IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

GENOTYPIC VARIATION OF GROUNDNUT GENOTYPES FOR YIELD AND DROUGHT TOLERANCE IN GROUNDNUT (*Arachis hypogaea* L.)

K.John, A.Srividhya, P.Latha, R.P. Vasanthi and C.Kiran kumar Reddy

Regional Agricultural Research Station, A.N.G.R.A.U, Tirupati-517502

ABSTRACT

The cultivated Groundnut or peanut is an annual self pollinated legume crop. It is the major oilseed crop in India and in Andhra Pradesh. Drought is the single most factor limiting productivity under rainfed conditions. High temperatures associated with drought also affect many physiological processes in plant resulting poor yield. TCGS- 1399 recorded the highest pod yield (2164 kg/ha) and kernel yield (1493 kg/ha) by TCGS-1439. TCGS-1417 recorded maximum 100-pod weight (86.0 g) amd highest 100 kernel weight of 44.0 g. The highest sound mature kernel per cent of 91.0% was recorded by TGCS-1425. The same genotype TCGS 1425 recorded high drought tolerance in terms of high drought adaptive leaf traits under rainfed conditions viz., High SPAD Chlorophyll Meter Reading (SCMR), low Specific Leaf Area (SLA), high Relative Water Content (RWC), high total chlorophyll (chl.) content, high Chlorophyll Stability Index (CSI) and low Relative Injury (RI) per cent compared to Kadiri-6. These genotypes could be utilized in the breeding programme.

Key words: Drought tolerance, Groundnut, Yield, Genotypic variation

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important annual oilseed legume crop, valued as a rich source of protein, minerals and vitamins. It is the major oilseed crop in India and in Andhra Pradesh. It is grown in both rainfed as well as irrigated conditions in *kharif* and *rabi/summer* seasons. In rainfed situation, the crop is exposed to moisture stress of varying intensities at different stages. Further, more than 80 % of groundnut area in India and Andhra Pradesh is under rainfed conditions. The remaining 20% is grown under protected irrigation conditions during post rainy (*rabi*)/ summer seasons. The three patterns of drought that affect groundnut crop are early drought, mid-season drought and end-of-season drought. Though early drought for 15-20 days soon after emergence is beneficial for the groundnut crop; the late two forms of drought cause substantial reduction in groundnut yield (Rao *et al*., 1989). To increase the productivity of groundnut under drought, there is a need for genotypes that are relatively tolerant to drought and high temperature stresses.

Drought is the single most factor limiting productivity under rainfed conditions. High temperatures associated with drought also affect many physiological processes in plant resulting poor yield. Further, heat tolerance will be necessary because of global climatic change (Schneider, 1989), coupled with increase in CO_2 concentration. During *rabi* season, especially in the late sown crop, January and February, yield gets reduced due to high temperature in March and April months during flowering and pod development stages. Further, the variety

must be acceptable to the producer, the processor and the consumer. Plant breeders and crop physiologists now believe that more rapid progress can be aided by a prior knowledge of the physiological basis of crop performance under drought conditions. Therefore identification of physiological traits contributing to superior performance of plants under drought and high temperature conditions and incorporating them into a well adapted variety has been a long term goal of groundnut scientists. Keeping these in view it is necessary to identify genotypes with drought resistance along with higher yield potential in order to stabilize production in rainfed situation. .

MATERIALS AND METHODS

The field experiment was conducted at Regional Agricultural Research Station (RARS), Tirupati. The material used in the present study consisted of 22 genotypes of peanut and were sown in a Randomized Block Design (RBD) with three replications during 2013 and 2014 at Regional Agricultural Research Station, Tirupati. In each replication every genotype was sown in seven rows of 5 m length with a spacing of 30 cm between the rows and 10 cm between the plants within the row. The genotype TCGS-1425 was studied for promising drought tolerance along with drought susceptible check Kadiri 6 during two kharif seasons (2016 and 2017) and two rabi seasons (2016-17 and 2017-18). The field was ploughed and harrowed until a fine tilth of soil was obtained FYM @ 10 t ha^{-1} was applied at the time of field preparation. Seed treatment was done with Bavistin @ 3 g kg^{-1}. The crop was raised under rainfed irrigation and recommended dose of chemical fertilizers at the rate of 20 kg N, 40 kg P_2O5 and 50 kg K_2O per hectare in the form of urea, single super phosphate, murate of potash and 500 kg of gypsum ha^{-1} was applied at peak flowering stage. Cultural practices like weeding were followed to maintain good crop growth apart from need based plant protection measures adopted during the crop season for controlling diseases and pests. The observations were recorded for all the genotypes separately on randomly chosen five competitive plants in each genotype in each replication for all the characters except days to 50 % flowering, was recorded on plot basis.

RESULTS AND DISCUSSION

Per se performance during days to 50% flowering, pod yield, shelling percent, kernel yield, 100 pod weight , 100 kernel weight and sound mature kernel per cent during 2013and 2014

The *per se* performance of 22 advanced breeding lines of groundnut for yield and yield traits was furnished in Tables 1 and 2. The *per se* performance for days to 50 % flowering ranged from 29.0 days (TCGS-1397 and TCGS-1433) to 32.0 days (TCGS-1426). Seven genotypes were come to flowering early when compared to general mean (30 days). For pod yield per plant the mean values ranged from 1075 kg/ha (Narayani) to 2164 kg/ha (TCGS-1399). Eleven genotypes gave higher pod yield when compared to general mean (1637 kg/ha). The mean values for the shelling per cent ranged from 63.0 % (TCGS-1429) to 75.0 % (Dharani). Ten genotypes gave superior shelling out-urn when compared to general mean (70%). The mean values of genotypes for kernel yield varied from 731 kg/ha (Narayani) to 1493 (TCGS-1439). Eleven genotypes gave higher kernel yield when compared to general mean (1111 kg/ha). For 100-pod weight, the mean values are varied from 63.0 g (TCGS-

1399 and TCGS-TCGS-1404) to 86.0 g (TGCS-11417). Eleven genotypes gave higher 100 pod weight when compared to general mean (75 g).

For 100-kernel weight, the mean values are varied from 31.0 g (TCGS-1441) to 44.0 g (TGCS-1417). Nine genotypes gave higher 100 kernel weight when compared to general mean (36 g). For sound mature kernel per cent mean, the mean values are varied from 84.0% (K-6) to 91.0% (TGCS-1425). Nine genotypes gave sound mature kernel per cent when compared to general mean (36 g). (Tables 1 and 2). Similar results were reported by John *et al* (2009), Gupta *et al.* (2015) and Bugati *et al.* (2020). Mahesh *et al.* (2018) and Nagaveni and Hasan khan (2019).

Genotypic variation for drought adaptive traits and quality traits of groundnut genotype TCGS-1425 grown under rainfed conditions during kharif 2016, 2017 and rabi 2016-17, 2017-18

The performance of groundnut genotype TCGS-1425for drought adaptive traits and quality traits was furnished in Tables 3 and 4. During kharif 2016, TCGS 1425 recorded high drought tolerance in terms of high drought adaptive leaf traits under rainfed conditions viz., High SPAD Chlorophyll Meter Reading (SCMR), low Specific Leaf Area (SLA), high Relative Water Content (RWC), high total chlorophyll (chl.) content, high Chlorophyll Stability Index (CSI) and low Relative Injury (RI) per cent compared to Kadiri-6. TCGS 1425 recorded high drought tolerance in terms of high drought adaptive gas exchange parameters and yield traits under rainfed conditions viz., High photosynthetic rate (Pn), low transpiration rate (E) and high water use efficiency (WUE). Also TCGS 1425 recorded high drought tolerance in terms of high drought adaptive yield traits viz., high shelling per cent and high yield (15 %) compared to Kadiri-6. TCGS 1425 recorded high total carbohydrate per cent and total free amino acids under rainfed conditions compared to Kadiri-6 (Table 3)

During Kharif 2017, TCGS 1425 recorded high drought tolerance in terms of high drought adaptive leaf traits under rainfed conditions viz., High SPAD Chlorophyll Meter Reading (SCMR), low Specific Leaf Area (SLA), high total chlorophyll (chl.) content, high Chlorophyll Stability Index (CSI) and low Relative Injury (RI) per cent compared to kadiri-6. TCGS 1425 recorded high drought tolerance in terms of high drought adaptive gas exchange parameters under rainfed conditions viz., low transpiration rate (E) and high water use efficiency compared to kadiri-6. Also TCGS 1425 recorded low plant height compared to kadiri-6. TCGS 1425 recorded high drought tolerance in terms of high drought adaptive yield and quality traits under rainfed conditions viz., high 100-kernel weight (100-KW), high shelling per cent (SP %) and high yield (40 %) compared to kadiri-6. Quality traits were on par with Kadiri-6 (Table 3).

During rabi 2016-17, TCGS 1425 recorded high drought tolerance in terms of high drought adaptive leaf traits viz., High SPAD Chlorophyll Meter Reading (SCMR), low Specific Leaf Area (SLA) and high Relative Water Content (RWC) under both irrigated and stress conditions compared to Kadiri-6. TCGS 1425 recorded high drought tolerance in terms of high drought adaptive leaf traits viz., high total chlorophyll (chl.) content and high Chlorophyll Stability Index (CSI) under both irrigated and stress conditions compared to Kadiri-6. TCGS

1425 recorded high drought tolerance in terms of high drought adaptive gas exchange parameters viz., high stomatal conductance (gs), moderate transpiration rate (E), high water use efficiency (WUE) and high chlorophyll fluorescence under both irrigated and stress conditions compared to kadiri-6. Photosynthetic rate (Pn) is on par with Kadiri-6. TCGS 1425 recorded high drought tolerance in terms of high drought adaptive yield parameters viz., high yield (17 %) under both irrigated and stress conditions compared to Kadiri-6 (Table 4).

During rabi 2017-18, TCGS 1425 recorded high drought tolerance in terms of high drought adaptive leaf traits viz., High SPAD Chlorophyll Meter Reading (SCMR), low Specific Leaf Area (SLA), high Relative Water Content (RWC) and high total chlorophyll content under both irrigated and stress conditions compared to Kadiri-6.TCGS 1425 recorded high drought tolerance in terms of high drought adaptive leaf traits and yield traits viz., moderate chlorophyll stability index, low relative injury per cent and high pod yields under both irrigated and stress conditions compared to Kadiri-6. TCGS 1425 recorded high drought tolerance in terms of high drought adaptive root traits viz., high root length and number of lateral roots under both irrigated and stress conditions compared to Kadiri-6.TCGS 1425 recorded high drought tolerance in terms of high drought adaptive root traits viz., high root shoot ratio under stress conditions compared to Kadiri-6 (Table 4).

REFERENCES

Bugati, C.H and Savithramma, D.L. 2020. Genetic variability studies in F_6 families and advance breeding lines derived from selected crosses for late leaf spot disease resistance, pod yield and its component traits in groundnut *(Arachis hypogaea* L.). *Journal of Agricultural Sciences.* 54(1): 129.

John K. Vasanthi, R.P. and Venkateswarlu, O (2009). Studies on variability and character association in Spanish bunch grounndnut (Aarachis hypogaeae L.). Legume Res., 32 (1) : 65-69.

Gupta, R.P., Vachhani, J.H., Kachhadia, V.H., Vaddoria, M.A and Reddy, P. 2015. Genetic variability and heritability studies in Virginia groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding*. 6(1): 253-256.

Mahesh, R.H., Hasan, K., Temburne, B.V., Janila, P and Amaregouda, A. 2018. Genetic variability, correlation and path analysis studies for yield and yield attributes in groundnut (*Arachis hypogaea* L.). *Journal of Pharmacognosy and Phytochemistry*. 7(1): 870-874.

Nagaveni, K and Hasan Khan. 2019. Genetic variability studies in terminal drought tolerant groundnut (*Arachis hypogaea* L.). *Journal of Pharmacognosy and Phytochemistry*.8(2): 747-750.

Rao R C N , Williams J H and Singh M 1989 Genotypic sensitivity to drought and yield potential of peanut. Agronomy Journal 81: 887-893.

Schneider S H 1989 The changing climate. Scientific America 261(3): 70-79.

Table-1. Per se performance of groundnut genotypes for days to 50% flowering, pod yield, shelling percent and kernel yield during 2013 and 2014

S.No	Entry	Days to 50% flowering			Pod yield (kg/ha)			Shelling %			Kernel yield (kg/hag)		
		2013	2014	Mean	2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
1	TCGS-1399	32	29	31	1954	2374	2164	60	67	64	1180	1591	1386
2	TCGS-1426	32	32	32	1925	2111	2018	69	71	70	1346	1494	1420
3	TCGS-1425	30	32	31	1361	2105	1733	70	72	71	952	1523	1238
4	Dharani	29	32	31	1353	2065	1709	74	76	75	1001	1561	1281
5	TCGS-1439	29	32	31	2084	2045	2065	75	71	73	1531	1455	1493
6	TCGS-1416	30	28	29	1521	2013	1767	71	72	72	1087	1445	1266
7	TCGS-1417	32	30	31	2000	1891	1946	71	67	69	1421	1273	1347
8	TCGS-1433	30	26	28	1283	1880	1582	71	74	73	916	1387	1152
9	TCGS-1405	32	29	31	1050	1861	1456	68	71	70	716	1328	1022
10	TCGS-1437	30	30	30	1717	1858	1788	70	68	69	1209	1263	1236
11	TCGS-1429	32	31	32	2051	1855	1953	62	63	63	1271	1176	1224
12	TCGS-1435	28	30	29	1352	1843	1598	72	69	71	974	1272	1123
13	TCGS-1412	31	29	30	1066	1834	1450	69	71	70	751	1308	1030
14	TCGS-1398	31	28	30	1405	1752	1579	71	70	71	999	1221	1110
15	TCGS-1397	26	30	28	1659	1750	1705	71	68	70	1175	1189	1182
16	TCGS-1415	28	30	29	1755	1721	1738	64	66	65	1123	1140	1132
17	Abhaya	30	30	30	1085	1718	1402	73	70	72	809	1209	1009
18	TCGS-1441	30	30	30	1345	1702	1524	67	67	67	898	1142	1020
19	Greeshma	29	31	30	832	1650	1241	68	75	72	563	1233	898
20	TCGS-1404	30	29	30	1085	1521	1303	71	70	71	778	1076	927
21	K-6	29	32	31	1064	1360	1212	70	69	70	744	942	843
22	Narayani	29	29	29	1023	1127	1075	67	69	68	690	771	731
	GM	30	30	30	1453	1820	1637	69	70	70	1006	1273	1111
	SE			0.20			0.83			0.80			0.53
	C.V (%)			6.53			45.93			69.32			54.20

Table-2. Per se performance of groundnut genotypes for 100 pod weight , 100 kernel weight and sound mature kernel per cent during 2013 and 2014

S.No	Entry	100 pod weight (g)			100 kernel weight (g)			SMK (%)		
		2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
1	TCGS-1399	69	57	63	27	40	34	92	83	88
2	TCGS-1426	79	90	85	35	43	39	82	91	87
3	TCGS-1425	64	65	65	31	32	32	91	90	91
4	Dharani	87	80	84	37	39	38	86	92	89
5	TCGS-1439	70	63	67	35	33	34	89	90	90
6	TCGS-1416	88	75	82	39	37	38	90	87	89
7	TCGS-1417	93	78	86	47	41	44	88	88	88
8	TCGS-1433	80	76	78	37	41	39	87	93	90
9	TCGS-1405	71	74	73	35	38	37	85	87	86
10	TCGS-1437	91	83	87	39	38	39	85	88	87
11	TCGS-1429	68	71	70	31	33	32	78	91	85
12	TCGS-1435	81	71	76	34	36	35	81	88	85
13	TCGS-1412	70	74	72	37	37	37	88	89	89
14	TCGS-1398	80	83	82	34	34	34	83	87	85
15	TCGS-1397	78	67	73	38	35	37	85	87	86
16	TCGS-1415	82	77	80	32	38	35	86	86	86
17	Abhaya	84	69	77	36	33	35	89	90	90
18	TCGS-1441	73	64	69	31	30	31	81	90	86
19	Greeshma	69	76	73	32	38	35	83	85	84
20	TCGS-1404	65	61	63	32	32	32	83	88	86
21	K-6	77	72	75	36	36	36	89	78	84
22	Narayani	77	75	76	33	35	34	91	83	87
	GM	77	73	75	35	36	36	86	88	87
	SE			1.68			1.02			0.86
	C.V (%)			13.73			18.48			4.57

Table 3: Genotypic variation for drought adaptive traits and quality traits of groundnut genotypes grown under rainfed conditions during kharif 2016 and 2017

S.No.	Traits	Khairf 2016		Kharif 2017	
		TCGS-1425	K-6	TCGS-1425	K-6
1	SCMR	51.70	44.20	47.00	37.00
2	SLA (cm/g)	145.0	172.9	166.81	224.31
3	RWC (%)	79.80	67.82	80.02	65.98
4	Chl. a (mg/g)	1.895	1.819	1.682	1.447
5	Chl. b (mg/g)	0.39	0.43	0.455	0.235
6	Total Chl. (mg/g)	2.26	2.15	2.136	1.681
7	CSI (%)	50.35	41.01	66.35	61.66
8	RI (%)	18.93	19.88	15.74	26.73
9	Pn µmoles $CO_2/m^2/s$	35.28	31.87	16.43	21.24
10	Gs mole H_2O $/m^2/s$	0.040	0.044	0.016	0.033
11	E mmole $H_2O/m^2/s$	10.36	12.87	4.83	6.59
12	WUE (mmole CO_2/ mole H_2O)	3.40	2.47	3.40	3.22
13	Chl. Fluorescence Fv/Fm	0.469	0.517	0.406	0.424
14	100 KW (g)	24.7	26.3	37.53	34.34
15	SP (%)	50.6	45.6	68.84	55.64
16	Pod yield kg./ha.	939.4	800.0	3430.07	1904.48
17	HI (%)	24.9	33.9	0.49	0.44
18	Total carbohydrates %	19.85	15.95	20.02	18.59
19	Total free amino acid (ug/g)	578.8	416.3	548.8	525.2
20	Protein (%)	26.0	25.6	25.8	25.9
21	Oil (%)	45.8	47.5	47.3	47.4

Table 4: Genotypic variation for drought adaptive traits and quality traits of groundnut genotypes under irrigated and stress (mid season stress (40-80 DAS)) conditions during *rabi* 2016-17 and 2017-18

S.No.	Traits	Treatment	Rabi 2016-17		Rabi 2017-18	
			TCGS-1425	K-6	TCGS-1425	K-6
1	SCMR	Control	51.6	44.3	55.33	42.07
		Stress	54.1	44.2	58.00	40.43
2	SLA (cm/g)	Control	137.2	186.0	141.38	158.30
		Stress	138.1	157.7	150.42	149.41
3	RWC (%)	Control	86.3	80.9	81.12	78.85
		Stress	78.5	65.9	76.03	73.14
6	Total Chl. (mg/g)	Control	2.07	1.16	1.67	1.05
		Stress	1.57	1.10	1.19	0.85
7	CSI (%)	Control	79.6	50.4	70.32	78.18
		Stress	50.4	46.3	38.77	45.25
8	RI (%)	Control	21.9	22.3	26.82	39.82
		Stress	35.9	55.8	54.13	62.68
9	Pn µmoles $CO_2/m^2/s$	Control	27.2	27.4	30.5	31.9
		Stress	20.1	21.3	17.9	16.7
10	gs mole $H_2O/m^2/s$	Control	0.054	0.081	0.026	0.030
		Stress	0.091	0.085	0.081	0.018
11	E mmole $H_2O/m^2/s$	Control	9.68	9.59	8.64	8.55
		Stress	6.50	7.66	7.86	6.89
12	WUE (mmole CO_2/ mole H_2O)	Control	2.80	2.86	3.53	3.73
		Stress	3.09	2.78	2.27	2.42
13	Chl. Fluorescence Fv/Fm	Control	0.550	0.563	0.527	0.550
		Stress	0.406	0.339	0.456	0.359
14	100 KW (g)	Control	40.1	42.9	34.83	40.16
		Stress	37.1	35.3	33.88	41.29
15	SP (%)	Control	75.3	69.8	74.3	65.9
		Stress	63.2	67.0	65.5	69.2
16	Pod yield kg./ha.	Control	3781.3	3098.1	3154.09	1916.30
		Stress	1510.9	1259.1	2128.54	1045.42