Indian J. Applied & Pure Bio. Vol. 38(1), 228-232 (2023). **ISSN: 0970-2091**
A web of Science Journal

Screening of Groundnut genotypes for cultivation under moisture stress condition

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Abstract

Moisture stress is the most significant factor, which limits production of groundnut. The moisture stress affects the crop at different growth stages during growing season. In groundnut moisture stress during flowering and pod filling stage is critical for yield. In the present study the response of 10 released groundnut varieties (VRI 2, VRI 6, VRI 8, TMV 7, TMV 13, TMV 14, K 6, JL 24, DHARANI, CO 3) and three cultures (VG 19721, VG 18089, VG 17008) were investigated to screen the groundnut genotypes for cultivation under moisture stress condition in pot experiment conducted at Sananandal village of Thiruvannamalai district (March to June 2020). The moisture stress was imposed by withholding the irrigation from flowering to pod initiation stage for stressed pot and regular irrigation was given for non stressed pots. Observation were recorded for pod yield (g plant^{-1}) and kernel yield (g plant^{-1}). The data were subjected to drought tolerance parameter viz., Drought tolerance index (DTI) and drought susceptibility index (DSI) for pod yield (g plant^{-1}). Among the genotypes TMV 7 is found highly tolerant to moisture stress based on drought tolerant index and drought susceptibility index. Groundnut genotype CO 3 were found to more sensitive to moisture stress when compared to rest of genotypes.

Key words : Groundnut, Moisture stress, DTI, DSI, Pod yield, Kernel yield.

Groundnut (*Arachis hypogaea* L.) is an important food and cash crop for resource poor farmers in Asia and Africa. It is one of the most nourishing foods available in the world. Apart from their nutritional value, groundnut has considerable medicinal value. It is consumed

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in many ways and various forms. Due to its high monosaturated content, it is considered healthier than saturated oils and is resistant to rancidity. Groundnut is particularly valued for its protein content (26%). In worldwide, groundnut is grown in an area of 30.82 Million hectare with the production of 50.31 Million tons and the average productivity of 1630 kg ha^{-1} (USDA, 2022). Globally, India ranks first in area and production after China. According to FAO and USDA report 2022, groundnut crop area in India is at 5.60 Million hectare in 2021-2022 increased from 4.135 Million hectare in last year (2019-2020). Similarly, production and productivity are estimated at 6.80 M tonnes and 1210 kg ha^{-1} respectively as against 5.275 million tons and 1269 Kg ha^{-1} respectively during previous year. (FAO & USDA,2022). Tamilnadu is one of the leading groundnut production states with an area, production and productivity of 0.41 lakh hectare, 0.94 million tons and 2310 kg ha^{-1}, respectively (Agricultural Statistics at a Glance, 2021.GOI).

In groundnut moisture stress during flowering and pod filling stage is critical for yield. This would result in drastic reduction in crop yield and magnitude of reduction would depend on groundnut varieties. Not only the yield of groundnut but also the quality also decreased under drought stress[8]. Therefore, in the present study the screening of ten groundnut genotypes and three cultures grown under moisture stress was investigated to evaluate their sensitivity to moisture stress during flowering to pod development stage.

Ten released groundnut genotypes (VRI 2, VRI 6, VRI 8, TMV 7, TMV 13, TMV 14, K 6, JL 24, DHARANI, CO 3) and three cultures (VG 19721, VG 18089, VG 17008) were used in this experiment to assess the tolerant genotype to moistures tress condition. These genotypes were evaluated both in non stressed and stressed condition during summer season (2020) at Sananandal village of Thiruvannamalai district, Tamil Nadu. The experiment was laid out in Completely Randomized Block design (CRD) with factorial arrangement and replicated thrice. High Density Polyethylene grow bags with the size of 15"×15" filled with soil were used for conducting the pot experiment. Seeds pre treated with fungicide and rhizobium were used for sowing. Uniform and undamaged 5 seeds were sown per pot. On day 15 days after emergence, seedlings were thinned and maintained 4 uniform seedlings per pot. Normal cultural practices were followed during the growing season except irrigation schedule for stressed pots. The moisture stress was imposed by withholding the irrigation from flowering to pod initiation stage for the stressed pots. Pod and kernel yield of all the genotypes were recorded both under non stress and moisture stress condition.

The relative moisture stress tolerance of each genotype was quantified with respect pod yield through Drought tolerance index (DTI)[6] and drought susceptibility index (DSI)[4] by using following formula is used

$$DTI = \frac{Ysi}{Ypi}$$

$$DSI = \frac{[(1 - Ys)/Yp]}{Yms/Ymp}$$

where, Ysi is yield of the ith genotype under stress conditions, Ypi is yield of the ith genotype

Table-1. Effect of moisture stress on pod and kernel yield (g plant^{-1}) among groundnut genotypes

GENOTYPES	Pod yield (g plant^{-1})			Kernel yield (g plant^{-1})		
	Moisture condition					
	I_1	I_0	MEAN	I_1	I_0	MEAN
T1- VRI 2	21.9	8.5	15.2	15.8	4.0	9.9
T2-VRI 6	26.3	16.5	21.4	19.3	11.2	15.3
T3- VRI 8	20.3	4.2	12.3	15.2	3.0	9.1
T4-TMV 7	19.2	13.2	16.2	14.1	9.1	11.6
T5-TMV13	20.9	10.0	15.5	15.4	4.2	9.8
T6-TMV14	24.1	8.5	16.3	18.7	4.0	11.4
T7-K6	37.9	12.4	25.1	23.2	7.5	15.4
T8-JL24	27.6	12.1	19.9	20.1	7.2	13.7
T9- DHARANI	35.5	7.2	21.4	22.2	3.8	13.0
T10- CO3	17.4	3.6	10.5	13.0	2.5	7.8
T11- VG19721	30.0	11.9	20.9	20.7	6.5	13.6
T12-VG18089	28.9	9.0	19.0	20.6	4.1	12.3
T13-VG 17008	25.6	9.7	17.6	19.2	4.1	11.7
MEAN	25.8	9.9		18.3	5.5	
	G	M	G x M	G	M	G x M
SEd	0.51	0.20	0.72	0.34	0.13	0.48
CD(p=0.05)	1.03	0.40	1.46	0.69	0.27	0.97

under non stress condition. Yms is the average yield across all genotypes under stress conditions, and Ymp is the average yield across all genotypes under non stress conditions. DTI and DSI was calculated for each genotype as a criterion of moisture stress tolerance. The genotype with highest value of DTI and lowest value for DSI indicates the highest level of drought tolerance and vice-versa[5].

Pod and kernel yield (g plant^{-1}) :

The pod and kernel yield observed were statistically analyzed and results showed that there is a significant difference in pod yield (g plant^{-1}) and kernel yield (g plant^{-1}) among groundnut genotypes and it ranges from 3.6 to 37.9 (g plant^{-1}) and 2.5 to 23.2 (g plant^{-1}). Due to moisture stress, significant changes in pod and kernel yield among different genotypes were noticed in moisture stress free condition compared to moisture stress. The percent reduction in pod and kernel yield due to moisture stress was 61.6 and 69.9. With regard to genotypes, there existed significant difference in pod and kernel yield among groundnut genotypes and it ranges from 10.5 to 25.1 (g plant^{-1}) and 7.8 to 15.4 (g plant^{-1}).

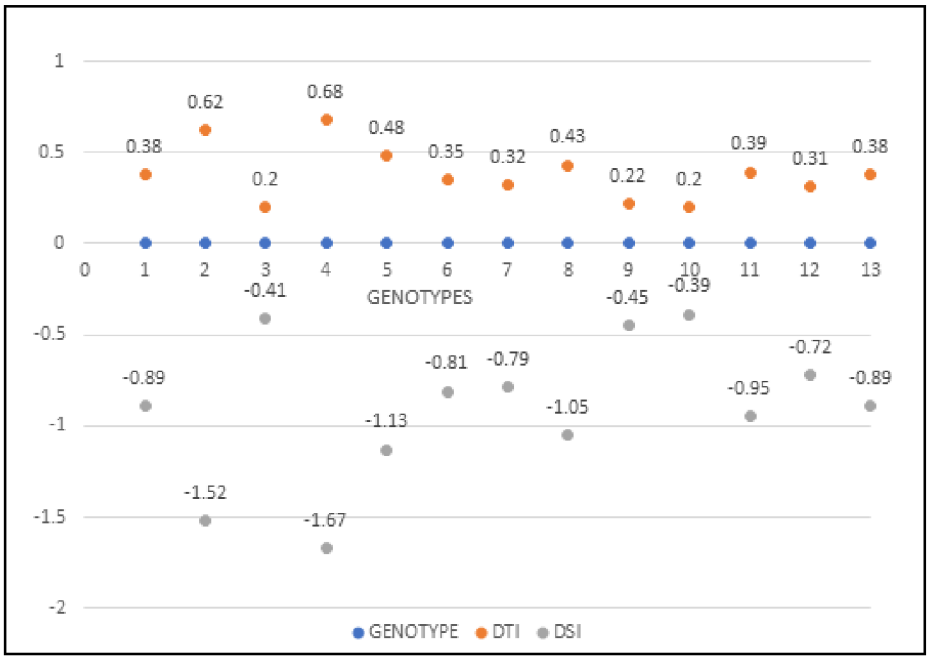

Figure 1: Effect of moisture stress on drought tolerant indices among groundnut genotypes.

The highest pod and kernel yield observed in groundnut genotype was K 6 and least recorded in groundnut genotype was CO 3. Interaction effect between moisture stress and groundnut genotype was found to be significant, with respect to moisture stress, the maximum reduction in pod and kernel yield was noticed on genotype dharani 35.5 to 7.2 and 22.2 to 3.8 g plant^{-1} (79.7% & 82.7%) and minimum reduction noticed on genotype TMV 7 19.2 to 13.2 and 14.1 to 9.1 g plant^{-1} (31.3 % & 35.3%) were presented in table-1.

Moisture stress affected pegging and pod development in groundnut genotypes. Pegs struggled to penetrate in crusted soils. Pods lost their turgor and shriveled, that resulted in formation of small and wrinkled kernels, which in turn reduced the pod and kernel yield severely in moisture stress condition. This findings is in conformity with studies of Arunachalam and Kannan[1]. Reddy *et al.*,[7] stated that pod and kernel development are progressively inhibited by moisture stress due to insufficient plant turgor and lack of assimilates. These stages can also be delayed by lack of water in the pod zone thus results in poor pod and kernel yield.

Drought tolerance index and drought susceptibility index :

The values of DTI ranged from 0.20 to 0.68 and DSI ranged from -0.39 to -1.67. However highest DTI and lowest DSI recorded on TMV 7 (0.68 and -1.67) followed by VRI 6 (0.62 and – 1.52) and lowest DTI and highest DSI recorded on CO 3 (0.20 and

-0.39) were presented in figure 1.

These results reveled that the genotypes TMV 7 followed by VRI 6 have the drought tolerant ability and better pod yield under moisture stress condition. The drought tolerant genotypes had smaller leaflets, ability to maintain greenness till maturity and ability to adjust narrow leaflet angles during peak sunshine hours, which might be contributed for their drought tolerance ability. Arunachalam and Kannan[1] suggested that the ability of maintaining chlorophyll density under moisture stress as drought resistance mechanism in plants.

Moisture stress during flowering to pod development stage reduced pod and kernel yield. The genotype K 6 have the ability to perform well in moisture stress free condition but it cannot tolerate in moisture stress. Groundnut genotype suitable for moisture stress condition should have drought tolerant ability. Based on the drought tolerance indices, groundnut genotype VRI 6 and TMV 7 were recorded consistent pod yield in moisture stress condition with high drought tolerance index and low drought susceptibility index.

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