The Pharma Innovation Journal 2023; 12(9): 674-681

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 674-681

www.thepharmajournal.com
Received: 07-06-2023
Accepted: 16-07-2023

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Genetic effects on PEG induced *invitro* drought stress screening of sorghum (*Sorghum bicolor* (L.) Moench) genotypes

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Abstract
The adaptable crop sorghum excels at withstanding drought conditions better than other crops ensuring food security, it is regarded as a valuable food and feed crop all over the world. Fifty sorghum genotypes were evaluated based on the seedling shoot and root characters for drought tolerance by inducing artificial drought stress using PEG 6000MW on different osmotic stress *viz.,* 0 bar, -2 bar, -5 bar and -7.5 bar. The highest germination percentage was recorded under severe stress condition (-7.5 bar) in Paiyur 2 and Tenkasi local. The genotypes *viz.,* CSV 24 SS, K12, Maduraikattaivellai local, Muthaiyampalayam local, Tenkasi local and Vilathikulam local showed maximum shoot and root length under maximum osmotic stress imposed. In addition, K12 and TNS 661 were observed as the best performer for fresh and dry root weight whereas Muthaiyampalayam local and Chittalanthur local had high seedling vigour index.The traits *viz.,* shoot length, root length, root-shoot length, fresh root weight, dry root weight and seedling vigour indexhadhigh heritability and genetic advance as percent of meanwhile germination percentage had moderate heritability and genetic advance as percent of mean. Hence, drought tolerant assessment and selection on seedling stage could be carried on the above seven traits. The trait seedling vigour index was highly associated with germination percentage, shoot length and root length, followed by root length with germination percentage and shoot length. The association studies revealed that trait seedling vigour index had a strong relationship with other traits considered. The present study identified the drought tolerant genotypes *viz.,* K12, Muthaiyampalayam local and Tenkasi local and it could be utilized in the sorghum crop improvement programmes to develop drought tolerant varities/hybrids.

Keywords: Sorghum, drought tolerance, heritability, genetic advance, association

Introduction
Sorghum [*Sorgum bicolor* (L.) Moench] stands in fifth place in the world's most important crop list (FAOSTAT, 2021) [15]. It is a C4 crop that originated from Sub-Saharan Africa and is one of the important staple food and feed croputilizedby many people who live in arid and semi-arid regions of the world. Sorghum is known as the "camel of cereals" and has wide adaptability to abiotic stress, can thrive well in hot and dry ecologies, also can withstand under water logging condition (Promkhmbut *et al.,* 2010; Masood Qadir *et al.,*2015; Kumari *et al.,* 2016; Chadalavada *et al.,* 2021) [30, 31, 23, 8]. It is a relatively drought tolerant crop adapted to extreme environments where other dominant crops fail to survive (Yahaya, 2021) [41]. A prolonged lack of plant-available water, typically as a result of insufficient precipitation or rainfall, is referred to as drought. It is a complex feature influenced by numerous interrelated plant and environmental factors. Drought is due to unusual high temperature and low humidity that cause plants to evapotranspire (Schumacher *et al.,*2022) [37] and leads to devastating production limitation that can happen at any stage of crop growth (Reddy *et al.,*2019) [34]. It is one of the major abiotic stress that has a global impact on crop growth and yield that may severely restricts sorghum production.
Although plant's developmental stages are affected by drought stress, seed germination, early seedling growth phase, and reproductive stages are particularly sensitive (Bobade *et al.,*2019; Kapanigowda *et al.,* 2013) [7, 19]. For the establishment of a strong root system and overall plant vigour, the seedling stage is crucial, and sorghum has developedmany adaptive mechanisms to tolerate drought stress during this crucial stage. The current study was performed to screen the sorghum genotypesestablished using PEG 6000 MW treatment based on seedling traits. The better performing genotypes were selected and were exposed to meet with the field environment for further evaluation.

Materials and Methods

The experiment was conducted with fifty accessions received from the Department of Millets, TNAU, Coimbatore (Table 1). Polyethylene glycol (PEG) 6000 MW is a water-soluble molecular compound that creates water stress by lowering the water potential in the root region of many other crops *viz.*, rice (Joshi *et al*.,2011) [18], wheat, oat and buffel grass (Maleki *et al.*,2019) [25]. PEG is a sticky, stiff chemical and was used as an artificial drought inducer for *in vitro* screening of drought related studies (Mehmandar *et al*.,2023) [26]. In this study, the screening was done under different concentrations *viz.*, control (0%), 10%, 15%, and 20% PEG (6000 MW) to induce osmotic potential at -2 bars (-0.2 MPa), -5 bars (-0.5 MPa), and -7.5 bars (-0.75 MPa) at 30 °C respectively (Michel and Kaufmann., 1973) [27].

$$\Psi s = -(1.18 \times 10^{-2})\, C - (1.18 \times 10^{-4})\, C^2 + (2.67 \times 10^{-4})\, CT + (8.39 \times 10^{-7})\, C^2 T$$

Where, Ψs = Osmotic potential (bar)
C = Concentration (g L^{-1} PEG-6000 in water)
T = Temperature (°C)

The experiment was conducted in a Completely Randomised design (CRD) with two replications. A volume of 7.5 ml of each concentration of PEG6000 MW and control (distilled water) solutions were poured into petri-plates to moisten the germination sheet that was placed inside. Before the seeds were placed on the germination sheet under aseptic conditions, seeds were treated with 0.1% sodium hypochloride solution for two minutes, followed by 70% ethanol treatment for 30 seconds (Yago *et al.*, 2011; Surendar *et al.*,2020) [40, 38] to ensure surface sterilisation. The petri plates were kept undisturbed for one week. On the 10th day after inoculation, the seedling characteristics namely germination percentage, shoot length, root length, fresh weight and dry weight were observed. Fresh and dry weight were measured through digital weighing balance (in grams). Seedlings were kept in hot air oven at 70 °C for 24 hours (Kaydan and Yagmur, 2008 and Rajarajan *et al.*, 2018) [21, 33] for drying. Seedling traits *viz.*, germination percentage, root and shoot length ratio and seedling vigour index were derived based on the following formulae:

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds}} \times 100 \quad \text{(Esechie, 1994)}$$

$$\text{Root shoot ratio} = \frac{\text{Root length}}{\text{Shoot length}} \quad \text{(Nour and Weibel 1978)}$$

Seed vigour Index = Germination percentage × Seedling length (Abdul Baki and Anderson, 1973)

Results and Discussion

To combat the inevitable loss at early stage caused by sudden unpredictable drought during crop duration it is necessary to study the seedling traits. The genotypes that evinced tolerance to drought, well performing at different water stress conditions, were selected to proceed further field level evaluation. The seedling characteristics measured in the experiment differed significantly for each genotype as shown by analysis of variance (Table 2).

Among the critical stages, germination and establishment of seedling shoot and root is the first and foremost process initiated by seeds in the developmental stages of crop. Due to its high molecular weight, PEG, an inert, non-ionic, long-chain polymer, that restricts waterto get absorbed by plants. It alters the osmotic potential of the medium by preventing or removing water from the plant cell and cell wall, stimulating conditions of water deprivation (Blum *et al*., 2017) [6].

Mean analysis of sorghum genotypes under different osmotic stress

The mean performance of genotypes for germination percentage, seedling vigour index, comparison of root-shoot ratio and fresh and dry root weight were depicted that each genotype showed variation in expression of traits in response to stress at -2 bars,-5 bars and -7.5 bars applied (Table 3a & 3b). Germination percentage was decreased with increase in the osmotic stress, similar changes were observed by Saint-Clair (1976) [36] and Mut *et al.* (2010) [28] in sorghum; Emmerich, W. E., and Hardegree, S. P. (1990) [13]; Badr *et al.*, (2020) [2] in maize, Govindraj *et al.*, 2010 [42] in pearlmillet and in oat by Basha, M. H and Mehta, A. K.(2016) [4]. At the maximum osmotic stress condition (-7.5 bar) the genotypes B 35, K12, Paiyur 2 and Tenkasi local showed high germination percentage ranged from 70 to 80%, followed by CSV 49SS, Edappadi local, Maduraikattaivellai local, Muthaiyampalayam local, Usilampatti local and Vilathikulam local were with 60% germination percentage.

Shoot length was observed to decrease with an increase in osmotic potential. The sorghum genotypes Muthaiyampalayam local (6.82), Markandapuram local (4.59 cm), Maduraikattaivellai local (3.33 cm), and Vilathikulam local (3.3 cm) showed highest shoot length at -7.5 bar stress level parallel to the findings of Jafar *et al.*, (2004) [17] and Patanè *et al.* (2013) [29].

As root is the primary part which directly encounters osmotic stress, it make quickly react to water potential adjustment lead to higher root length than shoot length. This impact was due to decreased water level in internal tissues and restricted cell division (Kaydan and Yagmur, 2008) [21] likewise, shoot traits were more sensitive to drought stress rather than root traits incline to increase (Qadir *et al.*, 2015) [31]. For the trait root length, genotypes Muthaiyampalayam local (7.5 cm), CO 28 (7.0 cm), K12 (5.8 cm), Maduraikattaivellai local (5.5 cm), TNS 661 (5.5 cm) APK 1(5.0 cm) and Vilathikulam local (3.3cm) had virtuous state comparitively.

Root-shoot length ratio indicates the developmental status of the seedling, root length was observed more than shoot length as the plant restricts shoot cell elongation rather root cell tend to grow. The root-shoot length ratio tend to increase along with the demanding osmotic stress condition (Xu *et al.*,2015; Govindraj *et al.*,2010) [42]. The higher performance were observed in CSV 24 SS (18.1), TNSS 227 (15.6), TNS 702 (14.9), Tenkasi local (13) and TNS703 (12.7) (Table 3a). The result was in agreement with Hameed *et al.*, (2010) [16] in wheat; Sabesanand Saravanan (2016) [35]. The performance of above mentioned genotypes under different concentrations of PEG solution was depicted in Fig. 1. Among the entries CSV 24 SS (0.2g), K12 (0.4g), Tiruvengadam local 2 (0.2g) and TNS 661(0.7g) were exhibited higher fresh root weight than other genotypes evaluated. In accordance with dry root weight, the entries *viz.*, K12 (0.09 g), M 35-1(0.09 g), TNS 661 (0.08 g) were identified as good performing genotypes. This results were in concurrence with observation recorded by Duman (2006) [12] in lettuce and Chen *et al.*, (2021) [9] in sorghum.

The seedling vigour index (SVI) was also greatly affected by increased osmotic stress condition provided. The range of seedling vigour index under -7.5 bar moisture stress observed from 0.0 to 862.5. The entries Muthaiyampalayam local (862.5), Madurai kattaivelai local (577.6), Chittalanthur local (594.3) showed maximum SVI followed by Tenkasi local (468.0), Vilathikulam local (444.3) were indicated in Table 3b. The above mentioned five well performing genotypes were compared with tolerant B 35 and susuceptible CO 26 entries seedling vigour index (SVI) at different osmotic stress was represented in Fig.2

Thus drought stress reduces the trait expression at seedling stage (Bibi *et al.*, 2010) [15] that includes germination percentage, shoot length, root length, fresh root weight and dry root weight. The above resutlts are seem to be uphold the declaration of Bibi *et al.*, (2012) [5]; Ali *et al.*, (2011) [1] in sorghum; Govindraj *et al.*, (2010) [42] in pearlmillet. Root-shoot length ratio and seedling fresh and dry root weight increased for tolerant genotypes, as they were less affected by low water potential caused by PEG solution, similar outcome was observed by Lawlor, 1969 in cotton and sunflower.

Genetic variability and coefficient of variation under different osmotic stress condition Phenotypic coefficient of variation and genotypic coefficient of variation for germination percentage, root length, fresh root weight, dry root weight and seedling vigour index showed high percentage of variation (Table 4). All traits exhibited high level of heritability range from 66.6% to 89.41% (Table 4) except germination percentage which recorded moderate heritability (55.62%). In case of genetic advance, all the traits were with high percentage ranging from 51.16% to 99.45%, the traits root-shoot ratio (99.45%) and seedling vigour index (87.44%) exhibited the highest genetic advance among seven traits. The traits *viz*., shoot length, root length, root-shoot ratio, fresh root weight, dry root weight and seedling vigour index had high heritability accompained with high genetic advance insists that these traits can be considered for selection as they were influenced by additive gene effect. The result was in accordance with Cisse, N. D., and Ejeta, G. (2003) and Rajarajan *et al.*, (2017) [10, 33].

Correlation analysis on seedling traits under -7.5 bar osmotic stress condition

The association studies emphasis on effect relationship among the traits that enable selection (Dewey and Lu, 1959; Karpe *et al.*, 2023) [11, 20]. The correlation coefficients were calculated for seedling traits in -7.5 bar osmotic solution (Table 5). Germination percentage (0.806), shoot length (0.865), root length (0.924) had strong positive link with seedling vigour index, followed by fresh root weight (0.656) and dry root weight (0.514).

Dry root weight showed positive significant association with other traits except root-shoot length ratio (0.063) that had positive non-significant relationship. Root shoot length ratio had negative correlation with fresh root weight (-0.051). Seedling trait shoot length (0.769) and germination percentage (0.755) were positively significant, linked with root length.

The genetic gain of sorghum genotypes were evaluated based on seedling traits that were inherently contributing to drought tolerance. Thus the present study would be the basic *in vitro* screening on sorghum drought tolerance further this analysis can aid to lead field level screening on good performing genotypes. Among the genotypes validated for drought toleranceunder *in vitro* screening the genotypes *viz*., K12, Maduraikattaivellai local, Markandapuram local, Muthaiyampalayam local and Vilathikulam local were unique at drought thriving capacity, while considering their overall performance at higher water demanding situation. Overall, polyethylene glycol (PEG 6000 MW) makes evaluation of seedlings under drought condition more easy and convenient in controlled environment.

Table 1: List of 50 sorghum genotypes used in PEG induced drought screening

S. No	Genotypes	S. No	Genotypes
1	APK 1	26	Kalugumalai local
2	Aruppukottai local	27	Keerambalur local
3	B 35	28	Kottatur local
4	Chinnamanjalcholam	29	M 35-1
5	Chittalanthur local	30	Maduraikattaivelai local
6	CO 26	31	Markandapuram local
7	CO 28	32	Muthaiyampalayam local
8	CO 30	33	Nainegaram local
9	CO 32	34	Paiyur 1
10	CO 4	35	Paiyur 2
11	CSV 24 SS	36	Periyamanjalcholam local
12	CSV 33 MF	37	PYR(RS) 16-1
13	CSV 43	38	Tenkasi local
14	CSV 49 SS	39	Tiruvengadam local-2
15	Dharmapuri local	40	TNS 661
16	Dhummanayakanpatti local	41	TNS 698
17	Edappadi local	42	TNS 700
18	ICS 27 B	43	TNS 701
19	IS 18551	44	TNS 702
20	IS 2122	45	TNS 703
21	K 11	46	TNSS 223
22	K 12	47	TNSS 225
23	K 13	48	TNSS 227
24	K 8	49	Usilampatti local
25	Kalakuruchi local	50	Vilathikulam local

Table 2: Analysis of variance for seedling traits on PEG treatment at different osmotic stress condition

Source	df	Germination %	Root length	Shoot length	R/S ratio	Fresh root weight	Dry root weight	Seedling vigour index
Genotypes	49	2947.45**	67.05**	39.30**	51.19**	0.37**	0.012**	1317282.1**
Treatment	3	80269.58**	2655.18**	1387.01**	100.28**	4.20**	0.110**	84157719.7**
G x T	147	339.82**	9.58**	5.41**	26.46**	0.06**	0.02**	190095.1**
Error	200	3150.00	0.57	0.069	0.94	0.001	0.001	7708.6

*significant at 5% probability level; **significant at 1% probability level

Table 3(a): Mean performance of sorghum genotypes on seedling characters under PEG induced drought stress

Sl. No.	Genotypes	Germination %				Shoot length (cm)				Root length (cm)				root-shoot length ratio			
		Osmotic potential (bar)				Osmotic potential (bar)				Osmotic potential (bar)				Osmotic potential (bar)			
		0	-3	-5	-7.5	0	-3	-5	-7.5	0	-3	-5	-7.5	0	-3	-5	-7.5
1	APK 1	100	80	60	55	5.0	2.43	1.74	1.18	10.9	8.8	6.9	5.0	2.2	3.6	4.0	4.2
2	Aruppukottai local	100	90	70	0	11.02	9.22	3.93	0.00	12.0	9.1	8.9	0.0	1.1	0.8	0.9	-
3	B 35	100	100	100	75	9.63	3.7	1.2	0.08	13.2	10.6	6.5	3.7	1.3	2.8	4.5	5.2
4	Chinnamanjalcholam	100	80	50	0	13.12	8.05	4.00	0.00	8.5	4.0	2.4	0.0	0.6	0.5	0.6	-
5	Chittalanthur local	100	90	60	25	8.51	5.46	5.7	1.85	9.5	7.2	6.2	1.8	1.1	1.3	1.6	1.0
6	CO 26	90	70	55	30	5.15	2.1	1.49	0.6	13.0	10.5	3.1	2.2	2.5	5.0	2.1	3.8
7	CO 28	100	60	30	0	5.51	1.65	0.82	0.5	21.5	17.1	12.7	7.0	2.8	7.2	12.8	3.5
8	CO 30	100	75	70	25	9.41	6.16	4.51	2.48	26.4	12.1	7.9	0.0	2.3	2.7	2.8	2.8
9	CO 32	10	80	55	30	10.32	5.45	3.15	2.1	19.6	10.1	4.2	2.5	2.5	2.2	2.5	4.9
SI. No	Genotypes	Germination %				Shoot length (cm)				Root length (cm)				root-shoot length ratio			
		Osmotic potential (bar)				Osmotic potential (bar)				Osmotic potential (bar)				Osmotic potential (bar)			
		0	-3	-5	-7.5	0	-3	-5	-7.5	0	-3	-5	-7.5	0	-3	-5	-7.5
10	CO 4	100	100	80	40	12.71	8.25	2.15	0.39	19.6	10.0	4.2	2.5	1.5	1.2	1.9	6.4
11	CSV 24 SS	100	100	60	30	8.98	4.02	3.71	0.25	18.2	13.0	11.2	4.3	2.0	2.7	3.5	18.1
12	CSV 33 MF	30	0	0	0	1.00	0.00	0.00	0.00	4.0	0.0	0.0	0.0	3.0	-	-	-
13	CSV 43	100	60	60	0	3.23	2.22	0.25	0.00	12.5	9.1	6.8	0.0	3.5	3.08	37.6	-
14	CSV 49 SS	100	100	80	60	11.55	4.63	0.03	0.01	18.3	9.6	8.7	3.5	1.5	2.1	4.0	4.7
15	Dharmapuri local	60	40	20	0	8.00	4.45	0.47	0.00	3.5	8.7	1.7	0.0	0.4	1.9	3.5	-
16	Dhummanayakanpati	100	85	60	0	10.25	8.55	3.15	0.00	12.3	8.9	4.6	0.0	1.2	1.0	1.4	-
17	Edappadi local	100	90	80	60	9.04	4.05	1.45	0.45	8.4	4.6	2.3	1.2	1.2	2.5	1.3	-
18	ICS 27 B	60	40	25	0	5.08	2.9	0.21	0.00	6.6	4.3	1.7	0.0	1.3	1.4	8.0	-
19	IS 18551	80	70	25	0	10.93	7.43	5.25	0.00	12.9	9.1	8.9	0.0	1.1	1.2	1.7	-
20	IS 2122	80	60	30	0	9.26	4.55	1.88	0.00	7.4	5.4	2.3	0.0	0.8	1.2	1.26	-
21	K 11	80	70	25	0	15.66	7.95	5.00	0.00	16.5	7.2	5.9	0.0	1.0	0.9	1.1	-
22	K 12	90	70	50	40	12.96	6.85	5.05	2.6	17.5	11.1	7.7	5.8	1.3	1.6	1.5	2.3
23	K 13	100	100	100	70	9.15	5.09	3.80	1.92	19.0	14.7	8.5	3.6	2.0	2.8	2.2	1.8
24	K 8	100	80	80	55	13.32	10.27	5.93	1.05	18.5	15.3	8.4	4.4	1.4	1.5	1.7	4.2
25	Kalakuruchi local	100	80	60	0	10.12	6.04	1.36	0.00	13.0	7.5	2.1	0.0	1.2	1.3	1.5	-
26	Kalugumalai local	80	40	20	0	12.15	10.37	1.25	0.00	7.9	3.7	2.5	0.0	0.6	1.3	2.0	-
27	Keerambalur local	80	60	40	0	12.55	5.58	2.2	0.00	15.7	6.3	1.6	0.0	1.2	1.1	0.7	-
28	Kottatur local	100	100	70	0	7.15	4.40	0.45	0.00	9.5	6.3	2.1	0.0	1.3	1.4	4.8	-
29	M 35-1	100	75	60	45	9.11	8.45	3.60	1.89	11.4	9.8	6.2	4.3	1.3	1.1	1.7	2.2
30	Maduraikattaivelai local	100	90	80	65	11.96	8.03	6.87	3.33	14.9	12.3	9.1	5.5	1.2	1.5	1.3	1.6
31	Markandapuram local	100	60	45	30	12.66	10.13	8.26	4.59	15.6	13.8	9.8	5.3	1.2	1.4	1.2	1.1
32	Muthaiyampalayam local	100	90	80	60	13.26	11.53	9.78	6.82	15.1	14.3	10.8	7.5	1.1	1.2	1.1	1.1
33	Nainegaram local	80	40	20	0	15.55	9.71	7.83	0.00	11.1	9.1	7.1	0.0	0.7	0.9	0.8	-
34	Paiyur 1	100	80	40	0	5.24	3.68	0.5	0.00	10.2	8.1	2.4	0.0	1.9	2.1	4.2	-
35	Paiyur 2	100	90	80	80	12.24	2.0	1.55	0.6	15.6	13.1	9.7	3.6	1.3	6.5	6.2	6.1
Si. No	Genotypes	Germination %				Shoot length (cm)				Root length (cm)				root-shoot length ratio			
		Osmotic potential (bar)				Osmotic potential (bar)				Osmotic potential (bar)				Osmotic potential (bar)			
		0	-3	-5	-7.5	0	-3	-5	-7.5	0	-3	-5	-7.5	0	-3	-5	-7.5
36	Periyamanjalcholam local	90	60	40	20	12.45	7.25	5.25	2.45	13.6	10.2	7.8	4.3	1.1	1.4	1.5	1.7
37	PYR(RS) 16-1	100	85	60	45	10.47	7.92	5.92	1.15	15.0	11.7	8.1	4.1	1.4	1.4	3.6	1.3
38	Tenkasi local	100	100	80	80	13.83	9.48	4.88	2.55	17.9	12.3	6.8	3.3	1.3	1.3	1.4	13
39	Tiruvengadam local2	100	60	50	35	13.00	6.48	3.9	1.31	16.1	10.8	5.1	3.3	1.2	1.6	1.9	2.5
40	TNS 661	100	85	70	50	9.95	5.34	3.83	2.33	23.7	16.7	9.9	5.5	2.4	3.1	2.5	2.3
41	TNS 698	100	100	60	0	8.6	0.575	0.5	0.00	16.2	11.5	6.0	0.0	1.8	2.4	12.4	-
42	TNS 700	80	25	0	0	9.75	1.89	0.00	0.00	17.2	10.1	0.0	0.0	1.7	5.4	-	-
43	TNS 701	100	80	40	0	6.57	1.97	0.57	0.00	15.3	10.9	4.0	0.0	2.3	5.5	6.8	-
44	TNS 702	100	80	60	40	4.25	2.06	0.57	0.22	13.0	11.3	7.1	3.3	3.0	5.5	12.7	14.9

45	TNS 703	100	100	80	40	8.27	1.13	0.45	0.2	15.7	10.9	5.6	2.5	1.9	9.6	12.6	12.7
46	TNSS 223	80	60	40	0	9.6	6.32	2.7	0.00	18.5	8.5	5.5	0.0	1.9	1.3	2.0	-
47	TNSS 225	80	65	20	0	9.50	3.6	1.9	0.00	16.9	11.9	6.1	0.0	1.7	3.3	3.5	-
48	TNSS 227	100	80	60	40	4.27	2.55	1.88	0.22	4.9	8.9	7.7	3.4	1.1	3.5	4.1	15.6
49	Usilampatti local	100	90	80	60	5.16	2.15	0.52	0.25	13.1	7.5	3.6	2.5	2.5	3.5	6.9	10.0
50	Vilathikulam local	100	90	80	60	12.31	9.04	7.1	3.30	15.5	12.2	5.4	7.8	1.2	1.3	1.4	3.2
S.Ed(G)		1.984				0.093				0.38				0.487			
S.Ed(T)		0.561				0.037				0.107				0.138			
S.Ed(GxT)		3.969*				0.263*				0.76*				0.972*			
CD 5%(G)		3.913				0.259				0.749				0.96			
CD 5%(T)		1.107				0.073				0.212				0.271			
CD 5%(GxT)		7.826				0.519				1.498				1.92			

*significant at 5% probability level

Table 3(b): Mean performance of sorghum genotypes on seedling characters under PEG induced drought stress

Si. N	Genotypes	Fresh root weight (g)				Dry root weight (g)				Seedling vigour index			
		Osmotic potential (bar)				Osmotic potential (bar)				Osmotic potential (bar)			
		0	**-3**	**-5**	**-7.5**	**0**	**-3**	**-5**	**-7.5**	**0**	**-3**	**-5**	**-7.5**
1	APK 1	0.4	0.3	0.2	0.1	0.10	0.06	0.05	0.04	1595.0	901.0	525.5	342.1
2	Aruppukottai local	0.1	0.9	0.07	0.0	0.09	0.09	0.09	0.00	2305.0	1545.3	525.0	0.0
3	B 35	0.7	0.5	0.4	0.1	0.09	0.04	0.03	0.01	2283.0	1435.0	775.0	343.1
4	Chinnamanjalcholam	0.6	0.3	0.1	0.0	0.08	0.07	0.01	0.00	2167.5	966.4	314.0	0.0
5	Chittalanthur local	0.5	0.2	0.09	0.07	0.05	0.04	0.03	0.01	1806.5	1143.0	457.5	94.3
6	CO 26	0.5	0.3	0.2	0.1	0.1	0.08	0.05	0.03	1638.0	885.5	257.0	84.7
7	CO 28	0.5	0.2	0.1	0.0	0.1	0.08	0.06	0.00	2136.5	823.2	340.1	0.0
8	CO 30	0.5	0.3	0.1	0.0	0.1	0.1	0.05	0.00	3093.0	1744.7	1207.5	236.4
9	CO 32	1.9	0.3	0.2	0.1	0.1	0.09	0.05	0.04	3672.0	1408.0	607.1	0.0
10	CO 4	0.6	0.4	0.2	0.1	0.09	0.07	0.06	0.03	3239.0	1825.0	508.0	115.0
11	CSV 24 SS	0.6	0.4	0.3	0.2	0.08	0.08	0.07	0.03	27722.0	1678.5	910.1	138.0
12	CSV 33 MF	0.09	0.0	0.0	0.0	0.04	0.0	0.0	0.0	151.0	0.00	0.00	0.0
13	CSV 43	0.4	0.2	0.06	0.0	0.06	0.05	0.03	0.0	1599.5	544.5	558.0	0.00
14	CSV 49 SS	0.7	0.4	0.2	0.06	0.1	0.09	0.07	0.04	2992.0	1427.0	867.4	332.0
15	Dharmapuri local	0.3	0.2	0.1	0.0	0.09	0.05	0.04	0.00	690.9	528.0	43.5	0.0
16	Dhummanayakanpati local	0.5	0.3	0.2	0.0	0.08	0.06	0.04	0.0	2260.0	1490.3	465.0	0.0
17	Edappadi local	0.4	0.3	0.2	0.09	0.09	0.07	0.06	0.02	1745.0	811.8	307.6	96.0
18	ICS 27 B	0.3	0.1	0.06	0.00	0.05	0.03	0.02	0.00	704.1	288.0	47.3	0.0
19	IS 18551	1.4	1.0	0.9	0.0	0.13	0.12	0.08	0.00	1907.0	1159.0	355.3	0.0
20	IS 2122	0.2	0.1	0.1	0.0	0.09	0.07	0.02	0.00	1337.00	600.0	127.0	0.0
21	K 11	1.2	0.4	0.3	0.0	0.14	0.09	0.07	0.00	2580.4	1061.9	276.0	0.0
22	K 12	1.7	0.7	0.5	0.4	0.26	0.24	0.1	0.09	2747.0	1260.0	640.0	337.6
23	K 13	0.4	0.3	0.2	0.1	0.12	0.08	0.07	0.03	2818.7	1984.0	1231.0	384.3
24	K 8	0.2	0.1	0.1	0.08	0.08	0.07	0.04	0.04	3184.5	2050.0	1152.8	303.3
25	Kalakuruchi local	0.2	0.2	0.1	0.0	0.1	0.06	0.04	0.00	2315.0	1087.6	208.0	0.0
26	Kalugumalai local	0.6	0.2	0.1	0.0	0.08	0.07	0.03	0.00	1611.6	563.0	75.0	0.0
27	Keerambalur local	0.5	0.3	0.07	0.0	0.09	0.07	0.01	0.00	2260.0	714.0	153.8	0.0
Si.N	**Genotypes**	**Fresh root weight (g)**				**Dry root weight (g)**				**Seedling vigour index**			
		Osmotic potential (bar)				**Osmotic potential (bar)**				**Osmotic potential (bar)**			
		0	**-3**	**-5**	**-7.5**	**0**	**-3**	**-5**	**-7.5**	**0**	**-3**	**-5**	**-7.5**
28	Kottatur local	0.5	0.3	0.1	0.0	0.1	0.07	0.04	0.00	1670.0	1075.0	182.0	0.0
29	M 35-1	0.7	0.6	0.5	0.1	0.1	0.11	0.09	0.09	2056.5	1371.4	591.3	277.9
30	Maduraikattaivelai local	0.5	0.4	0.2	0.1	0.08	0.07	0.06	0.04	2689.5	1834.5	1279.6	577.6
31	Markandapuram local	0.4	0.3	0.2	0.1	0.05	0.04	0.03	0.02	2831.0	1437.0	815.2	296.8
32	Muthaiyampalayam local	0.6	0.4	0.3	0.1	0.07	0.05	0.04	0.03	2841.0	2332.3	1649.2	862.5
33	Nainegaram local	0.4	0.3	0.2	0.0	0.05	0.04	0.03	0.00	2138.8	754.2	299.6	0.0
34	Paiyur 1	0.4	0.3	0.2	0.0	0.10	0.07	0.05	0.00	1552.0	942.8	238.0	0.0
35	Paiyur 2	0.4	0.1	0.09	0.07	0.08	0.04	0.02	0.01	2788.0	1360.8	900.0	338.0
36	Periyamanjalcholam local	0.5	0.3	0.1	0.08	0.09	0.06	0.05	0.03	2350.0	1047.0	524.2	136.0
37	PYR(RS) 16-1	0.5	0.4	0.2	0.07	0.08	0.06	0.04	0.02	2547.5	1671.2	844.5	239.0
38	Tenkasi local	0.5	0.3	0.2	0.1	0.09	0.07	0.06	0.04	3206.5	2359.0	915.0	468.0
39	Tiruvengadam local2	0.5	0.4	0.3	0.2	0.07	0.05	0.04	0.03	2915.0	1037.7	450.0	161.2
40	TNS 661	1.4	0.9	0.8	0.7	0.1	0.09	0.09	0.08	3365.5	1874.9	963.2	392.7
41	TNS 698	0.8	0.7	0.5	0.0	0.4	0.2	0.1	0.0	2484.0	1212.5	392.1	0.0
42	TNS 700	0.5	0.3	0.0	0.0	0.07	0.05	0.00	0.00	2161.6	301.8	0.0	0.0
43	TNS 701	0.5	0.3	0.1	0.0	0.07	0.05	0.03	0.00	2192.5	1033.0	183.0	0.0
44	TNS 702	0.3	0.2	0.2	0.1	0.09	0.08	0.05	0.04	1731.0	1072.8	463.0	141.5
45	TNS 703	0.5	0.2	0.2	0.1	0.06	0.05	0.04	0.01	2402.5	1213.0	490.0	110.0

46	TNSS 223	0.5	0.2	0.1	0.0	0.08	0.07	0.05	0.00	2254.0	892.8	330.4	0.0
47	TNSS 225	0.	0.5	0.3	0.0	0.1	0.09	0.03	0.00	2116.2	1011.7	161.7	0.0
48	TNSS 227	0.4	0.3	0.2	0.1	0.1	0.07	0.06	0.05	1920.0	1052.0	558.3	148.2
49	Usilampatti local	0.3	0.2	0.1	0.06	0.09	0.07	0.04	0.03	1827.5	871.2	331.6	168.3
50	Vilathikulam local	0.6	0.4	0.3	0.1	0.07	0.06	0.06	0.05	2782.5	1912.5	1316.0	444.3
S.Ed(G)		0.017				0.006				43.89			
S.Ed(T)		0.05				0.002				12.41			
S.Ed(GxT)		0.035*				0.012				87.79*			
CD 5%(G)		0.034				0.001				86.56			
CD 5%(T)		0.01				0.003				24.48			
CD 5%(GxT)		0.06				0.024				173.13			

*significant at 5% probability level

Table 4: Components of variance, heritability and genetic advance for seedling traits under PEG induced water stress condition

	PCV (%)	GCV (%)	Heritability (BS-%)	GAM (%)
Germination %	25.24	23.85	55.62	77.13
Shoot length	18.88	1.475	89.41	73.60
Root length	24.04	20.37	84.63	51.16
Root shoot legth ratio	87.54	10.50	89.14	99.45
Fresh root weight	1.5454	1.94	79.53	58.12
Dry root weight	13.51	13.29	70.16	52.89
Seedling vigour index	25.63	23.15	66.6	87.44

Table 5: Correlation coefficient seedling traits observed under osmotic stress condition -7.5 bars

	Germination %	Shoot length	Root length	Root shoot length ratio	Fresh root weight	Dry root weight	Seedling vigour index
Germination %	1	0.641**	0.769**	0.071	0.517**	0.539**	0.806**
Shoot length		1	0.755**	-0.306**	0.58**	0.409**	0.865**
Root length			1	0.025	0.707**	0.59**	0.924**
Root shoot legth ratio				1	-0.051	0.063	-0.133**
Fresh root weight					1	0.667**	0.656**
Dry root weight						1	0.514**
Seedling vigour index							1

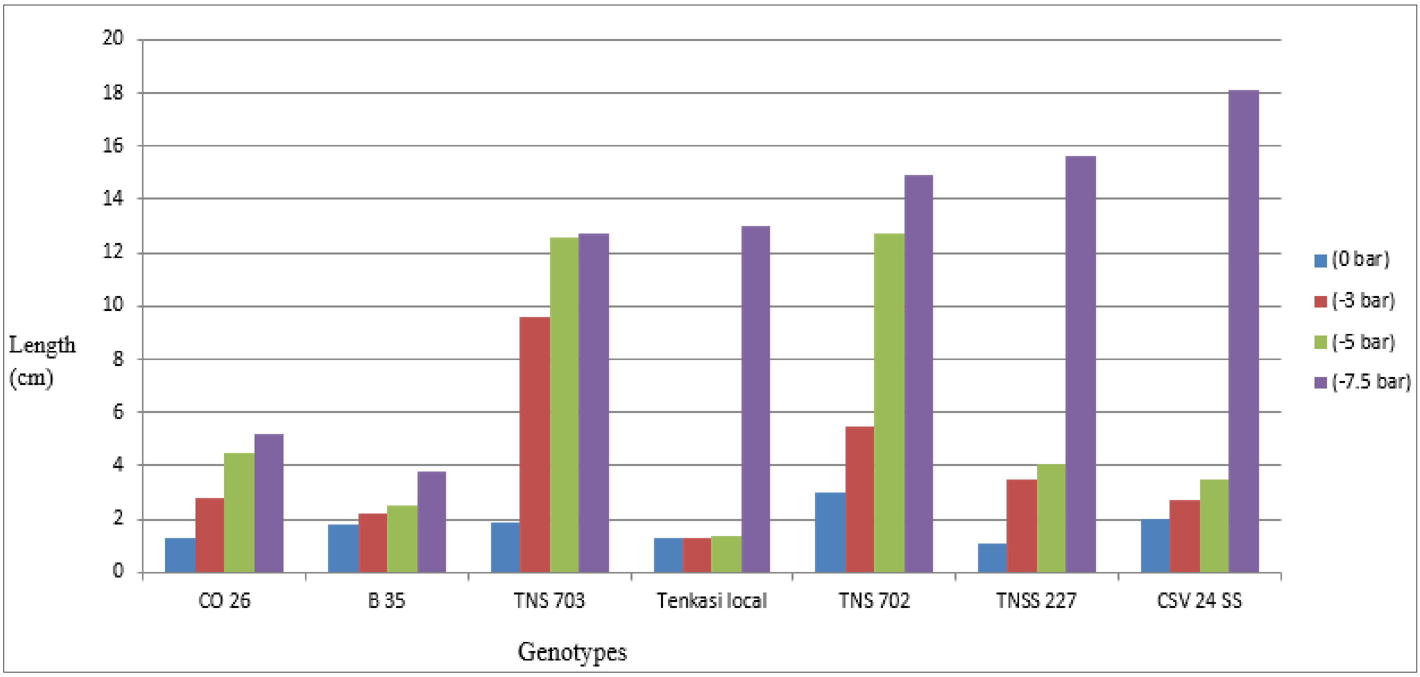

Fig 1: Effect of osmotic stress induced by PEG on root shoot length ratio of selected good performing genotypes with tolerant (B35) and susceptible genotypes (CO 26)

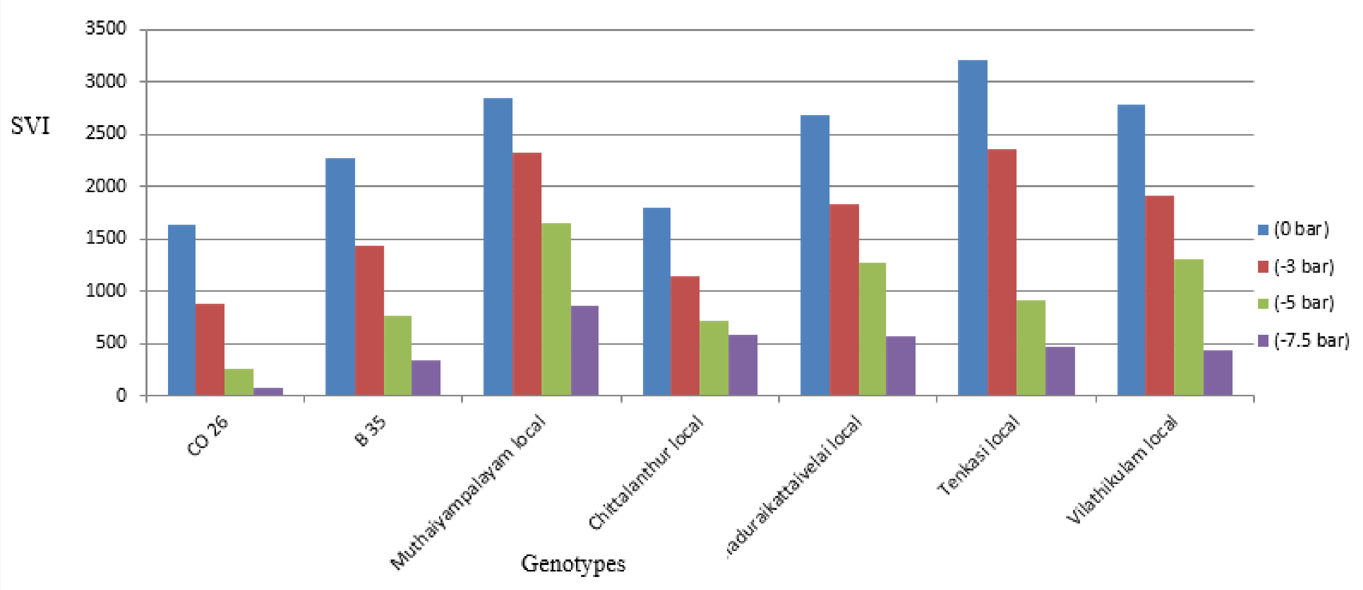

Fig 2: Performance of the promising sorghum genotypes on the basis of seedling vigour index (SVI) under PEG screening

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