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Identification of potential maize (*Zea mays* L.) hybrid at Kanpur agroclimatic condition

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Abstract
In the present investigation, heterosis, combining ability effects and yield related parameters were studied for various traits to developed and identify suitable and stable single cross hybrids. The analysis of variance for experimental design revealed the presence of significant amount of variability for most of the characters in the experiment. This suggested that the parental lines selected were quite variable for most of the characters under study. Further, the analysis of variance revealed that genotypes showed significance for all the traits indicating the presence of sufficient variability in the experiment/ study material. Presence of sufficient amount of variability encourages for screening of the genotypes for yield.
The *per se* performance of days to 50% tasseling, days to 50 % silking and anthesis silking interval revealed that the hybrids IL7 X IL8, IL1 X IL11, IL9 X IL12, IL9 X IL12 and IL5 X IL7 showed minimum value. On the basis of mean data we can identify the early maturity hybrids. Mean data revealed that yield and yield contributing traits revealed that the hybrids IL1 X IL8, IL7 X IL8, IL9 X IL10 and IL1 X IL3 showed maximum value. On the basis of mean data we can identify the high yielding genotypes hybrids.

Keywords: Maize, hybrid, per se performance, inbreed line

Introduction

Maize (*Zea mays* L.) 2n=20 is one of the most important cereal crops of the world and contributes to food security in most of the developing countries. Maize is third most important crop after rice and wheat in the world. Maize has assumed a place of prominence in Indian agriculture owing to its varied uses *viz*., human consumption, poultry feed, green fodder, value added products and industrial usage. Globally 67 percent of maize is used for livestock feed, 25 percent for human consumption and rest for industrial purposes. In addition to staple food for human being and quality feed for animals, maize serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries etc. Corn starch (Approximately 70 percent starch) is a major ingredient in home cooking and in many industrialized food products. Oil content of maize grain is about 4.5 percent, which has a high nutritional quality *i.e.,* it is being considered as the highest Poly Unsaturated Fatty Acid (PUFA), linoleic acid (61.99%). Maize contains 9% protein. Protein present in maize is called as Zein. Zein has a variety of industrial and food uses. There is a strong possibility to develop hybrids having higher yielding ability and nutritionally superior and industrially important with respect to high starch, protein and oil content. There is no other cereal crop which has immense potential as maize and therefore, maize occupies the unique place as “Queen of cereals” or “Miracle Crop”.
By origin, maize is native to South America. It is a seasonal crop and annually it can be harvested thrice, *i.e.* in *kharif, rabi* and *summer* seasons. In Rajasthan, it is grown as a major *kharif* season crop in major maize growing districts whereas *rabi* area is increasing in Banswara and Dungarpur district of the state where irrigation facilities are available. So that, *rabi* maize is gaining popularity among farmers and multinationals because of higher yield potential, long growing season, dry and cool temperatures and assured irrigation facilities.

In India, it is cultivated on an area of 98 lakh ha with production of 261.4 lakh tonnes and productivity 2679 kg/ha ha (Anonymous 2016-17), while in Rajasthan it occupied an area of 9.19 lakh ha with production of 13.79 lakh tonnes and productivity of 1501 kg /ha (Anonymous 2017). The productivity of maize in Rajasthan is very low than national productivity. Maize is highly allogamous crop and it has been successfully exploited in the production of hybrids (Venkatesh *et al.*, 2003) [10]. Paul and Duara (1991) [11] pointed out that the combining ability gave useful information on the choice of parents in terms of expected performance of the hybrids and their progenies. In India, development of maize hybrids was aimed mainly to capitalize on the expression of heterosis for grain yield. Very less emphasis was given for exploitation of heterosis for quality traits like oil, protein and starch. There is strong possibility to develop maize hybrids which are nutritionally superior and industrially important with respect to high oil, protein and starch content.

Materials and Methods

Experimentation Site

The field experiment was conducted at Breeding material developments and Field experiments will be done in the Agricultural Research Farm, Faculty of Agricultural Sciences & Allied Industries, Rama University, Mandhana, Kanpur during Kharif, 2023-24.

Experimental Materials

The 12 inbred lines of maize obtained from Faculty of Agricultural Sciences & Allied Industries, Rama University, Mandhana, Kanpur.

Result and Discussion

Analysis of variance for experimental design

Analysis of variance was performed to test the difference amongst parents and hybrids for all the ten traits and the result are presented in Table 1. The results revealed that the mean squares due to genotypes were highly significant for all the characters studied. The mean squares due to genotypes were further partitioned into parents, hybrids and parents vs. hybrids.

Table 1A: Analysis of variance for combining ability for different characters studied in maize (*Zea Mays* L.)

Source of Variations	df	DFF	DFS	ASI	PH	CL	NKRC	NKR	HGW	SYP	NCP	DM
Treatments	77	16432.45***	159.86***	323.35***	1289.42***	6.88***	694.14***	65.03***	3590.61***	1652.03***	41.78***	2475.05***
Parents	11	24445.45***	245.59***	258.33***	2744.29***	3.39***	833.60***	91.91***	4588.89***	801.30***	39.17***	3396.96***
Hybrids	65	13365.43***	122.75***	304.54***	866.82***	6.48***	652.24***	40.63***	3444.49***	1550.33***	42.69***	2304.61***
Parents vs. Hybrids	1	127645.68***	1629.12***	2261.59***	12754.91***	71.25***	1883.08***	1355.02***	2107.05***	17620.77***	11.13**	3412.82***
Error	154	48.19	0.59	14.90	1.68	0.59	41.07	2.07	40.87	1.18	1.11	48.19
Total	233	30765.27	318.82	197.26	1086.77	2.26	208.19	20.27	1011.92	416.49	12.45	56643.02

Per se performance of parents and their hybrids

The characters days to 50% flowering, days to maturity, plant height, the low scoring parent was considered as better parent. On the hand the parent with high yield and high oil content is also consider as better parents. The salient findings are described character wise in the next section.

Mean data revealed those days to 50% tasseling ranged from 59.50 days (IL11) to 107.50 days (IL1) and 55.00 days (IL7 X IL8) to 112.00 days (IL2 X IL12) for parents and hybrids respectively. The grand mean was of 77.01 days while the 77.01, 72.06 and 77.91 mean was observed for parents, hybrids and checks respectively. Mean data revealed those days to 50 % silking ranged from 63.25 days (IL11) to 112.75 days (IL1) and 58.50 days (IL7 X IL8) to 114.75 days (IL3 X IL12) for parents and hybrids respectively. The grand mean was of 80.89 days while the 75.94, 81.79 and 95.75 mean was observed for parents, hybrids and checks respectively.

Mean data revealed that anthesis silking interval ranged from 2.25 days (IL7) to 5.25 days (IL1) and 1.75 days (IL1 X IL11) to 6.50 days (IL4 X IL5) for parents and hybrids respectively. The grand mean was of 3.91 days while the 3.92, 3.91 and 5.25 mean was observed for parents, hybrids and checks respectively.

Mean data revealed that plant height ranged from 108.30 cm (IL3) to 186.13 cm (IL7) and
80.40 cm (IL4 X IL5) to 199.28 (IL9 X IL10) for parents and hybrids respectively.
The grand mean was of 138.30 cm while the 148.81, 136.39 and 88.74 cm mean was observed for parents, hybrids and checks respectively.

Mean data revealed that cob length ranged from 12.56 cm (IL11) to 15.18 cm (IL3) and
11.53 cm (IL1 X IL12) to 16.05 cm (IL1 X IL10) for parents and hybrids respectively. The grand mean was of 13.62 cm while the 13.22, 13.69 and 13.77 cm mean was observed for parents, hybrids and checks respectively.

Mean data revealed that Number of kernel rows per cob ranged from 11.68 (IL2) to 15.68 (IL10) and 10.09 (IL6 X IL11) to 15.12 (IL5 X IL8) for parents and hybrids respectively. The grand mean was of 13.29 while the 13.76, 13.20 and 13.43 mean was observed for parents, hybrids and checks respectively.

Mean data revealed that numbers of kernel per rows ranged from 18.86 (IL3) to 26.39 (IL8) and 14.85 (IL2 X IL12) to 29.40 (IL5 X IL10) for parents and hybrids respectively. The grand mean was of 21.18 while the 22.26, 20.98 and 19.63 mean was observed for parents, hybrids and checks respectively.

Mean data revealed that 100 grain weight ranged from 17.81(g) (IL2) to 24.37 (g) (IL12) and 16.51(g) (IL5 X IL12) to 25.31 (g) (IL8 X IL9) for parents and hybrids respectively. The grand mean was of 21.15(g) while the 21.92, 21.02 and 19.97(g) mean was observed for parents, hybrids and checks respectively.

Mean data revealed that yield per plant ranged from 50.14 (g) (IL6) to 97.14 (g) (IL9) and
38.63 (g) (IL5 X IL9) to 108.95 (g) (IL6 X IL10) for parents and hybrids respectively.
The grand mean was of 72.02 (g) while the 73.13, 71.82 and 74.12 (g) mean was observed for parents, hybrids and checks respectively.

Mean data revealed that numbers of cobs per plant ranged from 1.30 (IL8) to 2.45 (IL7) and 1.38 (IL7 X IL11) to 2.45 (IL2 X IL8) for parents and hybrids respectively. The grand mean was of 1.85 while the 1.86, 1.84 and 1.90 mean was observed for parents, hybrids and checks respectively.

Mean data revealed those days to maturity ranged from 95.75 days (IL9) to 114.50 days (IL2) and 92.00 days (IL9 X IL12) to 150.25 days (IL1 X IL4) for parents and hybrids respectively. The grand mean was of 120.14 days while the 112.81, 121.47 and 143.38 mean was observed for parents, hybrids and checks respectively.

Table 3: Mean performances of parents and their crosses for various characters

Genotypes	DFF	DFS	ASI	PH	CL	NKRC
IL1	107.50	112.75	5.25	108.59	12.85	12.03
IL2	84.00	88.25	4.25	124.55	13.15	11.68
IL3	95.25	100.00	4.75	108.30	15.18	13.75
IL4	83.50	87.75	4.25	122.80	12.66	15.00
IL5	62.75	65.75	3.00	177.61	12.65	14.68
P6	64.00	67.25	3.25	170.23	12.64	13.32
IL7	62.25	64.00	2.25	186.13	12.95	12.28
IL8	61.50	65.50	4.00	168.45	13.79	14.54
IL9	61.75	66.00	4.25	160.10	13.86	14.72
IL10	61.00	65.25	4.25	172.80	13.26	15.68
IL11	59.50	63.25	3.75	133.73	12.56	13.82
IL12	61.75	65.50	3.75	152.44	13.09	13.61
IL1 X IL2	84.00	87.75	3.75	116.61	14.73	12.87
IL1 X IL3	92.25	95.75	3.50	110.60	13.55	12.63
IL1 X IL4	91.25	95.25	4.00	109.18	13.50	14.30
IL1 X IL5	84.75	89.75	5.25	112.35	13.05	13.30
IL1 X IL6	90.50	94.25	4.00	126.84	12.88	12.70
IL1 X IL7	96.50	100.00	3.50	115.44	11.78	13.68
IL1 X IL8	90.00	94.50	4.50	107.10	13.10	12.60
IL1 X IL9	83.75	88.75	5.00	131.83	14.80	13.67
IL1 X IL10	86.50	91.50	5.00	106.00	16.05	12.65
IL1 X IL11	86.00	87.50	1.75	138.82	13.92	13.53
IL1 X IL12	91.50	96.25	4.75	140.11	11.53	12.53
IL2 X IL3	96.00	99.00	3.00	98.75	13.65	12.46
IL2 X IL4	83.25	88.50	5.25	121.76	12.04	13.58
IL2 X IL5	91.25	95.75	4.50	107.93	14.30	13.46
IL2 X IL6	98.00	103.00	5.00	106.12	14.22	10.30
IL2 X IL7	106.00	109.50	3.50	100.84	13.88	13.37
IL2 X IL8	81.75	87.25	5.50	145.74	12.98	12.38
IL2 X IL9	82.50	87.25	4.75	99.90	14.75	13.50
IL2 X IL10	84.50	89.00	4.50	109.61	15.03	13.22
IL2 X IL11	96.50	99.50	3.00	96.48	11.60	11.15
IL2 X IL12	112.00	114.75	2.75	95.80	14.35	11.47
IL3 X IL4	96.00	101.00	5.00	123.21	13.94	14.34
IL3 X IL5	86.00	89.00	3.00	119.76	13.23	12.37
IL3 X IL6	83.00	88.75	5.75	113.54	12.88	14.09
IL3 X IL7	84.25	89.25	5.00	115.08	15.60	12.05
IL3 X IL8	96.00	100.25	4.50	148.59	14.38	14.47
IL3 X IL9	100.75	104.75	4.00	111.84	13.87	14.37
IL3 X IL10	84.25	88.25	4.00	144.28	14.30	14.08
IL3 X IL11	99.75	103.75	4.00	95.14	13.58	14.30
IL3 X IL12	110.50	114.75	4.25	104.99	13.48	14.07
IL4 X IL5	85.00	91.50	6.50	80.40	14.65	13.25
IL4 X IL6	96.25	100.00	4.00	97.08	12.90	13.60
IL4 X IL7	97.50	103.50	6.00	108.94	12.37	12.89
IL4 X IL8	98.25	103.00	4.75	115.08	12.30	13.45
IL4 X IL9	101.75	106.75	5.00	102.48	13.30	12.95
IL4 X IL10	66.00	69.50	3.75	114.60	13.64	12.38
IL4 X IL11	64.50	68.25	3.75	156.13	14.53	13.23
IL4 X IL12	64.75	68.75	4.00	164.33	13.25	12.90
IL5 X IL6	65.75	69.50	3.75	160.69	12.48	14.15
IL5 X IL7	67.00	69.00	2.00	158.14	12.29	13.73
IL5 X IL8	59.50	64.00	4.50	180.29	13.04	15.12
IL5 X IL9	64.00	67.25	3.25	149.36	12.75	12.96
IL5 X IL10	58.75	61.25	2.50	187.23	15.08	13.48
IL5 X IL11	59.50	63.50	4.00	143.48	15.92	12.74
IL5 X IL12	63.50	65.75	2.25	155.55	13.40	14.21
IL6 X IL7	64.50	66.50	2.00	170.58	14.14	11.85
IL6 X IL8	60.00	63.75	3.75	167.61	14.33	12.26
IL6 X IL9	57.75	61.25	3.50	161.97	13.00	13.99
IL6 X IL10	58.75	62.25	3.50	168.32	14.35	13.61
IL6 X IL11	60.50	64.00	3.50	163.49	14.06	10.09
IL6 X IL12	61.50	65.25	3.75	181.60	14.07	13.40
IL7 X IL8	55.00	58.50	3.50	167.18	14.75	13.13
IL7 X IL9	63.00	66.75	3.75	181.35	14.54	13.10
IL7 X IL10	61.00	63.75	2.75	176.26	12.33	12.21
IL7 X IL11	64.50	67.50	3.00	164.71	14.21	11.50
IL7 X IL12	61.75	66.50	4.75	158.13	13.76	13.67
IL8 X IL9	63.50	67.25	3.75	173.99	14.39	13.29
IL8 X IL10	61.50	66.50	5.00	140.41	14.15	14.89
IL8 X IL11	60.75	62.75	2.00	182.03	14.86	11.51
IL8 X IL12	62.50	66.25	3.75	163.09	13.54	14.14
IL9 X IL10	63.25	65.75	2.50	199.28	13.52	14.11
IL9 X IL11	61.25	65.75	4.50	167.92	13.28	14.10
IL9 X IL12	55.50	59.00	3.50	151.18	13.60	14.52
IL10 X IL11	63.00	65.25	2.25	112.16	14.23	13.05
IL10 X IL12	60.25	63.75	3.50	154.75	13.47	14.29
IL11 X IL12	60.75	64.00	3.25	147.76	12.52	14.36
Check 1	85.00	91.50	6.50	80.40	14.65	13.25
Check 2	96.25	100.00	4.00	97.08	12.90	13.60
Grand Mean	77.01	80.89	3.91	138.30	13.62	13.29
Patent Mean	72.06	75.94	3.92	148.81	13.22	13.76
F1 Mean	77.91	81.79	3.91	136.39	13.69	13.20
Check Mean	90.63	95.75	5.25	88.74	13.77	13.43
C.V.	9.06	8.42	29.11	12.33	9.46	8.37
C.D. 5%	9.72	9.49	1.59	23.75	1.79	1.55
S.E.	3.49	3.40	0.57	8.52	0.64	0.56

Genotypes	NKR	HGW	SYP	NCP	DM
IL1	22.62	19.23	63.33	1.65	141.00
IL2	18.91	17.81	55.29	2.23	144.50
IL3	18.86	23.52	83.78	1.58	143.25
IL4	22.69	22.25	72.84	2.09	143.50
IL5	23.92	22.85	86.77	1.88	98.75
P6	21.06	21.87	50.14	1.95	97.00
IL7	22.42	22.77	53.60	2.45	99.25
IL8	26.39	21.40	86.16	1.30	96.00
IL9	24.59	22.89	97.14	1.88	95.75
IL10	25.98	24.19	74.69	1.95	96.50
IL11	19.87	19.89	66.02	1.88	99.00
IL12	19.78	24.37	87.83	1.55	99.25
IL1 X IL2	21.22	20.80	75.76	1.94	138.50
IL1 X IL3	20.59	19.50	53.71	2.15	147.25
IL1 X IL4	23.15	22.07	83.73	1.94	150.25
IL1 X IL5	21.80	19.15	76.30	2.30	149.25
IL1 X IL6	16.99	17.80	63.80	1.95	147.50
IL1 X IL7	20.06	21.88	72.23	2.10	148.00
IL1 X IL8	17.83	19.50	44.62	2.00	146.50
IL1 X IL9	26.11	19.22	93.17	1.71	150.75
IL1 X IL10	21.48	22.43	83.46	2.00	143.00
IL1 X IL11	19.09	16.88	62.62	2.15	143.00
IL1 X IL12	16.86	20.43	49.33	1.73	142.00
IL2 X IL3	21.52	24.64	77.54	1.84	140.00
IL2 X IL4	19.90	21.39	72.57	2.15	139.75

IL2 X IL5	20.27	20.03	99.95	2.08	137.25
IL2 X IL6	16.60	21.45	47.60	1.75	142.00
IL2 X IL7	21.82	19.85	81.21	1.86	141.00
IL2 X IL8	19.46	20.93	53.74	2.45	135.75
IL2 X IL9	26.26	20.45	69.13	1.80	136.00
IL2 X IL10	23.36	19.48	85.62	1.93	143.00
IL2 X IL11	16.93	21.94	54.63	1.93	142.50
IL2 X IL12	14.85	18.93	43.49	1.45	145.00
IL3 X IL4	23.77	21.44	85.99	1.45	146.50
IL3 X IL5	21.02	22.68	79.82	1.80	144.50
IL3 X IL6	16.86	23.10	65.77	1.69	142.50
IL3 X IL7	23.26	21.03	76.41	1.55	140.25
IL3 X IL8	18.47	20.74	72.03	1.69	149.00
IL3 X IL9	22.16	22.35	91.85	1.88	145.25
IL3 X IL10	21.95	21.40	83.54	1.63	143.75
IL3 X IL11	18.58	20.48	77.92	2.00	143.75
IL3 X IL12	22.22	24.20	71.76	1.50	144.00
IL4 X IL5	15.94	19.00	81.80	2.00	142.00
IL4 X IL6	23.33	20.94	66.45	1.80	144.75
IL4 X IL7	17.25	19.55	68.07	1.88	142.00
IL4 X IL8	15.51	19.28	52.62	1.48	145.25
IL4 X IL9	17.85	23.09	78.86	1.55	148.25
IL4 X IL10	22.39	19.02	64.82	1.50	94.50
IL4 X IL11	23.61	21.03	81.82	2.00	95.00
IL4 X IL12	23.07	19.60	52.90	1.94	94.25
IL5 X IL6	24.15	20.17	78.09	2.15	95.25
IL5 X IL7	17.82	17.79	62.49	2.15	99.50
IL5 X IL8	23.12	24.04	77.34	2.03	97.50
IL5 X IL9	20.71	20.25	38.63	2.00	94.50
IL5 X IL10	29.40	19.30	100.07	1.90	93.25
IL5 X IL11	23.72	23.08	83.67	1.94	95.00
IL5 X IL12	20.74	16.51	62.16	2.15	94.50
IL6 X IL7	19.42	17.18	51.33	1.65	98.50
IL6 X IL8	22.95	24.98	85.12	1.94	96.00
IL6 X IL9	21.65	22.79	68.92	2.05	95.25
IL6 X IL10	23.88	19.24	108.95	2.15	95.75
IL6 X IL11	15.80	22.14	48.83	1.75	96.50
IL6 X IL12	27.48	19.76	82.80	1.63	94.50
IL7 X IL8	24.04	19.73	71.18	1.80	97.50
IL7 X IL9	25.48	21.52	90.62	1.88	98.50
IL7 X IL10	18.28	22.58	53.81	1.96	97.50
IL7 X IL11	15.33	17.84	47.98	1.38	96.50
IL7 X IL12	20.15	23.34	84.70	1.53	98.25
IL8 X IL9	23.78	25.31	81.54	1.80	98.00
IL8 X IL10	19.67	23.38	68.14	1.56	98.50
IL8 X IL11	24.13	21.72	79.74	1.63	96.75
IL8 X IL12	19.99	21.99	72.54	2.00	98.00
IL9 X IL10	23.78	22.57	84.84	1.50	96.75
IL9 X IL11	21.54	20.55	80.29	1.88	95.25
IL9 X IL12	25.02	24.70	75.44	1.50	92.00
IL10 X IL11	17.52	25.31	86.86	1.94	97.50
IL10 X IL12	25.36	22.72	66.13	1.80	97.25
IL11 X IL12	16.86	18.97	51.55	1.63	99.25
Check 1	15.94	19.00	81.80	2.00	142.00
Check 2	23.33	20.94	66.45	1.80	144.75
Grand Mean	21.18	21.15	72.02	1.85	120.14
Patent Mean	22.26	21.92	73.13	1.86	112.81
F1 Mean	20.98	21.02	71.82	1.84	121.47
Check Mean	19.63	19.97	74.12	1.90	143.38
C.V.	16.28	13.15	21.83	15.93	1.74
C.D. 5%	4.80	3.87	21.91	0.41	2.92
S.E.	1.72	1.39	7.86	0.15	1.05

Discussion

In order to exploit heterosis, choice of suitable parents is an important step. The selection of parents depends on factors like *per se* performance of the parents and their combining ability. The concept of general and specific combining ability (Sprague and Tatum, 1942) helps the breeder in choosing the lines to be used as parents in the production of hybrids and also in identifying the superior hybrids having additive and non-additive genes. It is therefore necessary to assess the genetic potential of the parents in hybrid combination through systematic studies in relation to general and specific combining ability which are due to additive and non-additive gene actions. Thus, the information regarding heterosis, combining ability and nature of gene action are the basic requirements for a thorough understanding of genetic architecture of yield and its components.

The analysis of variance for experimental design revealed the presence of significant amount of variability among parents for most of the characters in the experiment. This suggested that the parental lines selected were quite variable for most of the characters under study. Further, the analysis of variance revealed that the variation due to moisture stress at two different times affect genotypes significantly for all the traits indicating the presence of sufficient variability in the experiment/ study material. Presence of sufficient amount of variability encourages for screening of the genotypes for moisture stress tolerance.

Hybrid is one of the greater practical contributions of genetics and has its most significant expression in maize crop. The breeding strategy for exploitation of heterosis in maize (*Zea mays* L) through the cultivation of single cross hybrids is primarily development on the development and identification of high *per se* performance diverse, vigorous and productive inbred lines with good seed quality in cross combinations to identify single crosses with high heterotic effects.

Genetic parameters like heterosis and combining ability provide adequate guide lines for selection of parents/crosses for getting desirable segregants/ exploitation of heterosis. Various mating design are available to derive information about the combining ability but for present study diallel mating design was used because in this design more number of parents and hybrids can be evaluated for their genetic worth.

The *per se* performance of days to 50% tasseling, days to 50 % silking and anthesis silking interval revealed that the hybrids IL7 X IL8, IL1 X IL11, IL9 X IL12, IL9 X IL12 and IL5 X IL7 showed minimum value. On the basis of mean data we can identify the early maturity hybrids. Mean data revealed that yield and yield contributing traits revealed that the hybrids IL1 X IL8, IL7 X IL8, IL9 X IL10 and IL1 X IL3 showed maximum value. On the basis of mean data we can identify the high yielding genotypes hybrids.

Conclusion

The ultimate choice of parents to be used in a breeding programme is determined by *per se* performance and their behavior in hybrid combination. It is therefore, necessary to assess genetic potentialities of the parents in hybrid combination through systematic studies in relation to general and specific combining abilities. The combining ability elucidates the nature of gene action involved in the inheritance of a trait. The general combining ability is attributed to additive, additive x additive interactions and is fixable in nature. On the other hand, specific combining ability is attributed to non-additive (*i.e.* dominance, dominance x dominance and additive x dominance) gene action and it is non- fixable.

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