Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 1(E), pp. 23197-23200, January, 2018

ISSN: 0976-3031

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

STUDIES ON GENETICS OF DROUGHT TOLERANCE IN GREEN GRAM (*VIGNA RADIATA* (L.) WILCZEK)

Eswaran R* and Anbanandan V

Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India-608002

DOI: http://dx.doi.org/10.24327/ijrsr.2018.0901.1417

ARTICLE INFO

Article History:

Received 17th October, 2017
Received in revised form 21st November, 2017
Accepted 05th December, 2017
Published online 28th January, 2018

Key Words:

Diallel. Drought, Combining ability, and Green gram

ABSTRACT

Six genotypes of green gram (*Vigna radiata* (L.) Wilczek) were matted in full diallel fashion to study the combining ability, nature of gene action under water stress condition. Twelve quantitative character *viz.,* days to first flowering, plant height, number of branches per plant, number of clusters per plant, number of flowers per cluster, number of pods per cluster, pod length, number of seeds per pod, 100 seed weight, seed yield per plant, harvest index and pollen fertility were recorded for 30 hybrids and their parents. The analysis of variance indicated that the parents and single cross hybrids differed among themselves for all the twelve characters studied. Based on the mean performance of the parents, the genotype RM8-668 and the hybrid RM8-652xCGG-09-05 were selected as the best parent and the best hybrid, respectively. The analysis of variance for combining ability revealed the importance of both GCA and SCA variances, illustrating the importance of both additive and non-additive genetic variance in the inheritance of the twelve traits of interest. When the parents were assessed for their overall combining ability, the parents namely RM8-668 and CGG-09-22 were identified as good general combiners. The cross combinations namely RM8-665xCGG-09-22, GG-09-05xCGG-09-24 and CGG-09-24xRM8-668 were identified as good specific combiners.

INTRODUCTION

Pulses have been shown to be an excellent source of dietary protein important for the human diet and play a key role in crop rotation due to their ability to fix nitrogen. In India, Pulses have long been considered as the poor man's major source of protein. India is the largest producer of pulses in the world with 25 per cent share in global production, of which 39 per cent from chick pea, 21 per cent from pigeon pea, 11 per cent from mungbean, 10 per cent from urd bean, 7 per cent from lentil and 5 per cent from field pea to the total production of pulses in the country. Pulses production in the country has fluctuated widely with no significant growth trend. The latest estimates indicate that the present production of pulses is about 23.63 million hectares with an average productivity of 625 kg/ha. The projected pulse requirement for the year 2025 is 29.44 million tonnes which necessitates annual growth rate of 4.02 per cent in production. To meet the projected requirement, the productivity needs to be uplifted to 1178 kg/ha and about 2.5 million heactares additional area has to be brought under pulses.

Food productivity is at a crossroad due to detrimental effects of various biotic and abiotic stresses; therefore minimizing these losses is a major area of concern to ensure food security under changing climate. Environmental abiotic stresses, such as drought, extreme temperature, cold, heavy metals, or high salinity, severely impair plant growth and productivity worldwide. Drought, being the most important environmental stress, severely impairs plant growth and development, limits plant production and the performance of crop plants, more than any other environmental factor (Shao *et al.,* 2009). Drought impacts include growth, yield, membrane integrity, pigment content, osmotic adjustment water relations, and photosynthetic activity (Benjamin and Nielsen, 2006; Praba *et al.,* 2009). Drought stress is affected by climatic, edaphic and agronomic factors. The susceptability of plants to drought stress varies in dependence of stress degree, different accompanying stress factors, plant species, and their developmental stages (Demirevska *et al.,* 2009).

Green Gram [*Vigna radiata* (L.) Wilczek] is one of the most important food legumes in the tropic and sub-tropic regions where drought is a major production constraint due to low and erratic rainfall (Singh *et al*., 1997). Greengram suffers

Corresponding author:* **Eswaran R
Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India-608002

considerable damage due to frequent drought. Moreover, greengram cultivars tend to be very sensitive to drought that occurs during the early stages of the reproductive phase and maturation phase (Thiaw *et al*., 1993). The water extraction capacity in greengram is low during the vegetative period. Therefore, genetic enhancement of greengram for drought tolerance by incorporating drought tolerance greengram lines represents the best and most cost-effective method for insuring sustainable and improved crop yield in variable and changing climates.

MATERIALS AND METHODS

Six diverse mungbean genotypes were selected for drought studies of which RM8-665, RM8-668and RM8-652 were drought resistant and CGG-09-24, CGG-09-05 and CGG-09-22 were susceptible. The selected genotypes were crossed in a diallal matting fashion and thus thirty crosses were obtained. An experiment involving 30 F1's and six parental lines was conducted in randomized block design with three replications at department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Tamil Nadu, India. Each parent and F1 was represented by single row of 2M length spaced at 30 cm distance. The plant to plant spacing was 10 cm within a row was maintained. The 30 hybrids along with their parents were imposed with water stress by withholding irrigation at 25 DAS (Biradar *et al*., 2007) and thereafter no irrigation was given upto harvest. Observations were recorded on randomly selected plants each in parents and in hybrids per replication for morphological traits viz., Days to first flowering, Plant height, number of branches per plant, number of clusters per plant, number of flowers per cluster, number of pods per cluster, pod length, number of seeds per pod, 100 seed weight, seed yield per plant, harvest index and pollen fertility. Data were subjected to analysis of variance (Panse and Sukhatame, 1978) for mean performance and combining ability analysis by adopting method-I and model I (Griffing 1956).

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences for all the characters studied indicating the prescence of high genetic variability in the reference population (Table 1.). The mean squares due to general combining ability and specific combining ability were significant for all the twelve traits studied, indicating the importance of both additive and non-additive gene action involved in the expression of the characters.

General combining ability were greater than the specific combining ability variance for the traits viz., plant height, number of branches per plant, number of clusters per plant, pod length, number of seeds per pod, seed yield per plant and harvest index indicating the predominance of additive gene action for these traits. Higher magnititude of gca variance over sca variance indicating additive gene action were reported by Weber *et al*(1970). The estimates of variance due to specific combining ability were less than the unity for days to first flowering, number of flowers per cluster, number of pods per cluster,100 seed weight and pollen fertility indicating that these traits were controlled by non-additive gene action suggesting that selection in the early generation may not be fruitful and hence selection should be postponed to later generations and intermating of segregants and effecting selection in the progenies may yield good result under water stress.

The gca effects of parents for different characters (Table 2.) showed that the parents RM8-668 and CGG-09-22 were good combiners with significant and positive gca effects for most of the traits studied. Higher gca effects are mostly due to additive gene action or additive x additive interaction effects (Griffing, 1956). In view of these, the genotypes RM8-668 and CGG-09-22 could be considered as the best combiners for the development of drought tolerant varieties in green gram. The parents showing high per se performance generally assumed to be good general combiners for respective characters. Therefore, mean performance could be used as one of the criteria for selection of superior general combiners. This could be considered as the best combining parents for developing drought tolerant as well as yield improvement. In the present study there were close agreement between per se performance of the parents viz., RM8-668 and CGG-09-22. Similar observations have been reported by Nadrajan (1986) Anbuselvam (2012).

Table 1 Analysis of variance for combining ability in green gram for yield and its component traits

	Mean Squares											
Source	**DFF**	**PL.HT**	**NBPP**	**NCPP**	**NFPC**	**NPPC**	**PL**	**NSPP**	**100SW**	**SYPP**	**HI**	**PF**
GCA	22.948**	26.63**	1.03**	1.81**	1.38**	0.628**	0.57**	2.14**	0.29**	0.84**	18.70**	48.05**
SCA	31.538**	5.298**	0.37**	0.60**	1.97**	0.64**	0.41**	0.79**	0.65**	0.30**	13.51**	62.99**
RCA	34.638**	9.77**	0.25**	0.77**	2.46**	1.11**	0.41**	1.36**	0.35**	0.40**	19.09**	96.88**
GCA/SCA	0.72	5.03	2.78	3.01	0.70	0.96	1.39	2.70	0.44	3.83	1.38	0.76
GCA/RCA	0.66	2.72	4.12	2.35	0.56	0.55	1.39	1.57	0.82	2.87	0.97	0.49

*-Significant at 5% level ** - Significant at 1% level

LEGANDS:DFF-Days to First Flowering ,PL.HT-Plant Height, NBPP- Number of Branches per Plant NCPP- Number of Clusters per Plant, NFPC- Number of Flowers per Cluster, NPPC,- Number of Pods per Cluster, PL- Pod Length, NSPP- Number of seeds per Pod,100 SW- 100 Seed Weight, SYPP-Seed Yield per Plant, HI- Harvest Index and PF-Pollen Fertility

Table 2 General Combining ability effects of parents for different traits in green gram under water stress

Traits/Genotypes	DFF	PL.HT	NBPP	NCPP	NFPC	NPPC	PL	NSPP	100SW	SYPP	HI	PF
RM8-665	-0.72	-1.66**	-2.00**	-0.65**	-0.60*	-0.22*	-0.17*	-0.66**	-0.07	-0.43*	-1.41**	3.19**
RM8-668	0.94	1.12**	0.09	0.34**	0.10	0.07	0.42**	0.51**	0.19*	-0.03	1.24*	1.45**
CGG-09-24	-1.72*	-1.13**	-0.12	-0.26*	0.19	-0.10	-0.09	-0.17	-0.04	-0.01	-1.00*	-1.24**
RM8-652	-1.02	-1.18**	-0.39**	0.29**	-0.17	-0.22*	-0.16	-0.09	0.11	-0.07	0.58	-0.42
CGG-09-05	0.58	1.01**	0.21*	0.24*	0.35	0.11	0.03	0.03	0.25*	0.19*	0.05	-0.61
CGG-09-22	1.94*	1.84	0.41**	0.03	0.13	0.36**	-0.02	0.39**	0.05	0.35*	1.70**	-2.36
S.E	0.82	0.38	0.09	0.10	0.23	0.10	0.87	0.08	0.09	0.07	0.49	0.44

*-Significant at 5% level ** - Significant at 1% level

Table 3 Specific Combining Ability effects of Hybrids for different traits in Green gram under water stress

Traits/Hybrids	DFF	PL.HT	NBPP	NCPP	NFPC	NPPC	PL	NSPP	100SW	SYPP	HI	PF
RM8-665 x RM8-668	-0.28	-1.59	0.20	-0.61	0.35	-0.19	-0.23	-0.08	-0.83**	-0.28	-1.57	5.3**
RM8-665 xCGG-09-24	3.39	-0.84	-0.17	0.24*	0.38	-0.34	0.89**	1.09**	0.10	0.05	-0.32	0.08
RM8-665 xRM8-652	7.36**	1.55	0.57**	0.59*	-0.34	0.08	0.18	-0.11	0.30	-0.24	5.33*	5.84**
RM8-665 x CGG-09-05	4.08**	0.85	-0.10	0.48*	-0.65	0.38	0.02	-0.77	0.81**	0.14	1.72	2.25
RM8-665 x CGG-09-22	-4.78*	1.35	0.55**	-0.19	1.21*	0.65**	-0.06	0.13	0.16	0.53*	-1.14	0.75
RM8-668 x RM8-665	-5.50*	0.17	-0.25	-0.25	-0.21	0.75**	0.81**	0.58**	0.05	0.18	4.60**	1.06
RM8-668 x CGG-09-24	-4.11*	0.21	-0.41*	-0.09	0.02	-0.13	-0.42*	-0.03	0.62**	0.06	0.58	-0.78
RM8-668 x RM8-652	-0.14	-3.06**	-0.27	0.47*	-0.22	0.28	0.54**	0.88**	0.25	0.35	0.44	-3.87
RM8-668 x CGG-09-05	-1.75	1.40	-0.23	-0.77**	-0.34	-1.21	0.21	0.42*	0.57**	-0.42*	-4.85**	1.36
RM8-668 x CGG-09-22	0.06	0.57	-0.19	0.42	-2.15**	-0.04	0.17	0.24	0.38	0.08	0.34	-8.45
CGG-09-24 x RM8-665	-3.38	-3.00**	-0.13	0.60*	-1.10	-0.76**	-0.08	0.88	-0.35	-0.35	-1.13	4.28**
CGG-09-24 x RM8-668	-1.00	1.83	-0.35	-0.48	1.31**	1.17**	0.61**	-1.08**	0.03	0.65**	-0.03	3.80**
CGG-09-24 x RM8-652	1.03	0.18	0.14	-0.32	-0.05	0.25	0.13	0.37*	-0.81*	0.13	-1.95	0.43
CGG-09-24 x CGG-09-05	1.58	-0.34	0.15	-0.04	0.11	0.06	0.36	-1.01**	-0.06	0.20	1.97	-2.63
CGG-09-24 x CGG-09-22	0.22	-1.18	0.37	-0.86**	-1.21*	0.01	-0.70	-0.04	-0.51*	-0.27	1.05	-0.52
RM8-652 x RM8-665	-3.17	-1.33	-0.03	-0.35	-0.68	1.00**	-0.87**	0.41	0.50	0.32	0.81	-1.60
RM8-652 x RM8-668	-5.00*	0.17	0.52*	0.11	-2.27**	-0.86**	0.11	0.08	-0.11	-0.31	-0.71	8.30**
RM8-652 x CGG-09-24	-4.17	-3.83**	0.25	0.35	0.73	1.17**	-0.16	0.76**	0.05	0.68**	-3.13*	-8.81**
RM8-652 x CGG-09-05	-2.78	1.21	0.07	-0.14	0.32	0.25	-0.54**	1.15**	0.42*	0.20	0.75	-1.07
RM8-652 x CGG-09-22	0.03	1.38	-0.71**	-0.45	-0.01	-0.96**	0.20	0.06	0.18	-0.26	-0.84	3.06**
CGG-09-05 x RM8-665	3.50	-1.17	0.60*	-0.28	0.85	-0.91**	-0.75**	0.08	-0.18	-0.63	-5.43	3.88**
CGG-09-05 x RM8-668	-2.67	0.17	0.87**	-0.15	1.60*	-0.63*	-0.10	-0.25	0.10	-0.40	1.48	-2.55*
CGG-09-05 x CGG-09-24	-5.00*	-2.50*	0.10	1.43**	1.38*	0.58**	0.55**	-0.30	-0.86**	-0.35	-2.26	9.85**
CGG-09-05 x RM8-652	-4.67*	3.33	0.12	0.77*	0.30	0.21	0.16	0.02	-0.51*	0.21	-5.60**	8.63**
CGG-09-05 x CGG-09-22	2.59	-2.81**	0.08	0.23	-0.02	0.57*	0.21	-0.28	-0.26	-0.25	1.43	-7.38
CGG-09-22 x RM8-665	-6.67**	0.50	-0.28	-0.30	0.50	0.18	-0.01	-1.38**	-0.16	0.05	1.28	-15.33**
CGG-09-22 x RM8-668	3.50	-0.83	0.13	0.17	0.23	-0.55*	-0.08	0.10	-0.85	-0.56*	2.23	-3.91**
CGG-09-22 x CGG-09-24	5.33*	3.83**	-0.05	0.28	-0.40	0.63**	-0.16	-1.27**	0.15	-0.03	2.96*	2.55**
CGG-09-22 x RM8-652	-3.17	1.00	-0.28	-1.28**	-1.78**	0.56**	-0.13	1.18**	0.30	0.61**	3.75**	-9.36**
CGG-09-22 x CGG-09-05	-0.33	-3.00	-0.03	0.52	0.61	0.18	0.53	-1.43**	-0.53	0.55**	3.46**	2.38
S.E	2.60	1.20	0.28	0.32	0.72	0.31	0.27	0.25	0.30	0.27	1.54	1.38

*-Significant at 5% level ** - Significant at 1% level

The specific combining ability is the deviation from the performance predicted on the basis of general combining ability (Allard, 1960) According to Sprague and Tatum (1942) the specific combining ability is controlled by non-additive gene action. The specific combining ability value of any cross is helpful in predicting the performance of a particular hybrid in relation to the gca of its parent (Peng and Virmani, 1990). Hence the sca effect should be given due importance for evaluation of hybrids. Among the hybrids studied, the hybrid CGG-09-05 x CGG-09-24 showed significant sca effects for the characters *viz*., days to first flowering, plant height, number of clusters per plant, number of flowers per cluster, number of pods per cluster, pod length and pollen fertility. Also the sca effects of the cross CGG-09-24 x RM8-668 24 was positively significant for the characters number of flowers per cluster, number of pods per cluster, pod length, 100 seed weight, seed yield per plant and pollen fertility.

The direct cross combination RM8-665 x CGG-09-22 was positively significant for days to first flowering, number of branches per plant, number of flowers per cluster, number of pods per cluster and seed yield per plant. From these observations, it was found that the gene action governing these genotypes were found to be additive and additive x additive. The prevelance of additive x additive interaction effect could be favourably exploited through heterosis breeding for developing drought tolerant genotypes. The cross combination CGG-09-05 x CGG-09-24, CGG-09-24 x RM8-668 and RM8-665 x CGG-09-22 involved parents with (i) high x high gca effects suggested the presence of additive x additive gene action, ii) high x low gca effects, indicated the presence of additive x dominance genetic interaction and iii) high x average (or) average x average (or) average x low gca effects showed the superiority due to complementary type of gene interactions.

The cross CGG-09-24 x RM8-668 which recorded significant sca effects did not possess superior mean performance for the traits such as number of clusters per plant and pod length. This indicated that superior performance of hybrids need not be the one with high sca effects and vice versa. The hybrids viz., RM8-668 x CGG-09-22 CGG-09-05 x RM8652, RM8-665 x CGG-09-05 recorded non-significant sca effects for almost all the traits studied. This indicated that these genotypes were governed only by additive gene action without interaction effect that is fixable.

References

Allard, R.W.1960. Principles of plant breeding, John wiley and sons. Inc., New york.

Anbuselvam, Y. 2000. Studies on genetics of certain quantitative traits in cowpea *(Vigna unguiculata* (L.) Walp). Ph.D., Thesis, Annamlai univ., Annamalainagar, India.

Benjamin JG, Nielsen DC (2006). Water deficit effects on root distribution of soybean, field pea and chickpea. *Field Crops Res*., 97: 248-253.

Biradar. S., P.M. Salimath and R.L. Ravikumar. 2007. Association of early vigour with Draught tolerance in greengram *(Vigna radiata* (L.) wilczek). Karnataka *J.Agric. Sci.,* 20(3): 610-612.

Demirevska K, Zasheva D, Dimitrov R, Simova-Stoilova L, Stamenova M, Feller U (2009). Drought stress effects on Rubisco in wheat: changes in the Rubisco large subunit. z *Acta Physiol. Plant*., 31: 1129- 1138.

Griffing, B. 1956b. Concept of general and specific combining ability in relation to diallel crossing systems. *Australian J. Biol. Sci.,* 9: 463-493.

Panse, V.G. and P.V.Sukhatme,1978. Statistical methods for agricultural workers 3rd Edn. ICAR, New Delhi, India. Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel cross system. *Australian J. Biol. Sci.,* 9: 463-493.

Shao HB, Chu LY, Jaleel CA, Manivannan P, Panneerselvam R, Shao MA (2009). Understanding water deficit stress-induced changes in the basic metabolism of higher plants-biotechnologically and sustainably improving agriculture and the ecoenvironment in arid regions of the globe. *Crit. Rev. Biotechnol*., 29: 131-151.

Peng, J.Y. and SS. Virmani. 1990. Combining ability for yield and four related traits in relation to breeding in rice. *Oryza*, 27:1-10.

Praba ML, Cairns JE, Babu RC, Lafitte HR (2009). Identification of physiological traits underlying cultivar differences in drought tolerance in rice and wheat. *J. Agron. Crop Sci*., 195: 30-46.

Singh BB, Chambliss OL, Sharma B (1997) Recent advances in cowpea breeding. In: Singh BB, Mohan Raj DR, Dashiell KE, Jackai LEN (eds) Advances in cowpea research, Co-publication of International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria and Japan International Research Centre for Agricultural Sciences (JIRCAS), Sayce Publishing, Devon, pp 114-128.

Thiaw S, Hall AE, Parker DR (1993) Varietal intercropping and the yields and stability of cowpea production in semiarid Senegal. *Field Crops Res* 33:217-233.

Sprague, G.P. and L.A. Tatum., 1942. General vs. specific combining ability in single crosses of corn. *J. American Soc. Agron.,* 34: 923-932.

Weber, C.R., Empig, L.T. and Thome, J.C., 1970. Heterotic performance and combining ability of two way F, soybean hybrids. *Crop. Sci.* 10: 159-160.

Nadarajan,N.,1986. Genetic analysis of fibre characters in cotton (Gossypium arboretum L.). *Ph.D. Thesis*, Tamil Nadu Agrl. Univ., Coimbatore, Tamil Nadu, India.

How to cite this article:

Eswaran R and Anbanandan V.2018, Studies on Genetics of Drought Tolerance In Green Gram (Vigna Radiata (L.) Wilczek). *Int J Recent Sci Res.* 9(1), pp. 23197-23200. DOI: http://dx.doi.org/10.24327/ijrsr.2018.0901.1417

****