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Cluster and Correlation Analysis in Blackgram (*Vigna mungo* L.) Genotypes under Drought

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In this study, twenty-one blackgram genotypes were screened under drought stress condition and non-stress condition during Jan-2018 at Plant Breeding farm, Annamalai University to study the genetic diversity and correlation. Eleven yield and yield related traits and two physiological traits were recorded for the statistical analysis. In cluster analysis, the genotypes were grouped into four clusters both in stress and non-stress condition. Clusters II and III (7) and cluster IV (8) had highest number of genotypes in stress and non-stress condition respectively. Highest cluster mean for seed yield per plant was recorded in cluster I (0.71 g) under stress situation and cluster II (5.05 g) in non-stress condition. Pearson correlation analysis under stress condition revealed that the characters plant height, number of branches, clusters per plant, pods per plant, pod length and seeds per pod had positive significant association with seed yield per plant while, pod weight, chlorophyll-a, chlorophyll-b and total chlorophyll had significant negative correlation with seed yield per plant. Plant height and seeds per pod recorded significant positive association with seed yield per plant under non-stress condition.

Key words: Blackgram, Drought, Yield, Chlorophyll.

Blackgram (*Vigna mungo* L.) is one of the important pulse crops in India. It is a rich source of protein (20.80 to 30.50 per cent) and also a good source of phosphoric acid and calcium. Blackgram is normally grown under rainfed conditions and as a result, it often experience drought situation that reduces productivity to a large extent. Many factors are associated with drought tolerance in legume crops. Breeding for drought tolerance is generally considered slow due to the quantitative and temporal variability of available moisture across years, the low genotypic variance in yield under these conditions, inherent methodological difficulties in evaluating component traits, together with the highly complex genetic basis of this character.

Selection for drought resistance and production of tolerant cultivars with high yield potential is the main objective of breeding programmes. However, an alternative breeding approach would be to improve drought resistance in high yielding genotypes through incorporation of morphological and physiological mechanisms of drought resistance. In order to identify sources of drought tolerance, it is necessary to develop selection and screening methods that are simple and reproducible under the target environmental conditions (Serraj et al., 2003). In addition, information on the genetic diversity and correlation of various yield and yield attributing characters will be useful for planning suitable breeding strategies to improve drought tolerance.

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Material and Methods

For this experiment, twenty one blackgram genotypes were grown in Plant Breeding Farm, Department of Genetics & Plant Breeding, Annamalai University in two treatments (T_0 - Irrigated & T_1 - Non-irrigated). The experiments were conducted in Randomized Block Design with two replications. The mean values of two replications were used for statistical analysis. The observations were recorded for eleven quantitative characters *viz.,* days to first flowering, plant height, number of branches, number of clusters per plant, number of pods per plant, pod length, pod weight, number of seeds per pod, seed size, 100 seed weight, seed yield per plant and four physiological characters *viz.,*chlorophyll-a, chlorophyll-b, total chlorophyll, leaf protein content. The data was subjected to statistical analysis using STAR (Statistical Tool for Agricultural Research) software.

Results and Discussion

The quantitative assessment of genetic diversity was made by wards minimum divergence method for yield, yield attributing and physiological traits. Genetic divergence was estimated for 15 characters of twenty one blackgram genotypes under drought stress and non-stress condition. All genotypes were grouped under four clusters (Table 1 and 2 and Fig. 1 and 2). Cluster I had four genotypes. Clusters II and III had maximum number of genotypes (7) and cluster IV had three genotypes under drought stress condition. Under non-stress condition, clusters I and II had four

genotypes. Cluster IV had maximum number of genotypes (8) followed by cluster III (5). The distribution of genotypes from different eco-geographical regions into these clusters was apparently random (Jeena and Singh, 2002). De and

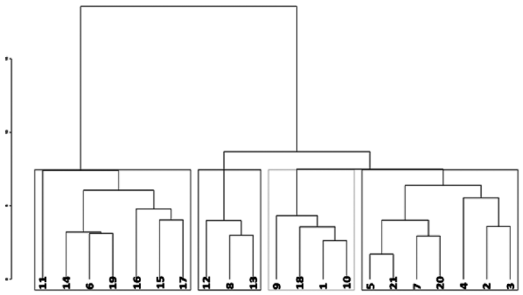

Fig. 1. Dendrogram for morphological data under stress condition (Dendrogram using agglomerative clustering method)

Rao (1987) and Singh *et al.,* (1987) also revealed that geographical diversity is not necessarily related to genetic diversity.

Cluster mean values for 15 characters are presented in Table 3 and 4. Under drought condition, cluster I recorded maximum mean value for number

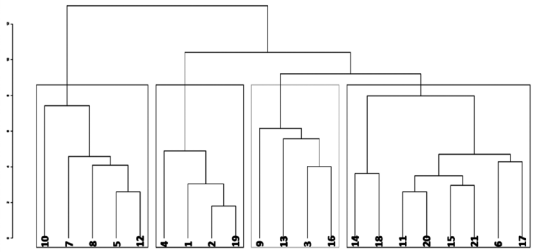

Fig. 2. Dendrogram for morphological data under normal condition (Dendrogram using agglomerative clustering method)

of pods per plant, pod length and seed yield per plant whereas cluster I showed minimum mean value for chlorophyll-a, chlorophyll-b and total chlorophyll content. This cluster may be chosen for hybridization programme for maximizing yield of drought tolerant blackgram genotypes. Cluster II showed minimum cluster

Table 1. Composition of clusters for 21 blackgram genotypes under stress condition

Clusters	Number of genotypes	Name of Genotypes
I	4	G1 (IC-343943), G9 (VBG-12005), G10 (VBG-12062), G18 (VBN(Bg)-4)
II	7	G2 (IC-343947), G3 (IC-343962), G4 (ABG-11013), G5 (KU-11680), G7 (VBG-10010), G20 (VBN(Bg)-7), G21 (MDU Local)
III	7	G6 (TBG-104), G11 (VBG-13017), G14 (RU-16-13), G15 (RU-16-14), G16 (KGB-28), G17 (T-9), G19 (VBN(Bg)-6)
IV	3	G8 (VBG-11011), G12 (ADT-5), G13 (RU-16-9)

mean value for days to first flowering and maximum cluster mean value for number of clusters per plant and 100 seed weight. Cluster II may be used to induce early flowering in blackgram genotype under drought condition through hybridization programme.

Cluster III had maximum cluster mean value for chlorophyll-a, chlorophyll-b and total chlorophyll content where as it recorded minimum mean value for seed yield per plant among the four clusters. Cluster

Table 2. Composition of clusters for 21 blackgram genotypes under normal condition

Clusters	Number of genotypes	Name of Genotypes
I	4	G1 (IC-343943), G2 (IC-343947), G4 (ABG-11013), G19 (VBN(Bg)-6)
II	4	G3 (IC-343962), G9 (VBG-12005), G13 (RU-16-9), G16 (KGB-28)
III	5	G5 (KU-11680), G7 (VBG-10010), G8 (VBG-11011), G10 (VBG-12062), G12 (ADT-5)
IV	8	G6 (TBG-104), G11 (VBG-13017), G14 (RU-16-13), G15 (RU-16-14), G17 (T-9), G18 (VBN(Bg)-4), G20 (VBN(Bg)-7), G21 (MDU Local)

IV was suitable for characters *viz.,* plant height, number of branches, pod weight, number of seeds per pod, seed size and leaf protein content. Therefore, this cluster may be selected for transferring the traits with high mean values through hybridization programme.

Under normal condition, cluster I was suitable for number of seeds per pod and leaf protein content. Cluster II had maximum mean values for plant height, pod length, pod weight, seed size, 100 seed weight and chlorophyll-a content. Cluster III recorded minimum mean value for days to first flowering and maximum cluster mean value for number of branches, number of clusters per plant, number of pods per plant, chlorophyll-b, total chlorophyll and seed yield per plant.

The blackgram genotypes were ranked based on the performance under drought stress condition (Table 5). Based on the ranking, the genotypes IC-343943, VBG-12005, VBG-12062 and VBN (Bg)-4) found tolerant genotypes. Three genotypes (VBG-11011, ADT-5, RU-16-9) ranked moderately tolerant.

The genotypes IC-343947, IC-343962, ABG-11013, KU-11680, VBG-10010, VBN(Bg)-7, MDU Local and TBG-104, VBG-13017, RU-16-13, RU-16-14, KGB-28, T-9, VBN(Bg)-6 were ranked as moderately susceptible and susceptible respectively.

Table 3. Cluster means of 21 blackgram genotypes for various characters under stress condition

Clusters	DFF	PH (cm)	B	CPP	PPP	PL (cm)	PW (g)	SPP	SS (mm)	HSW (g)	LP (µg/ml)	C-a (µg/ml)	C-b (µg/ml)	TC (µg/ml)	SYPP (g)
I	37.62	27.12	3.88	3.31	5.38	4.29	0.33	5.5	3.3	3.66	2346.81	3.19	1.73	4.91	0.71
II	35.29	27.96	3.71	3.32	4.86	4.04	0.28	4.21	3.6	4.23	3462.39	3.39	1.88	5.27	0.34
III	37.71	22.88	3.25	2.11	2.48	3.4	0.22	3.82	3.4	4.03	4283.56	7.85	6.28	14.13	0.21
IV	35.83	28.08	4.33	1.83	2.58	3.96	0.4	6.08	3.8	4.09	4653.59	4.37	2.79	7.16	0.42

DFF-Days to first flowering, PH-Plant height, B-Branches, CPP-Clusters per plant, PPP-Pods per plant, PL-Pod length, PW-Pod weight, SPP-Seeds per plant, SS-Seed size, HSW-Hundred seed weight, LP-Leaf protein, C-a-Chlorophyll a, C-b-Chlorophyll b, TC-Total chlorophyll, SYPP-Seed yield per plant.

Pearson correlation coefficients among all the characters were estimated under drought stress and non-stress conditions (Table 6). The results under drought stress condition showed that, seed yield per plant have significant positive correlation with plant height, number of branches, number of clusters per plant, number of pods per plant, pod length and number of seeds per pod whereas seed yield per plant recorded negative significant association with chlorophyll-a, chlorophyll-b and total chlorophyll content.

Table 4. Cluster means of 21 blackgram genotypes for various characters under normal condition

Clusters	DFF	PH (cm)	B	CPP	PPP	PL (cm)	PW (g)	SPP	SS (mm)	HSW (g)	LP (µg/ml)	C-a (µg/ml)	C-b (µg/ml)	TC (µg/ml)	SYPP (g)
I	34.81	85.69	6	4.25	14.62	4.28	0.35	6.33	3.7	4.23	3803.91	2.41	1.13	3.54	3.06
II	35.81	96.19	5.12	5.38	12	4.68	0.41	5.96	4	4.51	3459.41	6.08	3.13	9.2	2.88
III	31.7	89.35	6.45	7	23.3	4.64	0.37	6.07	3.6	4.24	2875.99	5.42	3.98	9.4	5.05
IV	35.84	57.5	6.12	6.02	10.81	4.12	0.36	4.98	3.7	4.38	3122.54	4.89	2.81	7.7	2.39

DFF-Days to first flowering, PH-Plant height, B-Branches, CPP-Clusters per plant, PPP-Pods per plant, PL-Pod length, PW-Pod weight, SPP-Seeds per plant, SS-Seed size, HSW-Hundred seed weight, LP-Leaf protein, C-a-Chlorophyll a, C-b-Chlorophyll b, TC-Total chlorophyll, SYPP-Seed yield per plant.

Similar results were reported by Ghanbari and Javan (2015) for positive significant correlation of number of pods per plant and pod length with seed yield under drought stress condition. Seed yield per plant showed negative correlation with leaf chlorophyll content because under drought condition

Table 5. Ranking of 21 blackgram genotypes under drought stress condition

Ranking	Name of Genotypes
Tolerant	G1 (IC-343943), G9 (VBG-12005), G10 (VBG-12062), G18 (VBN(Bg)-4)
Moderately Tolerant	G8 (VBG-11011), G12 (ADT-5), G13 (RU-16-9)
Moderately Susceptible	G2 (IC-343947), G3 (IC-343962), G4 (ABG-11013), G5 (KU-11680), G7 (VBG-10010), G20 (VBN(Bg)-7), G21 (MDU Local)
Susceptible	G6 (TBG-104), G11 (VBG-13017), G14 (RU-16-13), G15 (RU-16-14), G16 (KGB-28), G17 (T-9), G19 (VBN(Bg)-6)

144 high chlorophyll content resulted in lower seed yield. Plant height, number of clusters per plant, number of pods per plant and pod length recorded significant negative correlation with leaf chlorophyll content. The characters *viz.,* number of branches and number of clusters per plant showed significant positive association with plant height. Number of branches showed significant positive association with number of seeds per pod. Cluster per plant recorded high positive significant correlation with number of pods per plant. Number of pods per plant had positive significant correlation with pod length. The characters pod weight and seeds per pod showed significant positive association with pod length. Number of seeds per pod and seed size recorded significant positive association with pod weight and leaf protein had negative significant correlation with pod weight. Under non-stress condition, the characters plant height, number of pods per plant and number of seeds per plant recorded positive significant association with seed yield per plant.

Table 6. Correlation among various characters under normal and stress condition

Characters		PH	B	CPP	PPP	PL	PW	SPP	SS	HSW	LP	C-a	C-b	TC	SYPP
DFF	S	-0.3	0.054	-0.34	-0.120	0.004	-0.090	0.17	-0.28	-0.44	-0.039	0.34	0.16	0.25	-0.006
	N	-0.2	-0.05	0.054	-0.48*	-0.33	-0.15	-0.38	0.22	-0.03	0.28	-0.087	-0.32	-0.22	-0.504
PH	S	1.0	0.5*	0.53*	0.40	0.30	0.30	0.22	0.21	0.053	-0.29	-0.5**	-0.5**	-0.6**	0.45*
	N	1.0	-0.04	0.24	0.42	0.19	0.24	0.69**	-0.03	0.06	0.15	0.13	0.11	0.13	0.46*
B	S		1.00	0.046	0.096	0.24	0.19	0.58**	0.23	-0.12	-0.041	-0.37	-0.34	-0.37	0.57**
	N		1.00	0.17	0.28	-0.33	-0.52*	-0.16	-0.22	-0.19	-0.042	-0.063	0.10	0.025	0.25
CPP	S			1.00	0.83**	0.42	0.18	-0.023	0.11	-0.11	-0.44	-0.5**	-0.49*	-0.57**	0.45*
	N			1.00	0.32	-0.21	0.10	-0.130	-0.26	-0.092	-0.090	0.51*	0.52*	0.54*	0.23
PPP	S				1.00	0.56**	0.20	0.10	-0.025	-0.23	-0.50	-0.7**	-0.53*	-0.65**	0.51*
	N				1.00	0.24	-0.15	0.49*	-0.31	-0.22	-0.05	0.073	0.22	0.15	0.92**
PL	S					1.00	0.45*	0.60**	0.25	-0.19	-0.40	-0.71**	-0.67**	-0.73**	0.62**
	N					1.00	0.34	0.43	0.013	0.34	-0.36	0.18	0.19	0.19	0.30
PW	S						1.00	0.52*	0.59**	-0.032	-0.49*	-0.43	-0.52*	-0.51*	0.33
	N						1.00	0.14	0.069	0.20	-0.093	0.36	0.30	0.34	-0.078
SPP	S							1.00	0.28	-0.15	-0.10	-0.42	-0.38	-0.42	0.70**
	S							1.00	-0.034	0.030	0.23	-0.22	-0.096	-0.16	0.49*
SS	S								1.00	0.36	0.011	-0.31	-0.45*	-0.41	0.017
	N								1.00	-0.27	-0.012	0.003	-0.24	-0.13	-0.37
HSW	S									1.00	-0.060	0.061	0.069	0.069	-0.20
	N									1.00	-0.13	0.009	0.11	0.064	-0.17
LP	S										1.00	0.30	0.36	0.35	-0.43
	N										1.00	-0.17	-0.18	-0.19	-0.07
C-a	S											1.00	0.78**	0.92**	-0.52*
	N											1.00	0.81**	0.95**	0.15
C-b	S												1.00	0.95**	-0.46*
	N												1.00	0.95**	0.28
TC	S													1.00	-0.51*
	N													1.00	0.23

DFF-Days to first flowering, PH-Plant height, B-Branches, CPP-Clusters per plant, PPP-Pods per plant, PL-Pod length, PW-Pod weight, SPP-Seeds per plant, SS-Seed size, HSW-Hundred seed weight, LP-Leaf protein, C-a-Chlorophyll a, C-b-Chlorophyll b, TC-Total chlorophyll, SYPP-Seed yield per plant.S- Drought stress, N- Non-stress. * - 5 % Significance level & ** - 1 % significance

These findings are in accordance with Hemalatha *et al.* (2017) and Patidar and Sharma (2017). The character days to first flowering had negative significant correlation with number of pods per plant. Plant height had significant positive association with number of seeds per pod. Number of branches recorded negative significant association with pod weight. The character number of clusters per plant recorded positive significant correlation with chlorophyll content. Number of pods per plant showed significant positive association with number of seeds per plant.

References

De, R.N. and Rao, A.V.S. 1987. Genetic divergence in rice under low land situation. Crop Improvement, 14(2): 128-131.

Ghanbari, M. and Javan, S.M. 2015. Study the response of mung bean genotypes to drought stress by multivariate analysis. International journal of Agriculture Innovations and Research, 3(4): 1298-1302.

Hemalatha, K., Lal, S.S. and Lal, G.M. 2017. Study on genetic variability and correlation in Blackgram (Vigna mungo L. Hepper). Journal of Pharmacognosy and Phytochemistry. 6(4): 674-676.

Jeena, A.S. and Singh, I.S. 2002. Genetic divergence analysis in wild lentils. Legume research, 23(3): 175-179.

Patidar, M. and Sharma, H. 2017. Correlation and path coefficient studies in Blackgram (Vigna mungo L. Hepper). Journal of Pharmacognosy and Phytochemistry, 6(4): 1626-1628.

Serraj, R., Bidinger, F.R., Chauhan, Y.S., Seetharama, N., Nigam, S.N. and Saxena, N.P. 2003. Management of drought in ICRISAT cereal and legume mandate crops. 127-144.

Singh, S.K., Singh, R.S., Maurya, D.M. and Verma, O.P. 1987. Genetic divergence among low land rice cultivars. *Indian Journal of Genetics,* **39:** 315-322.