1926	8889	10814	1.584	0.462	0.271	0.169	0.469	1.584	9.90
75	2101	10421	12522	1.632	0.493	0.279	0.177	0.495	1.627	10.20
100	2320	11018	13338	1.644	0.508	0.281	0.178	0.511	1.649	10.27
SEm+	38.78	208.60	215.94	0.010	0.003	0.002	0.001	0.003	0.012	0.06
CD (P=0.05)	110.05	591.97	612.82	0.027	0.009	0.006	0.003	0.009	0.035	0.17

Table 2: Effect of different fertility levels on N, P, K and protein uptake by different sorghum genotypes

Treatments	Nutrient uptake (kgha^{-1}) Nitrogen Grain	Fodder	Total	Phosphorus Grain	Fodder	Total	Potassium Grain	Fodder	Total	Protein yield (kgha^{-1})
Genotypes										
SPH 1703	45.00	45.63	90.63	7.27	16.18	23.45	13.52	154.71	168.24	281.2
SPH 1705	47.65	48.16	95.82	8.09	17.29	25.38	14.59	162.42	177.01	297.8
SPV 2110	28.60	49.18	77.78	4.96	17.76	22.72	8.60	161.76	170.35	178.7
SPV 2122	26.98	52.11	79.09	4.70	18.53	23.23	8.24	170.22	178.46	168.6
SPV 2061	29.20	48.34	77.53	5.02	16.98	22.00	8.94	160.95	169.88	182.5
CSH 16	35.29	50.74	86.03	6.13	17.93	24.06	10.76	164.67	175.43	220.6
CSV 23	28.00	51.88	79.87	4.91	19.01	23.91	8.49	172.94	181.43	174.9
SEm+	1.02	1.61	2.08	0.18	0.58	0.64	0.30	5.60	5.68	6.40
CD (P=0.05)	2.90	NS	5.90	0.51	1.63	1.81	0.85	NS	NS	18.15
Fertility levels (% RDF)										
50	30.52	41.06	71.58	5.23	15.01	20.24	9.04	140.83	149.87	190.7
75	34.40	51.31	85.71	5.89	18.40	24.29	10.41	169.56	179.96	215.0
100	38.25	55.93	94.18	6.49	19.60	26.08	11.90	181.47	193.37	239.0
SEm+	0.67	1.06	1.36	0.12	0.38	0.42	0.20	3.67	3.72	4.19
CD (P=0.05)	1.90	3.00	3.86	0.33	1.07	1.19	0.55	10.41	10.55	11.88

Table 3: Effect of different fertility levels on available nutrient in soil after harvest the sorghum genotypes

Treatments	Available nutrient status ($kgha^{-1}$) N	P_2O_5	K_2O
Genotypes			
SPH 1703	246.53	20.01	341.65
SPH 1705	249.84	19.92	340.81
SPV 2110	259.03	20.70	360.19
SPV 2122	260.41	20.89	359.88
SPV 2061	256.58	20.29	362.07
CSH 16	256.60	19.64	351.47
CSV 23	254.01	20.18	361.23
SEm+	2.77	0.26	3.50
CD (P=0.05)	7.85	0.73	9.93
Fertility levels (% RDF)			
50	245.92	19.21	342.38
75	257.63	20.22	354.99
100	260.59	21.27	364.32
SEm+	1.81	0.17	2.29
CD (P=0.05)	5.14	0.48	6.50

over rest of the genotypes appear to be a resultant of remarkable improvement in different yield components, which was brought about due to adoption of genotypes. Such close associationship of grain yield with different yield components was also observed by Kumar *et al.* (2008), Sumeriya and Singh (2008), Dhaker *et al.* (2014) and Mawliya (2012).

Among the fertility levels, application of 100% RDF significantly increased the grain, fodder and biological yield over 50 and 75% RDF. The magnitudes of increases were in the order of 20.45 & 10.38, 23.96 & 5.73, 23.34 & 6.51 per cent over 50 & 75% RDF, respectively. Application of 100% RDF significantly recorded maximum N, P, K content in grain and dry fodder as well as its uptake by grain, fodder and total uptake over 50 and 75 % RDF. The corresponding magnitude of increases in total N, P, K and protein yield were in the order of 20.45, 10.42, 23.95, 5.73, 31.57, 9.88, 28.85, 7.37, 29.02, 7.45, 25.33 and 11.16 percent, respectively. In general, overall improvement in growth of sorghum plants under the influence of increasing rates of fertility levels could be ascribed due to the potential role of N, P and K fertilizer in modifying soil and plant environment conducive for better development of both morphological and biochemical components of the growth. 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 Kushwaha and Thakur (2006), Dhaker (2010), Pawar *et al.* (2014) and Gupta *et al.* (2015).

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