Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5238

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (6):** 725-729 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Combining Ability of Maize Inbreds for Yield and Component Traits in Multi Environment Diallel Analysis

K. Kuselan*, N. Manivannan[1], R. Ravikesavan[2], V. Paranidharan[3] and Rajan Gupta[4]

*Breeder (Maize), Rasi seeds Pvt. Ltd., Attur , Tamil Nadu, India

[1]National Pulses Research Centre, Tamil Nadu Agricultural University, Vamban, Tamil Nadu,India

[2]Department of Millets, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

[3]Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

[4]Principal Breeder (Maize), Rasi seeds Pvt. Ltd., Bangalore , Karnataka, India

*Corresponding Author E-mail: kuselan.krishna@yahoo.co.in

Received: 18.07.2017 | Revised: 23.08.2017 | Accepted: 27.08.2017

ABSTRACT

Studies on combining ability analysis were carried out at three locations during rabi 2015. Observations were recorded for 13 yield and yield contributing traits for 45 single cross hybrids developed using 10 parents in diallel fashion excluding reciprocals. Significance of GCA and SCA variance indicated the presence of both additive and non additive gene action for all traits. The significance of environmental variance indicated the influence of environment on all traits. This indicated that multilocation evaluation is important to assess the combining ability effects of parents and hybrids. The higher magnitude of SCA than GCA variance for all characters indicating predominance of non additive gene action than additive gene action. Among the 10 parents, inbred line namely RML 34, RML 27 and RML 1 recorded superior mean performance for yield and component traits. The parents RML 48 and RML 1 recorded desirable general combining ability for yield and component traits. There was no relationship between per se performance and general combining ability of parents for most of traits. Based on combining ability effects, parents RML 48 and RML 1 can be considered for yield improvement programme.

Key words: *Maize, Diallel, Combining ability, Grain yield*

INTRODUCTION

In India, maize is the third important food crop after rice and wheat. According to latest data (2015-16), it is being cultivated on 8.69 m ha with 80%area during *kharif* season. The current maize production is 21.7 mt, with an average productivity of 2.5 t/ha. Despite maize being predominantly rainfed crop its productivity is more than rice which is mainly grown under assured irrigated/ rainfed conditions. Maize contributes nearly 9% in the national food basket and more than 400 billion to the agricultural GDP at current prices. In addition it generates employment to over 1000 million man days at the farm and downstream agricultural and industrial sectors.

Cite this article: Kuselan, K., Manivannan, N. , Ravikesavan, R., Paranidharan,V. and Gupta, R., Combining Ability of Maize Inbreds for Yield and Component Traits in Multi Environment Diallel Analysis, *Int. J. Pure App. Biosci.* **5(6):** 725-729 (2017). doi: http://dx.doi.org/10.18782/2320-7051.5238

Maize is primarily used for feed (60%) followed by human food (24%), industrial (starch) products (14%) beverages and seed (1 % each). Thus, maize has attained an important position as industrial crop because 75% of its produce is used in starch and feed industries. The combining ability studies is one of the best options to select parents for heterosis breeding. It would be a useful to estimate the combining ability of parents, gene action and heterotic effects of crosses combining ability describes the breeding values of parental lines to produce hybrids. Sprague and Tatum[11] used the term general combining ability *(gca)* to designate the average performance of a line in hybrid combinations and used the term specific combining ability *(sca)* to define those cases in which certain combinations do relatively better or worse than would be expected on the basis of the average performance of the lines involved. Diallel crossing programs have been applied to achieve this goal by providing a systematic approach for the detection of suitable parents and crosses for the investigated characters. Hence an attempt has been made to assess the combining ability of 10 maize inbreeds over multi location in a diallel fashion for yield and component traits.

MATERIAL AND METHODS

A total of ten inbreds *viz.*, RML1, RML12, RML23, RML26, 2ML27, RML34, RML36, RML37, RML42 and RML48 were crossed in diallel fashion excluding reciprocals to obtain 45 F_1 hybrids. These hybrids along with parents were evaluated in randomized complete block design with three replication at three locations *viz*., Kattukotai (Tamil Nadu), Vadachennimalai (Tamil Nadu) and Bangalore (Karnataka) during *rabi* 2015. Each entry was evaluated in four rows of 4.0 m length. The distance between rows was 60 cm and between plants along the row was 25 cm. The observations *viz.*, days to 50% tasseling, days to 50% silking, plant height (cm), ear height (cm), cob Length (cm), cob girth (cm), number of grain rows per cob, number of grains per row, number of grains per cob, hundred grain weight (gm), grain yield per plant (gm), cob weight per plot (kg) and grain yield per plot (kg) were recorded. Analysis of data for general and specific combining ability was carried out following Griffing[5] Method II, Model I (fixed effect model). The statistical analysis was carried out using WINDOSTAT software.

RESULTS AND DISCUSSION

The ANOVA revealed that mean squares due to genotypes were significant for all the yield attributing traits indicating presence of sufficient amount of variability among the parents and crosses (Table 1). The mean sum of squares due to general combining ability (GCA) and specific combining ability (SCA) were significant for all the characters under studied (Table 2). This implies both the additive and non-additive gene actions were playing significant role in the expression of these characters as suggested by Badhe *et al.*[3], Singh *et al*[10]. The significance of environmental variance indicated the influence of environment on all traits. This indicated that multi location evaluation is important to assess the combining ability effects of parents and hybrids. The knowledge on combining ability assists in the selection of suitable parental lines. Among the various biometrical techniques available, combining ability analysis proposed by Griffing[5] had been extensively used by the breeders. It provides information on the performance of genotypes in hybrid combination and also the nature of gene action involved in the control of metric traits. The general and specific combining ability of parents and hybrids for the grain yield and its component traits are discussed hereunder. The per se performance of parents was present in Table 3. Among the parents RML 27, RML 34 and RML 1 recorded superior mean for grain yield per plant, cob weight per plot and grain yield per plot. Among these RML 27 also recorded superior mean for cob girth, number of grain rows per cob, no. of grains per cob and hundred grain weight. The parent RML 34 recorded superior mean performance for cob length, cob girth, no. of grain rows per cob, no. f grains per row and no. of grains per cob. The parent RML 1 recorded superior mean for no. of grains per row only. Hence based on grain yield and component traits, inbreds RML 27, RML 34 and RML 1 can be considered as superior parents.

The general combining ability of parents for thirteen characters presented in Table 4. The parent RML48 exhibited significant *gca* for characters, grain yield per plot, cob weight per plot, grain yield per plant, hundred grain weight, no of grains per row and no of grains per cob. The parent RML34 recorded desirable general combining ability effects for days to 50% tasseling, plant height, ear height, cob length, no of grain rows per cob, no of grains per row and no of grains per cob. Parent RML27 had desirable gca effects for five characters viz., days to 50% tasseling, days to 50% silking, cob girth, no of grain rows per cob, no. of grains per row and hundred grain weight. While, RML37 for days to 50% tasseling, days to 50% silking, ear height and hundred grain weight and RML12 for four characters days to 50% tasseling, days to 50% silking, no of grain rows per cob and no of grains per cob recorded desirable gca effects. The parent RML1 recorded significant *gca* for grain yield per plot, no of grains per row and no of grains per cob, RML26 for ear height, no of grain rows per cob and no of grains per cob, RML23 for cob length and hundred grain weight, RML36 for plant height and cob length and RML42 for hundred grain weight. Considering the gca performance and mean performance, it could be concluded that the parent showing significant high gca effects were not having higher mean value for respective characters except for few instances. However, relationship between per se and gca effects of parents were reported by Aly and Mousa[2], Mahgoub[6] and Reddy Yerva *et al*[8]. Hence, *per se* performance cannot be used to select parents for hybridization programme. rents.Based on the forgoing discussion, it can be concluded non additive gene action has predominant role in the expression of traits. The influence of environment is more in the expression of traits and hence multilocation evaluation is important to assess the combining ability effects of parents and hybrids. The parents RML 48 and RML 1 may be considered as good combiners for grain yield and component traits. These parents can be used in breeding programme for the grain yield improvement programme.

Table 1: Analysis of variance for diallel analysis for seed yield and its components traits in maize rabi 2015-16

Source of Variations	df	Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Cob length (cm)	Cob girth (cm)	No of grain rows per cob	No of grains per row	No of grains per cob	Hundred grain weight (gm)	Grain yield per plant (gm)	cob weight per plot(kg)	Grain yield per plot(kg)
Blocks within Environments	3	3.80**	8.43**	191.15	392.55*	4.42*	4.87**	2.07*	29.82**	15910.55**	7.61	569.26	1.56	0.64
Treatemnts	54	38.59**	47.04**	2718.36**	884.95**	25.38**	4.75**	14.33**	214.36**	77009.13**	60.19**	9278.8**	23.41**	12.47**
Parents	9	32.07**	33.75**	1593.67**	521.47**	9.36**	2.73**	21.05**	102.58**	40649.03**	63.64**	1909.06**	4.58**	2.44**
Hybrids	44	11.99**	13.97**	909.2**	608.05**	9.89**	2.79**	11.83**	52.53**	25248.35**	49.07**	2228.18**	5.49**	2.81**
Parents vs.Hybrids	1	1267.6**	1622.02**	92443.58**	16340.06**	851.21**	109.37**	63.8**	8340.86**	2681724.53**	518.11**	385833.81**	981.54**	527.64**
Error	162	0.95	1.04	174.10	116.61	1.25	0.52	0.62	6.89	2584.61	4.75	383.57	0.72	0.41

*** Significant at 5 % level, ** Significant at 1 % level.**

Table 2: Analysis of variance for combining ability for seed yield and its components traits in maize during rabi 2015-16

Source of Variations	df	Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Cob length (cm)	Cob girth (cm)	No of grain rows per cob	No of grains per row	No of grain per cob	Hundred grain weight (gm)	Grain yield per plant (gm)	Cob weight per plot(kg)	Grain yield per plot(kg)
GCA	9	23.79**	25.83**	1001.46**	763.62**	6.35**	1.92**	27.87**	77.21**	43084.22**	91.64**	1565.32**	2.06**	1.69**
SCA	45	18.39**	23.06**	1430.73**	378.25**	13.96**	2.47**	3.02**	113.18**	37588.64**	17.78**	5254.22**	13.63**	7.14**
ENVIRONMENTS	2	688.61**	381.55**	75654.79**	2827.4**	41.21**	7.45**	2.35**	425.68**	108101.42**	1065.04**	150166.05**	184.15**	162.18**
Error	162	0.48	0.52	87.05	58.3	0.63	0.26	0.31	3.44	1292.31	2.37	191.78	0.36	0.21

*** Significant at 5 % level, ** Significant at 1 % level.**

Components of variance

Source of Variations	Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Cob length (cm)	Cob girth (cm)	No of grain rows per cob	No of grains per row	No of grains per cob	Hundred grain weight (gm)	Grain yield per plant (gm)	cob weight per plot(kg)	Grain yield per plot(kg)
GCA Variance	0.65	0.70	25.40	19.59	1.16	0.05	0.77	2.05	1160.89	2.48	38.15	0.05	0.04
SCA Variance	5.97	7.51	447.89	106.64	4.45	0.74	0.91	36.58	12098.77	5.14	1687.47	4.42	2.31
Environmental Variance	15.29	8.47	1679.28	61.54	0.90	0.16	0.05	9.38	2373.54	23.61	3332.76	4.08	3.60
GCA/SCA Var.Ratio	0.11	0.09	0.06	0.18	0.04	0.06	0.85	0.06	0.10	0.48	0.02	0.01	0.02

Table 3: Per se performance of parents for seed yield and its components traits in maize during rabi 2015-16

Parents	Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Cob length (cm)	Cob girth (cm)	No of grain rows per cob	No of grains per row	No of grains per cob	Hundred grain weight (gm)	Grain yield per plant (gm)	cob weight per plot(kg)	Grain yield per plot(kg)
RML1	63.83	65.50	200.48**	108.31**	13.98	13.98	14.07	29.57**	320.00	28.25	97.33**	3.83**	3.01**
RML12	62.67	65.67	165.20	77.87	14.85**	14.13	16.33**	27.93**	385.70**	27.50	74.10	3.37	2.34
RML23	65.00**	67.33**	155.70	79.78	12.32	14.00	12.43	21.63	289.50	28.47	56.03	2.01	1.54
RML26	63.83	66.33	171.27	81.98	12.82	14.95**	18.80**	27.07	421.95**	25.17	76.77	3.75**	2.74**
RML27	62.83	65.00	193.52**	90.03**	14.13	15.13**	16.06**	27.87**	517.90**	29.58**	94.57**	4.18**	2.91**
RML34	64.00	66.33	171.60	82.40	16.87**	14.68**	15.67**	34.83**	410.65**	28.33	104.72**	4.46**	3.34**
RML36	65.67**	68.50**	149.13	80.53	13.77	12.75	13.53	21.73	239.05	25.25	55.28	2.23	1.78
RML37	61.00	63.00	175.37**	75.03	14.22	14.53**	14.00	25.23	274.55	34.92**	82.08	3.23	2.26
RML42	69.67**	71.83**	164.08	85.58	13.57	14.25	13.40	21.83	244.95	28.75*	66.55	2.50	1.69
RML48	65.10**	67.80**	156.60	83.50	13.20	13.80	14.00	27.50*	337.30	22.60	59.10	2.30	1.70
MEAN	64.36	66.73	170.30	84.50	13.97	14.22	14.83	26.52	344.16	27.88	76.65	3.19	2.33
S.E.	0.16	0.17	2.19	1.79	0.18	0.12	0.13	0.43	8.47	0.36	3.26	0.14	0.10
C.D.5%	0.32	0.33	4.34	3.55	0.36	0.23	0.25	0.86	16.73	0.71	6.44	0.27	0.21
C.D.1%	0.42	0.44	5.73	4.69	0.48	0.31	0.34	1.14	22.08	0.94	8.50	0.36	0.27

Table 4: Estimates of General combining ability effects for seed yield and its components traits in maize during rabi 2015-16

Parents	Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Cob length (cm)	Cob girth (cm)	No of grain rows per cob	No of grains per row	No of grains per cob	Hundred grain weight (gm)	Grain yield per plant (gm)	cob weight per plot(kg)	Grain yield per plot(kg)
RML1	-0.08	-0.31	11.70**	7.09**	-0.05	-0.21	-0.52**	0.86*	24.71**	0.21	3.32	0.15	0.42**
RML12	-0.51**	-0.36*	0.77	-2.16	-0.10	0.08	0.85**	0.15	37.34**	-0.31	0.44	0.23	0.11
RML23	0.23	-0.08	-2.10	-0.41	0.52**	-0.11	-1.60**	0.08	-55.18**	2.40**	4.12	0.08	-0.07
RML26	0.31	0.46**	-2.94	-3.73*	-0.66**	0.20	1.44**	-0.26	35.19**	-2.47**	-11.25**	-0.21	-0.17
RML27	-0.36**	-0.36**	4.03	-1.05	-0.38*	0.37**	0.34**	-0.99*	20.31*	0.87*	3.76	0.17	0.03
RML34	-0.97**	-1.00	-5.25**	-4.35*	0.42*	0.14	0.36**	2.94**	68.45**	-1.55**	3.20	-0.27*	-0.06
RML36	0.06	0.29	-5.59**	2.78	0.65**	-0.41**	0.23	-1.09*	-38.19**	-1.26**	-5.92	-0.17	-0.10
RML37	-0.56**	-0.63**	-3.05	-6.98**	-0.30	-0.21	-0.05	-1.98**	-60.78**	1.64**	-9.09**	-0.40**	-0.35**
RML42	2.03**	2.10**	-1.29	6.21**	-0.12	0.02	-1.01	-1.20**	-33.62**	1.53**	1.89	0.12	-0.07
RML48	-0.10	-0.10	3.70	2.50	0.03	0.10	0.10	1.50**	21.70*	1.00**	9.50**	0.30*	0.21*
SE(gi)	0.10	0.11	1.47	1.20	0.12	0.08	0.08	0.29	5.68	0.24	2.18	0.09	0.07

*** Significant at 5 % level, ** Significant at 1 % level.**

REFERENCES

1. Agriculture statistics at a Glance, Directorate of economics and statistics, Ministry of A Agriculture, GOI (Website: http://www.Dacnet.nic.nic /eands) (2012).
2. Aly, R.S.H. and Mousa, S.T.M. Combining ability for grain yield and other yield component traits using half diallel crosses of maize inbred lines. *J. Agric. Chem. and Biotech., Mansoura Univ.*, **2(12):** 317 - 329 (2011)
3. Badhe, P.L., Raut, D.M., Magar, N.M., Borole, D.N. and Pawar, V.Y. Diallel analysis in Cowpea (*Vigna unguiculata* (L.) Walp.) *E. J. Plant Breed*., ISSN 0975-928X (2016).
4. Chakraborty, S., Borah, H.K., Borah, B.K., Pathak, D., Baruah, B.K., Kalita, H. and Barman, B. Genetic Parameters and Combining Ability Effects of Parents for Seed Yield and other Quantitative Traits in Black Gram [*Vigna mungo* (L.) Hepper]. *Not. Sci. Biol.*, **2(2):** 121-126. (2010).
5. Griffing, B. Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Bio. Sci.*, **9:** 463-493 (1956).
6. Mahgoub, G.M.A. Partitioning of general and specific combining ability effects for estimating maternal and reciprocal effects. *J. Agric. Sci.*, **3:** 213-221 (2011).

7. Poehlman, J.M. Breeding Field Crops. 5th Edn. The AVI publish. Co. Inc. Westport, connecticut (2006).
8. Reddy Yerva, S. *et al*. Combining ability studies in maize *(Zea mays* L.) for yield and its attributing traits using Griffing's diallel approach*. E. J. of Plant Breed.*, **7(4):** 1046-1055 (2016).
9. Singh, A.K., Shahi, J.P. and Singh, J.K. Heterosis in maize. *J. App. Biol.*, **14:** 49-53 (2004).
10. Singh, P.K., Chaudhary, L.B. and Akhtar S.A. Heterosis in relation to combining ability in maize. *Journal Research , Birsa Agric. Univ.*, **14(1):** 37-43 (2002).
11. Sprague and Tatum. General and specific combining ability in single crosses of corn. *J. Am. Soc. Agron.*, **34:** 923–932 (1942).
12. Unay, A., Basal, H. and Konak, C. Inheritance of grain yield in a half-diallel maize population. *Turk. J. Agric. For.*, **28:** 239-244 (2004).