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Assessment of drought Associated Characters in Red Sorghum (*Sorghum bicolor*) Germplasm and Land Races

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ABSTRACT

From the farmer's field of Krishnagiri and Dharmapuri districts fourteen local land races of sorghum were collected and sixteen germplasm accessions from the Department of Plant Genetic Resources, TNAU, Coimbatore along with two promising sorghum varieties Paiyur 1 and Paiyur2 were taken for study and characterization was done for six drought tolerant traits. Among the 32 land races evaluated, Sorghum land races 16-05 (RS), 2457, 16-01 (RS), 2657, 4269 were found to be early in (82-85 days), high yielding (28 to 29.3g/plant), having high photosynthetic rate, (38.6 umolm^{2}s^{-1}), high Proline content (394 ugg^{-1}) and high soluble protein content (14.4 mgg^{-1}) and hence found to be tolerant to drought. These sorghum land races can be used as one of the parents in crossing programme for developing short duration, high yielding drought tolerant varieties in sorghum.

Key words: *Sorghumland races, Germplasm accessions, Drought and quantitative traits*

Introduction

Breeding sorghum for high and stable yield with improved drought tolerance has received top priority worldwide. As well these, traits that are required for adaptation to different sorghum production systems have also been considered. For example, improved post rainy season sorghums in India would require in addition to higher grain and fodder yields, tolerance to drought. Assortment, classification and assessment of sorghum genotypes are being done broadly throughout the world (Henley *et al.,* 2010). Germplasm lines were studied broadly for nutritive value, yield and other agronomic traits by phenotypic evaluation as well as by SSR molecular markers (Richard E. Boyles 2016). Tribal communities have been growing these land races from time immemorial (Sivaraj *et al.,* 2016). There were 128 exotic germplasm lines and 21 adapted varieties in a germplasm evaluation project of Kansas State University and they were evaluated for drought and disease resistance (Kampanigowda *et al.,* 2013). Germplasm lines were evaluated for agronomic traits under rainfed and irrigated conditions in Tanzania. Several useful lines were identified and documented (Ringo *et al*., 2014). Genotypic variation was studied in late sown genotypes of sorghum for nutritive value in terms of minerals and protein content under semi drought conditions in Dharwad (Badigannavar *et al.,* 2018).

Sorghum is extensively cultivated in an area of 2000 ha in Krishnagiri and 10000 ha in Dharmapuri

districts for the grain purpose as well as for fodder purposes. Only two local land races have been grown during onset of monsoons. Thalaivirichan cholam (open ear head resembling tail) with pearly white grains is being cultivated during onset of south west monsoon and it is relatively longer duration (160 days) and it is photo sensitive. Throughout onset of North West monsoon, local land races of red sorghum is being grown for the purpose of fodder. Thalaivirichan cholam are short, photo insensitive and ear heads are closed types. The grains are red in colour.

Regional Research Station, Paiyur released two varieties viz., Paiyur-1 (Thalai virichan cholam), Paiyur-2 (Sencholam; Red sorghum). Farmers cultivate the locally adapted land races every year by preserving portion of seeds. Eventhough red sorghum genotypes are rich in nutrients like Iron, flavanoids and proteins, and are usually grown for fodder purposes.

Objectives

Red sorghum genotypes characterization of based on descriptors provided by ICRISAT for Drought tolerant traits and identifying the drought tolerant high yielding red sorghum genotypesfor utilizing them in the future breeding work

Progress of work carried out

The sorghum germplasm accessions and local land races (RS types-27 nos. & TV types-5 nos) were sown on 06.09.2018 in G5. Descriptors for sorghum was obtained for characterization of local land races of red sorghum and TV types and sorghum

Table 1. Red Sorghum Land Races and Germplasm Accessions Characterization for Drought Associated Characters

S. No.	Sorghum land races	Transpiration Rate (mmol m^{-2} s^{-1})	Photosynthetic Rate (µmol m^{-2} s^{-1})	Leaf Temperature (°C)	Relative Water Content	Proline content (µg g^{-1}) (%)	Soluble Protein (mg g^{-1})
1.	TNAU-R0040-2482-IS 8012	11.5	32.5	29.0	75.6	328.4	13.0
2.	TNAU-R0040-2488-IS 9113	13.7	33.6	28.6	76.0	367.1	13.9
3.	TNAU-R0040-2493-IS 1233	14.2	34.7	28.4	74.8	338.9	13.7
4.	TNAU-R0040-2504-IS 12804	14.5	35.0	28.4	77.0	355.0	13.0
5.	PYR-(RS)-16-06-Kochamalai local	14.6	33.7	28.4	76.6	346.0	13.7
6.	PYR-(RS)-16-07-Puliyambatti local	10.4	31.6	29.4	72.4	312.0	12.0
7.	PYR-(RS)-16-08-Irumathur local	13.8	33.5	28.7	75.5	342.3	13.5
8.	PYR-(RS)-16-09-Kochamalai local	14.1	34.3	28.5	74.0	340.8	13.4
9.	PYR-2 (RS)	14.0	34.1	28.5	77.2	355.5	13.4
10.	TNAU-R0040-2457-IS 30536	16.8	38.6	27.9	80.9	388.2	13.9
11.	PYR-(RS)-16-01-Palacode local	15.3	37.5	28.3	80.1	380.0	13.4
12.	PYR-(RS)-16-02-Papparapatti local	12.0	32.8	28.6	74.5	336.2	13.2
13.	PYR-(RS)-16-04-Karimangalam local	12.6	33.1	28.5	75.3	339.5	13.6
14.	PYR-(RS)-16-05-Kochamalai local	16.7	38.6	27.8	81.5	394.5	14.4
15.	TNAUR00404269-PGR Red cholam 82	16.0	38.2	28.0	81.0	388.5	14.0
16.	TNAUR00404416-TKSV 1008	14.6	35.0	28.5	75.8	330.7	12.9
17.	TNAUR00404418-TKSV 1023	14.5	35.1	28.5	76.3	340.2	13.5
18.	TNAUR00404720-PGR Red cholam 108	13.9	34.4	28.7	77.0	346.5	13.4
19.	TNAU-R0040-4263-PGR Red cholam	14.1	34.7	28.3	73.8	338.5	13.4
20.	TNAU-R0040-4266-PGR Red cholam 63	13.7	33.5	28.6	78.0	361.1	13.6
21.	TNAUR00404267-PGR Red cholam 92	13.0	32.9	28.9	76.9	348.6	13.7
22.	TNAU-R0040-2508-IS 12965	14.8	35.2	28.3	76.4	345.0	12.9
23.	TNAU-R0040-2519-IS 14861	10.8	31.7	29.3	72.4	319.2	12.3
24.	TNAU-R0040-2520-IS 14862	13.6	33.4	28.8	73.9	340.5	13.1
25.	TNAU-R0040-2657-IS 30536	15.5	37.8	28.1	80.6	380.6	13.8
26.	PYR-(TV)-16-01-Palacode local	11.4	32.2	29.1	73.3	327.6	12.7
27.	PYR-(TV)-16-04-Karimangalam local	13.8	33.8	28.8	73.8	330.0	13.0
28.	PYR-1 (TV)	14.2	34.5	28.5	78.2	363.5	12.8
29.	PYR-(TV)-16-02-Papparapatti local	11.0	32.0	29.2	72.8	322.0	12.5
30.	PYR-(TV)-16-03-Kambainallur local	13.0	34.0	28.8	75.9	337.7	12.9

germplasm accessions.

The following local land races of red sorghum collected from Krishnagiri and Dharmapuri districts and Irungu Cholam from Theni districts were evaluated and characterized.

1	PYR-(RS)-16-01	Palacode local
2	PYR-(RS)-16-02	Papparapatti local
3	PYR-(RS)-16-03	Kambainallur local
4	PYR-(RS)-16-04	Karimangalam local
5	PYR-(RS)-16-05	Kochamalai local
6	PYR-(RS)-16-06	Kochamalai local
7	PYR-(RS)-16-07	Puliyambatti local
8	PYR-(RS)-16-08	Irumathur local
9	PYR-(RS)-16-09	Kochamalai local
10	PYR-(RS)-16-10	Govindhapuram local
11	PYR-(TV)-16-01	Palacode local
12	PYR-(TV)-16-02	Papparapatti local
13	PYR-(TV)-16-03	Kambainallur local
14	PYR-(TV)-16-04	Karimangalam local

The sorghum germplasms collected were also characterized based on descriptors obtained.

1	TNAUR0040-2519	IS 14861
2	TNAUR0040-2657	IS 30536
3	TNAUR0040-4263	PGR Red cholam
4	TNAUR0040-4266	PGR Red cholam 63
5	TNAUR0040-4267	PGR Red cholam 92
6	TNAUR0040-4269	PGR Red cholam 82
7	TNAUR0040-4416	TKSV 1008
8	TNAUR0040-4418	TKSV 1023
9	TNAUR0040-2448	IS 4092

Table 2. Red Sorghum Land Races and Germplasms characterized for Quantitative, Qualitative and Drought Associated Characters

S.No.	Characters observed		Range	Land races
I. Quantitative characters				
1.	Plant height (cm)	:	135 to 335.1 cm	Paiyur 1, 16-04 (RS), 16-03 (TV), 16-01 (TV), 16-02(TV), 4416, 4418, 4263
4.	Days to 50% flowering	:	44 to 78 days	4266, 4267, 4269, 4418, 4720, 16-05 & 16-07
5.	Days to maturity	:	82 to 113 days	16-05, 16-07, 16-06, 4266, 4267, 4269, 4418 & Paiyur 2
6.	No. of tillers/plant	:	1.0 to 2.4 nos.	16-04 (TV), 16-01 (RS), 16-02(RS), 16-05(RS), 16-06(RS), 2520, Paiyur 1
8.	100 seed weight (g)	:	1.4 to 3.91 g	16-08(RS), 16-06(RS), 2504, 2508, 4266, 4367, 4269, 4418,4720
9.	Fodder yield/plant (g)	:	121.3 to 323.1 g	16-02(TV), 2482,16-01(TV), Paiyur 2, , 16-03(TV), 16-04(TV), Paiyur 1,
10.	Grain yield/plant (g)	:	12.0 to 29.3 g	16-05(RS), 2457, 16-01(RS), 2504, 2657, 4266, 4269
II. Qualitative characters				
1.	Glume colour	:	Yellowish red/light red/dark red/blackish red/dull white	
2.	Grain plumpness	:	Plumpy/dimple	
3.	Inflorescence compactness	:	Loose/semi loose/ semi compact/ compact/ very lax/very loose panicles	
4.	Inflorescence shape	:	Elliptic/oval/erect	
6.	Endosperm colour	:	Yellow/white	
7.	Lustrousness	:	Non L/ Dull/ Lustrous	
8.	Waxiness	:	Waxy/Non waxy	
9.	Awns	:	Present/absent	
10.	Threshability	:	Easy/difficult	
11.	Seedling vigour	:	Poor/Medium/Good	
12.	Inflorescence exertion	:	Exerted/well exerted/ fully exerted/ slightly exerted/ peduncle recurved	
15.	Endosperm texture	:	Mostly corneous/ intermediate/ mostly starchy/ completely starchy	
III. Drought associated characters				
1.	Transpiration rate (mmol $m^{-2}s^{-1}$)	:	10.8 to 16.8 (mmol $m^{-2}s^{-1)}$	2519, 16-07 (RS), 2482, 16-01 (TV), 16-01 (TV),
2.	Photosynthetic rate (mmol $m^{-2}s^{-1}$)	:	31.6 to 38.6 (mmol $m^{-2}s^{-1}$)	2457, 16-05 (RS), 4269,16-01 (RS), 2657
3.	Leaf temperature (°C)	:	27.8 to 29.4 °C	16-05 (RS), 2457, 4269, 2657
4.	Relative water content (%)	:	72.4 to 81.5 %	16-05 (RS), 2457, 16-01 (RS), 4269, 2657
5.	Proline content (ugg^{-1})	:	312 to 394.5 ugg^{-1}	16-05 (RS), 2457, 16-01 (RS), 2657, 4269
6.	Soluble protein content (mgg^{-1}):		12 to 14.4 mgg^{-1}	16-05 (RS), 4269, 2657, 4267, 2457, 2488

10	TNAUR0040-2457	IS 30536
11	TNAUR0040-2482	IS 8012
12	TNAUR0040-2488	IS 9113
13	TNAUR0040-2493	IS 1233
14	TNAUR0040-2504	IS 12804
15	TNAUR0040-2508	IS 12965
16	TNAUR0040-4720	PGR Red cholam 108

Observations on the drought associated characters were recorded and are as follows

Conclusion

From the above findings, it can be concluded that the red sorghum land races 16-05 (RS), 2457, 16-01 (RS), 2657, 4269 were found to be early in maturity, high yielding, having high photosynthetic rate, Proline content and soluble protein content and hence drought tolerant.

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Conflict of Interest

There is no conflict of interest.

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