Int.J.Curr.Microbiol.App.Sci (2019) *8*(10): 835-844

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 8 Number 10 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.810.096

Evaluation of Large Seeded Groundnut Advanced Breeding Lines for Components of Pod Yield and Water Use Efficiency

K. Gangadhara[1*], M. C. Dagla[2], Kona Praveen[1], Narendra Kumar[1], B. C. Ajay[1], A. L. Rathnakumar[1] and H. K. Gor[1]

[1]*ICAR-Directorate of Groundnut Research, Junagadh, Gujarat, India*
[2]*Indian Institute of Maize Research, Ludhiana, Punjab, India*

**Corresponding author*

ABSTRACT

Keywords

Large seeded, Pod yield, Water use efficiency, Heritability

Article Info

Accepted:
07 September 2019
Available Online:
10 October 2019

One fifty large seeded advanced breeding lines of groundnut were evaluated for pod yield and water use efficiency by following Augmented RBD design with four checks. There are significant differences observed for days to flowering, hundred pod and kernel weight, shelling per cent, kernel length and width. High heritability coupled with high genetic advance as per cent of mean was observed for hundred pod weight and hundred kernel weight, suggesting scope for selection for their improvement. Pod yield per plant associated positively with shelling per cent, hundred pod and kernel weight, kernel width and SCMR. Superior advanced breeding lines identified for large seeded advanced breeding line with desirable pod yield and kernel traits can be useful donors for breeding programmes.

Introduction

Groundnut is major oilseed crop grown in an area of 53 lakh hectares and production of 95 lakh tonnes with productivity of 1731 kg/ha (FAOSTAT, 2017) in India. With limited land and water resources and growing population, agricultural productions systems need effective utilization of resource and exploitation of specific marketing opportunities like confectionery and table purpose in groundnut. Groundnut is major rainfed crop growing in kharif season, where uncertain rainfalls and occurrence of drought are major constraints affecting groundnut productivity.

There is need to develop high yielding large seeded groundnut varieties with high water use efficiency. Generally large-seeded Virginia types have longer maturity duration (>125 days) than small seeded

Valencia/Spanish types (100-110 days). Development of high yielding and large seeded genotype with short duration is most challenging, because short growing period reduces yield (Nigam, 2015). However, efficient partitioning of stored assimilates between the vegetative and reproductive parts(high crop growth rate during the grain-filling phase) of plants (Thakare *et al.*, 1982; Duncan *et al.*, 1978; Haro *et al.*, 2007; Phakamas *et al.*, 2008) may be possible to develop medium duration varieties to stabilize productivity in a cropping system. Incorporation of WUE traits along with medium maturity in varieties could potentially lead to increased yields under limited moisture availability. Two physiological traits SCMR and SLA have been considered to be surrogate traits for transpiration efficiency (Nigam *et al.*, 2005, Nageswara Rao *et al.*, 2001 and Uphadhaya, 2005). In view of this, in present investigation was carried out to assess the pod yield and WUE components in 150 large seeded advanced breeding lines developed at ICAR-Directorate of Groundnut Research, Junagadh.

Materials and Methods

One fifty large seeded advanced breeding lines of groundnut were planted Augmented Randomized Complete Block Design (ARBD) along with four checks at the Experimental plots of ICAR-Directorate of Groundnut Research, Junagadh, Gujarat, India during *kharif*-2017.A total of 150 advanced breeding lines belong to 130 Virginia and 20 Spanishtypes. ICAR-DGR is situated between 21.49° N latitude and 70.44°E longitude at an elevation of 107 meters above mean sea level. Recommended agronomic practices were followed to raise crop. The observations on days to first flowering, days to 50% plants flowering, days to maturity, hundred pod and kernel weight, shelling per cent, kernel width, kernel length and pod yield per plant were recorded on a five random plants from each breeding line. The surrogate traits of water use efficiency, SPAD chlorophyll meter reading (SCMR) and specific leaf area (SLA) were measured at 60 days after planting. SCMR was recorded at 60 days after sowing by collecting the second to third leaves from the top of the main stem of each plant and transported to a laboratory soon fresh weight was recorded. SCMR was measured immediately by a Minolta handheld portable SCMR meter (SPAD- 502 plus Minolta, Tokyo, Japan), using five leaflets per sample and care was taken to ensure that the SPAD meter sensor fully covered the leaf lamina, avoiding any interference from veins and midribs. The same samples were further measured for leaf area, using a leaf area meter (LI 3100C Area meter, LI COR Inc., USA). Genotypic and phenotypic coefficient of variation were worked out as per the method suggested by Burton and De Vane (1953), heritability and genetic advance were calculated according to Johnson *et al.*, (1955) and Robinson *et al.*, (1949).

Results and Discussion

Variability and genetic parameters

The analysis of variance for different traits exhibited significant differences among the advanced breeding lines for days to flowering, hundred pod and kernel weight and shelling per cent suggesting the considerable genetic variability is prevailing in the advanced breeding lines (Table 1). Days to first flowering ranged from 20 to 33 days and days to 50 per cent flowering ranged from 22 to 39 days. Maturity duration of advanced breeding lines was ranged from 116 to 127 days. The two surrogate traits of water use efficiency *viz.,* SPAD chlorophyll meter reading (SCMR) ranged between 27 and 44 and specific leaf area (SLA) ranged from 129 to 262 cm^2g^{-1} (Figure 1). Hundred pod weight ranged from

77 to 196g, whereas hundred kernel weight ranged from 31g to 73g. Shelling per cent was in the range of 53% to 75% (Figure 2). Seed size is one of the important trade attribute of confectionary groundnuts for export purpose. Kernel length and kernel width were ranged from 8 to 19 mm and 6 to 9 mm respectively. Pod yield was as low as 2.9g to as high as 18 g per plant (Table 2).

Selection efficiency mainly depends on the magnitude of genetic variability for components traits influencing yield. The nature and magnitude of variation for individual traits was assessed by phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance as per cent of mean (Table 2). Both days to first and 50 per cent flowering showed low GCV and PCV estimates, but high heritability and low genetic advance as per cent of mean suggesting the low variability and non-additive gene control. Similar results of low variability and high heritability and low genetic advance as per cent of mean of days to 50 per cent flowering was reported by Uma *et al.,* (2018).

Days to maturity had very low GCV and PCV estimates and low heritability coupled with genetic advance as per cent of mean suggesting the narrow range of variability and considerable influence of environment and little scope for selection.

This is in accordance with results of Memon *et al.*,(2018). Two surrogate traits of water use efficiency, SCMR and SLA showed low GCV estimates and moderate PCV and heritability estimates. Both hundred pod weight and hundred kernel weight exhibited moderate PCV and GCV estimates and high heritability and genetic advance as per cent of mean, suggesting the moderate variability and additive gene action. Rao *et al.,* (2014) observed moderate PCV and GCV estimates and high heritability for hundred kernel weight in groundnut.

Shelling percentage and kernel length had low PCV and GCV estimates and high heritability with low to moderate genetic advance as per cent of mean respectively indicating the complex genetic interactions in their expression and narrow range of variability for these traits. This kind of high heritability with low genetic advance as percent of mean for shelling per centage was in accordance with Dhakar *et al.,* (2016). Pod yield per plant showed high PCV estimates and low GCV estimates suggesting the low variability and considerable influence of environment on the pod yield. Moderate heritability and genetic advance as per cent of mean was observed for pod yield per plant.

Correlation analysis

Components traits *viz.,* shelling per cent, hundred pod and kernel weight, kernel width, SCMR, were associated significant positively with pod yield per plant (Table 3). SPAD cholorophyll meter reading (SCMR) was correlated significantly and positively with pod yield per plant and negative significant with SLA (Nageswara Rao *et al.,* 2001, Upadhyaya, 2005 and Kalariya *et al.,* 2014). SLA associated significant positively with days to 50 per cent flowering, days to maturity and kernel width. Days to maturity correlated positively with days to 50 per cent flowering, hundred pod weight, kernel length and width and negatively with shelling per cent.

Identification of trait specific genotypes

Rainfed groundnut crop productivity is affected by erratic rainfall distribution and identifying the efficient reproductive and water use efficient groundnut varieties is important breeding activity.

Table.1 Analysis of variance for components of pod yield and water use efficiency in groundnut genotypes

Source	DF	DFF	DFI	DM	SCMR	SLA	HPW	HKW	SP	KL	KW	PYL
Block	4	1.825	1.93	6.5	6.68	51.23	55.8	11.78	6.2787*	1.56	0.45	5.94
Genotypes	153	7.580*	4.4563*	6.7	12.03	381.08	411.00*	56.04*	12.470*	2.271*	0.35	7.19
Tests	149	7.282*	4.293*	6.5	11.98	387.12	330.49*	44.55*	11.971*	1.940*	0.31	6.11
Controls	3	9.65*	5.733*	8.3	2.71	192.69	895.73*	173.99*	13.192*	4.673*	1.789*	45.26*
Tests Vs controls	1	45.74*	24.85*	32.5	47.25*	46.02	10952.78*	1414.39*	84.627*	44.31*	3.019*	53.36*
Error	12	1.525	0.86	7.3	9.61	292.34	66.7	5.74	1.272*	0.53	0.26	6.98

Table.2 Estimates of genetic parameters for components of pod yield and water use efficiency in groundnut genotypes

Particulars	DFI	DFF	DTM	SCMR	SLA	HPW	HKW	SP	KL	KW	PYLP
Min	20.00	22.00	116.00	27.10	129.14	77.04	31.85	53.10	8.10	6.60	2.91
Max	33.00	39.00	127.00	44.30	262.87	196.08	73.03	75.40	19.80	9.80	18.38
Mean	26.99	29.96	122.01	36.09	182.68	120.54	48.08	66.69	16.42	8.20	9.96
σ^2p	4.81	8.09	6.69	13.06	428.44	364.20	48.03	13.61	1.92	0.32	7.69
σ^2g	3.95	6.78	1.40	5.18	238.75	312.11	42.05	11.61	1.27	0.06	2.53
PCV	8.12	9.50	2.12	10.01	11.33	15.83	14.41	5.53	8.44	6.87	27.83
GCV	7.36	8.69	0.97	6.31	8.46	14.66	13.49	5.11	6.85	3.04	15.96
h2	82.10	83.77	20.94	39.65	55.72	85.70	87.55	85.26	65.93	19.53	32.88
GAM	13.67	16.31	0.91	8.14	12.94	27.81	25.87	9.67	11.41	2.75	18.76

DFI-Days to first flowering **DFF-** Days to 50 per cent flowering **DTM-**Days to maturity **SCMR-**SPAD chlorophyll meter reading

SLA-Specific leaf weight **HPW-**Hundred pod weight **SP-**Shelling percentage **HKW-**Hundred kernel weight

KL-Kernel length **KW-**Kernel width **PYLP-**Pod yield per plant

Table.3 Phenotypic Correlation coefficients of components of pod yield and water use efficiency in groundnut genotypes

	DFI	DFF	DTM	SCMR	SLA	HPW	HKW	SP	KL	KW	KLWR	PYLP
DFI	1											
DFF	.845**	1										
DTM	0.106	.168*	1	-								
SCMR	-0.09	-0.115	-0.137	1								
SLA	0.144	.161*	.177*	-.338**	1							
HPW	-.203*	-.225**	.178*	0.127	0.094	1						
HKW	-0.154	-.188*	0.141	0.107	0.073	.915**	1					
SP	0.06	-0.031	-.317**	.254**	-0.117	-0.049	0.127	1				
KL	-0.139	-0.126	.167*	-0.02	0.038	.497**	.488**	-.160*	1			
KW	-0.012	-0.023	.210**	-0.007	.231**	.611**	.650**	-0.057	.224**	1		
KLWR	-0.113	-0.093	0.003	-0.022	-0.129	-0.008	-0.045	-0.126	.710**	-.523**	1	
PYLP	-0.091	-.230**	-0.049	.250**	0.148	.430**	.437**	.346**	0.092	.424**	-.230**	1

Table.4 Identification of desirable advanced breeding liens for component traits of water use efficiency and pod yield

ABL	DFF	ABL	DTM	ABL	SCMR	ABL	SLA	ABL	HPW	ABL	HKW	ABL	SP	ABL	KL	ABL	PYLP
PBS 19012	22	PBS 19012	116	PBS 29166	44.3	PBS 19019	129.1	PBS 29069	196.1	PBS 29069	73.03	PBS 29162	75.4	PBS 29069	19.8	PBS 29230	18.4
PBS 19014	24	PBS 29087	116	PBS 29233	43.9	PBS 29078	129.5	PBS 29079B	182	PBS 29079B	68.92	PBS 29163	75.3	PBS 29079B	19.1	PBS 29195	18.2
PBS 29229	25	PBS 19015	117	PBS 29229	43.4	PBS 29206	141.4	PBS 19029	159	PBS 29211	63.03	PBS 29226	72.9	PBS 29189	18.9	PBS 29192	16.4
PBS 19015	26	PBS 19021	117	PBS 29232	42.8	PBS 29167	142.8	PBS 29195	151.9	PBS 29199	60.9	PBS 29159	72.7	PBS 29072	18.8	PBS 29225	16
PBS 19013	27	PBS 19023	117	PBS 19019	42.3	PBS 29052	144.4	PBS 19022	149.3	PBS 29210	59.65	PBS 29173	72.6	PBS 29125	18.8	PBS 29194	15.6
PBS 19022	27	PBS 19030	117	PBS 29197	42.3	PBS 29172	147.5	PBS 29197	149.2	PBS 29197	59.12	PBS 29233	72.3	PBS 29211	18.6	PBS 29220	15.6
PBS 19023	27	PBS 29173	117	PBS 29162	41.5	PBS 29113	150.9	PBS 29191	147.5	PBS 29226	59.07	PBS 29174	72.3	PBS 29207	18.5	PBS 29210	14.7
PBS 19025	27	PBS 29177	117	PBS 19024	41.4	PBS 19023	152.3	PBS 29052	146.8	PBS 29191	58.82	PBS 29071	72.1	PBS 29192	18.3	PBS 29227	14.6
PBS 19029	27	PBS 19020	118	PBS 29215	41.4	PBS 19021	153	PBS 29218	146.5	PBS 29225	58.82	PBS 29232	71.9	PBS 29197	18.3	PBS 29218	14.4
PBS 19031	27	PBS 19028	118	PBS 19033	41.2	PBS 29088	153.9	PBS 29211	146.4	PBS 29078	58.4	PBS 29220	71.7	PBS 29078	18.2	PBS 29191	14.2
PBS 19032	27	PBS 19031	118	PBS 29220	41.2	PBS 29202	154.6	PBS 29227	145.4	PBS 19030	58.07	PBS 29230	71.6	PBS 29148	18.2	PBS 29197	14.1
PBS 19033	27	PBS 29068	118	PBS 29069	40.9	PBS 29226	155.2	PBS 29225	144.8	PBS 29206	57.37	PBS 29078	71.3	PBS 19023	18.1	PBS 29160	13.7
PBS 19034	27	PBS 29162	118	PBS 29159	40.9	PBS 29080	155.5	PBS 29169	144.7	PBS 29218	57.26	PBS 19030	71.3	PBS 29179	18.1	PBS 29193	13.5
PBS 29067	27	PBS 29171	118	PBS 29184	40.7	PBS 29207	155.7	PBS 29192	143.4	PBS 19029	56.45	PBS 29156	71.2	PBS 29212	18.1	PBS 29165	13.3
PBS 29079B	27	PBS 29202	118	PBS 29078	40.6	PBS 29162	156	PBS 29223	142.8	PBS 19022	56.39	TKG 19A	71.2	PBS 19014	18	PBS 29211	13.2
PBS 29136	27	PBS 29220	118	PBS 29175	40.6	PBS 29138	156.8	PBS 19030	142.5	PBS 29165	56.26	PBS 29235	70.9	PBS 19020	17.9	PBS 29190	13.2
PBS 29137	27	TKG 19A	119	PBS 19031	40.5	PBS 19033	157.5	PBS 29210	141.9	PBS 29195	55.93	PBS 29201	70.9	PBS 29177	17.9	PBS 29233	13.2
PBS 29171	27	PBS 29073	119	PBS 29155	40.5	PBS 19024	158	PBS 29082	141.8	PBS 29170	55.71	PBS 29070	70.9	PBS 29178	17.9	PBS 19025	13.1
PBS 29172	27	PBS 29080	119	PBS 29145	40.4	PBS 29090	158.2	PBS 29193	141.5	PBS 29077	55.45	PBS 29206	70.8	PBS 19028	17.8	PBS 29226	13.1
PBS 29182	27	PBS 29088	119	PBS 29223	40.4	PBS 29114	159	PBS 29214	141.3	PBS 29067	55.36	PBS 29225	70.7	PBS 19030	17.8	PBS 29214	13.1
PBS 29189	27	PBS 29100	119	PBS 29169	40.3	PBS 19030	159.4	PBS 29199	140.7	PBS 29169	55.24	PBS 29160	70.7	PBS 29073	17.8	PBS 29067	12.9
PBS 29219	27	PBS 29105	119	PBS 29212	40.3	PBS 29171	162.9	PBS 19031	140.7	PBS 29146	55.01	PBS 29164	70.6	PBS 29216	17.8	PBS 29164	12.8
BAU 13	28	BAU 13	123	BAU 13	35.3	BAU 13	184.1	BAU 13	90.5	BAU 13	36.3	BAU 13	68.6	BAU 13	14.4	BAU 13	11.1
GJGHPS1	30	GJGHPS1	121	GJGHPS1	35	GJGHPS1	178.8	GJGHPS1	97	GJGHPS1	37.8	GJGHPS1	68.4	GJGHPS1	14.5	GJGHPS1	8.7
Mallika	27	Mallika	121	Mallika	33.8	Mallika	189.9	Mallika	113	Mallika	47.7	Mallika	67.5	Mallika	16.3	Mallika	15.8
TKG 19A	28	TKG 19A	119	TKG 19A	33.9	TKG 19A	175.4	TKG 19A	80.8	TKG 19A	34.6	TKG 19A	71.2	TKG 19A	14.2	TKG 19A	10.6
CD	3.17		6.9		7.9		44.0		21		6.1		2.8		1.8		6.7

Fig.1 Frequency distribution of reproductive and water use efficiency related traits in 150 large seeded advanced breeding lines

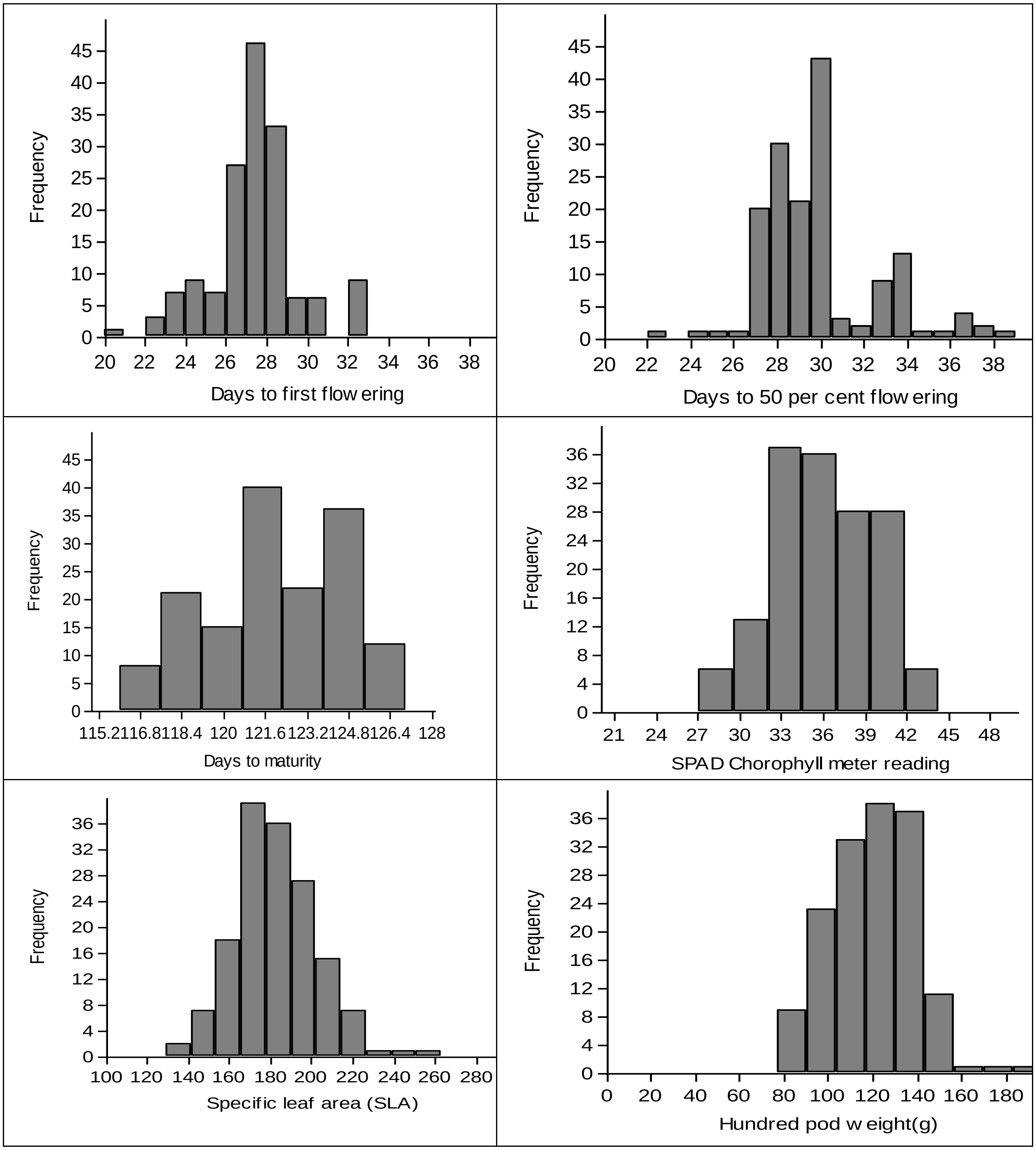
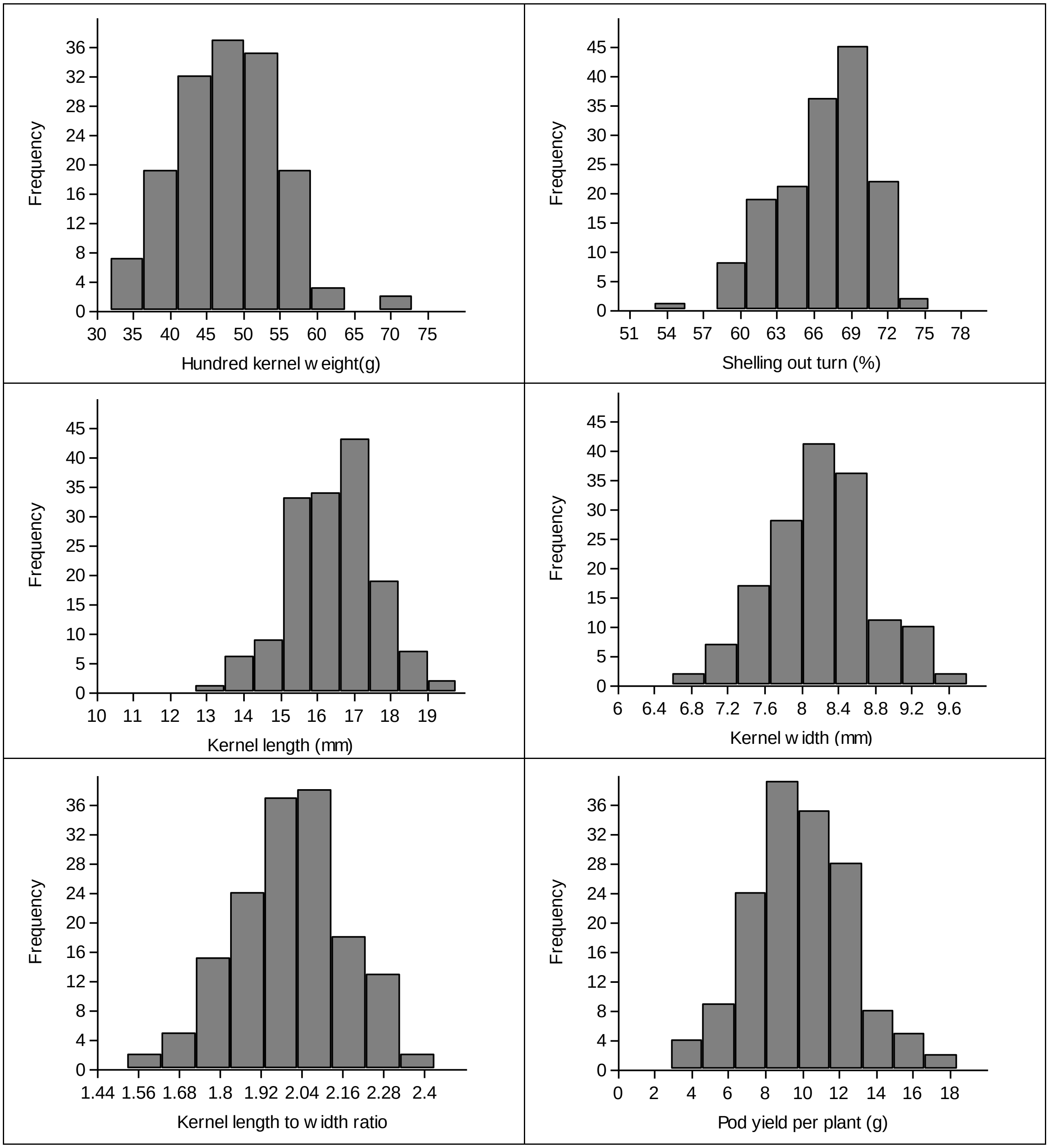


Fig.2 Frequency distribution pod yield component traits in 150 large seeded advanced breeding lines



Superior genotypes identified for reproductive and surrogate traits of water use efficiency are PBS 19012 and 19014 for days to flowering (20 days); PBS 29166 and 29233 for SCMR (>43) and PBS 19019 and 29078 for SLA (129 cm^2g^{-1}). Advanced breeding lines with more than 60g hundred kernel weight were, PBS 29069, 29079B, 29211 and 2919. Shelling per cent with more than 75% was observed in advanced breeding lines PBS 29162 and 29163 (Table 4). Five advanced breeding lines 29069, 29079B, 29189, 29072 had high kernel length (>18mm). Eight advanced breeding lines with high kernel size which in turn determined by kernel length to width ratio (>2.2) are PBS 19014, 29125, 29106, 29161, 19028, 29138, 29109, 29189 have been identified. Six advanced breeding lines PBS 29230, 29195, 29192, 29225, 29194 and 29220 were at par with checks with respect to pod yield per plant (15g). Superior advanced breeding lines identified for traits reproductive, confectionery and pod yield can be useful donors for breeding programmes.

References

Burton, G. W. and De vane, E. M., 1953, Estimating heritability in tall fescue (*Festuca arundinaceae*) from replicated clonal material. *Agron. J.,* 45: 479-481.

Dhakar, T.R., Sharma, H., Kumar, R. and Kunwar, R. 2016, genetic variability using phenotypic and genotypic variables simultaneously in groundnut (*Arachis hypogaea* L.), The Bio Scan, 11(4): 3043-3047.

Duncan, W.G., Mccloud, D.E., Mcgraw, R.L. and Boote, K.J. (1978). Physiological aspects of peanut yield improvement. *Crop Sci*. 18: 1015-1020.

FAOSTAT,2017,www.fao.org/faostat/en/#data/QC

Haro, R.J., Otegui, M.E., Collino, D.J. and Dardanelli, J.L. (2007). Seed yield determination and radiation use efficiency in irrigated peanut crop: Response to temperature and source-sink ratio variations. *Field Crops Res.* 103: 217-228.

Johnson, H. W., Robinson, H. F. and Comstock, R. E., 1955, Estimation of genetics and environmental variability in soybean. *Agron. J.,* 47: 477-483.

Kalariya, K.A., Singh, A.L., Chakraborty, K., Ajay, B.C., Zala, P.V., Patel, C.B. Nakar, R.N., Goswami, N. Mehta, D., 2017, SCMR: A more pertinent trait than SLA in peanut genotypes under transient water deficit stress during summer, *Proc. Natl. Acad. Sci., India, Sect. B Biol. Sci*.87(2):579–589.

Memon, J.T., Kachhadia, V.H., Vachhani, J.H. and Dedamiya, A.P., 2018, Genetic variability, heritability and genetic advance for quantitative characters in F_2 generation of groundnut (*Arachis hypogaea* L.). *Inter. J. of Chemical Studies*. 6(4): 1598-1603.

Nageshwar Rao, R. C., Talwar, H. S. and Wright, G. C. 2001, Rapid assessment of specific leaf area and leaf nitrogen in peanut using chlorophyll meter. *J. Agronomy and Crop Science*, 186: 175-182.

Nigam, S.N., 2015, Groundnut at a Glance, Published by U.S. Government's Feed the Future Innovation Lab for Collaborative Research on Peanut Productivity and Mycotoxin Control., pp*:* 68.

Nigam, S.N., Chandra., S., Sridevi.K.R., Bhukta, M., Reddy, A.G.S., Rachaputi, N.R., Wright, G.C., Reddy, P.V., Deshmukh, M.P, Mathur, R.K., Basu, M.S., Vasundhara, S., Varman, P.V., Nagda, A.K. 2005, Efficiency of physiological trait-based and empirical selection approaches for drought tolerance in groundnut, *Annals of Applied Biology*, 146:433–439

Phakamas, N., Patanothai, A., Jogloy, S., Pannangpetch, K. and Hoogenboom, G. (2008). Physiological determinants for pod yield of peanut lines. *Crop Sci*. 48: 2351-2360.

Rao, V.T., Venkanna, V., Bhadru, D. and Bharathi, D, 2014, Studies on variability, character association and path analysis on groundnut (*Arachis hypogaea* L.) *Inter. J. of Pure and applied Sciences*, 2(2):194-197.

Robinson, H. F., Comstock, R. E. and Harvey, P. H., 1949, Estimates of heritability and degree of dominance in corn. *Agron. J.*, 41: 353-359.

Thakare, R.G., Pawar, S.E., Jashua, D.C., Mitra, R. and Bhatia, C.R. (1982). Variation in some physiological components of yield in induced mutants of mungbean. In *Induced Mutation-A tool in Plant Breeding.IAEA-SM-251/5.*International Atomic Energy Agency, Vienna, Austria.

Uma R Byadagi, Venkataravana P and Priyadarshini SK, 2018, Genetic variability studies in F2 and F_3 populations of three crosses of groundnut (*Arachis hypogaea* L), *Journal of Pharmacognosy and Phytochemistry*, 7(5): 3139-3143.

Upadhyaya, H.D. 2005. Variability for drought resistance related traits in the mini core collection of peanut. *Crop Sci*. 45:1432–1440.

How to cite this article:

Gangadhara, K., M. C. Dagla, Kona Praveen, Narendra Kumar, B. C. Ajay, A. L. Rathnakumar and Gor, H. K. 2019. Evaluation of Large Seeded Groundnut Advanced Breeding Lines for Components of Pod Yield and Water Use Efficiency. *Int.J.Curr.Microbiol.App.Sci.* 8(10): 835-844. doi: https://doi.org/10.20546/ijcmas.2019.810.096