Electronic Journal of Plant Breeding, 8(2): 591-600 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00090.4

Research Note

Combining ability analysis for yield and its component characters in maize (*Zea mays* L.)

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

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

[1]National Pulses Research Centre, TNAU, Vamban, Tamil Nadu, India.

[2]Department of Millets, CPBG, TNAU, Coimbatore, Tamil Nadu, India.

[3]Department of Plant Pathology, TNAU, Coimbatore, Tamil Nadu, India.

E-mail: kuselan.krishna@yahoo.co.in

(Received: 04 March 2017; Revised: 25 May 2017; Accepted: 31 May 2017)

Abstract

Line × tester analysis was carried out involving fourty two lines and three testers in maize for assessing the combining ability for yield and its component characters. Hybrids recorded significant variance for all characters studied. Variance due to parents were significant for characters *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, 100 grain weight (gm) and grain yield per plant (gm). The variance due to *sca* was higher than *gca* indicating the predominance of non-additive type of gene action for the above mentioned traits. Among the lines, the line RML 12, was identified as the best general combiner with higher *per se* performance for most of the yield contributing traits followed by RML1, RML 26, RML 27 and RML 34. Considering the testers, RML 48 was found as the best general combiner with better mean performance for most of the yield contributing traits followed by RML 47. Among the crosses, RML12 x RML48 was found to be the superior with positive significant *sca* effects and better mean performance for grain yield, cob girth, number of grain rows per cob and no of grains per cob. Similar superior positive significant *sca* effects with better mean performance were also observed in RML26 x RML48 (no of grains per cob, grain yield per plant and grain yield per plot), RML27 x RML48 (grain yield per plant, grain rows per cob, grains per cob) and RML37 x RML48 (cob girth, hundred grain weight, grain yield per plant and grain yield per plot.

Key words

Maize, line x tester analysis, *per se* performance, combining ability and heterosis

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. Maize is primarily used for feed (60%) followed by human food (24%), industrial (starch) products (14%) and bevarages 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. In India, maize is predominantly cultivated as rainfed crop but due to focused research on single cross hybrids (SCH) since 2006, the productivity of maize has increased @ 134 kg/ha/annum. The adoption of SCH technology in India is around 60%,with this adoption of technology it has registered a growth rate of more than 7% in production and 6% in productivity in last five years.

Study of combining ability is important for selecting parents for hybridization. Sprague and Tatum (1942), first time proposed the concepts of general combining ability (*gca*) and specific combining ability (*sca*). According to them, GCA variance is due to additive variance and SCA variance is due to non-additive variance, both act as an important diagnostic tool in selection of suitable parents and cross combination. Among the various design used for combining ability analysis, Line x Tester analysis (Kempthorne, 1957) has been extensively used to assess the combining ability of parents and crosses for different quantitative characters as well as to study the extent of heterosis for yield, yield contributing characters in maize.

The present investigation was carried out at Research and Development Farm of Rasi Seeds, Attur, during *rabi* 2014-15. The experimental were conducted in three locations *viz.*, Kattukotai, Vadachennimalai and Bangalore the pooled analysis result data are given below, the materials consisted of 126 hybrids obtained by crossing of 42 lines *viz.*, RML1, RML3, RML4, RML5, RML6, RML7, RML8, RML9, RML10, RML11, RML12, RML13, RML14, RML15, RML17,

DOI: 10.5958/0975-928X.2017.00090.4

RML18, RML19, RML20, RML21, RML22, RML23, RML24, RML25, RML26, RML27, RML28, RML30, RML33, RML34, RML35, RML36, RML37, RML38, RML39, RML40, RML41, RML42, RML43, RML44, RML45, RML46 and RML49 and three testers *viz.* RML47, RML48 and RML50. The hybrids and parents were evaluated in randomized block design with two replications in four meter row with spacing of 60 x 25 cm. All the recommended agronomical practices and plant protection measures were followed as and when required to raise a good crop of maize. Five plants in parents and hybrids were randomly selected in each replication and observations were recorded for 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, 100 grain weight (gm) and grain yield per plant (gm). The mean values were subjected to line x tester analysis as suggested by Kempthorne (1957).

The analysis of variance revealed significant differences among the parents and hybrids for all the traits studied. Variance due to lines and testers were highly significant for all the characters. Variance due to interaction effects of lines and testers were highly significant for all the characters (Table 1).

Analysis of variance for combining ability for yield and yield contributing characters in maize is presented in the table 2. Further the variation present in the hybrids is partitioned into portions attributable to lines, testers, lines x tester components. The per cent contribution towards the total variance was maximum due to the interaction of lines and testers for the traits grain yield per plant, grain yield per plot, hundred grain weight, days to 50% silking, days to 50% tasseling and ear height while contribution of lines alone was maximum towards the total variance for cob length, cob girth and plant height (Table 2).

The magnitude of specific combining ability variances was much greater than those of general combining ability variances for all the characters, which indicated the preponderance of non-additive gene action for all the characters. The role of non-additive gene action for grain yield and other some traits have been reported earlier by Appunu and Satyanarayana (2007), Jagdishkumar and Sanjeev kumar (2014), Kanagarasu *et al*. (2010), Singh and Singh (1998), Prasad and Pramod Kumar (2003), Subramaniyan and Subbraman (2006), Jayakumar and Sundram (2007), Rajitha *et al.* (2014), Vijayabharathi *et al*. (2009). The *gca* effects of parents is presented in (Table 3).The estimates of *gca* showed that among the lines, RML12, RML23, RML26, RML27, RML30, RML35, RML36 and RML37 have exhibited positive and significant *gca* effects for grain yield per plot.RML27, RML12 and RML37 have positive and significant *gca* effects for grain yield per plant and RML23 and RML37 have positive and significant *gca* effects for hundred grain weight. The lines RML34, RML37 and RML42 have positive and significant *gca* effects for cob length, cob girth,number of grain rows per cob and no of grains per cob respectively and hence these lines were good combiners for above traits. RML1, RML26 and RML34 were found to be good combiners for number of grains per row. Among the testers, RML48 was the best combiner for cob length, cob girth, number of grains per row, number of grains per cob, hundred grain weight and grain yield per plant. With respect to earliness and reduced plant height and ear height RML48 was found to be the best combiner. None of the parent was found to possess positive and significant *gca* effects for all traits. However, the lines RML1, RML12, RML23, RML26, RML27, RML34, RML36, RML37, RML42 and tester RML48 were found to be the best combiners for grain yield and other yield characters.

The best crosses with significant *sca* effects for various traits are listed in table 4. Among of 126 crosses, many of the crosses were found to perform well for one or more characters. None of the crosses were found desirable for the traits combinedly *i.e.*, different crosses expressed significant *sca* effects for different characters. However, out of 126 crosses, 5 crosses had shown highly significant positive *sca* effects for grain yield per plant. Among them RML1 x RML48, RML12 x RML48, RML26 x RML48, RML30 x RML47 and RML40 x RML47 expressed maximum *sca* effects along with high *per se* performance for grain yield per plant. The crosses which exhibited significant desirable *sca* effects were RML5 x RML50 for days to 50 per cent tasseling and RML5 x RML48 for plant height. Similarly while considering cob and grain characters, the crosses viz., RML6 x RML48 (cob length), RML12 x RML48 (cob girth), RML15 x RML47 (number of grains per cob), RML1 x RML50 (hundred grain weight), RML30 x RML47 (grain yield per plant), RML40 x RML47 (hundred grain weight and grain yield per plant. The results, thus obtained in the present study are mostly in conformity with the earlier findings of Pal and Prodhan (1994), Rao *et al.* (1996), Sentayehu alamerew *et al.* (2015), Mahto and Gunguli (2003) and Malik *et al.* (2004) for grain yield and other component characters. It is evident that the best three crosses exhibiting desirable *sca* effects for grain yield were showed the involvement of parents with high x high *gca* effects.

DOI: 10.5958/0975-928X.2017.00090.4

Thus three crosses namely, RML1 x RML48, RML12 x RML48 and RML26 x RML48 which have shown high *sca* effects for grain yield involving parents of positive and significant *gca* effects can be exploited for the development of single cross hybrids since non additive gene action for most of the traits was observed. Further they can also be used for population improvement programme through reciprocal recurrent selection.

References

Appunu, C. and Satyanarayana, E. 2007. Heterosis for grain yield and its components in maize (*Zea mays* L.). *J. Res. ANGRAU,* **35**(3): 27-30.

Jagdish Kumar and Sanjeev Kumar. 2014. Line x Tester Analyses For Yield And Its Components In Indigenous Maize (*Zea Mays* L) Germplasm Of Mid Hills, India. *Agric. Sci. Res J.,* **5**(3): 50- 56.

Jayakumar, J. and Sundram, T. 2007. Combining ability studies for grain yield and other yield components in maize. *Crop Res.,* **33**: 179-186.

Kanagarasu, S., Nallathambi, G. and Ganesan, K.N. 2010. Combining ability analysis for yield and its component traits in maize (*Zea mays L.*) *Electron. J. Plant Breed.,* **1**(4): 915-920.

Kempthorne, O. 1957. An introduction to genetic statistics.John Willy and Sons. Inc. New York, pp. 545.

Mahto, R.N. and Ganguli, D.K. 2003. Combining abilityanalysis in inter varietal crosses of maize (*Zea mays* L.). *Madras Agric. J.,* **90**: 29-33.

Malik, S.I., Malik, H.N., Minhas, N.M. and Munir, M. 2004. General and Specific combining ability studies in maize. *Int. J. Agri. Biol.,* **6**: 856-859.

Pal, A.K. and Prodhan, H.S. 1994. Combining abilityanalysis of grain yield and oil content along with some other attributes in maize (*Zea mays* L.). *Indian J. Genet.,* **54**: 376-380.

Prasad, S.K. and Pramod Kumar. 2003. Line x tester analysis for combining ability in maize. *J. Res. (RAU),* **13**: 68-72.

Rajitha, A., Ratna Babu, D., Lal Ahamed, M. and Srinivasa Rao, V. 2014. Heterosis and combining ability for grain yield and yield component traits in maize (*Zea mays* L.) *Electron. J. Plant Breed.,* **5**(3): 378-384.

Rao, G.P., Rai, B., Singh, S.V. and Saah, J.P. 1996. Heterosis and combining ability in inter- varietal crosses of maize. *Madras Agric. J.,* **83**: 291-295.

Sprague and Tatum. 1942. First time proposed the concepts of general combining ability (*gca*) and specific combining ability (*sca*).

Sentayehu alamerew and Warsi, M.Z.K. 2015. Heterosis and Combining ability of Sub tropical maize inbred lines. *Afric. Cr. Sci. J.,* **23**(2): 123 – 133.

Singh, D.N. and Singh, I.S. 1998. Line x Tester analysis in maize (*Zea mays* L.). *J. Res. (BAU),* **10**: 177-182.

Subramanian, A. and Subbaraman, N. 2006. Combining ability analysis for yield and its contributing traits in maize. *Indian J. Agric. Res.,* **40**: 131-134.

Vijayabharathi, A., Anandakumar, C.R. and Gnanamalar, R.P. 2009. Combining ability analysis for yield and its components in popcorn (*Zea mays* var. Everta Sturt.). *Electron. J. Plant Breed.,* **1**: 28-32.

Electronic Journal of Plant Breeding, 8(2): 591-600 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00090.4

Table 1. Analysis of variance for Parents and hybrids for yield and its component characters in maize

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 (g)	Grain yield per plant (g)
Replicates	1	104.21**	66.90**	3557.14**	7845.71**	0.04	7.61**	2.53	101.87**	10546.59	2.89	4714.77**
Crosses	125	5.43	6.68**	544.68**	225.84**	3.86**	2.33**	8.04**	30.14**	16191.54**	27.63**	1589.6**
Parents	44	25.77**	27.29**	626.89**	315.82**	7.87**	2.52**	15.05**	58.89**	28499.21**	56.28**	1835.56**
Parent vs Crosses	1	6528.15**	6393.79**	519087.86**	118962.63**	5501.29**	1554.24**	434.15**	45641.37**	14393074.7**	4699.92**	2383335.96**
Environments	2	12427.41**	11670.97**	841651.22**	60599.19**	53.9**	39.86**	2.65	209.68**	56442.6**	2323.77**	50966.27**
Error	510	2.24	2.59	175.45	85.19	1.27	0.44	2.25	9.62	2958.41	5.25	403.84

*, ** significant at 5 % and 1 % levels, respectively

Table 2. Analysis of variance for combining ability analysis for yield and its component characters in maize

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)
Replicates	1	73.04**	41.44**	1386.46**	4586.03**	0.05	1.62*	10.61 *	49.52*	760.40	22.52 *	1935.36*
Line effect	41	12.41**	13.49**	921.59**	478.45**	4.78 **	4.15**	18.63 **	44.05**	34914.05**	55.14 **	2218.34**
Tester effect	2	6.39*	40.1**	6169.67**	196.18	58.01 **	23.77**	4.02	399.43**	72035.25**	190.02 **	26104.84**
Line * Tester effect	82	1.92*	2.46**	219.03	100.25	2.08 **	0.90**	2.85	14.18**	5468.24**	9.92 **	677.3**
Environments	2	8914.42**	8459.98**	684833.93**	50456.57**	33.67 **	24.01**	4.99	7.85	3090.79	1834.84 **	26342.4**
Error	375	1.35	1.65	187.33	87.90	1.22	0.34	2.31	8.34	2416.70	4.60	442.69
GCA		0.05	0.18	24.96	1.87	0.22	0.10	0.07	1.57	374.19	0.87	101.91
SCA		-0.05	-0.02	7.26	2.51	0.13	0.08	0.10	0.76	418.31	0.78	45.58
GCA/SCA		-0.99	-16.64	6.87	1.49	3.31	2.59	1.34	4.13	1.79	2.23	4.47

*, ** significant at 5% and 1% levels, respectively

Electronic Journal of Plant Breeding, 8(2): 591-600 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00090.4

Table 3. Estimates of general combining ability (*gca*) effects for yield and its component characters in maize

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 (g)	Grain yield per plant (g)
Lines											
RML-1	-0.64	-1.27 **	8.90 **	10.40	0.33	0.19	-0.02	2.31 **	36.46*	0.68	7.86
RML-3	-0.70	-0.77 *	-1.31	4.41 *	1.10 **	-0.66 **	0.20	-0.48	-34.83*	0.28	-7.93
RML-4	0.29	0.16	3.12	6.29 **	-0.77 **	-0.27	-0.87 *	0.72	-20.53	-0.54	-10.36
RML-5	1.12 * *	1.11 **	5.22	9.56 **	-0.08	-0.54 **	-1.51 **	-2.15 **	-87.89**	1.01	-20.18*
RML-6	0.68	0.05	0.55	-2.88	-1.11 **	-0.56 **	-0.34	-2.55 **	-50.72	-1.40*	-32.45**
RML-7	1.12 * *	1.16 **	-9.01 * *	-3.99	-0.46	0.49 **	1.03 **	-0.17	37.65**	-2.12**	-0.52
RML-8	0.79 *	-0.22	-7.40 *	-1.66	-0.40	-0.44 **	-0.16	0.18	-2.41	-0.85	0.55
RML-9	1.90 * *	2.11 **	-10.37 **	-3.22	-0.58 *	0.19	2.89 **	-1.51 *	67.19**	-3.62**	-5.01
RML-10	0.73 *	0.38	14.24 *	3.25	-0.55 *	-0.10	1.41 **	-2.48 **	13.49	-0.43	-3.16
RML-11	1.01 * *	1.05 **	0.32	1.37	0.34	-0.38 *	0.97 **	-0.10	37.83**	-0.96	2.40
RML-12	-0.20	-0.11	1.66	-3.48	0.07	0.25	1.61 **	-0.09	64.02**	-0.54	13.17 *
RML-13	1.35 * *	1.77 **	-9.38 **	-10.27	-0.64 *	0.06	0.10	-0.38	-0.51	-1.26*	-6.72
RML-14	0.29	0.38	-9.26 **	-0.39	0.57 *	0.00	-0.42	4.21 **	48.02**	-1.43*	2.39
RML-15	-0.98 **	-1.00 *	3.68	-2.61	0.40	0.18	-0.36	0.33	-6.07	0.31	0.67
RML-17	0.01	0.16	0.41	0.88	-1.03 **	0.32	0.23	-1.93 *	-19.99	1.01	-4.01
RML-18	-1.31 * *	-0.89 *	-10.89 **	-13.36 **	-0.05	0.00	0.26	-1.09	-5.87	0.31	-2.69
RML-19	0.23	0.66	0.38	0.79	0.27	-0.33 *	-1.54 **	1.85 *	-33.53*	0.20	-8.15
RML-20	0.01	0.27	-1.96	-2.41	0.60 *	-0.97 **	-0.89 *	1.53 *	-10.57	-0.93	-6.39
RML-21	0.07	0.16	-2.29	0.83	-0.16	-0.34 *	-0.20	1.31	14.42	-2.21**	0.42
RML-22	-0.26	0.05	-2.70	-4.70 *	0.08	0.19	0.03	-2.11 **	-31.85*	0.14	-3.42
RML-23	-0.59	-0.94 *	1.45	2.42	0.41	0.09	-1.34 **	-0.12	-51.92**	4.70**	3.69
RML-24	-1.76 **	-2.16 **	-12.93	-8.40 **	-0.81**	-0.25	-0.05	-2.11 **	-32.91*	0.28	-9.71
RML-25	-0.09	-0.27	-0.64	1.38	0.30	-0.23	-1.25 **	0.10	-45.85 22**	0.59	-5.67

DOI: 10.5958/0975-928X.2017.00090.4

Table 3. Contd.,

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 (g)	Grain yield per plant (g)
RML-26	-0.42	-0.16	-4.29	-4.58 *	0.20	0.79 **	2.01 **	1.65*	109.20**	-3.15**	7.99
RML-27	-0.14	-0.00	8.79 **	0.62	0.32	1.08 **	0.97 **	0.83	53.20**	0.67	29.63 *
RML-28	0.46	0.27	8.28 *	4.29	-0.10	-0.02	0.37	-0.19	12.46	0.81	7.03
RML-30	-0.14	-0.05	4.28	-3.00	0.36	0.38 *	0.06	3.18 **	55.22**	-1.12*	19.28 *
RML-33	-0.26	-0.72	-9.30 **	-0.29	0.28	-0.37 *	-1.65 **	1.49 *	-41.59**	2.45**	-0.43
RML-34	-1.20 * *	-1.27 **	1.91	-1.23	0.79 **	-0.15	0.32	2.60 **	55.71**	-2.21**	4.57
RML-35	-0.26	0.05	10.29 **	3.18	0.15	1.20 **	1.01 **	0.41	47.66**	1.01	23.05
RML-36	0.07	0.61	2.49	8.41 **	0.82 **	-0.20	0.08	1.00	20.85	0.84	5.79
RML-37	-1.26 * *	-1.00 *	-0.08	-6.91 **	0.23	0.76 **	-0.18	-0.43	-12.30	2.23**	15.13*
RML-38	-1.09 * *	-1.11 **	5.97	4.42 *	-0.03	-0.43 **	-0.02	1.12	18.48	-0.71	-0.79
RML-39	0.40	0.66	6.47 *	1.08	-0.70 *	0.60 **	1.37 **	-0.00	55.53**	-2.62 **	5.75
RML-40	0.40	0.44	16.22 *	3.00	-0.35	0.25	-0.76 *	-1.73 *	-53.58**	4.01 **	0.70
RML-41	-0.70	-0.55	-7.86 *	-2.03	-0.08	-0.63 **	-1.74 **	-0.50	-73.54**	1.76 **	-14.11
RML-42	1.57 * *	1.55 **	-2.72	9.71 **	0.54 *	-0.31 *	-1.27 **	0.03	-47.89**	0.53	-7.75
RML-43	0.29	-0.05	1.90	-1.89	-0.05	0.14	-0.21	-1.22	-26.88*	1.28 *	0.12
RML-44	0.40	-0.00	-14.29 *	-1.00	-0.60 *	-0.03	-0.05	-1.02	-17.26	-1.04	-12.89
RML-45	-0.42	-0.27	3.62	5.75 *	0.21	-0.61 **	-0.67	-0.53	-32.95*	0.14	-4.12
RML-46	-1.20 * *	-0.55	2.47	-4.78 *	-0.12	0.58 **	0.69	-0.03	26.33	0.28	10.76
RML-49	0.40	0.33	4.00	1.06	0.27	0.07	-0.09	-1.89 *	-32.24*	2.98**	5.79
Testers											
RML-47	0.03	0.45**	-4.45	-0.02	0.00	-0.13 **	0.14	-0.41 *	-1.29	-0.94**	-6.29**
RML-48	0.14	0.19*	-0.86	-0.87	0.47 **	0.35 **	-0.08	1.41 **	17.51**	0.76 **	11.74**
RML-50	-0.17*	-0.26 **	5.32 **	0.89	-0.48 **	-0.21 **	-0.05	-0.99 **	-16.22**	0.18	-5.44 **
S.E.(Lines)	0.35	0.37	3.12	2.17	0.26	0.15	0.35	0.73	12.82	0.54	4.73
S.E.(Testers)	0.09	0.10	0.83	0.58	0.07	0.04	0.09	0.19	3.42	0.14	1.26

*, ** significant at 5% and 1% levels, respectively

Electronic Journal of Plant Breeding, 8(2): 591-600 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00090.4

Table 4. Estimates of specific combining ability (*sca*) effects for yield and its component characters in maize

S.No	Hybrids	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 (g)	Grain yield per plant (g)
1	RML-1 X RML-47	-0.31	-0.02	-2.56	0.51	-0.37	-0.04	-0.10	-1.00	-20.60	-1.28	-16.75*
2	RML-1 X RML-48	-0.09	-0.36	1.66	-2.74	0.56	-0.05	0.00	1.34	23.06	-0.74	10.78*
3	RML-1 X RML-50	0.40	0.37	0.90	2.23	-0.20	0.09	0.10	-0.35	-2.46	2.01 *	5.97
4	RML-3 X RML-47	-0.09	0.49	-11.33*	-5.44	0.42	-0.64 *	-1.80**	2.17	0.14	-2.33*	-15.38
5	RML-3 X RML-48	-0.03	-0.03	7.41	5.75	0.55	0.49	3.33**	-1.99	25.43	0.21	6.14
6	RML-3 X RML-50	0.12	-0.46	3.92	-0.32	-0.97	0.15	-1.53*	-0.18	-25.58	2.12 *	9.23
7	RML-4 X RML-47	-0.92	-1.13	1.59	-0.81	0.25	0.20	0.01	-0.21	-2.22	1.16*	5.61
8	RML-4 X RML-48	0.30	0.03	6.54	3.07	0.42	0.36	0.24	1.06	26.75	2.12*	13.51
9	RML-4 X RML-50	0.62	1.10	-8.13	-2.26	-0.67	-0.56*	-0.26	-0.86	-24.53	-3.29 **	-19.13*
10	RML-5 X RML-47	-0.92	-0.90	-5.78	-4.95	-0.14	0.19	-0.01	-0.10	-1.34	1.03	12.49
11	RML-5 X RML-48	-0.53	-0.42	11.74*	5.04	0.11	0.03	0.16	1.11	20.63	0.15	0.35
12	RML-5 X RML-50	1.45 *	1.32	-5.96	-0.09	0.03	-0.22	-0.14	-1.01	-19.29	-1.18	-12.85
13	RML-6 X RML-47	0.36	-0.02	5.07	4.00	0.28	-0.23	0.08	0.37	7.99	-2.13*	1.09
14	RML-6 X RML-48	0.08	0.31	2.61	-1.05	0.97 *	0.08	0.24	1.71	36.66	1.15*	8.55
15	RML-6 X RML-50	-0.44	-0.29	-7.68	-2.95	-1.25	0.15	-0.32	-2.08	-44.65	0.99	-9.65
16	RML-7 X RML-47	0.41	0.21	-2.07	-3.69	-0.02	-0.24	0.23	-1.24	-11.89	-0.92	-11.89
17	RML-7 X RML-48	-0.53	0.20	11.180*	3.53	0.06	0.45	-0.67	0.60	-13.35	1.13	13.33
18	RML-7 X RML-50	0.12	-0.40	-9.11	0.16	-0.05	-0.21	0.43	0.64	25.24	-0.21	-1.44
19	RML-8 X RML-47	-0.42	0.10	5.36	3.98	0.45	0.20	0.10	1.47	28.90	-1.61	11.42
20	RML-8 X RML-48	0.30	-0.42	5.70	4.29	0.25	0.38	-0.27	0.31	-5.86	2.09*	1.22
21	RML-8 X RML-50	0.12	0.32	-11.06*	-8.270 *	-0.70	-0.58 *	0.17	-1.78	-23.04	-0.49	-12.65
22	RML-9 X RML-47	-0.20	0.26	-1.34	-2.16	0.44	0.14	2.41**	-1.86	20.27	0.00	7.06
23	RML-9 X RML-48	0.36	0.25	0.84	-2.81	-0.09	-0.36	-0.59	1.78	33.31	-0.46	-7.04
24	RML-9 X RML-50	-0.16	-0.52	0.51	4.96	-0.35	0.22	-1.82**	0.09	-53.58	0.46	-0.01
25	RML-10 X RML-47	0.97	1.15	-5.16	-0.74	0.45	0.30	0.52	0.21	22.34	-1.61	-0.36
26	RML-10 X RML-48	-0.47	-0.53	10.19	5.55	-0.74	-0.31	-0.58	0.11	-16.14	-0.24	-4.29
27	RML-10 X RML-50	-0.49	-0.63	-5.04	-4.82	0.29	0.01	0.06	-0.32	-6.20	1.85	4.65
28	RML-11 X RML-47	0.52	0.82	-2.21	-0.12	0.30	-0.19	0.10	-0.61	-5.51	-2.66**	-7.66
29	RML-11 X RML-48	-0.25	-0.36	3.14	-1.11	-0.48	0.19	0.00	-0.20	-1.47	0.79	-0.69
30	RML-11 X RML-50	-0.27	-0.46	-0.93	1.23	0.18	0.00	-0.10	0.81	6.97	1.88	8.35
31	RML-12 X RML-47	-0.09	-0.02	2.56	2.60	0.16	-0.24	-0.21	1.08	8.77	-0.50	12.03
32	RML-12 X RML-48	0.30	0.47	-0.17	0.85	0.56	0.57 *	0.76	1.29	57.00*	0.21	13.46*
33	RML-12 X RML-50	-0.22	-0.46	-2.39	-3.45	-0.72	-0.34	-0.54	-2.37	-65.78	0.29	-25.50**

DOI: 10.5958/0975-928X.2017.00090.4

Table 4. Contd.,

S.No	Hybrids	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 (g)	Grain yield per plant (g)
34	RML-13 X RML-47	-0.64	0.10	-2.80	-0.01	0.39	-0.06	-0.10	-0.03	-3.40	-1.53	-0.29
35	RML-13 X RML-48	0.58	0.25	-5.09	-4.26	-0.53	0.25	0.40	-1.73	-11.21	0.60	-3.06
36	RML-13 X RML-50	0.06	-0.35	7.89	4.27	0.14	-0.20	-0.30	1.75	14.61	0.93	3.35
37	RML-14 X RML-47	-0.26	-0.02	-1.82	3.04	0.31	0.58 *	0.43	-1.73	-6.79	1.06	6.18
38	RML-14 X RML-48	0.64	0.81	-6.68	-8.51*	-0.43	-0.16	0.47	-0.69	9.60	-0.49	-6.78
39	RML-14 X RML-50	-0.38	-0.79	8.50	5.46	0.12	-0.42	-0.90	2.42	-2.81	-0.57	0.60
40	RML-15 X RML-47	-0.31	-0.63	-4.17	-1.34	0.14	-0.23	0.23	2.18	45.47 *	-0.94	10.63
41	RML-15 X RML-48	0.42	0.86	-1.49	-4.22	0.56	0.63 *	-0.27	-1.08	-27.94	0.60	-6.43
42	RML-15 X RML-50	-0.10	-0.24	5.65	5.55	-0.70	-0.40	0.03	-1.10	-17.53	0.35	-4.20
43	RML-17 X RML-47	-0.98	-0.46	4.83	2.93	-0.62	-0.10	0.23	-0.34	2.22	0.36	-2.57
44	RML-17 X RML-48	0.58	0.20	-2.75	1.12	0.16	0.17	-0.33	-0.57	-18.26	0.15	1.15
45	RML-17 X RML-50	0.40	0.26	-2.08	-4.05	0.46	-0.07	0.10	0.91	16.03	-0.51	1.41
46	RML-18 X RML-47	0.36	-0.24	-0.69	-3.86	-0.30	0.47	-0.12	-1.75	-32.73	1.06	-5.82
47	RML-18 X RML-48	0.08	0.25	-0.91	0.96	0.19	-0.16	0.38	1.45	40.34	-0.24	5.30
48	RML-18 X RML-50	-0.44	-0.02	1.60	2.90	0.11	-0.31	-0.26	0.30	-7.62	-0.82	0.52
49	RML-19 X RML-47	0.30	-0.29	-0.60	0.79	0.24	0.24	-0.52	1.37	1.21	0.50	0.19
50	RML-19 X RML-48	-0.47	-0.30	-10.35	-6.63	-0.28	-0.26	-0.02	-0.89	-17.43	0.21	-4.80
51	RML-19 X RML-50	0.17	0.60	10.95	5.84	0.03	0.02	0.55	-0.48	16.22	-0.71	4.61
52	RML-20 X RML-47	-0.14	-0.40	-2.69	-2.64	-0.16	0.10	-0.17	-0.02	-6.10	-0.69	-5.26
53	RML-20 X RML-48	0.08	0.42	-1.11	-0.38	0.60	-0.37	-0.07	0.19	-0.37	0.35	1.40
54	RML-20 X RML-50	0.06	-0.02	3.80	3.02	-0.44	0.28	0.23	-0.17	6.47	0.35	3.85
55	RML-21 X RML-47	-0.53	-0.96	3.98	0.58	-0.45	-0.32	-0.06	0.14	0.37	0.08	-7.88
56	RML-21 X RML-48	0.36	0.70	-2.31	-1.54	0.41	0.23	-0.36	0.11	-11.09	0.04	1.54
57	RML-21 X RML-50	0.17	0.26	-1.67	0.96	0.04	0.09	0.41	-0.25	10.72	-0.13	6.33
58	RML-22 X RML-47	0.80	0.32	0.96	2.82	-0.17	-0.17	0.30	-0.20	6.41	-0.61	-1.82
59	RML-22 X RML-48	-0.14	-0.03	4.64	0.97	0.74	0.31	-0.33	2.44	28.23	-0.65	3.90
60	RML-22 X RML-50	-0.66	-0.29	-5.59	-3.79	-0.57	-0.14	0.03	-2.25	-34.63	1.26	-2.07
61	RML-23 X RML-47	-0.87	-1.18	-2.63	-2.65	0.35	0.08	0.08	1.52	25.74	1.50	9.01
62	RML-23 X RML-48	0.19	0.14	5.71	3.17	-0.04	-0.23	0.18	0.45	12.23	-1.63	-5.15
63	RML-23 X RML-50	0.67	1.04	-3.08	-0.53	-0.31	0.15	-0.26	-1.97	-37.97	0.13	-3.86
64	RML-24 X RML-47	-0.03	-0.46	-2.68	-0.25	0.08	0.28	0.32	-0.16	10.48	0.42	-0.77
65	RML-24 X RML-48	-0.81	-0.30	3.84	5.67	-0.88	0.49	0.02	-1.56	-22.46	0.46	-2.64
66	RML-24 X RML-50	0.84	0.76	-1.16	-5.43	0.80	-0.77 **	-0.34	1.72	11.98	-0.88	3.41

DOI: 10.5958/0975-928X.2017.00090.4

Table 4. Contd.,

S.No	Hybrids	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 (g)	Grain yield per plant (g)
67	RML-25 X RML-47	0.63	0.49	0.27	-2.84	-0.26	-0.54	-0.21	-1.92	-36.38	0.78	-18.78*
68	RML-25 X RML-48	-0.31	-0.36	1.35	0.28	-0.36	0.14	0.22	-0.51	0.61	-0.26	6.01
69	RML-25 X RML-50	-0.33	-0.13	-1.61	2.55	0.62	0.40	-0.01	2.43	35.78	-0.51	12.77
70	RML-26 X RML-47	-0.20	0.04	1.48	-1.24	-0.53	-0.20	-0.68	-0.70	-39.06	1.19	-2.05
71	RML-26 X RML-48	0.03	0.03	-2.31	-1.68	-0.23	-0.54	0.02	-1.63	-25.61	-0.10	11.08*
72	RML-26 X RML-50	0.17	-0.07	0.83	2.92	0.76	0.74**	0.66	2.32	64.66 **	-1.10	-9.03
73	RML-27 X RML-47	0.36	0.54	-1.31	-0.11	-0.35	-0.18	-0.37	-1.32	-36.61	0.94	-5.86
74	RML-27 X RML-48	-0.42	-0.64	2.74	5.17	-0.15	0.02	0.33	-0.48	7.98	-0.26	4.20
75	RML-27 X RML-50	0.06	0.10	-1.43	-5.06	0.49	0.16	0.03	1.80	28.62	-0.68	1.65
76	RML-28 X RML-47	0.58	0.76	-0.90	-0.01	0.52	0.20	-0.57	0.02	-21.48	0.31	1.64
77	RML-28 X RML-48	-0.36	-0.58	-0.75	-3.00	-0.72	-0.64*	-0.20	-0.65	-16.53	0.35	-6.30
78	RML-28 X RML-50	-0.22	-0.18	1.65	3.01	0.21	0.44	0.77	0.63	38.01	-0.65	4.66
79	RML-30 X RML-47	-0.14	0.76	-2.80	-5.18	0.30	0.52	0.28	1.67	39.79	0.17	17.16 *
80	RML-30 X RML-48	0.42	-0.08	1.65	3.04	0.38	-0.04	-0.42	-0.36	-22.01	-0.54	-1.91
81	RML-30 X RML-50	-0.27	-0.68	1.15	2.14	-0.68	-0.49	0.15	-1.31	-17.78	0.38	-15.25
82	RML-33 X RML-47	0.13	0.10	1.16	-0.39	0.50	-0.05	-0.35	1.56	9.21	0.42	9.88
83	RML-33 X RML-48	0.03	-0.08	-3.17	1.09	-0.59	-0.20	-0.25	-0.94	-24.07	-1.63	-13.55
84	RML-33 X RML-50	-0.16	-0.02	2.01	-0.70	0.09	0.25	0.59	-0.62	14.86	1.21	3.67
85	RML-34 X RML-47	0.58	0.32	-2.37	-0.41	-0.12	-0.17	-0.06	-0.25	-6.32	-0.25	0.67
86	RML-34 X RML-48	0.30	0.31	-8.12	1.77	-0.20	-0.01	-0.02	-1.31	-20.01	-0.54	-14.86
87	RML-34 X RML-50	-0.88	-0.63	10.49	-1.36	0.32	0.19	0.08	1.57	26.33	0.79	14.19
88	RML-35 X RML-47	0.47	0.49	1.66	3.43	-0.49	0.07	-0.28	-0.13	-12.48	-0.89	-8.33
89	RML-35 X RML-48	-0.14	-0.19	-4.30	0.08	-0.18	-0.35	-0.11	-0.69	-13.80	0.57	-0.07
90	RML-35 X RML-50	-0.33	-0.29	2.64	-3.52	0.67	0.28	0.39	0.82	26.28	0.32	8.41
91	RML-36 X RML-47	0.30	0.43	2.99	3.57	0.59	0.14	0.19	1.65	34.81	0.86	5.15
92	RML-36 X RML-48	-0.81	-0.75	0.14	-2.45	0.07	-0.23	0.02	1.02	18.38	-1.68	-0.05
93	RML-36 X RML-50	0.51	0.32	-3.13	-1.12	-0.66	0.09	-0.21	-2.66*	-53.19	0.82	-5.09
94	RML-37 X RML-47	0.47	0.21	-1.90	-1.74	-0.47	-0.37	-0.41	-0.97	-29.53	0.81	-6.99
95	RML-37 X RML-48	-0.14	-0.30	3.88	6.95	0.32	0.50	-0.18	0.20	-3.41	0.68	6.10
96	RML-37 X RML-50	-0.33	0.10	-1.98	-5.22	0.15	-0.13	0.59	0.78	32.93	-1.49	0.89
97	RML-38 X RML-47	0.13	-0.18	2.71	1.32	0.10	-0.07	0.03	-0.54	-7.76	0.83	-1.56
98	RML-38 X RML-48	0.03	0.14	-5.18	-1.33	0.11	0.30	0.40	0.16	20.78	-0.79	2.33
99	RML-38 X RML-50	-0.16	0.04	2.46	0.01	-0.21	-0.23	-0.43	0.38	-13.03	-0.04	-0.77

DOI: 10.5958/0975-928X.2017.00090.4

Table 4. Contd.,

S.No	Hybrids	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 (g)	Grain yield per plant (g)
100	RML-39 X RML-47	0.13	-0.13	3.68	2.00	-0.37	-0.11	-0.30	1.69	16.54	0.25	-0.67
101	RML-39 X RML-48	0.53	0.53	-3.24	-0.65	-0.40	-0.50	-0.20	-1.57	-28.60	-0.38	-10.34
102	RML-39 X RML-50	-0.66	-0.40	-0.44	-1.35	0.77	0.61*	0.50	-0.12	12.06	0.13	11.01
103	RML-40 X RML-47	-0.70	-1.24	-0.38	2.48	0.59	0.38	0.37	2.23	48.39*	1.78	22.70*
104	RML-40 X RML-48	0.19	0.09	1.37	1.66	0.30	-0.12	-0.40	0.03	-14.70	-1.43	-3.26
105	RML-40 X RML-50	0.51	1.15	-0.99	-4.14	-0.89	-0.26	0.03	-2.26	-33.69	-0.35	-19.44
106	RML-41 X RML-47	0.08	-0.24	3.01	2.25	-0.24	-0.22	-0.06	-1.71	-25.50	1.94*	-1.33
107	RML-41 X RML-48	0.14	0.25	-4.48	-4.36	0.05	0.00	0.04	1.23	18.38	-0.85	0.32
108	RML-41 X RML-50	-0.22	-0.02	1.46	2.11	0.19	0.22	0.01	0.48	7.12	-1.10	1.01
109	RML-42 X RML-47	0.47	0.49	-0.82	-1.64	-0.33	0.31	-0.26	-0.55	-16.51	1.25	0.00
110	RML-42 X RML-48	-0.97	-0.86	-2.38	-0.95	0.42	-0.06	0.04	1.29	19.25	-0.71	4.82
111	RML-42 X RML-50	0.51	0.37	3.20	2.59	-0.09	-0.25	0.21	-0.73	-2.74	-0.54	-4.81
112	RML-43 X RML-47	0.58	0.76	1.18	1.88	-0.80	-0.22	-0.15	-0.92	-19.87	0.17	-3.31
113	RML-43 X RML-48	-0.36	-0.42	0.36	-0.11	0.08	-0.29	-0.21	0.32	-2.30	0.54	-1.52
114	RML-43 X RML-50	-0.22	-0.35	-1.54	-1.77	0.72	0.51	0.36	0.60	22.16	-0.71	4.83
115	RML-44 X RML-47	-0.20	-0.13	3.28	-1.18	-0.39	0.14	0.32	-0.75	0.71	0.00	1.67
116	RML-44 X RML-48	-0.14	-0.30	-0.81	-1.80	-0.49	-0.26	-0.51	-1.35	-37.83	0.79	-7.56
117	RML-44 X RML-50	0.34	0.43	-2.47	2.97	0.87	0.12	0.19	2.10	37.12	-0.79	5.89
118	RML-45 X RML-47	-0.20	0.32	3.06	1.33	0.27	-0.26	-0.12	1.43	18.72	-1.61	-5.69
119	RML-45 X RML-48	0.53	0.31	-8.73	-6.08	-0.67	0.14	-0.22	-0.90	-22.89	0.60	-5.33
120	RML-45 X RML-50	-0.33	-0.63	5.68	4.75	0.41	0.12	0.35	-0.52	4.17	1.01	11.02
121	RML-46 X RML-47	0.25	0.43	-6.12	-2.20	-0.78	-0.19	0.41	-1.84	-16.52	-0.38	-17.71*
122	RML-46 X RML-48	-0.36	-0.42	1.52	2.08	-0.50	-0.21	-0.59	0.26	-15.56	-0.75	1.71*
123	RML-46 X RML-50	0.12	-0.02	4.60	0.12	1.28 **	0.40	0.18	1.58	32.08	0.29	16.00
124	RML-49 X RML-47	-0.70	-0.96	16.31**	6.05	0.22	0.49	0.23	0.08	10.07	1.47	14.18
125	RML-49 X RML-48	0.86	1.20	-13.88*	-6.46	0.09	-0.37	-0.47	0.65	-5.74	-1.32	-11.58
126	RML-49 X RML-50	-0.16	-0.24	-2.44	0.41	-0.31	-0.12	0.23	-0.73	-4.33	-0.15	-2.59
	S.E.	0.61	0.65	5.40	3.76	0.46	0.27	0.61	1.26	22.20	0.93	8.20

*, ** Significant at 5 and 1 per cent level, respectively