INFLUENCE OF PLANT DENSITIES ON THE EXPRESSION OF HETEROSIS AND COMBINING ABILITY IN MAIZE (*Zea mats* L.)

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تأثير كثافة الزراعة على قوة الهجن وقدرة الائتلاف فى الذرة الشامية

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ملخص البحث

أجرى هذا البحث بغرض تقدير قوة الهجين والقدرة على الائتلاف وتفاعلاتها مع كثافة الزراعة العادية (٢٤ ألف نبات / فدان) وكثافة الزراعة العالية (٤٨ ألف نبات / فدان) •

وأستخدم لتنفيذ هذا البحث ثمانية آباء (هجن فرديه) وستة وخمسون هجينا زوجيا نتجت كهجن تبادليه من هذه الآباء • وقد زرعت هذه المواد الوراثية مع الهجين الزوجى بيونير ٥١٤ فى تجربتين ، الأولى بالكثافة العادية والأخرى بالكثافة العالية فى مزرعة كلية الزراعة بشبين الكوم فى ثلاثة تكرارات بنظام القطاعات الكاملة العشوائية • وسجلت القراءات لصفات محصول النبات الفردى ، وزن المائة حبه ، عدد الصفوف / كوز ، عدد الحبوب / الصف ارتفاع النبات ، نسبة المقاومة لمرض الذبول المتأخر ، ميعاد التزهير للنوره المؤنثه • وحللت البيانات بطريقة جريفنج ـ الطريقة الثالثة ـ النموذج الأول وحسبت قوة الهجن بطريقة الأب الثابت (هجين زوجى بيونير ٥١٤) •

والآتى ملخص لأهم نتائج هذا البحث :ـ

١ ـ كان تباين الكثافة الزراعية معنويا لمعظم الصفات وكانت معظم قيم متوسطات الصفات المدروسة أعلى فى الكثافة العادية عنه فى الكثافة العالية •

٢ ـ كان تباين التراكيب الوراثية وقدرة الائتلاف العامة والخاصة معنويا لمعظم الصفات فيما عدا صفتى عدد الصفوف / كوز وميعاد التزهير وذلك فى كثافتى الزراعة والتحليل المشترك لهما • كذلك كان تفاعل القدرتين العامة والخاصة على الائتلاف مع كثافة الزراعة معنويا لمعظم الصفات المدروسة •

٣ ـ كان تباين القدرتين العامة والخاصة على الائتلاف لصفتى المحصول للنبات وعدد الحبوب / صف فقط معنويا وأعلى فى الكثافة الزراعية العادية عنه فى الكثافة العالية • كذلك كان تباين القدرة العامة وتفاعلها مع كثافة الزراعة أعلى عن تباين القدرة الخاصة وتفاعلها مع كثافة الزراعة وهذا يدل على ملاءمة وأفضلية الكثافة الزراعية العادية عند تقييم المواد الوراثية وتقدير قوة الهجين ومكونات قدرة الائتلاف وفاعلية الانتخاب •

٤ ـ أمكن تحديد ثلاثة هجن فردية أبوية وعشرة هجن زوجية كأفضل مواد وراثية حيث تفوقت فى قدرتها الائتلافية العامة والخاصة وقوة الهجين (مابين ٦ الى ١٦٪ عن الأب الثابت) وفى متوسطات المحصول • وهذه التراكيب الوراثية يمكن استغلالها مباشرة فى تحسين القدرة المحصولية فى برامج تربية محصول الذرة الشامية •

ABSTRACT

The main objective of the present study was to estimate heterosis and combining ability components and their interaction with plant densities (24,000 and 48,000 plant/feddan) for grain yield/plant, 100-kernel weight, no. of kernels/row, no. of rows/ear, ear height, late wilt disease resistance % and silking date. Significant density mean squares were detected for most studied traits with overall mean values at the normal plant density (24,000 plant/faddan) being higher than the corresponding ones at the high plant density (48,000 plant/faddan). Genotypes, general (GCA) and specific (SCA) combining ability mean squares reached the significance level for all traits except no. of rows/ear and silking date in both plant densities as well as in the combined analysis. Appreciable interaction values of genotypes, GCA and SCA by plant density were detected for most traits. Only for grain yield/plant and no. of kernels/row, the variances of GCA and SCA were higher in the normal plant density than in the high plant density. The variance estimates of GCA and GCA X plant density interactions were higher than those corresponding of SCA and SCA X plant density interactions for most traits studied. Normal plant density was considered as an optimum or non-stress environment for evaluating and selection of superior genotypes, where it gave-high values of heterosis and genetic parameters.

Three parental single crosses and new ten double crosses were defined as superior, efficient and prospective genotypes in breeding programs for improving yielding ability since these crosses gave the highest values of mean performances, specific combining ability and heterotic effects (from 6% to 16%) relative to the check parent (double cross-Pioneer 514).

INTRODUCTION

Comstock and Moll (1963) defined the genotype by environment interaction as the differential response of phenotypes to the change in environments. They classified the environment in two categories: macro-and micro-environmental variations. Macro-environmental variation is caused by the fluctuation in variables which have large and easily recognized variations i.e., years, locations, fertility levels, planting dates, and plant density. Whereas, micro-environmental variation arises from plant to plant variations within macro-environments. The contribution of macro-and micro-environmental effects to the magnitude of various genetic types was previously recorded by many investigators (Saki, 1955; Matzinger, 1963; Mather and Jinks, 1971 and others).

Since plant densities used by the maize breeder in development and evaulation is very important, the optimum stand density which maximizes the genetic components required for efficient selection must be determined. Information on the interaction between plant densities and genetic components is greatly needed.

The aim of the present work was to estimate heterosis combining ability components for seven quantitative traits under two plant densities, i.e., 24,000 (normal plant density) and 48,000 plant/faddan (high plant density) in 56 double crosses resulting from eight parental single crosses. Another aim was the edentification of the most superior double crosses to utilize immediately in improvement maize breeding programs.

MATERIALS AND METHODS

This investigation was carried out at the Experimental Research Station at Shebin El-Kom, Minufiya University. Eight parental single crosses were used in the study to obtain 56 F_1's by diallel crossing system in 1986 season. The parents were S.C.I (G.6 x Rg10), S.C.2 (G.6 x G.303 A), S.C.3 (Rg10 x G.303 A), S.C.4 (Rg10 x G.307 A), S.C.5 (Rg10 x G.4), S.C.6 (G.303 A x G.4), S.C.7 (G.303 A x M.25), and S.C.8 (G.307 A x G.4).

All parents used in the study were produced by the Agronomy/ Department, Faculty of Agriculture at Shebin El-Kom. In 1987 season Pioneer 514 were sown in two adjacent experiments with two plant stand densities (normal and high densities, i.e., 24,000 and 48,000 plant/faddan). In the two experiments a randomized block design was used with three replications. Each plot included two rows of 20 single hill plants. Distance between rows was 70 cm and different plant densities were attained by varying distances between hills. Normal agricultural practices were applied during the growing season.

Data were collected from competitive plants within each plot and were averaged over the number of harvested plants. The studied characters were: yield per plant, 100-kernel weight, number of kernels/row, number of rows/ear, ear height, late wilt disease resistance %, and silking date. A sample of shelled grain from each plot was taken for estimating moisture % to adjust the weight grain yield/plant to 15.5 percent moisture.

Heterosis of the F_1 generation was determined for all characters by comparing each hybrid with the check variety Pioneer-514(heterosis relative to the constant parent). Estimates of general and specific combining ability were calculated by partitioning the differences among genotypes (crosses) only as given by model-1 method 3 of Griffing (1956). The combined analysis of two plant desnities were carried out whenever homogeneity of variance was detected.

RESULTS AND DISCUSSION

The analysis of variance for all the traits studied in each of the two experiments and their combined analysis are presented in Table 1. Densities mean squares for all traits except number of rows/ear were highly significant indicating an overall differences between the two densities. These results are not in harmony with those obtained by Cross and Hammond (1982) and Fathy (1984) where they concluded that plant densities had no influence on most agronomic traits including grain yield.

Genotypes mean squares reached the significant level of probability for all traits studied except for number of rows/ear and silking date in both densities as well as in the combined analysis (Table 1). Appreciable genotypes by plant density interactions were detected for all traits except also for number of rows/ear and silking date. This might indicate that genotypes behaved somewhat differently from one plant density to another. At the same time, this finding indicates that the crosses differed in their mean performances in most traits under study. The mean performances of the tested 56 F_2's as an average over the two plant densities are presented in Table 2 and 3 for grain yield/plant, the crosses 1 x 8, 6 x 1, 6 x 3, 8 x 5, and 8 x 7 outyielded the other crosses and surpassed the check double cross variety Pionear 514 by an average increase of 16 32%, meanwhile the crosses 1 x 2, 1 x 7, 2 x 1, 2 x 5, 3 x 6, 3 x 8,5 x 2, Table (I): Observed mean squares from anaylsis of variance for all studied traits.

Traits	Densities a)	(D)	Rep/D	Genotypes (G)	GCA	SCA	Reciprocal effects	GXD	GCA XD	SCA XD	Recip. XD	Error	GCA/SCA	GCA XD/SCA XD
Grain yield/plant	d_1		568	2064**	4381**	2855**	919*					531	1.5	
	d_2		78	848**	1897**	932**	523					287	2.0	
	c	175772**	323	1478**	2935**	2150**	634	1434**	3343**	1637**	808**	409	1.4	2.0
100-kernel weight	d_1		0.2	35**	58**	41**	25**					6	1.4	
	d_2		12.0	52**	103**	46**	42**					8	2.2	
	c	2568**	6	51**	124**	40**	41**	36**	37**	47**	26**	7	3.1	0.8
No.of kernels/row	d_1		38	42*	83**	70**	11*					22	1.2	
	d_2		6	27**	29*	33**	22*					10	0.88	
	c	2045**	22	45**	73**	70**	21	24*	39*	33**	12	16	1.0	1.2
No.of rows/ear	d_1		2	1	3	1	1					1	3.0	
	d_2		2	2	4	2	1					1	2.0	
	c	2	2	2	4	2	1	1	3*	1	1	1	2.0	3.0
Ear height	d_1		1755**	306**	1447**	219**	75					56	6.6	
	d_2		412*	287**	1567**	97	104					90	16.2	
	c	16394**	1084**	502**	2843**	213*	123	91	171	103	56	73	13.4	1.7
Late wilt disease resistance	d_1		745**	340**	486**	296*	335*					142	1.6	
	d_2		865**	888**	1894**	141	1170**					162	13.4	
	c	99613**	805**	502**	1908**	283	335*	726**	472*	194	1170**	152	7.9	2.4
Silking date	d_1		9.0	1.2	1.3	1.1	1.3					1.6	1.2	
	d_2		55	2.8	4.3	3.0	2.2						1.4	
	c	195**	32**	2.0	2.8	2.0	1.9	2.0	2.0	2.0	1.7	3.2	1.4	1.0

a) indicates that d_1, d_2 and c normal, high densities and their combined, respectively.

* and ** significant at 0.05 and 0.01 levels of probability, respectively.

Table (2): Mean performance of F_I's for all characters studied as average of two densities.

Parents (a)	Grain yield/plant								100-kernel weight							
	I	2	3	4	5	6	7	8	I	2	3	4	5	6	7	8
I	-	I33	I23	I22	II3	I23	I35	I42	-	3I	32	32	3I	32	34	38
2	I22	-	I06	99	I35	II2	I37	I23	34	-	36	32	39	27	28	28
3	II2	II2	-	I20	I05	I36	II7	I36	33	37	-	34	36	38	34	40
4	II2	93	II4	-	I00	I09	II0	90	32	32	37	-	33	34	33	3I
5	92	II8	II7	97	-	I22	II8	I49	30	29	3I	30	-	3I	30	29
6	I43	I06	II3	II6	I27	-	I0I	II6	36	35	37	32	32	-	3I	32
7	II2	I07	I06	II3	I97	I29	-	II3	36	27	33	30	29	36	-	3I
8	I20	II6	I26	I04	I60	II4	I42	-	34	3I	32	33	34	33	32	-
L S D (0.05)	(46), check variety pioneer D.C 5I4=I25								(6.0), check variety pioneer D.C 5I4= 50							
	Number of kernels/row								Number of rows/ear							
I	-	35	34	3I	34	34	38	33	-	I3	I3	I3	I4	I4	I3	I3
2	33	-	33	33	36	35	30	37	I2	-	I3	I3	I2	I3	I3	I4
3	34	32	-	3I	28	33	38	38	I3	I3	-	I2	I2	I2	I3	I4
4	35	34	32	-	33	30	33	39	I3	I3	I3	-	I4	I3	I3	I3
5	26	36	26	35	-	37	36	36	I3	I3	I3	I3	-	I3	I3	I4
6	36	37	36	34	37	-	35	34	I4	I3	I3	I3	I3	-	I3	I3
7	37	33	34	36	35	33	-	35	I4	I3	I2	I3	I3	I3	-	I4
8	35	36	36	35	34	35	35	-	I4	I3	I4	I3	I3	I3	I4	-
L.S.D (0.05)	(9), check variety pioneer D.C 5I4=4I								(2.3), check variety pioneer d.c 5I4=I6							

Con t. Table (2):

	Ear height								Late wilt disease resistance %							
	I	2	3	4	5	6	7	8	I	2	3	4	5	6	7	8
I	-	I23	II7	II4	III	I33	I35	I37	-	5I	36	30	5I	37	38	48
2	I29	-	I33	I4I	I37	I4I	I33	I48	42	-	60	53	46	63	46	60
3	I25	I38	-	I3I	I25	I33	I38	I4I	45	52	-	49	53	23	39	39
4	I24	I28	I27	-	I26	I43	I39	I42	50	48	52	-	68	68	59	73
5	I22	I38	I28	I30	-	I36	I45	I42	65	66	69	69	-	68	67	68
6	I35	I38	I40	I40	I34	-	I39	I46	68	66	68	58	68	--	77	84
7	I29	I33	I33	I40	I45	I52	-	I46	52	7I	68	59	6I	62	-	90
8	I43	I46	I52	I50	I37	I44	I48	-	66	74	63	69	59	80	75	-

L.S.D (0.05) (79), check variety pioneer D.C 5I4=I50 (28), check variet pioneer D.C 5I4=85

Silking date

I	-	66	67	67	67	66	66	66
2	67	-	66	67	66	66	68	67
3	67	67	-	68	68	66	67	67
4	66	68	68	-	67	67	67	67
5	66	68	68	68	-	68	67	67
6	66	67	67	67	67	-	67	66
7	66	67	68	67	67	67	-	68
8	67	68	67	67	66	67	67	-

L.S.D (0.05) (2.03), check variety pioneer D C 5I4- 64

(a) S.C. I (G.6 X RgII)
S.C. 2 (G.6 X G.303 A)
S.C. 3 (RgIO X G.303 A)
S.C. 4 (RgIO X G.307 A)
S.C. 5 (RgIO X G.4)
S.C. 6 (G.303 A X G.4)
S.C. 7 (G 303 A X M.25)
S.C. 8 (G.307 A X G.4)

Table (3): Mean performance and heterosis % of F_1's for grain yield/plant.

Parent	Dens.	Mean performance 1	2	3	4	5	6	7	8	Heterosis % 1	2	3	4	5	6	7	8
1	d_1	-	142	154	131	197	133	172	174	-	14*	23**	5	-22	6*	38**	39**
	d_2	-	125	92	113	29	112	98	110	-	0	-26	-10	3	-10	-22	-12
	c	-	133	123	122	113	123	135	142	-	6*	-2	-3	-10	-2	8*	14*
2	d_1	126	-	134	106	144	118	136	145	0.8	-	7*	-15	15**	-6	9*	16*
	d_2	118	-	78	93	126	106	138	101	-6	-	-38	-26	0.8	-15	10	-19
	c	122	-	106	99	135	112	137	123	-2	-	-15	-21	8*	-10	10*	-2
3	d_1	126	116	-	162	135	141	131	155	0.80	-7	--	30**	8*	13*	5	24**
	d_2	98	108	-	77	74	131	103	117	-22	-14	-	-38	-41	5	-18	-6
	c	112	112	-	120	105	136	117	136	-10	-10	-	-4	-16	9*	-6	9*
4	d_1	118	103	128	-	118	113	132	110	-6	-18	2	--	-6	-10	6	-11
	d_2	106	84	101		82	104	87	70	-15	-33	-19	-	-34	-17	-30	-44
	c	112	93	114	-	100	109	110	90	-10	-26	-9	-	-20	-13	-12	-29
5	d_1	83	151	147	107	-	171	149	185	-34	21**	18**	-14	-	37**	19*	48**
	d_2	101	84	88	87	-	73	86	113	-19	-33	-30	-30		42	-31	-10
	c	92	118	117	97	-	122	118	149	-26	-6	-6	-22	-	-2	-6	19**
6	d_1	179	140	125	135	171	-	116	134	43**	-4	0	8	37	-	-7	7*
	d_2	106	93	[illegible]	97	[illegible]		86	98	-15	-26	-18	-22	-34	-	-31	[illegible]
	c	143	106	113	116	127	-	101	116	14*	-15	-10	-7	[illegible]	-	19	-7
7	d_1	168	136	123	148	129	163	-	130	34**	9	-2	18**	3	30**	-	4
	d_2	56	77	89	77	65	95	-	93	-55	-38	-29	-38	-48	24	-	-26
	c	112	107	106	113	97	129	-	112	10*	-14	-15	-10	-22	3	-	-10
8	d_1	150	133	162	116	219	137	192	-	20**	6*	30**	-7	75**	10*	54**	-
	d_2	91	98	91	92	101	91	91		-27	-22	-27	-26	-19**	-27	-27	
	c	120	116	[illegible]	104	160	114	142		-4	-7	[illegible]	17	8	-8	14	-

L.S.D (0.05) at 0.05 level of probability for d_1 = 37
L.S.D (0.05) at 0.05 level of probability for d_2 = 27
L.S.D (0.05) at 0.05 level of probability for combined = 46

* and ** significant at 0.05 and 0.01 levels of probability, respectively.

P3

5 x 6, 5 x 8, 6 x 5, 7 x 1, and 8 x 3 gave an average increase over the check variety by 6.33%. The remaining crosses had low yielding ability and gave an overall mean less than the check variety. As for other traits, some cross surpassed the check variety. High values of mean performance and heterotic effects for grain yield/ plant were obtained under the normal plant density (24,000 plant/ faddan). These results were in compeletly agreement with those obtained by Cross and Hammond (1982) and Fathy (1984) who reported high estimates of mean performance, heterosis effects, and combining ability components with low plant densities than those resulting with high plant densities. Frey and Maldnado (1967) defined the stress environment as the one in which mean performance for a certain attribute is low. Therefore, the high plant density (48,000 plant/ faddan) seemed to be the stress environment, while the normal plant density could be considered as the non-stress environment.

The analysis of variance for combining ability in each plant density as well as in the combined for all traits studied are presented in Table 1. The data revealed highly significant differences for general and specific combining ability in most cases for all traits except number of rows/ear and silking date. This indicates the importance of both additive and non-additive genetic variances in this respect. An inconsestent trend for GCA and SCA effects was detected from one density to another in most traits except for yield/ plant and number of kernels/row, where the estimates of GCA and SCA effects were higher in the normal plant density than in the high plant density for these traits. This result for grain yield/plant support the finding reported by Kata et al. (1975), Cross and Hammond (1982) and Fathy (1984) who showed that the amount of additive and dominance variances of GCA and SCA were in low plant densities more than in the high plant density. It seemed that the environment variation would curtain the genetic variance during the high plant density. Generally, it could be concluded that the general combining ability GCA or the additive genetic variance played the major role in the inheritance for all traits in most cases where it is evident from the ratios between GCA and SCA effects (Table 1). These ratios ranged from 1:1 to 16.2:1.

The inheritance of maize yield and its components as well as plant characters were studied by many investigators, El-Rouby et al. (1973), Goomber (1973), Shehata and Dhwan (1975), Nawar and El-Hosary (1982), Cross and Hammond (1982), Nawar and Khamis (1983), Fathy (1984), Nawar (1985) and many others. They reported that the GCA was larger than SCA for yield and its components. On the other side, the GCA exhibited a greater degree of interaction with plant densities than did SCA for all traits studied except 100-kernel weight and silking date. These results were in general agreement with those obtained by Kata et al. (1975), Cross and Hammond (1982) and Fathy (1984). Meanwhile, Matzinger et al. (1959), Nawar and Khamis (1983) and Nawar (1985) suggested that the additive effects were more biased by interaction with environments than the non-additive effects, while Rojas and Sprague (1952) showed that with a selected set of lines the variance components for the interaction of environment with SCA was greater than interaction with GCA.

General combining ability effects of each parent for each trait are presented in Table 4. The parental single crosses S.C 1 had significantly positive and negative general combining ability for grain yield and late wilt disease resistance % respectively, while S.C.8 had significantly positive general combining ability for grain yield, number of kernels/row, ear height and late wilt disease resistance %.

The parental S.C.6 had moderate value of GCA effect for yield and highly significant value of GCA for ear height and late wilt disease resistance %.

Table (4): Estimates of general combining ability.

Parents		Grain yield/ plant	100-kernel weight	No. of kernels/ row	Ear height	Late wilt disease resistance %
G.6 X Rg_{II}	(I)	5.98*	0.52	-0.25	-10.38**	-12.02**
G.6 X G.303 A	(2)	-5.26	-1.07	0.02	0.39	-1.62
Rg_{10} X G.303A	(3)	1.28	2.62**	-1.30*	-3.25**	-9.54**
Rg_{10} X G.307A	(4)	-10.89**	-0.26	-0.81	2.18	-1 17
Rg_{10} X G 4	(5)	0.32	-1 39**	-0.61	-3 59**	4.83**
G 303A X G.4	(6)	4.21	0.61	0.50	4.48**	5 15**
G 303A X M.25	(7)	-3.90	-1.22**	0.63	4.57**	3.66*
G.307A X G 4	(8)	8.28**	0.13	1.89**	9.97**	10.71**
L.S.D $(\hat{g}_i - \hat{g}_j)$ 0.05		8.09	1.05	1.60	3.42	4.93
L.S.D $(\hat{g}_i - \hat{g}_j)$ 0.01		10.65	1.39	2.11	4.50	6.49

* and ** significant at the probability level of 0.05 and 0.01, respectively.

The estimates of specific combining ability effects for the F_1's are presented in Table 5. Significantly positive and desirable SCA effects were obtained from the crosses 1 x 7, 2 x 5, 3 x 6, 4 x 7 and 5 x 8 for grain yield/plant; 1 x 7, 1 x8, 1 x 3, and 1 x 5 for 100-kernel weight; 1 x 7 and 5 x 6 for number of kernels/row and 1 x 5, 2 x 7, 5 x 7, and 6 x 8 for prolificay and tall plants.

From the previous results it could be recommended that the three parents S.C.(1), S.C.(6), S.C.(8) and the ten double crosses (17.99 of F_1's), i.e., 1 x 7, 1 x 8, 2 x 5, 3 x 6, 3 x 8, 5 x 8, 6 x 1, 6 x 3, 8 x 5 and 8 x 7 would be efficient and prospective in breeding programs for improving grain yield per plant because these crosses gave the highest values of mean performances, specific combining ability and relatively heterotic effects relative to the constant parent. Normal plant density (24,000 plant/faddan) considered as optimum or non-stress environment for evaluating the genetic material under investigation especially for grain yield where it gave moderate genetic parameteres and heterosis values.

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Table (5): Estimates of specific combining ability for the crosses studied.

Parent	I	2	3	4	5	6	7	8	I	2	3	4	5	6	7	8
	Grain yield/plant								100-kernel weight							
I	-	9	-7	5	-28**	7	I5*	0.I2	-	0.23	-4**	-I	-I.6	0.I8	3**	2*
2		-	-4	-5	I8*	-4	-I2	-3		-	2**	0.64	4**	-I	-3**	-2*
3			-	4	-8	I6*	-6	6			-	0.6I	-2**	I	-0.4I	0.72
4				-	-3	-3	I6*	-I3				-	0.32	0.3I	-0.05	-0.85
5					-	I0	-7	20**					-	-0.79	-I.03	0.0I
6						-	-II	-I5*						-	I.09	-0.77
7							-	5							-	0.33
L.S.D $(s_{ij} - s_{ik})_{0.05}$	2I.4											2.80				
$(s_{ij} - s_{kl})_{0.01}$	I9.8											2.59				
	No. of kernels/row								Ear height							
I	-	I.46	2.II	-0.22	-3.83**	0.39	2.68*	-I.67	-	-0.0I	-I.04	-4.3	5.4*	4.I	2.I	4.5
2		-	0.82	-0.32	2.32	0.88	3.75**	0.24		-	2.7	0.63	5*	-I.2	-7.7**	0.56
3			-	-I.42	-5.20	I.28	2.24	I.97			-	-I.60	-2.I	-0.8	-I.3	3.8
4				-	0.97	I.97	0.65	I.56				-	-I.9	3.4	I.7	2.6
5					-	2.67*	I.2I	I.86					-	-I.4	8.6**	-2.8
6						-	-I.15	-I.92						-	0.9	-5.2*
7								I.88							-	-3.5
L.S.D $(s_{ij} - s_{jk})_{0.05}$	4.23										9.04					
L.S.D $(s_{ij} - s_{kl})_{0.01}$	3.91										8.37					

* and ** significant at 0.05 and 0.01 levels of probability, respectively.

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