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Estimation of SCA effects and corresponding mean performance of crosses in F_1 and F_2 generations obtained from 10-parent diallel cross in Indian mustard

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Abstract
This study was cried out during the years 1997-98 and 1998-99 in *Rabi* season on research farm of the Brahmanand Mahavidyalya Rath, Hamirpur UP, India. Data were recorded and analysed. Three hybrid combinations namely CSR 1020 x CSR 1102, CSR 1014 x CSR 1066 and CSR 1020 x CSR 1027 showed significant and desirable SCA effects for seed yield. These crosses also showed highest per se performance for days to flowering, number of secondary branches per plant, number of siliquae per main shoot, seeds per siliqua and oil content respectively. It clearly indicated the involvement of additive and additive interaction effects.
Crosses CSR 1118 x CSR 1104, CSR 1082 x CSR 1025, CSR 1082 x CSR 1102, CSR 1014 x CSR 1102 and CSR 1066 x CSR 1104 in F_1; CSR 1088 x CSR 1025, CSR 1088 x CSR 1082, CSR 1014, x CSR 1082, CSR 1020 x CSR 1118, CSR 1020 x CSR 106 and CSR 1088 x CSR 1014 in F2 exhibited significant and desirable SCA effects involving one parent with desirable GCA effects and other parent with undesirable GCA effects, which means high x low general combiners. The combination which possessed high SCA effects with one good and with one poor combiner is the indicative of the presence of dominance and epistatic nature of gene effects. Such cross could produce desirable transgressive segregants.
Two crosses in F_2 revealed significant and desirable SCA effects when both the parents involved in the combination expressed GCA effects (Low x Low) general combiners. These combinations were CSR 1014 x CSR 1066 and CSR 1066 x CSR 1102. Such hybrid combinations are produced due to non-additive gene effects and as such these could not be exploited in self-pollinated crops such as Indian mustard.

Keywords: SCA effects, corresponding mean performance, F_1 and F_2 generations, diallel cross and Indian mustard

Introduction
Indian mustard is mostly grown timely as well as late sown crops. About 40 per cent of the total crop in the country is occupied under late sown irrigated conditions. These crops have been found to suffer from terminal heat stresses and also poor grain filling. Therefore, it becomes necessary to produce such varieties, which thrive reasonably well under timely and late sown situations.
While going to increase the genetic potentialities of any crop, the most complex problem facing the breeder is the judicious selection of the parents from the gene pool. This is because the yield is a complex character, comprising a number of components, each of which is polygenetically controlled and, therefore, very susceptible to the environmental fluctuations. It is also desirable that selection for suitable parents involved in a hybridization programme should be based on the ability of a line to nick well with other lines and produces superior genotypes. For this purpose, the breeders use different biometrical approaches like, diallel, partial diallel and line x tester mating design for selecting the suitable parents through estimation of variances and effects. Under such condition mating designs, like diallel mating system is most liked as compared to other biometrical approaches, because this mating design provides complete information with regard to parental stock as well as their hybrid combinations.

The mustard seed is largely crushed for oil, which is perhaps the cheapest source of energy in our diet and is mainly used for culinary purposes in Indian homes. The oil serves as a rich source of energy in predominantly vegetarian diet consumed in the country. The oil cake is used for cattle feed and manure (Singh. 2004) [3].

For stepping up the production, the present study "Estimation of SCA effects and corresponding mean performance of crosses in F_1 and F_2 generations obtained from 10-parent diallel cross in Indian mustard [*Brassica juncea* (L.) Czern and Coss] was essentially felt significant involving a set of 10 parents and their each 45 F_1s (excluding reciprocal crosses) and F_2s.

Review and Literature

Bunson (1980) [1] in winter rape (*Brassica napus*) advocated that gca variances were much higher than those of sca for all the traits studied. Reciprocal effects were significant for yield and days to flowering.

Chauhan and Singh (1979) [2] in Indian mustard observed highly significant gca and sca variances for both F_1 and F_2 generations. The additive gene action was found more for days to flowering and maturity in both the generations. For primary branches, non-additive gene action in F_1 and both additive and non-additive gene action in F_2 was observed. The higher magnitude of σ^2s and $\sigma\ ^2$g indicated over dominance for number of secondary branches, length of main receme, yield per plant reflecting the importance of non-additive gene action.

Methods and Material

The combining ability analysis was worked out by the procedure suggested by Griffing's (1956b) Method 2, Model. The mathematical model for combining ability analysis is assumed to be :

$X_{ijkl} = u + g_i + g_j + S_{ij} + 1/bc\ e_{ijkl}$
i, j = 1, 2, 3, b;
k = 1, 2, 3, b;
I= 1, 2, 3, c;

Where
U = population mean
g_i = General combining ability (gca) of i^{th} parent.
Gj = gca of j^{th} parent.
S_{ij} = specific combining ability of the cross between i^{th} parent such that S_{ij} = Sj
E_{ijkl} = Environmental effect associated with the ijk^{th} individual observation of i^{th} individual in k^{th} block wtih i^{th} as female parent and j^{th} as male parent.
The usual restrictions, such as gii = 0 and
$S_{ijj} = s_{ij} = 0$, (For each i) are imposed.
The analysis of variance table for combining ability is as follows:

ANOVA for combining ability

Source of variation	d.f.	S.S.	M.S.	'F' test
gca	n-1	Sg	Mg	Mg/Me, for n-1, m.d.F.
sca	N(n-1)/2	Ss	Ms	Ms/Me, for n (n-)/2, mdf
Erro	M	Me	Me	-

Sg = $1/n + 2\ \{\sigma\ (X_i + X_{ij})2 – (4/n)\ x^2 \ldots\}$

Sp = $i^{\Sigma\Sigma}j\ x_{ij}^2 – 1\ n+2\ \sigma\ (x_1 + x_{ij})^2 + \{2/\ (n+1)\ (n+2)\}$ x..2
Mel = Me'/r

Where
r = Number of replications
Me'= Error M.S. obtained from ANOVA
Sg = Sum of squares (S.S.) due to g.c.a.
Ss = Sum of squares due to s.c.a.
n = Number of parents
x_i = Total of the array involving i^{th} as a female
x.. = Grand total
x_{ii} = Value of i^{th} parent of the array
X_{ij} = Value of the cross, with i^{th} as a female parent and j^{th} as a male parent.
The component of variances will be estimated as under:

gca expected ms. = $\sigma^2 + 1/(n-1)Si\ g_i^2$ or σ^2 gca = (Mg – Me)/n+2
sca expected m.s. $\sigma^2 + 2/n\ (n-1)\ s^2_{ij}$ or σ^2 sca = (Ms-Me)

Where
Mg = Mss gca, Ms = Mss sca and Me = Mss error of combining ability analysis and n = number of parents.
The general predictability ratio (GPR) was computed as :

GPR = $2\sigma^2$ gca/$2\sigma^2$ gca + σ^2sca

Estimates of various effects

The various effects were estimated as follows :
gca effect on i^{th} parent = $g_i = 1/\ (n+2)\ \{\sigma\ (X_i\ x\ X_{ii}) – (2/n)\ X \ldots.\}$ sca effect on ij^{th} cross = $s_{ij} = x_{ij} – 1\ (n+2)\ \{x_i – x_{ij} + x_{jj}) + 2x\ /\ (n+1)\ (n+2)\ x\ldots.$
Where, gi and sij are the estimates of the general and specific combining ability effects respectively and n, x_i, x_i, x_{ij}, x .. and x_{ij} are the same as explained earlier, x_j = total of the arrays involving j^{th} parent as a male and x_{ij} = the value of j^{th} parent of the array.

Estimation of standard errors

SE $(g_i) = \{(n-1)\ \sigma^2e/n\ (N+2)\}^{0.5}$
SE $(S_i) = \{(n^2+\ n+2)\ \sigma^2e/\ (N+1)\ (n+2)\}^{0.5}$
SE $(S_{ij}) = \{2\ (n-1)\ \sigma^2e/\ (n+1)\ (n+2)\}^{0.5}$
SE (gi-gi) = $\{\sigma^2e/(n+2)\}0.l5$
SE $(S_{ii}-S_{ij}) = \{2(n-2)\ \sigma^2e\ /\ (n+2)\}^{0.5}$
SE $(S_{ij} – S_{ik}) = \{2\ (n+1)\ \sigma^2e/\ (n+2)\}^{0.5}$
SE $(S_{ij} – S_{kl}) = \{2n\ \sigma^2e/\ (n+2)\}^{0.5}$

Where
σ^2e = Me'/r, taken as error M.S. from the combining ability analysis.

Results and Discussion

Specific combining ability effects

The estimates of specific combining ability (sca) effects for each 45 F_1 hybrids and F_2 progenies along with their mean performance are presented in Table-8. The criteria for sorting out desirable and significant specific combiners were the same, which was followed in case of gca effects.

Significant and desirable sca effects were recorded in 7 cases for days to flowering in F_1 generation. Among these, CSR 1020 x CSR 1066, CSR 1014 x CSR 1025, CSR 1027 x CSR 1066, CSR 1020 x CSR 1014, CSR 1027 x CSR 1082, CSR 1027 x CSR 1118 and CSR 1025 x CSR 1118

showed maximum sca effect. In F_2 generation only 8 were found the best specific combinations as they revealed significant and desirable sca effects. Eight superior crosses sorted out were CSR 1088 x CSR 1066, CSR 1025 x CSR 1066, CSR 1082 x CSR 1104, CSR 1025 x CSR 1104, CSR 1020 x CSR 1082, CSR 1082 x CSR 1118 CSR 1082 x CSR 1066 and CSR x CSR 1025. Among these combinations none was common in F_1 and F_2 generations.

In case of plant height, among 38 significant cases in F_1 generation, 15 cross combinations showed desirable (negative) and significant sca effects. These crosses were CSR 1020 x CSR 1088, CSR 1020 x CSR 1014,CSR 1020 x CSR 1066, CSR 1088 x CSR 1066, CSR 1088 x CSR 1104, CSR 1027 x CSR 1118, CSR 1014 x CSR 1082, CSR 1014 x CSR 1025, CSR 1014 x CSR 1118, CSR 1082 x CSR 1025, CSR 1025 x CSR 1118, CSR 1025 x CSR 1104, CSR 1025 x CSR 1102, CSR 1066 x CSR 1104 and CSR 1104 x CSR 1102. In F_2 generation, out of 36 significant cases, 19 were found as desirable and significant (negative). The crosses were CSR 1020 x CSR 1088, CSR x 1020 x CSR 1027, CSR 1020 x CSR 1025, CSR 1020 x CSR 1066, CSR 1088 x CSR 1025, CSR 1027 x CSR 1014, CSR 1027 x CSR 1025, CSR 1027 x CSR 1102, CSR 1014 x CSR 1082, CSR 1014 x CSR 1025, CSR 1014 x CSR 166,m CSR 104 x CSR 1102, CSR 1082 x CSR 1025, CSR 2082 x CSR 1118, CSR 1025 x CSR 1066, CSR 1025 x CSR 1118, CSR 1025 x CSR 1102 and CSR 104 x CSR 1102, Cross combination namely CSR 1020 x CSR 1088, CSR 1020 x CSR 1066, CSR 1088 x CSR 1066, CSR 1014 x CSR 1082, CSR 1014 x CSR 1025, CSR 1082 x CSR 1025, CSR 1025 x SR 1118, CSR 1025 x CSR 1102 and CSR 1104 x CSR 1102 were found common as desirable in both the generation.

Significant and desirable sca effects were recorded in 5 cases for number of primary branches per plant in F_1 generation. On the basis of merit, 5 superior crosses were sorted out as CSR 1066 x CSR 1118, CSR 1020 x CSR 1088, CSR 1088 x CSR 1102, CSR 1020 x CSR 1027 and CSR 1014 x CSR 1102. In F2 progenies, 14 crosses has shown significant and desirable sca effects. Out of these, 10 crosses on merit basis were CSR 1082 x CSR 1102, CSR 1088 x CSR 1014, CSR 114 x CSR 1025, CSR 1020 x CSR 1066, CSR 1088 x CSR 1082, CSR 1025 x CSR 1104, CSR 1020 x CSR 1102, CSR 1088 x CSR 1066, CSR 1020 x CSR 1027 and CSR 1027 x CSR 1014. Cross CSR 1020 x CSR 1027 was common in both F_1 and F_2 generations.

In F_1 generation, significant and desirable sca effects for number of secondary branches per plant were observed in 15 cross combination. In these, 10 F_1s, in order of merit had been CSR 1020 x CSR 1027, CSR 1066 x CSR 1118, CSR 1014 x CSR 1102, CSR 1082 x CSR 1118, CSR 1088 x CSR 1104, CSR 1082 x CSR 1104, CSR 1014 x CSR 1066, CSR 1082 x CSR 1104, CSR 1014 x CSR 1066, CSR 1082 x CSR 1102, CSR 1025 x CSR 106 and CSR 1020 x CSR 1102. In F_2 progenies, 19 crosses revealed significant and desirable sca effects. Out of these 10 cross combination, in order of merit were CSR 1088 x CSR 1014, CSR 1020 x CSR 1066, CSR 1088 x CSR 1082, CSR 1020 x CSR 1027, CSR 1020 x CSR 1118, CSR 1027 x CSR 1104, CSR 1082 x CSR 1102, CSR 1088 x CSR 1025, CSR 1020 x CSR 1102 and CSR 1020 x CSR 1014.

In case of number of siliquae per main receme, 23 cases revealed significant and desirable sca effects in F_1 generation. Out of these 10 combination, in order of merit were CSR 1066 x CSR 1118, CSR 1020 x CSR 1102, CSR 1118 x CSR 1104, CSR 1020 x CSR 1025, CSR 1082 x CSR 1025, CSR 1027 x CSR 1102, CSR 1027 x CSR 1066, CSR 1020 x CSR 1027, CSR 1027 x CSR 1025 and RK-8605 x CSR 1102. In F_2 population, 19 were shorted out as desirable specific combiners as these combinations revealed significant sca effects. Out of these 10 cross combinations were CSR 1020 x CSR 1066, CSR 1088 x CSR 1082, CSR 1025 x CSR 1104, CSR 1020 x CSR 1027, CSR 1014 x CSR 1066, CSR 1088 x CSR 1014, CSR 1027 x CSR 1104, CSR 1020 x CSR 1118, CSR 1014 x CSR 1025 and CSR 1088 x CSR 1025.

In F_1 generation, significant and desirable sca effects for number of seeds per siliqua were observed in 16 cross combinations. In these, 10 crosses in order of rank were CSR 1014 x CSR 1025, CSR 1027 x CSR 1066, CSR 1118 x CSR 1102, CSR 1082 x CSR 1104, CSR 1088 x CSR 1102, CSR 1020 x CSR 1082, CSR 1027 x CSR 1082, CSR 1118 x CSR 1104, CSR 1014 x CSR 1082 and CSR 1066 x CSR 1118. In F_2 progenies, 14 crosses revealed significant and desirable sca effects. Out of these, 10 combinations, in order of merit, were CSR 1118 x CSR 1102, CSR 1020 x CSR 1082, CSR 1014 x CSR 1082, CSR 1027 x CSR 1025, CSR 1025 x CSR 1104 CSR 1088 x CSR 1014, CSR 1020 x CSR 1014, CSR 1027 x CSR 1082, CSR 1118 x CSR 1104 and CSR 1020 x CSR 1102. Among these, 3 combinations namely, CSR 1118 x CSR 1102, CSR 1020 x CSR 1082 and CSR 1118 x CSR 1104 were common in both F_1 & F_2 generations.

In case of siliqua length, the crosses, which revealed significant and desirable sca effects, were 7 in first filial generation. Among these, the maximum sca effects, in order of ranking were namely, CSR 1088 x CSR 1118, CSR 1014 x CSR 1082, CSR 1088 x CSR 106, CSR 1104 x CSR 1102, CSR 1027 x CSR 1025, CSR 1020 x CSR 1066 and CSR 1027 x CSR 1102 In F_2 population, 5 cases revealed significant and desirable sca effects. Among these, the maximum sca effects, in order of ranking were namely CSR 1118 x CSR 1102, CSR 1025 x CSR 1104, CSR 1027 x CSR 1014, CSR 1088 x CSR 1014 and CSR 1025 x CSR 1102.

In F_1 generation, significant and desirable sca effects for biological yield were observed in 17 cross combinations. In these, 10 crosses in order of merit, were CSR 1014/CSR 1102, CSR 1082/CSR 1004, CSR 1020/CSR 1118, CSR 1088/CSR 1025, CSR 1025/CSR 1066, CSR 1014/ CSR 1066, CSR 1025/CSR 1118, CSR 1025/CSR 1104, CSR 1066/CSR 1104 and CSR 1166 / CSR 1102. In F_2 progenies, 21 crosses revealed significant and desirable sca effects. Out of these, 10 cross combinations, in order of merit were CSR 1020/CSR 1088, CSR 1014/CSR 1118, CSR 1014/CSR 1102, CSR 1082/CSR 1025, CSR 1020/CSR 1082, CSR 1088/CSR 1066, CSR 1082/CSR 1104, CSR 1025 / CSR 1118, CSR 1066/ CSR 1104 and CSR 1118 x CSR 1102.

In respect of 1000-seed weight, the crosses, which exhibited significant and desirable sca effects were 19 in first filial generation. Out of these, 10 crosses in order of ranking, were CSR 1020 x CSR 1066, CSR 1088 x CSR 1066, CSR 1020 x CSR 1104 CSR 1088 x CSR 1025, CSR 1027 x CSR 1102, CSR 1014 x CSR 1104, CSR 1118 x CSR 1102 CSR 1104 x CSR 1102, CSR 1014 x CSR 1082 and CSR 1014 x CSR 1102. In F_2 crosses 24 were found to be the best specific combinations on the basis of significant and desirable sca effects. Out of these, 10 crosses, in order of merit, CSR 1014 x CSR 1104, CSR 1020 x CSR 1104, CSR

1020 x CSR 1025, CSR 1088 x CSR 1102, CSR 1082 x CSR 1025, CSR 1014 x CSR 1118, CSR 1082 x CSR 1102, CSR 1025 x CSR 1102, CSR 1088 x CSR 1027 and CSR 1066 x CSR 1102. Among the crosses CSR 1014 x CSR 1104 and CSR 1020 x CSR 1104 were common in both F_1 and F_2 generation.

In F_1 generation, significant and desirable sca effect for oil content were observed in 5 cross combinations. In these, order of merit, were CSR 1027 x CSR 1082, CSR 1088 x CSR 1014, CSR 1088 x CSR 1027, CSR 1088 x CSR 1118 and CSR 1088 x CSR 1102. In F_2 progenies, 7 had given significant and desirable specific crosses. Among these, on the basis of maximum sca effects, in order of ranking were namely CSR 1027 x CSR 1082, CSR 1088 x CSR 1027, CSR 1088 x CSR 1102, CSR 1025 x CSR 1066, CSR 1118 x CSR 1104, CSR 1025 x CSR 1118 and CSR 1082 x CSR 1025. Among these combinations CSR 1027 x CSR 1082, CSR 1088 x CSR 1027 and CSR 1088 x CSR 1102 were common in both the generation.

In case of seed yield per plant, 23 crosses exhibited significant and desirable sca effects in first filial generation. Out of these, 10 crosses, in order of merit, were CSR 1027 x CSR 1102, CSR 1066 x CSR 1118, CSR 1118 x CSR 1104, CSR 1020 x CSR 1102, CSR 1082 x CSR 1025, CSR 1082 x CSR 1102, CSR 1014 x CSR 1066, CSR 1020 x CSR 1027, CSR 1014 x CSR 1102 and CSR 1066 x CSR 1104. In F_2 progenies, 20 crosses revealed significant and desirable sca effects. Out of these, 10 combinations, in order of merit were CSR 1088 x CSR 1025, CSR 1088 x CSR 1082, CSR 1014 x CSR 1082, CSR 1020 x CSR 1102, CSR 1014 x CSR 1066, CSR 1020 x CSR 1118, CSR 1020 x CSR 1066, CSR 1020 x CSR 1027, CSR 1066 x CSR 1102 and CSR 1088 x CSR 1014. Among these crosses CSR 1020 x CSR 1102, CSR 1014 x CSR 1066 and CSR 1020 x CSR 1027 were common in both the generations.

Table 1: Estimation of sca effects and corresponding mean performance of crosses in F_1 and F_2 generations obtained from 10-parent diallel cross in Indian mustard

Cross combination	Days to flowering				Plant height (cm)			
	sca effect	Mean	sca effect	Mean	sca effect	Mean	sca effect	Mean
CSR 1020 / CSR 1088	2.64**	68.83	1.53	70.37	-5.29**	194.17	-10.20**	180.73
CSR 1020 / CSR 1027	-0.77	65.70	0.65	70.80	1.35	207.96	-4.00**	197.13
CSR 1020 / CSR 1014	-2.71**	62.67	2.47**	71.33	-3.52**	201.80	0.95	194.10
CSR 1020 / CSR 1082	-0.05	68.07	-2.25**	68.67	7.77**	213.83	18.06**	215.27
CSR 1020 / CSR 1025	1.29	69.40	3.06**	73.53	8.91**	216.80	-2.06**	195.87
CSR 1020 / CSR 1066	-4.73**	62.47	0.11	70.00	-7.68**	193.27	-23.53**	170.27
CSR 1020 / CSR 1118	-1.18	66.73	-0.15	69.77	1.29	201.77	6.73**	197.33
CSR 1020 / CSR 1104	2.25*	68.23	1.3	69.33	14.68**	182.73	19.51**	192.27
CSR 1020 / CSR 1102	-0.46	65.40	-0.03	68.87	5.87**	204.03	1.95	192.27
CSR 1088/ CSR 1027	-0.78	68.50	0.77	69.60	15.48**	218.63	0.20	197.60
CSR 1088 / CSR 1014	3.28**	71.47	-0.05	69.03	5.45**	206.60	4.12**	193.60
CSR 1088 / CSR 1082	-0.83	70.07	2.86**	74.00	4.93**	207.53	9.03**	202.50
CSR 1088 / CSR 1025	-1.05	69.87	0.60	71.30	11.74	216.17	-3.07*	191.67
CSR 1088 / CSR 1066	0.12	70.13	-3.11**	67.00	-16.18**	181.30	-8.74**	181.33
CSR 1088 / CSR 1118	1.49*	69.23	-0.31	69.83	9.68**	206.70	-1.87	185.00
CSR 1088 / CSR 1104	-0.43	68.37	1.52*	69.70	-7.15**	157.4	5.09**	174.93
CSR 1088 / CSR 1102	0.63	69.30	-0.08	69.03	7.40**	202.10	13.11**	199.70
CSR 1027 / CSR 1014	2.84**	71.30	-1.00	69.40	-1.74	206.57	-6.41**	193.20
CSR 1027 / CSR 1082	-2.23**	68.93	3.38**	75.83	-1.59	208.17	1.80	205.47
CSR 1027 / CSR 1025	1.14	72.33	-0.74	71.27	0.45	212.03	-7.46**	197.47
CSR 1027 / CSR 1066	-3.25**	67.03	1.71*	73.13	1.43	206.07	5.97**	206.23
CSR 1027 / CSR 1118	-2.13**	68.87	-0.35	71.10	-20.97**	184.10	6.73**	203.50
CSR 1027 / CSR 1104	2.16**	71.23	0.57	70.07	7.14**	173.89	11.74**	190.97
CSR 1027 / CSR 1102	1.19	70.13	-1.03	69.40	2.44**	204.30	-8.82**	187.97
CSR 1014/ CSR 1082	-0.07	70.00	-0.34	70.83	-21.27**	186.50	-5.55**	190.13
CSR 1014 / CSR 1025	-3.74**	66.37	1.74*	72.47	-11.79**	197.80	-11.51*	185.43
CSR 1014 / CSR 1066	0.68	69.87	-0.97	69.17	4.43**	207.07	-8.25**	184.03
CSR 1014 / CSR 1118	-0.87	69.03	-0.97	69.20	-3.34**	198.83	-1.01	188.07
CSR 1014 / CSR 1104	0.18	67.80	0.69	68.90	26.45**	196.20	1.33	172.57
CSR 1014 / CSR 1102	-0.35	67.50	0.79	69.30	4.37**	204.23	-4.03**	184.77
CSR 1082 / CSR 1025	0.66	73.47	-1.85*	70.93	-2.40**	208.63	-3.83**	197.17
CSR 1082 / CSR 1066	1.37	73.27	-1.89*	70.30	6.91**	211.00	4.16**	200.50
CSR 1082 / CSR 1118	-1.08	71.53	-1.99*	70.23	3.07**	206.70	-39.94**	153.20
CSR 1082 / CSR 1104	-0.68	70.00	-2.50**	67.77	13.90**	185.10	18.24**	193.53
CSR 1082 / CSR 1102	-0.13	70.43	2.43**	73.63	7.85**	209.17	-1.75	191.10
CSR 1025 / CSR 1066	-1.12	70.80	-2.92**	68.83	5.15**	211.07	-20.80**	176.80
CSR 1025 / CSR 1118	-1.61*	71.03	-1.45	70.33	-17.15**	188.30	-15.20**	179.80
CSR 1025 / CSR 1104	2.09**	72.80	0.61	70.43	-6.009**	166.93	29.28**	205.83
CSR 1025 / CSR 1102	-0.05	7.53	-2.43**	68.33	-8.17**	194.97	-5.38**	188.73
CSR 1066 / CSR 1118	2.67**	74.40	0.27	71.47	2.63**	201.13	-1.07	188.67
CSR 1066 / CSR 1104	-0.17	69.63	1.13	70.37	-2.74**	163.33	21.77**	193.67
CSR 1066 / CSR 1102	-0.41	69.27	1.13	71.30	2.25	198.43	14.62*	204.07
CSR 1118 / CSR 1104	5.05**	75.57	2.34**	71.60	41.49**	206.80	28.87**	197.57
CSR 1118 / CSR 1102	-0.73	69.67	-1.23	68.97	4.44**	200.17	15.78**	202.3

CSR 1104 / CSR 1102	0.40	68.87	2.19**	70.43	-13.63**	149.67	-27.54**	140.87
S.E. (m) ±	-	1.1388	-	1.2041	-	-	-	-
SE (sij) ±	0.7417	-	0.7843	-	1.179	-	.263	-
S.E. (sij – sik) ±	1.0903	-	1.1529	-	1.733	-	1.856	-
S.E. (sij – skl) ±	1.0396	-	1.0992	-	1.653	-	1.769	-

Table- 1. Contd……

Cross combination	No. of Primary branches				No. of secondary branches			
	F_1		F_2		F_1		F_2	
	sca effect	Mean	sca effect	Mean	sca effect	Mean	sca effect	Mean
CSR 1020 / CSR 1088	0.81**	6.47	-1.05**	4.80	1.14*	13.33	-4.76**	9.33
CSR 1020 / CSR 1027	0.64**	6.63	0.74**	6.27	3.13**	16.77	3.36**	16.07
CSR 1020 / CSR 1014	0.33	5.93	-0.08	6.07	0.96	13.47	2.16**	16.90
CSR 1020 / CSR 1082	-0.03	5.73	-0.49*	5.33	-1.26*	12.13	-1.81**	10.70
CSR 1020 / CSR 1025	-0.06	6.13	-0.40	5.90	1.10*	15.73	-1.45**	12.70
CSR 1020 / CSR 1066	-0.59**	5.47	0.95**	7.17	-0.16	13.53	4.48**	18.47
CSR 1020 / CSR 1118	-0.25	6.00	0.19	6.17	-0.14	13.97	3.29**	17.33
CSR 1020 / CSR 1104	-0.18	5.77	0.32	6.40	-1.19*	11.93	-1.33**	12.00
CSR 1020 / CSR 1102	0.17	6.33	0.76**	6.97	1.75**	15.81	2.62**	16.83
CSR 1088/ CSR 1027	.24	5.83	0.16	5.43	0.95	13.13	0.31	12.87
CSR 1088 / CSR 1014	-0.45*	4.77	1.04**	6.93	-1.60**	9.47	4.68**	19.27
CSR 1088 / CSR 1082	0.06	5.43	0.90**	6.47	-0.12	11.83	3.54**	15.90
CSR 1088 / CSR 1025	-0.03	5.77	0.15	6.20	-0.18	13.00	3.07**	17.07
CSR 1088 / CSR 1066	-0.40	56.27	0.76*	6.72	-0.68	11.57	1.50**	15.33
CSR 1088 / CSR 1118	0.11	5.97	-0.19	5.53	0.75	13.40	1.34**	15.23
CSR 1088 / CSR 1104	0.12	5.67	0.68**	6.50	2.43**	14.10	1.86**	15.03
CSR 1088 / CSR 1102	0.66*	6.43	-0.69**	5.25	0.06	12.67	-2.36**	11.67
CSR 1027 / CSR 1014	-0.01	5.53	0.73**	6.30	0.56	13.07	-0.61**	12.60
CSR 1027 / CSR 1082	0.16	5.87	0.02	5.27	0.97	14.37	-1.14**	9.83
CSR 1027 / CSR 1025	-0.33	5.80	-1.10**	4.63	0.70	15.33	-1.42**	11.20
CSR 1027 / CSR 1066	-0.23	5.77	-1.14**	4.50	-0.09	13.60	-1.38**	11.07
CSR 1027 / CSR 1118	-0.19	6.00	-0.20	5.20	-1.53**	12.57	-0.81**	11.70
CSR 1027 / CSR 1104	0.42	6.30	0.63**	6.13	0.48	13.60	3.21**	15.00
CSR 1027 / CSR 1102	0.36	6.47	-0.73**	4.90	0.35	14.40	-0.91**	11.77
CSR 1014/ CSR 1082	-0.16	5.17	0.44*	6.30	0.03	12.30	1.49**	14.50
CSR 1014 / CSR 1025	-0.25	5.50	0.99**	7.33	-1.11*	12.40	1.62**	16.27
CSR 1014 / CSR 1066	0.35	5.97	0.14	6.40	2.17**	14.73	1.85**	16.33
CSR 1014 / CSR 1118	0.36	6.17	-0.16	5.87	1.46**	14.43	-0.62**	13.92
CSR 1014 / CSR 1104	-0.40	5.10	-0.52*	5.60	-2.23**	9.77	-0.11	13.72
CSR 1014 / CSR 1102	0.54*	6.27	-0.18	6.07	2.80**	15.73	0.29	15.00
CSR 1082 / CSR 1025	0.09	6.00	-0.55**	5.47	0.91	15.30	-2.25**	10.17
CSR 1082 / CSR 1066	-0.28	5.50	0.13	6.07	-1.32*	12.13	0.62**	12.87
CSR 1082 / CSR 1118	-0.26	5.70	-0.66**	5.03	2.74**	16.60	-1.74**	10.57
CSR 1082 / CSR 1104	0.41	6.07	-0.90**	4.90	2.35**	15.23	-0.22	11.37
CSR 1082 / CSR 1102	0.05	5.93	1.24**	7.17	2.15**	15.97	3.19**	15.67
CSR 1025 / CSR 1066	0.08	6.28	-0.72**	5.70	1.87**	15.56	-1.09**	12.80
CSR 1025 / CSR 1118	0.01	6.40	0.32	6.50	-1.33*	13.77	0.35	14.30
CSR 1025 / CSR 1104	0.18	6.27	0.89**	7.17	1.52*	15.63	1.27**	14.50
CSR 1025 / CSR 1102	-0.68**	5.63	-0.24	6.17	-0.42	14.63	-0.18	13.93
CSR 1066 / CSR 1118	0.91**	7.17	0.21	6.30	2.81**	16.97	-1.65**	12.13
CSR 1066 / CSR 1104	0.28	6.23	-0.01	6.19	1.32**	14.50	-0.73**	12.33
CSR 1066 / CSR 1102	0.24	5.93	0.05	6.37	-2.61**	11.50	-0.35	13.60
CSR 1118 / CSR 1104	0.13	6.27	-0.12	5.83	-0.89	12.70	0.24	13.37
CSR 1118 / CSR 1102	0.27	6.63	0.52*	6.60	-1.39*	13.13	0.62*	14.63
CSR 1104 / CSR 1102	-0.29	5.77	0.15	6.33	-0.57	12.97	-1.39**	11.90
S.E. (m) ±	-	0.3442	-	0.3312	-	0.8597	-	0.3836
SE (sij) ±	0.2242	-	0.2157	-	0.5599	-	0.2240	-
S.E. (sij – sik) ±	0.3295	-	0.3171	-	0.8231	-	0.3673	-
S.E. (sij – skl) ±	0.3142	-	0.3024	-	0.7848	-	0.3502	-

Table-1. Contd……

Cross combination	No. of siliquae/main receme				No. of seeds/siliqua			
	F_1		F_2		F_1		F_2	
	sca effect	Mean	sca effect	Mean	sca effect	Mean	sca effect	Mean
CSR 1020 / CSR 1088	42.85**	48.81	-186.25**	36.44	-0.71**	11.52	0.39	12.83
CSR 1020 / CSR 1027	91.62**	62.69	143.27**	65.06	0.65**	13.07	0.43*	13.57
CSR 1020 / CSR 1014	10.40	49.07	87.71**	58.77	-0.20	11.61	1.01**	13.56
CSR 1020 / CSR 1082	-52.39**	46.12	-59.45**	40.86	1.17**	13.13	1.90**	14.18
CSR 1020 / CSR 1025	144.63**	67.01	-14.71**	51.35	0.34	12.05	-0.38	12.16
CSR 1020 / CSR 1066	4.93	52.97	63.84**	66.87	-0.13	13.27	0.09	13.64
CSR 1020 / CSR 1118	-20.57	52.01	122.43**	63.14	-0.10	12.73	-0.05	13.00
CSR 1020 / CSR 1104	-109.96**	36.05	1.30	49.66	-0.58*	11.01	-1.80**	10.77
CSR 1020 / CSR 1102	152.85**	74.52	108.51**	61.59	0.17	11.72	0.76**	12.82
CSR 1088/ CSR 1027	52.83**	50.36	42.78**	50.49	-0.10	12.00	-0.37	11.79
CSR 1088 / CSR 1014	-77.93**	31.78	138.22	59.31	0.13	11.61	1.09**	12.67
CSR 1088 / CSR 1082	22.25*	45.13	156.49**	57.94	-0.36	11.28	0.69**	12.00
CSR 1088 / CSR 1025	-1.53	46.94	110.76**	59.38	-0.93**	10.46	0.39	11.95
CSR 1088 / CSR 1066	-106.46**	33.38	-41.61**	41.81	0.37	13.44	-1.15**	11.43
CSR 1088 / CSR 1118	-31.69**	42.45	-32.44**	43.14	0.73**	13.25	-0.61**	11.47
CSR 1088 / CSR 1104	23.78**	40.97	80.67**	53.08	0.75**	12.01	0.55	12.14
CSR 1088 / CSR 1102	53.03**	56.08	-1.85	46.04	1.27	12.49	-0.71**	10.37
CSR 1027 / CSR 1014	-14.67	47.12	-38.96**	37.25	-0.67**	11.00	-0.32	11.95
CSR 1027 / CSR 1082	-25.42*	49.37	20.58**	40.01	1.12**	12.95	1.00**	13.01
CSR 1027 / CSR 1025	88.93**	65.00	-67.51**	37.21	0.42	12.00	1.35**	13.61
CSR 1027 / CSR 1066	100.71**	63.11	-49.97**	36.63	1.58**	14.85	0.22	13.50
CSR 1027 / CSR 1118	-156.76**	38.45	-15.91**	40.45	-1.20**	11.50	0.25	13.03
CSR 1027 / CSR 1104	55.25**	53.12	137.03**	54.38	-0.53*	10.93	0.27	12.56
CSR 1027 / CSR 1102	110.46**	70.83	-117.59**	30.13	0.09	11.50	-0.320	11.47
CSR 1014/ CSR 1082	26.63*	49.07	74.66**	44.68	0.97**	12.18	1.63**	13.05
CSR 1014 / CSR 1025	8.41	51.44	115.83**	54.82	1.78	12.74	0.24	11.91
CSR 1014 / CSR 1066	71.38**	54.67	140.77**	54.98	0.70**	11.94	0.27	12.96
CSR 1014 / CSR 1118	60.42**	55.17	141.77**	27.13	0.01	12.09	-1.51**	10.68
CSR 1014 / CSR 1104	-65.44**	35.55	-166.86**	23.26	-1.61**	9.23	0.47*	11.23
CSR 1014 / CSR 1102	77.44**	62.03	-166.38**	24.52	0.61**	11.41	-0.36	10.84
CSR 1082 / CSR 1025	130.03**	66.93	-31.10**	36.93	0.30	11.42	-0.78**	10.63
CSR 1082 / CSR 1066	1.80**	51.04	-62.62**	31.44	-1.35**	11.45	-1..05**	11.37
CSR 1082 / CSR 1118	-3.23	52.13	-101.06**	28.01	0.12	12.36	-0.11	11.81
CSR 1082 / CSR 1104	62.51**	51.68	-116.62**	25.09	1.30**	12.30	0.37	11.80
CSR 1082 / CSR 1102	37.39	61.35	4.39	38.40	0.93**	11.89	0.11	11.03
CSR 1025 / CSR 1066	-4.82	54.57	-107.85**	32.94	0.25	12.80	0.18	12.87
CSR 1025 / CSR 1118	-39.38**	52.71	4.68	44.60	-0.90**	11.09	0.05	12.23
CSR 1025 / CSR 1104	60.86**	55.70	149.11**	57.60	0.14	10.89	1.20**	12.89
CSR 1025 / CSR 1102	-7.96	61.01	-51.37**	38.84	-0.44	10.27	0.33	11.52
CSR 1066 / CSR 1118	173.52**	70.93	-41.11**	37.69	0.97**	14.65	0.09	13.29
CSR 1066 / CSR 1104	34.93**	50.04	-7.54	39.68	-1.17**	11.26	-0.69**	12.01
CSR 1066 / CSR 1102	-17.19	57.02	52.90**	46.93	-0.11	12.27	0.70**	12.90
CSR 1118 / CSR 1104	131.76**	61.32	16.75**	42.52	1.09**	12.97	0.78**	12.99
CSR 1118 / CSR 1102	2.41	60.57	40.76**	46.13	1.32**	13.15	2.30**	14.00
CSR 1104 / CSR 1102	-132.82**	40.02	-65.60**	34.13	-1.14**	9.45	0.23	11.44
S.E. (m) ±	-	16.6087	-	6.39395	-	0.3711	-	0.3413
SE (sij) ±	10.8179	-	4.5200	-	0.2417	-	0.2223	-
S.E. (sij – sik) ±	15.9016	-	6.6441	-	0.3553	-	3.2678	-
S.E. (sij – skl) ±	15.1616	-	6.3349	-	0.3388	-	0.3116	-

Table-1. Contd……

Cross combination	Siliqua length (cm)				Days to maturity			
	F_1		F_2		F_1		F_2	
	sca effect	Mean	sca effect	Mean	sca effect	Mean	sca effect	Mean
CSR 1020 / CSR 1088	-0.15	4.33	-0.47**	3.94	23.19**	156.67	-53.88**	91.00
CSR 1020 / CSR 1027	0.17	4.71	-0.13	4.25	-3.26	138.33	28.76**	167.67
CSR 1020 / CSR 1014	-0.02	4.37	0.34	4.80	14.47**	150.67	19.99**	155.00
CSR 1020 / CSR 1082	0.07	4.49	-0.08	4.14	30.67**	171.67	-22.71**	100.33
CSR 1020 / CSR 1025	-0.34*	5.01	-0.31	4.13	18.17**	161.67	-0.76	135.43
CSR 1020 / CSR 1066	0.32	5.04	0.04	4.63	-10.92**	126.67	19.84**	148.33
CSR 1020 / CSR 1118	-0.3*	3.99	0.16	4.70	-25.81**	115.67	16.76**	155.00
CSR 1020 / CSR 1104	-0.04	4.17	-0.01	4.22	1.85	126.67	17.04**	138.67
CSR 1020 / CSR 1102	-0.19	4.01	-0.35*	3.78	6.25*	153.67	6.80**	132.67
CSR 1088/ CSR 1027	-0.45**	3.91	0.29	4.55	34.75**	141.67	21.46**	148.33

CSR 1088 / CSR 1014	-0.15	4.07	0.40*	4.75	-5.09	96.33	4.36**	147.33
CSR 1088 / CSR 1082	0.26	4.51	0.34	4.44	-4.56	101.67	20.66**	131.67
CSR 1088 / CSR 1025	-0.06	4.13	0.30	4.61	-22.06**	86.67	25.84**	150.00
CSR 1088 / CSR 1066	0.35**	4.90	-0.14	4.33	-5.03	78.33	-24.79**	91.67
CSR 1088 / CSR 1118	0.93**	5.15	0.24	4.66	6.63*	101.67	5.46**	131.67
CSR 1088 / CSR 1104	-0.20	3.85	-0.09	4.02	-5.97	96.67	32.07**	141.67
CSR 1088 / CSR 1102	-0.08	3.95	-0.47**	3.54	-12.98**	106.67	14.50**	128.33
CSR 1027 / CSR 1014	-0.15	4.13	0.44	4.75	-11.11***	96.67	-7.00**	110.00
CSR 1027 / CSR 1082	-0.42**	3.88	-0.30	3.77	-10.28**	103.33	-7.70**	97.33
CSR 1027 / CSR 1025	0.40	4.63	-0.06	4.22	12.30**	106.67	-9.85**	108.33
CSR 1027 / CSR 1066	0.25	4.85	-0.03	4.47	-1.58	123.33	4.52**	115.00
CSR 1027 / CSR 1118	-0.04	4.23	-0.18	4.21	-1.59	113.33	29.77**	150.00
CSR 1027 / CSR 1104	-0.13	3.97	-0.08	4.00	14.14**	96.67	4.71	108.33
CSR 1027 / CSR 1102	0.32*	4.41	-0.41*	3.57	-10.62**	135.00	-32.86**	75.00
CSR 1014/ CSR 1082	0.89**	5.05	-0.07	4.08	-12.78**	98.33	19.19**	120.33
CSR 1014 / CSR 1025	0.29	4.38	-0.01	4.36	-2.20	98.67	32.38**	146.67
CSR 1014 / CSR 1066	-0.55**	3.91	0.01	4.54	-17.75**	103.33	15.08**	125.67
CSR 1014 / CSR 1118	0.07	4.20	-0.46**	4.02	-7.76*	91.67	-36.34**	80.00
CSR 1014 / CSR 1104	-0.05	3.90	-0.06	4.11	42.9**	85.00	-28.06**	71.67
CSR 1014 / CSR 1102	-0.34*	3.60	-0.05	4.01	-11.25**	158.33	-33.43**	70.53
CSR 1082 / CSR 1025	-0.23	3.89	-0.23	3.89	1.33	105.00	-28.99**	73.33
CSR 1082 / CSR 1066	-0.57**	3.91	-0.36*	3.91	-0.89	111.67	-21.29**	73.33
CSR 1082 / CSR 1118	-0.21	3.95	-0.29	3.95	7.44*	113.33	-19.37**	85.00
CSR 1082 / CSR 1104	0.28	4.26	0.34	4.26	-26.83**	105.00	-17.76**	700.00
CSR 1082 / CSR 1102	0.19	4.16	0.34	4.16	-1.17	93.33	3.0**	95.00
CSR 1025 / CSR 1066	-0.42**	4.00	-0.33	4.17	-20.06**	111.67	-24.44**	83.33
CSR 1025 / CSR 1118	-0.36*	3.73	-0.09	4.35	-16.60**	96.67	-20.85	96.67
CSR 1025 / CSR 1104	0.14	4.05	0.55**	4.69	-16.60**	116.67	-0.24	100.67
CSR 1025 / CSR 1102	0.22	4.13	0.37*	4.41	12.33	135.00	-10.15**	95.00
CSR 1066 / CSR 1118	-0.51**	3.95	0.02	4.63	-0.81	110.00	-28.15**	81.67
CSR 1066 / CSR 1104	-0.22	4.05	-0.53**	3.76	-6.75*	87.41	-11.54**	81.67
CSR 1066 / CSR 1102	0.19	4.46	-0.18	4.01	-13.42**	103.33	10.89**	108.33
CSR 1118 / CSR 1104	0.13	4.08	0.12	4.37	-3.03	95.00	3.71**	106.67
CSR 1118 / CSR 1102	-0.30	3.63	0.70**	4.85	4.36	125.00	-11.80**	95.66
CSR 1104 / CSR 1102	0.33*	4.09	0.33	4.17	-30.65**	73.33	-7.25**	83.33
S.E. (m) ±	-	0.2546	-	0.2848	-	4.9031	-	4.2796
SE (sij) ±	0.1658	-	0.1855	-	3.1936	-	0.8815	-
S.E. (sij – sik) ±	0.2437	-	0.2727	-	4.6944	-	4.0974	-
S.E. (sij – skl) ±	0.2324	-	0.2600	-	4.4759	-	3.9067	-

Table-1. Contd……

Cross combination	1000-seed weight (g)			
	F_1		F_2	
	sca effect	Mean	sca effect	Mean
CSR 1020 / CSR 1088	-0.16**	4.10	0.24**	4.45
CSR 1020 / CSR 1027	-0.18**	3.78	-0.07	3.85
CSR 1020 / CSR 1014	-0.14*	4.46	-0.78**	3.51
CSR 1020 / CSR 1082	0.24**	4.35	0.22**	4.51
CSR 1020 / CSR 1025	-0.80**	3.12	0.48**	4.42
CSR 1020 / CSR 1066	0.75**	4.78	-0.45**	3.34
CSR 1020 / CSR 1118	0.02	3.75	-0.05	3.75
CSR 1020 / CSR 1104	0.55**	4.80	0.85**	4.90
CSR 1020 / CSR 1102	-0.17**	3.41	-0.12**	3.60
CSR 1088/ CSR 1027	-0.01	3.70	0.30**	3.93
CSR 1088 / CSR 1014	-0.16**	3.91	0.20**	4.21
CSR 1088 / CSR 1082	0.10*	3.96	0.01	4.01
CSR 1088 / CSR 1025	0.44**	4.10	0.11*	3.77
CSR 1088 / CSR 1066	0.71**	4.49	-0.02	3.48
CSR 1088 / CSR 1118	0.03	3.50	-0.30**	3.22
CSR 1088 / CSR 1104	-0.37**	3.63	-0.93**	2.84
CSR 1088 / CSR 1102	-0.46**	2.86	0.36**	3.79
CSR 1027 / CSR 1014	-0.17**	3.60	-0.42**	3.29
CSR 1027 / CSR 1082	0.23	3.79	0.16**-	3.87
CSR 1027 / CSR 1025	-0.42**	2.94	0.57**	2.80
CSR 1027 / CSR 1066	-0.21**	3.27	0.07	3.27
CSR 1027 / CSR 1118	0.06	3.23	1.20**	3.43
CSR 1027 / CSR 1104	0.18**	3.87	-0.03	3.45
CSR 1027 / CSR 1102	0.43**	3.45	0.15**	3.25

CSR 1014/ CSR 1082	0.7**	4.19	0.22**	4.31
CSR 1014 / CSR 1025	-0.10*	3.62	0.18**	3.92
CSR 1014 / CSR 1066	-0.26**	3.58	0.15*	3.73
CSR 1014 / CSR 1118	0.12**	3.65	0.35**	3.95
CSR 1014 / CSR 1104	0.41**	4.47	0.87**	4.72
CSR 1014 / CSR 1102	0.28**	3.67	-0.33**	3.18
CSR 1082 / CSR 1025	0.22**	3.73	0.36**	4.10
CSR 1082 / CSR 1066	-0.18**	3.45	0.17**	3.75
CSR 1082 / CSR 1118	-0.30**	3.02	-0.18**	3.42
CSR 1082 / CSR 1104	-0.04	3.80	0.07	3.92
CSR 1082 / CSR 1102	0.08	3.25	0.35**	3.87
CSR 1025 / CSR 1066	-0.07	3.37	-0.37**	2.87
CSR 1025 / CSR 1118	-0.02	3.10	.17**	3.42
CSR 1025 / CSR 1104	0.12**	3.77	-0.90**	2.60
CSR 1025 / CSR 1102	0.26**	3.23	0.32**	3.48
CSR 1066 / CSR 1118	-0.21**	3.03	-0.16**	2.93
CSR 1066 / CSR 1104	0.08	3.85	-0.01	3.33
CSR 1066 / CSR 1102	-0.01	3.08	0.26**	3.27
CSR 1118 / CSR 1104	-0.01	3.45	0.14**	7.50
CSR 1118 / CSR 1102	0.31**	3.10	0.19**	3.22
CSR 1104 / CSR 1102	0.31**	3.18	0.01	3.28
S.E. (m) ±	-	0.0821	-	0.0759
SE (sij) ±	0.0535	-	0.0494	-
S.E. (sij – sik) ±	0.0787	-	0.0727	-
S.E. (sij – skl) ±	0.0750	-	0.0693	-

Table-1. Contd……

Cross combination	Oil content (%)				Seed yield/plant (G)			
	F_1		F_2		F_1		F_2	
	sca effect	Mean	sca effect	Mean	sca effect	Mean	sca effect	Mean
CSR 1020 / CSR 1088	0.08	4.50	-0.03	41.43	0.15	21.10	-7.74**	17.82
CSR 1020 / CSR 1027	-0.11	42.03	-0.07	42.10	3.11**	5.97	4.43**	27.55
CSR 1020 / CSR 1014	-0.04	41.07	-0.08	4.07	1.23**	2.97	2.22**	25.85
CSR 1020 / CSR 1082	0.11	39.10	-0.15	39.17	0.25	22.02	-1.81	20.30
CSR 1020 / CSR 1025	0.07	40.00	-0.15	39.80	0.84*	23.47	-0.20	23.21
CSR 1020 / CSR 1066	-0.04	39.00	-0.07	39.10	2.18**	25.34	4.87	27.67
CSR 1020 / CSR 1118	-0.05	40.95	-0.10	41.20	0.51	23.13	5.45**	27.92
CSR 1020 / CSR 1104	-0.10	39.47	0.31**	39.93	-2.34**	17.56	3.35*	25.00
CSR 1020 / CSR 1102	-0.10	40.00	-0.06	40.10	3.93**	26.54	6.34**	27.85
CSR 1088/ CSR 1027	0.19**	43.50	0.36**	43.63	-1.75**	17.21	2.14**	21.55
CSR 1088 / CSR 1014	0.26**	42.53	0.15	42.40	-4.20	13.64	3.90**	23.82
CSR 1088 / CSR 1082	-0.05	40.33	-0.22*	40.20	1.75**	19.62	6.83**	25.22
CSR 1088 / CSR 1025	-1.03**	40.07	-1.05**	40.00	1.81**	20.54	7.07**	26.77
CSR 1088 / CSR 1066	0.10	40.30	0.09	40.37	-0.98	18.29	-2.70**	16.39
CSR 1088 / CSR 1118	0.13*	42.30	0.10	42.30	0.82*	19.54	-2.85**	15.90
CSR 1088 / CSR 1104	-0.04	40.70	-0.03	40.70	0.36	16.36	-0.30	17.64
CSR 1088 / CSR 1102	0.13*	42.30	.10	42.30	0.82*	19.54	-2.85**	15.90
CSR 1027 / CSR 1014	-0.26**	42.74	-0.30**	42.67	2.17**	17.28	-3.87**	13.91
CSR 1027 / CSR 1082	0.60**	41.70	0.70**	41.83	2.38**	21.85	1.44**	17.69
CSR 1027 / CSR 1025	-0.03	41.79	-0.03	41.73	0.87**	21.21	-3.07**	14.50
CSR 1027 / CSR 1066	-0.03	40.90	-0.15	40.83	1.56**	22.44	-0.89**	16.06
CSR 1027 / CSR 1118	-0.13*	42.99	-0.15	42.77	-5.07**	15.26	0.30	16.93
CSR 1027 / CSR 1104	0.07	41.53	-0.07	41.37	-0.08	17.53	3.42**	19.22
CSR 1027 / CSR 1102	-0.06	11.96	-0.13	41.83	7.06**	27.38	-4.57**	11.13
CSR 1014/ CSR 1082	0.04	40.10	0.12	40.23	0.61	18.91	6.46**	23.22
CSR 1014 / CSR 1025	0.04	40.82	0.12	40.87	1.59**	20.81	3.70**	21.77
CSR 1014 / CSR 1066	-0.08	39.80	0.03	40.00	3.21**	22.97	6.18**	23.64
CSR 1014 / CSR 1118	-0.05	41.80	-0.03	41.87	1.50**	20.71	-5.13**	12.06
CSR 1014 / CSR 1104	0.08	40.50	0.08	40.50	-2.16**	14.33	-5.16**	11.15
CSR 1014 / CSR 1102	-0.02	40.93	-0.15	40.80	3.04**	22.24	-5.73**	10.48
CSR 1082 / CSR 1025	0.04	38.93	0.19*	39.10	3.88**	23.12	-0.85**	15.70
CSR 1082 / CSR 1066	0.06	37.93	-0.17*	37.97	-4.50**	15.28	-2.52**	13.42
CSR 1082 / CSR 1118	-0.16	39.80	-0.16	39.90	0.45	19.69	-4.35**	11.26
CSR 1082 / CSR 1104	0.04	38.57	0.08	38.67	0.60	17.12	-3.65	11.14
CSR 1082 / CSR 1102	-0.16*	38.90	-0.02	39.10	3.28**	22.50	0.86**	15.54
CSR 1025 / CSR 1066	0.12	38.83	0.33**	36.10	0.41	21.05	-5.10**	12.15
CSR 1025 / CSR 1118	0.12	40.80	0.20*	40.90	-3.25**	16.85	1.24**	18.15
CSR 1025 / CSR 1104	-0.11	39.13	-0.3**	38.83	2.74**	20.12	2.43**	18.52

CSR 1025 / CSR 1102	-0.01	39.77	-0.12	39.63	-0.53	19.56	-1.39**	14.60
CSR 1066 / CSR 1118	-0.08	39.70	-0.08	39.83	5.29**	25.93	-3.15**	13.15
CSR 1066 / CSR 1104	-0.15*	38.20	-0.01	38.43	2.99**	20.90	-1.42**	14.06
CSR 1066 / CSR 1102	-0.15*	38.73	0.00	38.97	-1.43**	19.20	4.37**	17.94
CSR 1118 / CSR 1104	-0.05	40.27	-0.03	40.33	3.95**	21.32	3.52**	18.67
CSR 1118 / CSR 1102	-0.05	40.80	-0.07	40.83	1.77**	21.85	2.71**	17.75
CSR 1104 / CSR 1102	0.12	39.30	-0.29**	39.13	-4.29**	13.06	-1.05**	13.17
S.E. (m) ±	-	0.3480	-	0.3764	-	0.7291	-	0.6348
SE (sij) ±	0.0788	-	0.0923	-	0.3463	-	0.2624	-
S.E. (sij – sik) ±	0.1159	-	0.1357	-	0.5090	-	0.3858	-
S.E. (sij – skl) ±	0.1105	-	0.1293	-	0.4853	-	0.3678	-

* Significant at 5 % level; ** Significant at 1 % level

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