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Correlation Studies in Post-rainy Sorghum (*Sorghum bicolor* L. Moench) Genotypes against Moisture Stress Tolerance

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ABSTRACT: In present investigation, help to exploit genotypic and phenotypic correlation for sorghum grain yield, its contributing credits and drought tolerance mechanism using 45 (36 hybrids + 9 parents) genotypes were assessed by randomized block design with three replicas. Terminal drought (post-flowering) occurrence has been the most detrimental condition which is mainly limiting the rabi sorghum production as well as productivity. Refinement of post rainy sorghum varieties through plant breeding has been steady but could be hastened if the drought scenario in the cultivated regions were understood better. The current experiment exposed that, morpho-physiological traits viz., leaf chlorophyll content index, stay green score green leaf area are favourably significant and found associated with economic yield and straw yield. Consequently, mentioned attributes should selected for moisture stress tolerance in post rainy sorghum. Hence the resulted information can assist in capitalizing the search for moisture stress adaptive traits and improvement practices to moisture stress situations and thus strengthen the development in post rainy sorghum through trait specific association.

Keywords: Sorghum, Correlation, Stay green, Moisture stress, green leaf area.

INTRODUCTION

Post rainy sorghum (*Sorghum bicolor* L. Moench) is significant feed and fodder crop. It is also an important C4 mechanism crop in cereal group and is incredibly habituated for the moisture stress climate because of its anatomical and morphological qualities such as deeper root system, thick wax covering on leaf and physiological replies like quiescence, osmotic flexibility, and mechanism of stay green. Hatch and Slack photosynthetic pathway in this crop permit it to cultivate in higher light frequency, increased temperature and minimum water accessibility and it is also greatly effective in fixing atmospheric CO_2. These parameters construct sorghum to diminish the threats and allows for economically lucrative and sustainable dry land agriculture system with the regular variations in climate, accessibility of water to the sorghum in post rainy conditions is becoming necessary to catch the production needs (Patil *et al*., 2020). Sorghum known for to survive in different stresses, including salinity, high temperature, severe drought and flooding as equated to other crops of cereal (Ejeta and Knoll 2007), nevertheless, sorghum cultivated in rain fed area is affected by water stress at the post-flowering stage (Kebede *et al.,* 2001).

Development of a drought tolerant sorghum variety is now need of the time due to the frequently changing climatic conditions and expanding human and livestock population (WHO, 2021). Sorghum gives differential response to moisture stress based on the circumstance post flowering and pre-flowering stage). The post-flowering occurrence of moisture stress is supplements with stay-green characters and results in early leaf and stem senescence, decreased seed size and lodging (Borrell *et al.,* 2000). Drought conditions emerge before the anthesis stage of sorghum and degrades grain number, biomass, panicle size, and grain yield (Sanchez *et al.,* 2002).

Various experiments have been conducted to determine the selection benchmarks for moisture stress tolerance. Importance of leaf water relations and their considerable interaction with moisture stress tolerance which are flag leaf related traits was also studied by various workers (Agarwal and Sinha 1984). The accomplishment in plant breeding under moisture limiting condition is restricted therefore analysis and identification of plant traits with sound and desirable association with moisture stress tolerance and maximum yield under moisture limiting condition is essential (Richards, 2004).

The frequency of correlation of traits is assessed by character association studies. These findings from

experiments help the researcher to which trait should be taken for selection to achieve the highest increase in the economic yield under limiting conditions. The association between the various characters would assist to select different morpho-physiological parameters, which are of prime importance for the study of moisture stress tolerance in rabi sorghum.

Lower productivity in the crops is mainly a result of various biotic and abiotic stresses. Moisture stress is the main abiotic factor in rabi sorghum which affects the crop growth and condition. Water limiting conditions affects the grain yield and growth of the sorghum even though it is considered as drought tolerant crop. Assessment of the characters (mainly physiological and morphological) associated to moisture stress given higher attention in drought related experiments. Sorghum yield has been affected by moisture stress at both the flowering stages which are pre as well as post flowering. Highly variable response in grain yield and low productivity of *rabi* sorghum is reported because of post flowering moisture stress. Tolerant and superior accessions are required to reduce the adverse effect cause due to post flowering drought. Favourable characters displaying positive genetic correlation guarantees the attempt of the investigator for improving traits simultaneously. It is also observed that the absence correlation between traits is applicable for the mutual improvement of the two traits. Whereas, an undesirable or non-positive correlation among identified traits makes it tough to enrich a significant improvement in desirable characters.

MATERIALS AND METHODS

The experimental material consists of 45 genotypes including nine parental lines, selected parents were crossed in half-diallel fashion to generate 36 hybrids. The experiments were conducted in randomized block design including three replications in medium deep black soil in rained condition at Regional Research Station Amravati, during *rabi* 2017-2018. Paired row sowing of each entry having 3 m length with inter row spacing of 45 cm and plant to plant spacing of 15 cm was designed. Needful operations were conducted to establish an ideal crop condition. Observations were collected on five randomly selected plants from each replication for significant yield and its contributing characters *viz.*, days to fifty per cent flowering, days to maturity, panicle length, panicle breadth, plant height, shoot to root ratio, seedling vigour, leaf chlorophyll content index (90 days after sowing), relative water content, stay green score, green leaf area, fodder yield and grain yield. Mean generated from data of five plants was calculated and further used for statistical analysis. Estimation of phenotypic and genotypic correlations coefficients and variation components were formulated by using the formulae given by Burton (1952) ; Johnson *et al.* (1955).

RESULT AND DISCUSSION

The presented worked was carried out to examine the degree of character association ship of important moisture stress tolerant characters with yield and its attributes in rabi sorghum. Analysis of variance displayed the differences generated among the treatments with respective of all the traits investigated were found significant at five as well as one per cent level of significance, Indicating the presence of considerable amount of variation needed for effective selection of these traits in the genotypes under study.

Tolerance to moisture stress seems to be a complex character which is rely on a number of different impacting components. The know-how of association of various moisture stress tolerance affecting components is of prime importance in drought tolerance breeding programme. Hence, this investigation will provide reliable findings on extent, nature and effectively of selection in rabi sorghum.

Data generated from the simple correlation coefficient analysis of 45 genotypes is presented in Table 1. The results of the investigation were in accordance with the earlier reports by Ghorade *et al.* (2013); Gadakh *et al.* (2018). Findings may verify the restricted involvement of environment in modifying the total expression of the genotypes.

Earliness traits such as days to 50 per cent flowering exhibited significant and positive correlation with number of days to maturity along with shoot root length whereas number of days to maturity displayed significant and positive association for shoot root length at the phenotypic and genotypic level.

Genotypic and phenotypic correlation coefficient revealed that, positive and significant association of plant height was recorded with panicle breadth, panicle length, seedling vigour, chlorophyll content index (90 DAS), green leaf area, stay green score, fodder yield and grain yield. Thus, maximum desirable traits showing a crucial role in moisture stress tolerance are found to be associated with plant height (Iyanar *et al*., 2001; Umakanth *et al.*, 2005).

Panicle length flashed significant and positive association with panicle breath, plant vigour, fodder yield, chlorophyll content and grain yield on the other hand Panicle breath recorded significant positive association with vigour, chlorophyll content index-90 days, fodder yield and grain yield.

Seedling vigour also exhibited positive highly significant with leaf chlorophyll content index, relative water content (30 DAF), leaf area, grain yield and fodder yield.

Significant and positive correlation of the trait chlorophyll content index was found with, green leaf area, fodder yield, stay green score and grain yield, also the relative water content which is an important trait correlates positively and significantly with fodder yield on both genotypic and phenotypic coefficients. High chlorophyll content in leaves, delayed senescence, and chlorophyll fluorescence as well as higher transpiration efficiency rate and lower canopy temperature and are important physiological traits which formulate moisture stress tolerance to sorghum (Kapanigowda *et al*., 2013). Therefore, these characters should give preference in improvement for drought tolerance in post rainy sorghum.

Green leaf area showed desirable and significant correlation with relative water content, fodder yield and grain yield. Stay green score also displayed positive and highly significant correlation with grain yield and fodder yield whereas the fodder yield recorded significant correlation in positive direction with grain yield at genotypic and phenotypic level. Stay-green known for its important role in drought-tolerance in sorghum. The results are in conformity with Dev Kumar *et al.* (2021).

Table 1: Values of genotypic and phenotypic correlation coefficient (r) for various traits in post rainy sorghum for Amravati Location.

Traits		D.F	D.M	P.H	P. L	P. B	Shoot/ Root	Vigour	CCI	L.A	RWC	SGS	F. Yield	G. Yield
D.F	G	1	0.99**	-0.74**	-0.51**	-0.49**	0.48**	-0.34**	0.14	-0.62**	-0.20*	-0.28**	-0.77**	-0.53**
	P	1	0.64**	-0.54**	-0.38**	-0.37**	0.24*	-0.20*	0.06	-0.46**	-0.10	-0.21*	-0.51**	-0.36**
D.M	G		1	-0.58**	-0.36**	-0.42**	0.50**	-0.13	0.12	0.12	-0.04	-0.24*	-0.58**	-0.44**
	P		1	-0.47**	-0.26**	-0.34**	0.29**	-0.10	0.12	-0.39**	-0.04	-0.20*	-0.44**	-0.31**
P.H	G			1	0.60**	0.57**	-0.39**	0.43**	0.25**	0.53*	0.11	0.45**	0.85**	0.53**
	P			1	0.60**	0.57**	-0.25*	0.33**	0.16	0.55**	0.12	0.45	0.78**	0.49**
P. L	G				1	0.71**	-0.27**	0.58**	0.30**	0.46**	-0.04	0.19	0.58**	0.52**
	P					0.71**	-0.20*	0.44**	0.19*	0.47**	-0.02	0.20	0.53**	0.48**
P. B	G					1	-0.43**	0.44**	0.27**	0.44**	0.19	0.25	0.55**	0.65**
	P					1	-0.33**	0.34**	0.17	0.45**	0.15	0.26	0.50**	0.60**
Shoot/ Root	G						1	-0.27**	-0.30**	-0.48**	-0.13	-0.21*	-0.38**	-0.56**
	P						1	-0.19*	-0.13	-0.36**	-0.07	-0.15	-0.22*	-0.38**
Vigour	G							1	0.47**	0.69**	0.25**	0.06	0.58**	0.63**
	P							1	0.20*	0.52**	0.29**	0.05	0.30**	0.48**
CCI	G								1	0.19*	0.09	0.28**	0.36**	0.27**
	P								1	0.12	-0.01	0.18	0.20*	0.15
L.A	G									1	0.40**	0.11	0.65**	0.66**
	P									1	0.32**	0.12	0.59**	0.60**
RWC	G										1	-0.22*	0.26**	0.15
	P										1	-0.15	0.20*	0.11
SGS	G											1	0.43**	0.21*
	P											1	0.40**	0.20*
F. Yield	G												1	0.63**
	P												1	0.52**
G. Yield	G													1
	P													1

D.F: Days to flowering
D.M: Days to maturity
S.G. S: stay green score
P.B: panicle breadth
P.L: Panicle length
CCI: Chlorophyll content index (90DAS)
L.A: Leaf area
R.W.C: Relative water content (30 DAF)
P.H: Plant height

CONCLUSIONS

This investigated study confirmed that the simple correlation coefficients of leaf chlorophyll content index with relative water content, green leaf area, fodder yield, and grain yield were found significant and in positive magnitude. This revealed that the selection criteria focusing for leaf area would, thus, result in the increased chlorophyll content, relative water content, and can hence introduced delayed senescence by the stay green mechanism. The results also pointed that the influence of the external factors on these traits is not much more as there is absence of variation between phenotypic and genotypic correlations coefficients of these characters. Therefore, attention should be drawn towards reflected traits for drought tolerance at the time of deciding a breeding strategy for drought tolerance with higher grain yield.

FUTURE SCOPE

The identified physiological along traits along with agronomical traits can be further exploited to strengthen the moisture stress breeding in rabi sorghum and the same traits can be capitalised in terms of higher fodder yield as well as grain yield in rabi sorghum.

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Conflict of Interest. None.

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