RESEARCH PAPER
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Character association for grain yield and some of the growth parameters associated with drought tolerance in *Rabi* sorghum

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Correlation studies in five line, twelve testers and the resultant sixty hybrids developed by line x tester design revealed that grain yield per plant was positively and significantly correlated with all the growth parameters related with drought *viz.,* chlorophyll content at 75 DAS, proline content, specific leaf weight, leaf area ratio at 75 DAS, crop growth rate at 60-75DAS, relative growth rate at 60-75 DAS and net assimilation rate at 60-75DAS. This indicated that increase in grain yield in *Rabi* sorghum under drought condition may be because of increase in one or more of these growth parameters.

Key words : Correlation, Drought, Water stress

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INTRODUCTION

Sorghum [*Sorghum bicolor* (L.)Moench] is the important cereal crop as it is a source of food for rural masses, food for cattle population and the raw material for the industries. Also with the present situation sorghum cultivation is the heart of the dryland agriculture. Being a C_4 plant sorghum can utilize sunlight and water efficiently. In Maharashtra, about 9.34 lakh ha. area is under *Kharif* sorghum while 32.5 lakh ha area is under *Rabi* sorghum. *Rabi* sorghum is normally grown under stored and receding soil moisture conditions. The yield levels of the *Rabi* sorghum have reached to the pleatue and there is need to break this yield plateau. Hybridization is the suitable technique to obtain the superior cross combinations with significant heterosis. Knowledge of the interrelationship between yield and some of the growth parameters associated with drought tolerance in *Rabi* sorghum enables the breeder to plan the breeding programmed accordingly to develop drought tolerant genotypes. The present investigation was undertaken to study the extent of association between yield and some of the growth parameters associated with the drought tolerance in *Rabi* sorghum.

RESEARCH METHODOLOGY

The experimental material consisted of five lines *viz.,* AKMS 27A, AKMS 30A, AKMS 90A, AKMS 14A and AKMS 40A and ten testers *viz.,* AKR 493, AKR 494, AKR 495, AKR 496, AKR 497, AKR 498, AKR 499, AKR 500, AKR 422 and AKR 456, and sixty hybrids developed by crossing five lines with twelve testers by line x tester fashion. The experiment was conducted during *Rabi* 2006-07 on the sorghum research unit, Dr.PDKV, Akola (M.S.). The experiment was laid out in Randomized Block Design with spacing of 45x15 cm. in three replications under drought condition. Five competitive plants were selected from each entry in each replication for recording the observations on grain yield per plant and seven growth parameters associated with drought tolerance *viz.,* chlorophyll content at 75 DAS, proline content, specific leaf weight, leaf area ratio at 75 DAS, crop growth rate at 60-75DAS, relative growth rate at 60-75 DAS and net assimilation rate at 60-75DAS in *Rabi* sorghum. The data were subjected to analysis of variance and covariance (Panse and Sukhatme, 1967). Genotypic and phenotypic correlation co-efficients for all the characters were estimated by using method suggested by Hayes *et al.* (1955).

RESEARCH FINDINGS AND ANALYSIS

The genotypic correlation were generally of higher magnitude than the phenotypic correlation (Table 1) indicating the inherent association between various traits. Total chlorophyll content was important and used to produce high capacity of photosynthetase by initiating photosynthetic reaction and transporting particularly in stress condition. Considering phonotypic correlation, it was observed that total chlorophyll content at 75 days after sowing was positively and significantly correlated with proline content and grain yield per plant. Considering genotypic correlations, it was observed that total chlorophyll content at 75 DAS was positively and significantly correlated with proline content, leaf area ratio at 75DAS, crop growth rate at 60-75 days after sowing and grain yield per plant. Similar observations were recorded by Dhopte *et al*. (1995) reported that total chlorophyll content was correlated positively and significantly with grain yield per plant. Reddy *et al.* (2012) reported that chlorophyll stability index is associated with desiccation tolerance under terminal water deficit condition and can be used as one of the reliable selection criteria in rapid screening for post rainy adapted genotypes for drought tolerance.

Proline content showed the positive significant correlation with grain yield per plant at phenotypic level. However, at genotypic level, proline content was significantly and positively correlated with leaf area ratio at 75 days after sowing, crop growth rate at 60-75 days after sowing, net assimilation rate at 60-75 days after sowing and grain yield per plant under water stress condition. Singh *et al.* (1974) recorded similar observations and reported positive correlation of proline content and yield.

Specific leaf weight showed positive and significant phenotypic correlation with grain yield per plant and net assimilation rate at 60-75 days after sowing. However, at genotypic level, it showed positive significant correlation with grain yield per plant and growth parameters such as net assimilation rate at 60-75 days after sowing, crop growth rate at 60-75 days after sowing and leaf area ratio at 75 days after sowing. Increase in leaf area ratio and specific leaf weight increased the assimilation of the photosynthete definitely which ultimately and indirectly boosted up the economics of sorghum. Similar results were obtained by Rao (2003) and Pawar and Chetti (1998) who observed similar positive correlations between specific leaf weight and grain yield per plant under water stress condition. They also reported positive and significant correlations of specific leaf weight with net assimilation rate, leaf area ratio and crop growth rate under water stress condition.

Leaf area ratio at 60-75 days after sowing showed positive and significant correlation with grain yield per plant at phenotypic level along with crop growth rate at 60-75 days after sowing and relative growth rate at 60-75 days after sowing and net assimilation rate. However, at genotypic level it showed positive and significant correlation with grain yield per plant and other growth parameters such as crop growth rate at 60-75 days after sowing , relative growth rate at 60-75 days after sowing, net assimilation rate. It can be said that increase in leaf area ratio results positively in building up these important traits. Dhoran (1987) gave similar results and found positive and significant correlation of leaf area ratio with grain yield per plant and relative growth rate. Reddy *et al.* (2012) reported that leaf area index of a genotype which produced high dry matter could be considered as an indicator of grain yield. However,

Table 1: Phenotypic (P) and genotypic (G) correlation coefficients between grain yield per plant and growth parameters associated with drought tolerance

Sr. No.	Characters		Chlorophyll content at 75 DAS	Proline content	Specific leaf weight	Leaf area ratio at 75 DAS	Crop growth rate at 60-75 DAS	Relative growth rate at 60-75 DAS	Net assimilation rate at 60-75 DAS	Grain yield /plant
1.	Chlorophyll content at 75 DAS	P		0.202*	0.078	0.140	0.195	0.058	0.062	0.615**
		G		0.551**	0.048	0.270**	0.312**	0.017	0.044	0.768**
2.	Proline content	P			0.004	0.126	0.127	0.008	0.082	0.223*
		G			0.031	0.381**	0.339**	0.038	0.238**	0.270**
3.	Specific leaf weight	P				0.154	0.212	0.180	0.218*	0.240**
		G				0.338**	0.288**	0.188	0.301**	0.284**
4.	Leaf area ratio at 75 DAS	P					0.547**	0.281**	0.583**	0.207*
		G					0.753**	0.418**	0.830**	0.407**
5.	Crop growth rate at 60-75 DAS	P						0.726**	0.869**	0.213*
		G						0.658**	0.838**	0.275*
6.	Relative growth rate at 60-75 DAS	P							0.778**	0.267**
		G							0.746**	0.434**
7.	Net assimilation rate at 60-75 DAS	P								0.211*
		G								0.409**

*and** indicates Significant of value at P=0.05 and P=0.01, respectively

Pawar and Chetti (1998) found negative correlations of leaf area ratio with net assimilation rate, crop growth rate and specific leaf weight under water stress condition.

Crop growth rate is nothing but relative growth rate expressed on unit ground area basis. In crop community parameters, net assimilation rate is insufficient to describe growth of crop considering phenotypic correlations, crop growth rate at 60-75 days after sowing recorded positive and significant correlation with relative growth rate at 60-75 days after sowing, net assimilation rate at 60-75 days after sowing and grain yield per plant. However, genotypic correlations revealed that crop growth rate at 60-75 days after sowing was positively and significantly correlated with grain yield per plant and other traits such as relative growth rate at 60-75 days after sowing, net assimilation rate at 60-75 days after sowing. It indicated that increase in crop growth rate ultimately increased these parameters. Dhoran (1987) observed similar correlations between crop growth rate and grain yield per plant. Pawar and Chetti (1998) found crop growth rate was positively and significantly correlated with grain yield per plant and relative growth rate. However, they found that crop growth rate was negatively and significantly associated with net assimilation rate under water stress condition.

Relative growth rate is comparable compound interest growth representing rate of simple addition and compound addition of total dry matter per plant. Relative growth rate at 60-75 days after sowing showed positive and significant correlation at phenotypic level with grain yield per plant. Relative growth rate enhanced the leaf area and in turn productivity as plants favouring assimilates of more carbohydrates which ultimately results in good economic yield and in turn drought tolerance capacity of plants. Lamani *et al.* (1997) recorded similar observations and reported positive significant association between RGR and grain yield per plant. Pawar and Chetti (1998) found positive and significant correlation between grain yield per plant and RGR under water stress condition.

Net assimilation rate is efficiency of crop growth and efficiency of light utilization. Since dry matter variation is mainly is attributed to photosynthesis, leaf area was considered as a measure for production capital. Net assimilation rate at 60-75 days after sowing showed positive association between grain yield per plant both at genotypic and phenotypic level. It is growth contributing trait that matter and materialized the ultimate yield. Pawar and Chetti (1998) observed positive correlation with grain yield per plant under water stress condition. Lamani *et al.* (1997) observed that in M-35-1 net assimilation rate was correlated significantly and positively with grain yield per plant under water stress condition.

There was positive and significant genotypic and phenotypic correlation between grain yield per plant and all the growth parameters *viz.,* chlorophyll content at 75 DAS, proline content, specific leaf weight, leaf area ratio at 75 DAS, crop growth rate at 60-75DAS, relative growth rate at 60-75 DAS and net assimilation rate at 60-75DAS indicating that increase in grain yield in *Rabi* sorghum under drought condition is because of increase in one or more of the above characters.

Thus, from this study it is concluded that all the seven growth parameters under study have shown desirable and significant correlation both at phenotypic and genotypic levels with grain yield per plant under drought condition and hence, need to be considered as important parameters for increasing grain yield under drought condition.

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