The Pharma Innovation Journal 2022; 11(12): 3514-3520

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(12): 3514-3520

www.thepharmajournal.com
Received: 19-10-2022
Accepted: 23-11-2022

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Correlation and path analysis studies in *rabi* sorghum (*Sorghum bicolor* (L.) Moench.) mutants

Sudhir Patil, Hirakant Kalpande, Ambika More, Rushikesh Karpe and Ashok Badigannavar

Abstract
The material comprised of total 60 mutants lines and three local checks and one national check of *rabi* sorghum were evaluated for correlation coefficient and path analysis studies in complete randomized block design with two replications during *rabi* season of 2020-21 under at Research Farm, Department of Agricultural Botany, College of Agriculture, VNMKV, Parbahni (M.S.). This study aims to analyze and determine the traits having greater interrelationship with grain yield for production of high yielding mutants *rabi* sorghum genotypes. Results revealed grain yield per plant had positive significant correlation with plant height (0.7439), stem girth (0.6249), panicle length (0.7333), panicle breadth (0.432), panicle weight (0.9577), fodder yield per plant (0.6752), biological yield per plant (0.8591) at genotypic level. At phenotypic level, plant height (0.5402), stem girth (0.4085), panicle length (0.5082), panicle breadth (0.2978), panicle weight (0.8635), fodder yield per plant (0.5027), biological yield per plant (0.7329), zinc content (0.2045) exhibited positive association with grain yield. Four characters exhibited positive direct effect on grain yield per plant at both phenotypic as well as genotypic level, leaf area (G= 0.098, P= 0.225) had highest direct effect on grain yield, followed by internodal length (G=0.211, P=0.544), panicle length (G=0.314, P=1.090), panicle weight (G=0.450, P=2.769), had highest direct effect on grain yield.

Keywords: Path analysis studies, *rabi* sorghum, *Sorghum bicolor* (L.) Moench, panicle

Introduction

Sorghum (*Sorghum bicolor* L. Moench) is one of the C_4 cereal which is highly suited for the drought environment mainly due to its morphological and anatomical characteristics such as thick leaf wax, deep root system and physiological responses such as osmotic adjustment, stay green, quiescence. C_4 photosynthetic pathway in sorghum allows it to grow in high temperature, high light intensity and low water availability and it is highly efficient in fixing carbon dioxide. With the frequent changes in climate, water availability to the crop is becoming very essential to meet the production needs. Sorghum (*Sorghum bicolor* L.), the fifth most important cereal crop in terms of production and planting area, has attracted widespread attention in recent years as a potential “star” crop to tackle the challenges of global food security. Sorghum is the staple food in the human diet especially for poor and most food insecure people living in semi-arid tropics. It is used as whole grain or processed into flour, it is gluten free and have essential nutrients (proteins, vitamins and minerals) and nutraceuticals (phenolics, antioxidants and cholesterol lowering waxes). Firstly, cultivated sorghum is remarkably unique in that, it has a variety of end uses as food, feed, forage, fuel, beverage and broom. Sorghum is widely cultivated in more than 100 countries around the world. The top 10 sorghum producers, the USA, Sudan, Mexico, Nigeria, India, Niger, Ethiopia, Australia, Brazil and China, contribute about 77 % of the world sorghum production (Aruna and Cheruku, 2018) [7]. Sorghum is grown on 40.97 million hectares in world with an annual yield of 62.01 million tonnes of grain and a productivity of 1490 kg/ha. In India 4.24 million ha land is covered with an annual yield of 4.78 million tonnes of grain with a productivity of 1125 kg/ha. And in Maharashtra 1.94 million ha land is covered with an annual yield of 1.76 million tonnes of grain with a productivity of 911 kg/ha. (Anonymous, 2021) [4]. In India, the major sorghum growing states are Maharashtra, Karnataka and Andhra Pradesh which contributes nearly 93 per cent of area and production. Remaining area is distributing in states of Tamil Nadu, Gujarat, Madhya Pradesh and Rajasthan. Sorghum is unique to adopt environmental extremes abiotic and biotic stress.

Rabi sorghum occupies large area mainly in the states of Maharashtra, Karnataka and Andhra Pradesh with an average productivity of 819 kg/ha (Low). It's area is consistent over many years and it is an important component of dry land economy irrespective of its low productivity. The reasons for low productivity include biotic and abiotic stresses. The major abiotic stress limiting crop growth is drought. Sorghum as a staple food in the world, improving the crop is a key to ensure food security to the increasing population. Even though sorghum is considered as drought tolerant crop, growth and yield reduction occurs due to water stress. Identification of the traits (especially morphological and physiological) related to drought stress given higher importance in drought related studies. At both pre and post flowering stages sorghum is effected by water stress. Due to post flowering drought *rabi* sorghum is highly effected and it shows highly variable and low productivity. Even though it is one of the highly valued crops due to its good grain quality. For reducing the risk due to post flowering drought superior genotypes are required. Correlation measures the level of dependence traits and out of numerous correlation coefficients. It is often difficult to determine the actual mutual effects among traits (Ikanovic, *et al.* 2011) [13]. The estimates of correlations alone may be often misleading due to mutual cancellation of component traits. So, it becomes necessary to study path coefficient analysis, which takes in to account the casual relationship in addition to degree of relationship (Mahajan, *et al.* 2011) [20]. The path coefficient analysis initially suggested by Wright (1921) [29] and described by Dewey and Lu (1959) [10] allows partitioning of correlation coefficient into direct and indirect contributions (effects) of various traits towards dependent variable and thus helps in assessing the cause-effect relationship as well as effective selection.

Material and Methods

Experimental material for the proposed work consists of 60 mutant sorghum genotypes derived from r*abi* sorghum variety Parbhani Moti along with four checks *viz.* M 35-1, CSV-29R, Parbhani Moti and Super Moti. These 64 genotypes were grown in randomized block design with two replications at Research Farm, Agricultural Botany, COA, VNMKV, Parbhani during *rabi* 2020-21. The data pertaining to days to 50 % flowering, days to maturity, plant height, 1000 grain weight, grain yield per plant, fodder yield per plant, biological yield per plant, harvest index Fe, Zn, protein were recorded on five randomly selected representative plants in each entry from each replication except days to 50 % flowering and days to maturity which were recorded on the plot basis.

The iron and zinc from seed sample was estimated from di-acid extract digest with proper dilution using Atomic Absorption Spectrometer (AAS) with different wavelength after proper dilution (Allen, 1961a and Allen, 1961b). The nitrogen content in seed was determined by Micro Kjeldhal's method (AOAC, 1993) [5]. Once the nitrogen content has been determined it was converted to a protein content using the appropriate conversion factor (% Protein) = (F X % N) where, F=6.25. All these estimations were estimated at the Department of Soil Science and Agricultural Chemistry, COA, VNMKV, Parbhani.

In this experiment above mentioned 17 characters used for studying character associations and indirect and direct effects on yield.

Statistical analysis

Replication-wise mean values for all the characters were subjected to statistical analysis. All the statistical analysis were performed using R package software (R Core Team, 2020) [23].

The mean data for different characters obtained from the experiment laid out in randomized block design (RBD), was statistically analyzed by the statistical procedure provided by Panse and Sukhatme, (1961) [22]. The phenotypic and genotypic variances were calculated by using the respective mean square values from the variance table (Johnson *et al*. 1955) [17]. Analysis of co-variances between all the pairs of the characters under study was carried out as per the procedure of analysis of variance and co-variance as described by Singh and Chaudhari (1979). The appropriate variances and co-variances were used to calculate phenotypic and genotypic correlation (Johnson *et al*. 1955) [17]. Pearson's correlation coefficients between yield and its components were further partitioned into direct and indirect effects with the help of path coefficient analysis using method suggested by Dewey and Lu (1959) [10]. Path analysis was done by using R-package software (R Core Team, 2020) [23].

Results and Discussion

In general the genotypic correlation was generally of higher magnitude than phenotypic correlation (Table 1 and 2) indicating the inherent association between various characters studied. In genotypic correlation, grain yield per plant had positive significant correlation with plant height (0.7439) Umakant *et al.*, (2004) [27], stem girth (0.6249), panicle length (0.7333), panicle breadth (0.432), panicle weight (0.9577), Vidyadhar *et al.* (2006) [28] fodder yield per plant (0.6752) Godbharle *et al.* (2010) [12], biological yield per plant (0.8591), while it had significant and negative association with internodal length (-0.3975), 1000 grain weight (-0.603), harvest index (-0.2612). However, grain yield per plant had non-significant association with days to 50 % flowering (-0.1443) Akatwijuka *et al*. (2019) [1], days to maturity (-0.1143), leaf area (-0.0542), iron content) (0.0809), zinc content (0.2346), protein content (-0.2373).

In phenotypic correlation, grain yield per plant had positive significant association with plant height (0.5402) Umakant *et al.*, 2004) [27], stem girth (0.4085), panicle length (0.5082), panicle breadth (0.2978), panicle weight (0.8635), fodder yield per plant (0.5027) Godbharle *et al.* (2010) [12], biological yield per plant (0.7329), zinc content (0.2045) while it had negative significant correlation with internodal length (-0.2365), 1000 grain weight (-0.408), protein content (-0.2069). However, it had non-significant association with days to 50 % flowering (-0.047), days to maturity (-0.0064) Akatwijuka *et al*. (2019) [1], leaf area (0.0506), harvest index (0.0243), iron content (0.0484).

Table 1: Genotypic correlation coefficient for yield and its components in sorghum mutant lines

Charters	Days to 50% flowering	Days to maturity	Plant height	Leaf area	Internodal length	Stem girth	Panicle length	Panicle breadth	Panicle weight	1000 grain weight	Fodder yield per plant	Biological yield per plant	Harvest index	Iron (Fe) content	Zinc (Zn) content	Protein content	Grain yield per plant
Days to 50% flowering	1.000																
Days to maturity	0.769 **	1.000															
Plant height	-0.5016 **	-0.5793 **	1.000														
Leaf area	0.1239	-0.0328	0.4568 **	1.000													
Internodal length	-0.0166	-0.1107	-0.4683 **	-0.1551	1.000												
Stem girth	-0.2308	-0.3064 *	0.4031 **	0.051	-0.5112 **	1.000											
Panicle length	0.0369	0.5701 **	0.4948 **	-0.0184	-0.3947 **	0.5571 **	1.000										
Panicle breadth	0.3897 **	0.8753 **	-0.0708	0.594 **	0.1895	0.0549	0.5611 **	1.000									
Panicle weight	-0.2871 *	-0.2772 *	0.7213 **	-0.0449	-0.3308 **	0.5548 **	0.6292 **	0.3796 **	1.000								
1000 grain weight	-0.04	-0.3367 **	-0.7331 **	0.4302 **	0.5034 **	-0.4031 **	-0.6356 **	-0.0132	-0.6026 **	1.000							
Fodder yield per plant	-0.2231	-0.4887 **	0.611 **	0.0339	-0.4966 **	0.7989 **	0.4693 **	0.317 *	0.7437 **	-0.5025 **	1.000						
Biological yield per plant	-0.2323	-0.3669 **	0.6752 **	0.0083	-0.4789 **	0.757 **	0.5688 **	0.3529 **	0.9181 **	-0.5697 **	0.9305 **	1.000					
Harvest index	0.1808	0.6374 **	-0.3754 **	-0.0125	0.5959 **	-0.4374 **	-0.1493	-0.0233	-0.3798 **	0.2405	-0.8225 **	-0.6615 **	1.000				
Iron (Fe) content	0.1408	-0.2721 *	0.0439	-0.1339	-0.1596	0.0637	0.1847	-0.2108	0.006	-0.1643	0.0176	0.0233	0.0185	1.000			
Zinc (Zn) content	-0.3446 **	-0.2052	0.4099 **	0.372 **	-0.2224	0.0095	0.0294	-0.1045	0.1614	-0.1392	0.1727	0.1952	-0.0012	-0.1869	1.000		
Protein content	0.2343	0.2437	-0.2283	-0.3908 **	0.2151	-0.1392	-0.1577	0.0426	-0.1866	0.1133	-0.2284	-0.2385	0.224	0.1106	-0.4333 **	1.000	
Grain yield per plant	-0.1443	-0.1143	0.7439 **	-0.0542	-0.3975 **	0.6249 **	0.7333 **	0.432 **	0.9577 **	-0.603 **	0.6752 **	0.8591 **	-0.2612 *	0.0809	0.2346	-0.2373	1.000

*, ** significance at 5% and 1% respectively

Table 2: Phenotypic correlation coefficient for yield and its components in sorghum mutant lines

Charters	Days to 50% flowering	Days to maturity	Plant height	Leaf area	Internodal length	Stem girth	Panicle length	Panicle breadth	Panicle weight	1000 grain weight	Fodder yield per plant	Biological yield per plant	Harvest index	Iron (Fe) content	Zinc (Zn) content	Protein content	Grain yield per plant
Days to 50% flowering	1.000																
Days to maturity	0.5801 **	1.000															
Plant height	-0.2211 *	-0.1079	1.000														
Leaf area	-0.0859	-0.06	-0.0673	1.000													
Internodal length	0.1023	0.0344	-0.3159 **	0.0675	1.000												
Stem girth	-0.1076	-0.1063	0.2542 **	-0.011	-0.253 **	1.000											
Panicle length	0.0391	0.1573	0.3628 **	-0.0864	-0.2214 *	0.3152 **	1.000										
Panicle breadth	0.1542	0.2378 **	0.158	0.1702	0.0038	0.124	0.3424 **	1.000									
Panicle weight	-0.1332	-0.036	0.5398 **	-0.0217	-0.2487 **	0.4632 **	0.5046 **	0.3284 **	1.000								
1000 grain weight	-0.0455	-0.1976 *	-0.3307 **	0.1958 *	0.2861 **	-0.286 **	-0.4228 **	-0.0346	-0.4668 **	1.000							
Fodder yield per plant	-0.1403	-0.1074	0.3058 **	0.0453	-0.3551 **	0.4963 **	0.3358 **	0.2213 *	0.6294 **	-0.3859 **	1.000						
Biological yield per plant	-0.1517	-0.0992	0.4768 **	0.0161	-0.3607 **	0.5291 **	0.4744 **	0.2971 **	0.8621 **	-0.4633 **	0.8872 **	1.000					
Harvest index	0.1743 *	0.1232	-0.072	-0.0434	0.3625 **	-0.2425 **	-0.1518	-0.1055	-0.244 **	0.2089 *	-0.7127 **	-0.5441 **	1.000				
Iron (Fe) content	0.0573	-0.0633	0.0085	-0.032	-0.137	0.0444	0.1605	-0.12	0.0365	-0.1117	0.1242	0.0793	-0.068	1.000			
Zinc (Zn) content	-0.2117 *	-0.0709	0.2769 **	0.1857 *	-0.1528	0.0074	0.0246	-0.0655	0.152	-0.1178	0.1524	0.1851 *	-0.04	-0.1699	1.000		
Protein content	0.1439	0.0842	-0.1542	-0.1951 *	0.1478	-0.108	-0.1321	0.0267	-0.1757 *	0.0958	-0.2015 *	-0.2261 *	0.1639	0.1006	-0.4333 **	1.000	
Grain yield per plant	-0.047	-0.0064	0.5402 **	0.0506	-0.2365 **	0.4085 **	0.5082 **	0.2978 **	0.8635 **	-0.408 **	0.5027 **	0.7329 **	0.0243	0.0484	0.2045 *	-0.2069 *	1.000

*, ** significance at 5% and 1% respectively

Table 3: Path coefficient analysis for yield and its components at genotypic level in sorghum mutant lines

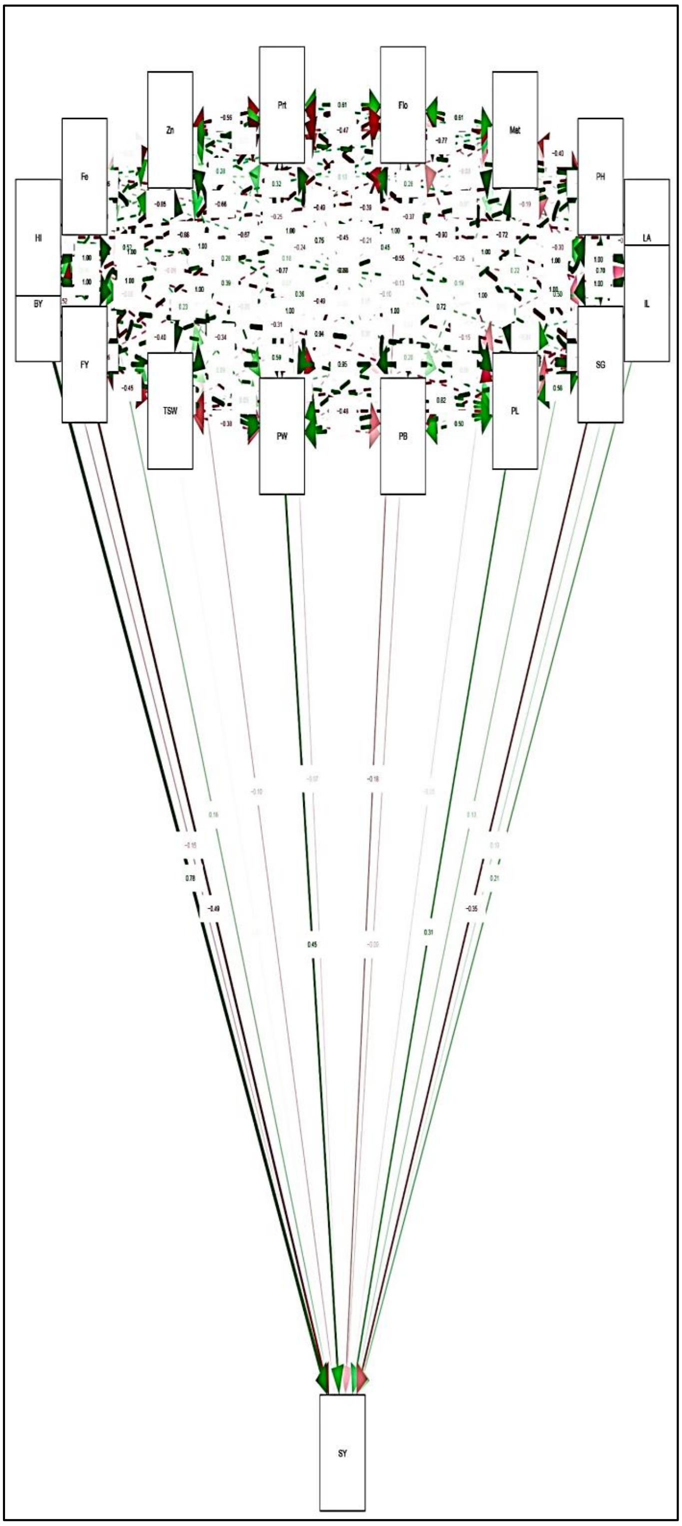
Charters	Days to 50% flowering	Days to maturity	Plant height	Leaf area	Internodal length	Stem girth	Panicle length	Panicle breadth	Panicle weight	1000 grain weight	Fodder yield per plant	Biological yield per plant	Harvest index	Iron (Fe) content	Zinc (Zn) content	Protein content	Grain yield per plant
Days to 50% flowering	-0.181	-0.113	0.056	0.008	-0.001	-0.019	0.020	-0.146	-0.448	0.000	-0.099	0.222	0.013	-0.016	-0.072	0.007	-0.1443
Days to maturity	0.340	-0.047	0.065	-0.002	-0.004	-0.025	0.313	-0.328	-0.432	-0.069	-0.218	0.350	0.046	0.031	-0.043	0.007	-0.1143
Plant height	-0.222	0.085	0.131	0.030	-0.017	0.033	0.272	0.027	1.125	-0.150	0.272	-0.645	-0.027	-0.005	0.086	-0.007	0.7439 **
Leaf area	0.055	0.005	-0.051	0.098	-0.006	0.004	-0.010	-0.222	-0.070	0.088	0.015	-0.008	-0.001	0.015	0.078	-0.012	-0.0542
Internodal length	-0.007	0.016	0.053	-0.010	0.211	-0.042	-0.217	-0.071	-0.516	0.103	-0.221	0.457	0.043	0.018	-0.046	0.006	-0.3975 **
Stem girth	-0.102	0.045	-0.045	0.003	-0.019	-0.355	0.306	-0.021	0.865	-0.083	0.356	-0.723	-0.031	-0.007	0.002	-0.004	0.6249 **
Panicle length	0.016	-0.084	-0.056	-0.001	-0.014	0.046	0.314	-0.210	0.982	-0.130	0.209	-0.543	-0.011	-0.021	0.006	-0.005	0.7333 **
Panicle breadth	0.172	-0.128	0.008	0.039	0.007	0.005	0.308	-0.086	0.592	-0.003	0.141	-0.337	-0.002	0.024	-0.022	0.001	0.432 **
Panicle weight	-0.127	0.041	-0.081	-0.003	-0.012	0.046	0.346	-0.142	0.450	-0.124	0.331	-0.877	-0.027	-0.001	0.034	-0.006	0.9577 **
1000 grain weight	0.000	0.049	0.083	0.028	0.018	-0.033	-0.349	0.005	-0.940	0.017	-0.224	0.544	0.017	0.019	-0.029	0.003	-0.603 **
Fodder yield per plant	-0.099	0.072	-0.069	0.002	-0.018	0.066	0.258	-0.119	1.160	-0.103	-0.487	-0.889	-0.059	-0.002	0.036	-0.007	0.6752 **
Biological yield per plant	-0.103	0.054	-0.076	0.001	-0.018	0.062	0.313	-0.132	1.432	-0.117	0.414	0.775	-0.047	-0.003	0.041	-0.007	0.8591 **
Harvest index	0.080	-0.094	0.042	-0.001	0.022	-0.036	-0.082	0.009	-0.592	0.049	-0.366	0.632	-0.154	-0.002	0.000	0.007	-0.2612 *
Iron (Fe) content	0.062	0.040	-0.005	-0.009	-0.006	0.005	0.102	0.079	0.009	-0.034	0.008	-0.022	0.001	0.162	-0.039	0.003	0.0809
Zinc (Zn) content	-0.152	0.030	-0.046	0.024	-0.008	0.001	0.016	0.039	0.252	-0.029	0.077	-0.186	0.000	0.021	-0.098	-0.013	0.2346
Protein content	0.104	-0.036	0.026	-0.026	0.008	-0.011	-0.087	-0.016	-0.291	0.023	-0.102	0.228	0.016	-0.013	-0.090	-0.070	-0.2373

*, ** denotes significance at 5% and 1% respectively. R = 0.083

Table 4: Path coefficient analysis for yield and its components at phenotypic level in sorghum mutant lines

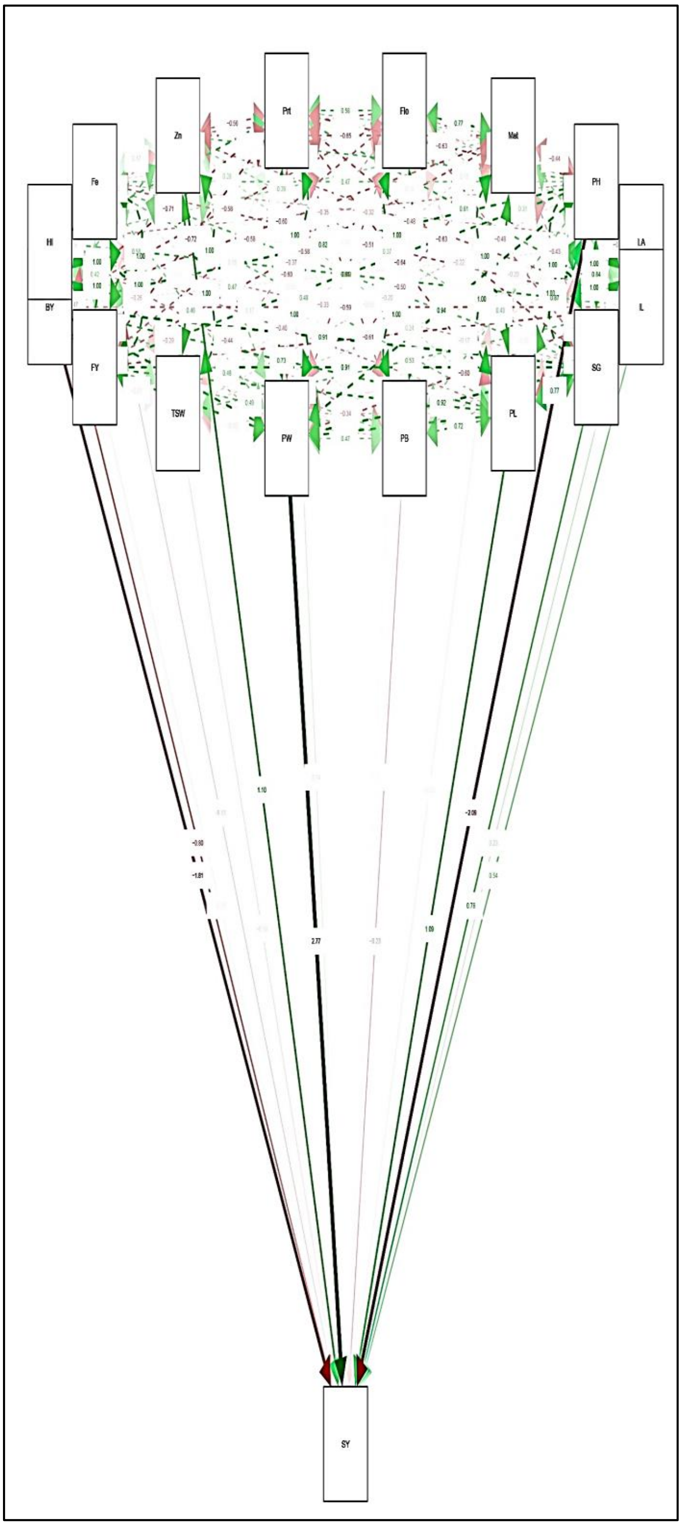
Charters	Days to 50% flowering	Days to maturity	Plant height	Leaf area	Internodal length	Stem girth	Panicle length	Panicle breadth	Panicle weight	1000 grain weight	Fodder yield per plant	Biological yield per plant	Harvest index	Iron (Fe) content	Zinc (Zn) content	Protein content	Grain yield per plant
Days to 50% flowering	-0.022	-0.019	-0.011	-0.007	-0.010	0.004	0.004	-0.001	-0.078	0.000	-0.037	-0.027	0.088	-0.001	0.005	-0.009	-0.047
Days to maturity	0.030	-0.055	-0.005	-0.005	-0.003	0.004	0.015	-0.001	-0.021	0.000	-0.029	-0.018	0.062	0.001	0.002	-0.005	-0.0064
Plant height	-0.012	0.004	-2.088	-0.006	0.029	-0.009	0.034	-0.001	0.316	0.000	0.082	0.086	-0.036	0.000	-0.007	0.009	0.5402 **
Leaf area	-0.004	0.002	-0.003	0.225	-0.006	0.000	-0.008	-0.001	-0.013	0.000	0.012	0.003	-0.022	0.000	-0.004	0.012	0.0506
Internodal length	0.005	-0.001	-0.016	0.006	0.544	0.009	-0.021	0.000	-0.146	0.000	-0.095	-0.065	0.183	0.002	0.004	-0.009	-0.2365 **
Stem girth	-0.006	0.004	0.013	-0.001	0.024	0.779	0.030	-0.001	0.271	0.000	0.132	0.095	-0.122	-0.001	0.000	0.006	0.4085 **
Panicle length	0.002	-0.005	0.018	-0.007	0.021	-0.011	1.090	-0.002	0.295	0.000	0.090	0.085	-0.077	-0.002	-0.001	0.008	0.5082 **
Panicle breadth	0.008	-0.008	0.008	0.014	0.000	-0.005	0.032	-0.234	0.192	0.000	0.059	0.053	-0.053	0.002	0.002	-0.002	0.2978 **
Panicle weight	-0.007	0.001	0.027	-0.002	0.023	-0.017	0.047	-0.002	2.769	0.000	0.168	0.155	-0.123	-0.001	-0.004	0.010	0.8635 **
1000 grain weight	-0.002	0.006	-0.017	0.016	-0.027	0.010	-0.040	0.000	-0.273	-0.097	-0.103	-0.083	0.105	0.002	0.003	-0.006	-0.408 **
Fodder yield per plant	-0.007	0.004	0.016	0.004	0.033	-0.018	0.031	-0.001	0.368	0.000	-0.051	0.159	-0.360	-0.002	-0.004	0.012	0.5027 **
Biological yield per plant	-0.008	0.003	0.024	0.001	0.034	-0.019	0.044	-0.002	0.505	0.000	0.237	-1.812	-0.275	-0.001	-0.004	0.013	0.7329 **
Harvest index	0.009	-0.004	-0.004	-0.004	-0.034	0.009	-0.014	0.001	-0.143	0.000	-0.190	-0.098	-0.796	0.001	0.000	-0.010	0.0243
Iron (Fe) content	0.003	0.002	0.000	-0.003	0.013	-0.002	0.015	0.001	0.021	0.000	0.033	0.014	-0.034	-0.147	0.004	-0.006	0.0484
Zinc (Zn) content	-0.011	0.002	0.014	0.015	0.014	0.000	0.002	0.000	0.089	0.000	0.041	0.033	0.000	0.002	1.100	0.026	0.2045 *
Protein content	0.008	-0.003	-0.008	-0.016	-0.014	0.004	-0.012	0.000	-0.103	0.000	-0.054	-0.041	0.083	-0.001	0.010	0.136	-0.2069 *

*, ** denotes significance at 5% and 1% respectively. R = 0.127



Note: Flo-Days to 50% flowering, Mat- Days to maturity, PH- Plant height, LA- Leaf area, IL- Internodal length, SG- Stem girth, PL-Panicle length, PB-Panicle breadth, PW-Panicle weight, TSW-Test weight, FY- Fodder yield per plant), BY-Biological yield per plant, HI-Harvest index, Fe-Iron, Zn-Zinc, Prt.-Protein, SY-Seed yield per plant.

Fig 1: Genotypic path coefficient analysis for grain yield and yield contributing traits in sorghum mutant lines during *rabi*-2020-21



Note: Flo-Days to 50% flowering, Mat- Days to maturity, PH- Plant height, LA- Leaf area, IL- Internodal length, SG- Stem girth, PL-Panicle length, PB-Panicle breadth, PW-Panicle weight, TSW-Test weight, FY- Fodder yield per plant, BY-Biological yield per plant, HI-Harvest index, Fe-Iron mg/kg seed), Zn-Zinc, Prt.-Protein, SY-Seed yield per plant.

Fig 2: Phenotypic path coefficient analysis for grain yield and yield contributing traits in sorghum mutant lines during *rabi*-2020-21

Path analysis creates a decision for grain yield improvement *i.e.*, to carry out the indirect selection for the trait which shows direct effect on the grain yield. Selection for a trait is effective when both the values of correlation and direct effect are higher and positive as this indicates its true association. Simultaneous consideration is made for indirect caused factors for selection if the direct effect is negative or negligible and correlation coefficient is positive. In order to reduce undesirable indirect effect, direct selection for the traits is followed if the direct effect is positive or high and correlation coefficient is negative. In present study, genotypic path analysis, characters like plant height (0.131), leaf area (0.098), internodal length (0.211), panicle length (0.314), panicle weight (0.450), 1000 grain weight (0.017), biological yield per plant (0.775), iron content (0.162) exhibited positive direct effects towards grain yield per plant . However, days to 50 % flowering (-0.181), days to maturity (-0.047), stem girth (-0.355), panicle breadth (-0.086), fodder yield per plant (-0.487), harvest index (-0.154), zinc content (-0.098), protein content (-0.070) recorded negative direct effects towards grain yield per plant. While the residual effect is 0.083 i.e. negligible hence the influence of other character is miner. Whereas, in phenotypic path analysis, characters like leaf area (0.225), internodal length (0.544), stem girth (0.779), panicle length (1.090), panicle weight) (2.769), zinc content (1.100), protein content (0.136) recorded positive direct effects towards grain yield per plant, while days to 50 % flowering (-0.022), days to maturity (-0.055), plant height (-2.088), panicle breadth (-0.234), 1000 grain weight (-0.097), fodder yield per plant (-0.051), biological yield per plant (-1.812), harvest index (-0.796), iron content (-0.147) recorded negative direct effects towards grain yield per plant similar results were reported by Srivas and Singh (2004) [25], Iyanar and Khan (2005) [15], Kishore and Singh (2005) [19], Deepalakshmi *et al*. (2007) [9], Sukhchain and Singh (2008) [26], Bahadur and Lodhi (2009) [8], Mia *et al*. (2009) [21], Iyanar *et al.* (2010) [14], Jain *et al*. (2010) [16], Din *et al.* (2012) [11], Arunkumar (2013) [6], Kalpande *et al*. (2014) [14].

Conclusion

Thus, it may be concluded from the present study that, the traits like plant height, leaf area, panicle length, panicle weight, fodder yield and biological yield had greater importance. These traits had significant contribution in the expression of grain yield in same direction. Such strong relation in either direction between the traits indicates that, they are heritable and genetically controlled characters which could be inherited into desired genotypes. Simultaneous increment in the grain as well as fodder yield as indicated by strong correlation in desirable direction is rewarding for the development of dual-purpose *rabi* adopted sorghum suitable for *rabi* sorghum areas where it is mostly cultivated on residual soil moisture. Selection may be practiced in positive direction based on these characters towards improved grain yield. Hence, due consideration should be given to these characters, while planning a breeding strategy for increased grain yield/ plant.

References:

1. Akatluwijuka R, Rubaihayo PR, Odong TL. Correlations and path analysis among sorghum (*Sorghum bicolor* L. Moench) cultivars in the highlands of southwestern Uganda. African Journal of Agricultural Research. 2019;27(3):437–444
2. Allen JE. The determination of copper by atomic absorption spectrophotometry. Spectrochim. Acta. 1961a;17:459-466.
3. Allen JE. The use of organic solvents in atomic absorption spectrophotometry. Spectrochim. Acta. 1961b;17:467-463.
4. Anonymous. Directorate of economics & statistics, DA & FW Agricultural Statistics at a glance; c2021.
5. AOAC. Official Method of Analysis. Association of Official Analytical Chemists, Washington, D. C; c1993.
6. Arun Kumar B. Studies on genetic parameters and interrelationships among yield contributing traits in sorghum. The Bioscan. 2013;8(4):1311-1314.
7. Aruna C, Cheruku D. Genetic improvement of grain sorghum. In: Aruna C, Visarada KBRS, Bhat BV, Tonapi VA (eds). Breeding sorghum for diverse end uses. *Woodhead Publishing.* Cambridge, UK; c2018. p. 157-173.
8. Bahadur R, Lodhi GP. Correlation and path analysis and their implications in fodder oat improvement. Environment and Ecology. 2009;27(4):1474-1477.
9. Deepalakshmi AJ, Ganesamurthy K. Studies on genetic variability and character association in kharif sorghum (Sorghum bicolor (L.) Moench); c2007.
10. Dewey DR, Lu KHA. Correlation and path coefficient analysis of components of crested wheat grass seed production. Agron J. 1959;51(9):575-581.
11. Din AAEA, Hessein EM, Ali EA. Path coefficient and correlation assessment of yield and yield associated traits in sorghum (*Sorghum bicolor* L.) genotypes. American-Eurasian Journal of Agriculture & Environment Science. 2012;12(6):815-819.
12. Godbharle AR, More AW, Ambekar SS. Genetic variability and correlation studies in elite ‘B’ and ‘R’ lines in *kharif* sorghum. Electronic Journal of Plant Breeding. 2010;1(4):989-993.
13. Ikanovic J, Djordje J, Radojka M, Vera P, Dejan Marija S, Sveto R. Path analysis of the productive traits in sorghum species. Genetika. 2011;43(2):253-262.
14. Iyanar KG, Vijayakumar, Fazllullah Khan AK. Correlation and path analysis in multicut fodder. Electronic Journal of Plant Breeding. 2010;1(4):1006-1009.
15. Iyanar K, Khan AKF. Correlation and path analysis in multicut fodder sorghum. Annals of Agricultural Research. 2005;26(2):228-230.
16. Jain SK, Elangovan M, Patel NV. Correlation and path coefficient analysis for agronomical trait in fodder sorghum. Indian Journal of Plant Genetic Resources. 2010;23(1):15-18.
17. Johnson HW, Robinson HF, Comstock RE. Estimates of Genetic and Environmental Variability in Soybeans. Agronomy Journal. 1955;47:314-318.
18. Kalpande HV, Chavan SK, More AW, Patil VS, Unche PB. Character association, genetic variability and component analysis in sweet sorghum [*Sorghum bicolor (L. Moench)*]. Journal of Crop and Weed. 2014;10(2):108-110.
19. Kishore N, Singh LN. Variability and association studies under irrigated and rainfed situations in the sub-montane region in fodder sorghum. [*Sorghum bicolor* (L.) Moench]. Crop Research (Hisar). 2005;29(2):252-258.

20. Mahajan RC, Wadikar PB, Pole SP, Dhuppe MV. Variability, correlation and path analysis studies in sorghum. Res. J of Agric sci. 2011;2(1):101-103.
21. Mia AA, Rahim MA, Mahmud F. Genetic variability, correlation coefficient and path analysis in sorghum (S*orghum bicolor* L.) Bangladesh J. Prog. Sci & Tech. 2009;7(1):149-152.
22. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian council of agricultural research. New Delhi, 1961, 381.
23. Core Team R. R. A language and environment for statistical computing, R foundation for Vienna, Austria. https://www. R project. Org; c2020.
24. Singh RK, Chaudhary BD. Biometrical Methods in Quantitative Genetic Analysis. Biometrical Methods in Quantitative Genetic Analysis; c1979.
25. Srivas SK, Singh UP. Genetic variability, character association and path analysis of yield and its component traits in fodder maize (*Zea mays* L.). Range Management and Agro forestry. 2004;25(2):149-153.
26. Sukhchain, Kamal Singh. Association analysis among vegetative traits in fodder sorghum (*Sorghum bicolor*). Range Mgmt. and Agroforestry. 2008;29(2):147-148.
27. Umakant AV, Madhusudhana R, Latha KM, Rafia SM, Kiran VSS. Analysis of genetic variation and trait interrelationship in sorghum. National J Pl. Impr. 2004;6(2):104-107.
28. Vidyadhar B, Chand P, Devi IS. Genetic variability and character association for yield attributes in pearl millet (*Pennisetum sp.*) germplasm. Journal of Research ANGRAU. 2006;34(4):114-117.
29. Wright S. Correlation and causation. Journal of Agricultural Research. 1921;20:557-585.