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Evaluation of Germplasm Accessions for Drought Tolerance in Green gram [*Vigna radiata* (L.)]

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A B S T R A C T

An experiment was conducted to screen 200 germplasm accessions of green gram for drought tolerance using augmented design during summer 2015 under drought stress condition. ANOVA revealed high significant differences among germplasm accessions for yield, yield component traits and also for drought tolerance traits.Mean squares attributable to ‘Genotypes *vs* check entries’ were significant for all the traits except seeds per podand relative water content. Genotypic coefficient of variation and phenotypic coefficient of variation were found to be on higher side for grain yield, yield components such as clusters per plant, pods per cluster and pods per plant. Higher values of GCV and PCV were also observed for drought tolerance traits such as chlorophyll content (spad chlorophyll meter reading), leaf water potential, proline content, relative water content and specific leaf area. The grain yield, yield component traits and drought tolerance traits exhibited high heritability (broad sense) coupled with high to moderate expected GAM.

Introduction

Among pulse crops, green gram is an important annual legume grown principally for its high protein seeds that are used as human food (Singh *et al.*, 1988). The wild mung bean progenitor of present day cultivated species is widely distributed in the

Godavari and Krishna river belts of south India and in the foothills of western Himalaya of Eastern India (Fuller, 2007; Smartt, 1990).Important beneficial factors making the green gram crop popular are; short duration (90-120 days), nitrogen fixing ability, inhibition of soil erosion, soil enrichment, low input requirements and wide adaptability.

Despite holding such a great promise, mung bean is often grown in mostly rain-fed marginal lands with limited inputs making it prone to a number of abiotic stresses. Among these stresses, drought is the major stress leading to heavy crop loss. Water is required for almost every aspect of plant growth and metabolism and its shortage affects various physiological and biochemical processes (Ahmad *et al.,* 2014).

Soil moisture deficit is a multidimensional stress affecting plants at various levels of their organization (Yordanov, 2000). Beebe *et al.*, (2013) reported that adaptation to drought, encompasses diverse mechanisms that enable plants to survive and produce in periods of drought stress. Single trait taken alone cannot be a good indicator of drought, since a number of traits jointly influence yield under drought stress (Kao *et al.*, 1994).

Green gram is reported to be more susceptible to water deficits than any other grain legumes. Reduction in crop photosynthesis is caused by reduction in plants leaf leading to dry matter accumulation (Pandey *et al.*, 1984). Siddiqui *et al.,* (2007) reported that pod setting stage and late flowering traits appear to be the most sensitive stages to soil moisture stress and yield.

Various physiological processes associated with growth, development, and economic yield of a crop are affected due to water stress (Allahmoradi *et al.,* 2011).Breeding efficiency for drought tolerance heavily relies on need to identify the specific physiological, biochemical and genetically controlled traits that may improve yields under drought stress condition.

So far, the drought stress has not been properly dissected into its different components at physiological, bio-chemical, genetic and molecular genetics levels. Only limited information is available in pulse crops, placing constraints in designing an appropriate breeding methodology to facilitate genetic improvement.

Materials and Methods

The experiment was conducted at experimental plot of College of Agriculture, Hassan, University of Agricultural Sciences, Bangalore. The experimental site is geographically located at Southern Transitional Zone (Zone-7) of Karnataka with an altitude of 827 m above Mean Sea Level (MSL) and at 33′ N latitude and 75^0 33′ to 76^0 E38′ longitude. The study material consisted of 200 germplasm accessions collected from different research institutions / organizations representing different agro-climatic zones. List of germplasm accessions used in the study with their source is given in table No1.

Layout of the experiment

The experiment was conducted in an Augmented Randomized Complete Block Design with 200 germplasm accessions and 5 check varieties. As per the augmented RCBD, the check entries were replicated twice randomly in each block. There were 5 blocks, each block had 5 plots of size 3x3 m^2 thus each block size was 15 m^2. The gross area of experimental plot was 75 m^2. The row spacing was 30 cm and inter plant distance was 10 cm. The experiment was conducted during *summer* 2015. Recommended crop production practices were followed during the crop growth period to raise healthy crop.

Imposing drought condition

Drought condition was imposed by withholding irrigation 25 days after sowing (Baroowa and Gogoi, 2015; Pooja *et al.*, 2019). Since the experiment was conducted during *summer* season, there were no unpredicted rains during the entire cropping period hence the drought condition was effectively imposed. The rainfall data of experimental site during the cropping period is given in table No.2.

Plant sampling and data collection

Observations were recorded on five randomly chosen competitive plants from each germplasm accession for all the characters except days to 50 *per cent* flowering and days to maturity, which were recorded on plot basis. The values of five competitive plants were averaged and expressed as mean of the respective characters. The observations were taken on the traits like; Days to 50% flowering, Days to maturity, Plant height (cm), Clusters per plant, Pods per cluster, Pods per plant, Pod length (cm), Seeds per pod, test weight, Threshing %, Harvest index (%),SCMR (SPAD Chlorophyll meter reading), Leaf water potential(Mpa), Proline content ($\mu g\ g^{-1}$), Relative water content, Specific leaf area and Seed yield per plant

Results and Discussion

Assessment of genetic variability for grain yield and its component traits

For successful crop improvement programmes, breeders need to define and assemble the required genetic variability and select for yield indirectly through yield associated and highly heritable characters (Mather, 1949). Selection is only effective if the trait has high heritability otherwise attempts to improve character through selection will be futile.

Analysis of variance

Analysis of variance revealed highly significant mean squares attributable to germplasm accessions for all the traits. Significant mean squares were recorded for all the traits. (Table 3). Mean squares attributable to 'Genotypes *vs* check entries' were significant for all the traits except seeds per podand relative water content. These results suggest significant differences among the germplasm accessions. The germplasm accessions as group differed significantly for all of the traits under investigation, similarly, check entries as group differed significantly for most the traits under study.

Descriptive statistics for yield parameters

Genetic variability is a pre-requisite for quantifying variability and assessing relative contribution of genetic and non-genetic sources on the quantitative traits which is useful in formulating appropriate selection strategies. The mean and range values do not reflect the total variability present in the material.

Hence, actual variance has to be estimated for the traits to know the extent of variability existed in them. The absolute values of phenotypic and genotypic variance can't be used for making comparison of degree of variability across characters as they the traits differ in their units of measurement. Hence, co-efficient of variation (PCV and GCV) which are free from measurement units are used for making comparison. Higher values for these parameters indicate large variability and *vice versa*.

The values of different descriptive statistics in given in table4. Days to 50 *per cent* flowering varied from 33.00 days to 60.00 days with a mean of 41.61days. Days to maturity varied from 60.00 days to 81.00 days with a mean of 69.14 days. Plant height ranged from 19.18 cm to 58.57 cm with mean value of 37.74 cm. Values of cluster per plantvaried from 1.53 to 8.25 with mean value of 5.00. Minimum value of 1.75 and maximum value of 4.50 with mean value of 3.23 was observed for the trait pods per cluster. Pods per plant had range of values from 4.38 to 35.72 with mean value of 16.81. Pod length varied from 4.05 to 7.67 with mean value of 5.83. Seeds per pod ranged from 3.07 to 9.70 with a mean of 6.63.

Minimum and maximum values for the trait test weight were 1.71gms and 5.49 gms respectively with mean value of 3.45 gms. Threshing percentage varied from 42.89 *per cent* to 76.93 *per cent* with mean value of 62.03 *per cent*. Minimum value of 20.52 and maximum value of 55.95 with mean value of 35.11 was observed for the trait harvest index. Spad chlorophyll meter reading had range of values from 36.59 to 87.41 with mean value of 55.55. Leaf water potential varied from -8.14 Mpa to -2.16 Mpa with mean value of -5.74. Proline content values ranged from 62.70 ($\mu g\, g^{-1}$) to 201.33($\mu g\, g^{-1}$) with mean value of 120.98($\mu g\, g^{-1}$). Relative water content recorded lowest value of 33.63 and highest value of 97.18 with a mean of 68.59. Specific leaf area had a minimum value of 31.96 and maximum of 298.29 with mean value of 156.52. Seed yield per plantranged from 0.74 gms to 11.05 gms with a mean value of 4.02 gms. The estimates of standardized range across traits provide clues about the occurrence of genotypes with extreme expression.

The standardized range were relatively higher for all the quantitative traits such as; plant height (1.04), cluster per plant(1.34), pods per cluster(0.85), pods per plant (1.87), pod length (0.62), seeds per pod (1.00) test weight (1.10), threshing percentage (0.55), harvest index (1.01), spad chlorophyll meter reading (0.91), leaf water potential (-1.04), proline content (1.15), relative water content (0.93), specific leaf area (1.70) and seed yield per plant (2.56) except for days to 50% flowering (0.48) and days to maturity (0.30). Higher ranges for plant height and other traits in green gram are reported by Muthuswamy *et al.*, (2019).

Table.1 List of germplasm accessions used in the study and their source

Sl. No.	Germplasm	Location
1	KM13-16	ARS, Bidar
2	KM13-19	ARS, Bidar
3	KM13-39	ARS, Bidar
4	GG13-7	ARS, Bidar
5	GG13-6	ARS, Bidar
6	KM13-44	ARS, Bidar
7	GG13-10	ARS, Bidar
8	SML-668	ARS, Bidar
9	KM13-9	ARS, Bidar
10	IPM99-125	ARS, Bidar
11	LGG-596	RARS, Guntur
12	LGG-572	RARS, Guntur
13	LGG-450	RARS, Guntur

14	LGG-583	RARS, Guntur
15	LGG-590	RARS, Guntur
16	LGG-588	RARS, Guntur
17	LGG-589	RARS, Guntur
18	LGG-579	RARS, Guntur
19	LGG-562	RARS, Guntur
20	LGG-582	RARS, Guntur
21	LGG-585	RARS, Guntur
22	AKL-170	NBPGR, Akola
23	PLM-110	UAS, Bangalore
24	LGG-577	RARS, Guntur
25	IC-436624	IIPR, Kanpur
26	IC-436723	IIPR, Kanpur
27	IC-413316	IIPR, Kanpur
28	IC-436746	IIPR, Kanpur
29	VGG10-010	TNAU, Coimbatore
30	VGG04-011	TNAU, Coimbatore
31	VGG04-007	TNAU, Coimbatore
32	COGG-93	TNAU, Coimbatore
33	VBNGG-2	TNAU, Coimbatore
34	TARM-2013	TNAU, Coimbatore
35	VGG04-005	TNAU, Coimbatore
36	COGG-920	TNAU, Coimbatore
37	VGG07-003	TNAU, Coimbatore
38	VGG10-002	TNAU, Coimbatore
39	VGG-112	TNAU, Coimbatore
40	IC-92048	NBPGR, Akola
41	AKL-103	NBPGR, Akola
42	AKL-39	NBPGR, Akola
43	AKL-106	NBPGR, Akola
44	AKL-225	NBPGR, Akola
45	AKL-95	NBPGR, Akola
46	AKL-194	NBPGR, Akola
47	AKL-212	NBPGR, Akola
48	AKL-195	NBPGR, Akola
49	AKL-211	NBPGR, Akola
50	KM13-11	ARS, Bidar
51	KM13-30	ARS, Bidar
52	KM13-45	ARS, Bidar
53	KM13-18	ARS, Bidar
54	KM13-5	ARS, Bidar
55	KM13-02	ARS, Bidar
56	KM13-37	ARS, Bidar

57	KM13-23	ARS, Bidar
58	KM13-55	ARS, Bidar
59	KM13-12	ARS, Bidar
60	GG13-9	ARS, Bidar
61	KM13-49	ARS, Bidar
62	GG13-4	ARS, Bidar
63	GG13-54	ARS, Bidar
64	KM13-20	ARS, Bidar
65	GG13-5	ARS, Bidar
66	Chinamung	ARS, Bidar
67	GG13-2	ARS, Bidar
68	KM13-26	ARS, Bidar
69	KM13-47	ARS, Bidar
70	KM13-41	ARS, Bidar
71	KM13-11	ARS, Bidar
72	KM13-42	ARS, Bidar
73	GG13-11	ARS, Bidar
74	GG13-8	ARS, Bidar
75	GG13-12	ARS, Bidar
76	KM13-48	ARS, Bidar
77	IPM2-3	ARS, Bidar
78	IPM2-14	ARS, Bidar
79	PDM-139	ARS, Bidar
80	LGG-580	RARS, Guntur
81	PM-112	TNAU, Coimbatore
82	LGG-578	NBPGR, Akola
83	LGG-563	NBPGR, Akola
84	LGG-594	NBPGR, Akola
85	TM-96-2	NBPGR, Akola
86	LGG-593	NBPGR, Akola
87	LGG-591	NBPGR, Akola
88	PM-115	NBPGR, Akola
89	LGG-587	NBPGR, Akola
90	PM-113	NBPGR, Akola
91	LGG-586	NBPGR, Akola
92	IC-436775	NBPGR, Akola
93	IC-413311	NBPGR, Akola
94	IC-398984	NBPGR, Akola
95	IC-436767	NBPGR, Akola
96	IC-436573	NBPGR, Akola
97	LGG-584	NBPGR, Akola
98	LGG-592	NBPGR, Akola
99	LGG-555	NBPGR, Akola

100	LGG-564	NBPGR, Akola
101	LGG-460	RARS, Guntur
102	LGG-595	RARS, Guntur
103	LGG-566	RARS, Guntur
104	IC-553514	IIPR, Kanpur
105	IC-413319	IIPR, Kanpur
106	IC-436542	IIPR, Kanpur
107	IC-546493	IIPR, Kanpur
108	IC-436594	IIPR, Kanpur
109	IC-436630	IIPR, Kanpur
110	IC-436668	IIPR, Kanpur
111	IC-436555	IIPR, Kanpur
112	IC-413314	IIPR, Kanpur
113	AKL-20	NBPGR, Akola
114	AKL-89	NBPGR, Akola
115	AKL-228	NBPGR, Akola
116	AKL-184	NBPGR, Akola
117	AKL-182	NBPGR, Akola
118	AKL-230	NBPGR, Akola
119	AKL-229	NBPGR, Akola
120	AKL-86	NBPGR, Akola
121	IC-436646	IIPR, Kanpur
122	IC-343964	IIPR, Kanpur
123	IC-436528	IIPR, Kanpur
124	IC-436723	IIPR, Kanpur
125	IC-546491	IIPR, Kanpur
126	IC-546481	IIPR, Kanpur
127	IC-398988	IIPR, Kanpur
128	VGG10-005	TNAU, Coimbatore
129	VBN-223	TNAU, Coimbatore
130	COGG-912	TNAU, Coimbatore
131	VBN(G9)-3	TNAU, Coimbatore
132	ML-1165	TNAU, Coimbatore
133	VGG04-025	TNAU, Coimbatore
134	VGG04-004	TNAU, Coimbatore
135	VGG04-149	TNAU, Coimbatore
136	COGG-954	TNAU, Coimbatore
137	VGG08-002	TNAU, Coimbatore
138	VBN-1	TNAU, Coimbatore
139	VGG-119	TNAU, Coimbatore
140	VC3890-A	TNAU, Coimbatore
141	DGGV-4	UAS, Raichur
142	KPS-1	UAS, Raichur

143	CGG-973	UAS, Raichur
144	CN9-5	UAS, Raichur
145	KPS-2	UAS, Raichur
146	VC-6173	UAS, Raichur
147	VC-6368	UAS, Raichur
148	CO-6	UAS, Raichur
149	Harsha	UAS, Raichur
150	PLM-92	UAS, Bangalore
151	MH-709	UAS, Raichur
152	LGG-460	RARS, Guntur
153	KGS-5	UAS, Raichur
154	Barimung-4	UAS, Raichur
155	AKL-189	NBPGR, Akola
156	AKL-168	NBPGR, Akola
157	AKL-218	NBPGR, Akola
158	AKL-179	NBPGR, Akola
159	AKL-185	NBPGR, Akola
160	AKL-163	NBPGR, Akola
161	COGG-912	TNAU, Coimbatore
162	IC-73451	NBPGR, Akola
163	IC-105690	NBPGR, Akola
164	IC-73534	NBPGR, Akola
165	IC-73412	NBPGR, Akola
166	IC-39605	NBPGR, Akola
167	IC-73472	NBPGR, Akola
168	IC-92053	NBPGR, Akola
169	IC-73779	NBPGR, Akola
170	IC-73462	NBPGR, Akola
171	IC-118992	NBPGR, Akola
172	IC-53783	NBPGR, Akola
173	IC-73456	NBPGR, Akola
174	IC-73458	NBPGR, Akola
175	AKL-105	NBPGR, Akola
176	AKL-213	NBPGR, Akola
177	AKL-169	NBPGR, Akola
178	AKL-220	NBPGR, Akola
179	AKL-84	NBPGR, Akola
180	AKL-82	NBPGR, Akola
181	AKL-97	NBPGR, Akola
182	AKL-226	NBPGR, Akola
183	AKL-24	NBPGR, Akola
170	IC-73462	NBPGR, Akola
171	IC-118992	NBPGR, Akola

172	IC-53783	NBPGR, Akola
173	IC-73456	NBPGR, Akola
174	IC-73458	NBPGR, Akola
175	AKL-105	NBPGR, Akola
176	AKL-213	NBPGR, Akola
177	AKL-169	NBPGR, Akola
178	AKL-220	NBPGR, Akola
179	AKL-84	NBPGR, Akola
180	AKL-82	NBPGR, Akola
181	AKL-97	NBPGR, Akola
182	AKL-226	NBPGR, Akola
183	AKL-24	NBPGR, Akola
184	AKL-174	NBPGR, Akola
185	AKL-161	NBPGR, Akola
186	AKL-180	NBPGR, Akola
187	AKL-222	NBPGR, Akola
188	AKL-187	NBPGR, Akola
189	AKL-216	NBPGR, Akola
190	AKL-29	NBPGR, Akola
191	AKL-90	NBPGR, Akola
192	AKL-227	NBPGR, Akola
193	AKL-200	NBPGR, Akola
194	AKL-92	NBPGR, Akola
195	AKL-183	NBPGR, Akola
196	AKL-176	NBPGR, Akola
197	AKL-191	NBPGR, Akola
198	AKL-165	NBPGR, Akola
199	AKL-164	NBPGR, Akola
200	AKL-192	NBPGR, Akola

Table.2 Meteorological data of experimental site for the year 2015

Year	**Months**	**Temperature (°C)**	**Relative humidity (%)**	**Rainfall (mm)**
2015	January	21.32	61.03	0.59
	February	23.10	50.72	Nil
	March	25.34	58.70	2 mm (25.03.2015)
	April	25.87	66.55	Nil

The standardized range were relatively higher for all the quantitative traits such as; plant height (1.04), cluster per plant(1.34), pods per cluster(0.85), pods per plant (1.87), pod length (0.62), seeds per pod (1.00) test weight (1.10), threshing percentage (0.55), harvest index (1.01), spad chlorophyll meter reading (0.91), leaf water potential (-1.04), proline content (1.15), relative water content (0.93), specific leaf area (1.70) and seed yield per plant (2.56) except for days to 50% flowering (0.48) and days to maturity (0.30).

Table.3 Summary of augmented ANOVA for grain yield and component traits of germplasm accessions under drought condition

Sources of Variations	DF	DFF	DM	PH	CPP	PPC	PPP	PL	SPP	TW
Blocks (b)	4	14.74 **	8.18***	65.31**	2.23**	0.11*	25.23**	1.49**	5.05**	1.77 **
Entries (e) (Genotypes + Checks)	204	17.10 **	18.01**	84.47**	3.60**	0.51**	72.94**	0.75**	2.70**	0.35 **
Checks	4	34.57 **	37.01**	22.56**	1.40**	0.42**	12.50**	0.87**	3.98**	0.81 **
Genotypes	199	14.215 **	15.14**	85.71**	3.67**	0.51**	73.91**	0.73**	2.69**	0.31 **
Checks vs Genotypes	1	521.64 **	513.06**	85.01**	0.16**	1.45**	121.60**	4.52**	0.03	5.42 **
Error	16	1.32	0.74	0.98	0.04	0.02	0.98	0.009	0.05	0.05

Sources of Variations	DF	TP	HI	SCMR	LWP	PC	RWC	SLA	SYPP
Blocks (b)	4	37.12*	247.54 **	396.55 **	1.17 **	470.90 **	423.68 *	4067.34 *	2.11 **
Entries (e) (Genotypes + Checks)	204	37.20 **	54.41 *	98.71 **	2.45 **	1707.90 **	425.40 **	4283.10 **	7.01 **
Checks	4	17.09	64.39 *	24.49	0.82 **	942.07 **	63.06	1924.20	3.76 **
Genotypes	199	27.67 *	53.01 *	79.58 *	2.33 **	1712.67 **	433.68 **	4294.15**	7.10 **
Checks vs Genotypes	1	2014.79 **	293.20 **	4203.25 **	32.57 **	3822.09 **	227.32	11518.68**	0.42*
Error	16	9.83	19.57	31.14	0.03	1.48	130.64	1339.95	0.09

*Significant at P =0.05, ** Significant at P=0.01

DFF : Days to 50% flowering Pods plant-1 HI : Harvest index (%) SLA : Specific leaf area
DM : Days to maturity PL : Pod length (cm) SCMR : SPAD Chlorophyll meter reading SYPP : Seed yield plant-1
PH : Plant height (cm) SPP : Seeds per pod LWP : Leaf water potential(Mpa)
CPP : Cluster plant-1 TW: test weight (g) PC : Proline content (μg g−1)
PPC : Pods cluster-1 TP : Threshing % RWC : Relative water content (%)

Table.4 Descriptive statistics for grain yield and its component traits of germplasm accessions under drought condition

Descriptive	DFF	DM	PH	CPP	PPC	PPP	PL	SPP	TW
Mean	41.61	69.14	37.74	5.00	3.23	16.81	5.83	6.63	3.45
Std.Error	0.26	0.27	0.58	0.12	0.04	0.54	0.56	0.10	0.03
Variance	15.93	17.37	78.13	3.32	0.47	66.93	0.71	2.55	0.35
Minimum	33.00	60.00	19.18	1.53	1.75	4.38	4.05	3.07	1.71
Maximum	53.00	81.00	58.57	8.25	4.50	35.72	7.67	9.70	5.49
Standardized Range	0.48	0.30	1.04	1.34	0.85	1.87	0.62	1.00	1.10
Skewness	0.38	0.30	-0.31	-0.11	-0.18	0.23	0.08	-0.13	-0.04
Kurtosis	-0.28	-0.31	-0.41	-1.18	-1.09	-0.96	-0.83	-0.99	1.02
GCV (%)	8.10	5.17	10.90	17.05	20.38	118.24	6.51	10.95	14.27
PCV(%)	8.55	5.32	11.21	17.50	20.94	122.14	6.71	11.46	15.93
h^2 (bs) (%)	89.79	94.63	94.53	94.77	94.72	93.70	94.13	91.34	80.21
GAM (5%)	15.81	10.37	5.38	40.10	40.86	61.73	34.20	29.69	33.73

Descriptive	TP	HI	SCMR	LWP	PC	RWC	SLA	SYPP
Mean	62.03	35.11	55.55	-5.74	120.98	68.59	156.52	4.02
Std. Error	0.39	0.49	0.66	0.10	2.63	1.34	4.25	0.16
Variance	35.25	55.37	99.21	2.25	1563.92	404.32	4069.02	6.42
Minimum	42.89	20.52	36.59	-8.14	62.70	33.63	31.96	0.74
Maximum	76.93	55.95	87.41	-2.16	201.33	97.18	298.29	11.05
Standardized Range	0.55	1.01	0.91	-1.04	1.15	0.93	1.70	2.56
Skewness	-0.24	0.01	0.35	0.69	0.319	-0.20	-0.17	0.66
Kurtosis	0.24	-1.00	-0.43	-0.46	-1.24	-1.57	-0.97	-0.37
GCV (%)	6.58	15.84	12.25	11.81	32.13	24.26	33.56	29.45
PCV(%)	8.35	20.33	16.02	12.19	32.14	29.48	41.13	30.38
h^2 (bs) (%)	62.15	60.70	58.45	93.87	81.00	67.72	66.60	93.96
GAM (5%)	10.70	25.42	19.29	34.77	66.15	41.13	56.43	49.67

DFF : Days to 50% flowering
DM : Days to maturity
PH : Plant height (cm)
CPP : Cluster plant-1
PPC : Pods cluster-1
PPP: Pods plant-1
PL : Pod length (cm)
SPP : Seeds per pod
TW: test weight(g)
TP : Threshing %
HI : Harvest index (%)
SCMR : SPAD Chlorophyll meter reading
LWP : Leaf water potential(Mpa)
PC : Proline content(μg g−1)
RWC : Relative water content (%)
SLA : Specific leaf area
SYPP : Seed yield plant-1

Higher ranges for plant height and other traits in green gram are reported by Muthuswamy *et al.,* (2019). The magnitude of variation revealed by GCV and PCV in germplasm accessions were low for days to 50% flowering (8.10% and 8.55 % respectively) days to maturity (5.17 % and 5.32 % respectively) threshing percentage (6.58 % and 8.35 % respectively) and pod length (6.51 % and 6.71% respectively). Low GCV and PCV values indicate presence of limited variability for these traits. Moderate GCV and PCV values were observed for plant height (10.90% and 11.21 % respectively), cluster per plant(17.05 % and 17.05% respectively) harvest index (15.84 % and 20.33 % respectively), spad chlorophyll meter reading (12.25 % and 16.02 % respectively) and leaf water potential (11.81 % and 12.19 % respectively).

Higher standardized range (1.87) resulted in higher GCV and PCV values for pods per plant(118.24% and 122.14% respectively). Similarly higher GCV and PCV values were observed for proline content (31.13% and 32.14% respectively), relative water content (24.26% and 29.48 % respectively), specific leaf area (33.56 % and 41.13 % respectively) and seed yield per plant (29.45% and 30.38% respectively). Muthuswamy *et al.,* (2019) and Tejbir *et al.,* (2009)have reported similar findings on GCV and PCV estimates.

Heritability is a quantitative measure which provides information about the relative contribution of genetic factors to the phenotypic expression. The estimates of genetic advance may be biased if phenotypic variance contains a fraction of genetic variance due to non-additive effects (Hanson *et al.*, 1956).According to Johnson *et al.*, (1955), heritability estimates along with genetic gain would be more useful and informative in predicting effectiveness of selection. Hence it is essential to consider the predicted genetic advance along with heritability estimates as a tool in selection for increased efficiency. Germplasm accessions exhibited relatively higher heritability for all the quantitative traits; days to 50% flowering (89.79 %) , days to maturity (94.63 %), plant height (94.53 %), cluster per plant(94.77 %), pods per cluster(94.72 %), pods per plant(93.70 %), pod length (94.13 %), seeds per pod (91.34%) test weight (80.21 %), threshing percentage (62.15 %), harvest index (60.70 %), spad chlorophyll meter reading (58.45 %), leaf water potential (99.96 %), proline content (81.00 %), relative water content (67.72 %), specific leaf area (66.60 %) and seed yield per plant(93.96%) . Kate *et al.,* (2017) has reported high heritability coupled with moderate genetic advance for the traits; plant height, days to maturity, pods per plant, protein content, and grain yield per plant in green gram.

Higher expected GAM coupled with high heritability of grain yield and its component traits like primary branches per plant(187.76) pods per plant(97.68), cluster per plant(74.54), seeds per pod (48.06) and pods per cluster(40.86). The higher GAM was also recorded for physiological traits governing drought tolerance such as leaf water potential (53.38), proline content (66.15), relative water content (41.13) and specific leaf area (56.43). Kousar *et al.,* (2007) also reported high heritability coupled with genetic advance for pods per plant and plant height. Similar findings were reported by Gadakh *et al.,* (2013) and Hemavathy *et al.,* (2014)

The study revealed that germplasm accessions differed greatly for phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (broad sense) and genetic advancement for all the agronomic and physiological traits under drought condition.

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