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Estimation of Combining Ability and Gene Action by Using Line X Tester Procedure in Bread Wheat (*Triticumastivum*., L).

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Abstract

The present research was conducted to study the combining ability and gene action for morphological, yield and its components traits in F1 crosses of wheat using line x tester procedure. Experiment was conducted incloudingthirty genotypes consisting of ten lines, L1,L2, L3, L4, L5, L6, L7, L8, L9, L10and three testers namely; Sids 12 (T1), Gemmeiza 11 (T2) and Line 137 ((T3).Thirtycrosses and their parents were evaluated under two irrigation treatments in randomized complete block design with three replications at experimental Research Farm, Faculty of Agriculture Benha Univ. during the winter successive growing seasons 2017/18 and 2018/19. The obtained results could be summarized as follows;highly significant differences were found among irrigation treatment, genotypes and its partitioning lines, testers and line x testers for all the studied traits. Also, interaction between irrigation treatment and mention source of variance were significant for most traits under study. Genetic analysis revealed that the importance of both additive and non-additive components in the inheritance of all traits.The non-additive was more important for most studied traits.The best general combining ability was L8 for earliness, plant height, No. of spikes /plant and grain yield. The crosses T1 x L3, T2 x L1, T2 x L2, T2 x L4, T3 x L4 and T3 x L6 showed highly significant positive Sij effects (desirable) for biological yield/ plant and grain yield/ plant.

Key words*: Wheat, combining ability, drought stress, GCA and SCA.*

Introduction

Bread wheat (*Triticumaestivum* L.) is a major food crop in the world. In Egypt, it is used as a stable food grain for urban, rural and bedewing societies and as a major source of straw for animal feeding. However, geometrical increase in the Egyptian population has been a challenge for agricultural scientists. To improve yield potential of wheat there is requirement to have knowledge regarding the nature of combining ability of available parents to be used in the hybridization programme and also about the nature of gene action involved in the expression of economically important quantitative as well as qualitative traits **Hassan *et al.* (2007), Al Saadoon (2017),AL Sadoonet al. (2019)and Al-Tamimi et al (2020).** For the development of genetically superior high yielding varieties, identification of superior parents is an important pre-requisite**.** Earlier research review revealed that both general and specific combining ability were involved for yield and yield components, **Chaudhry*et al.*(1992), Al Saadoon et al. (2017), EL-Hosary et al. (2019) and Al-Tamimi et al (2020).** For effective improvement in yield of wheat, one can use combining ability analysis to test the performance of selected parents in different cross combinations and can characterise the nature and magnitude of gene effects in the expression of various yield contributing traits.

Keeping the above in view, the present line × tester analysis was planned to estimate general and specific combining ability effects to identify better parents as well as high cross combinations for further improvement in wheat.

Material and Methods

The present study was carried out at Faculty of Agriculture at moshtohor, Egypt during 2017/18and 2018/19 seasons, Egypt. In 2017/18 season, line x tester mating design was performed through 10lines in addition to three testers to produce the hybrid seeds of 30 crosses. Parents of the beforementioned genotypes are listed in Table 1.

In 2018/19, the 13 parents along with the 30 F_1'S were grown in randomized complete block design with three replications. The sowing date was on 4th Dec. 2018. Two adjacent experiments were conducted. The first experiment was irrigated only once after planting irrigation and the second one was normally irrigated five irrigations. Each genotype was grown in 2 rows of 3m length with inter row and intra row spacing of 30cm and10cm respectively. To raise a good crop stand all the recommended cultural practices were followed. The recommended cultural practices were applied at the proper time. Data were recorded on a sample of 10 plants/replication in each genotypes whereas for days to 50% flowering (day),plant height (cm), number of spikes per plant, number of grains per spike, 1000-grain weight (g) and grain yield per plant (g). Data for the characters depicting significant difference were further analyzed for line x tester according to **Singh and Chaudhry (1979).**

Table 1. The name and pedigrees of the parental genotypes**.**

NO.	Genotype	Pedigree	Origin
L_1	M101	MILAN \ S71101 \\ OAPYMex	CIMMYT
L_2	M102	MILAN \ S7102\\ OAPYMex	CIMMYT
L_3	M103	MILAN \ S7103 \\ OAPYMex	CIMMYT
L_4	M104	MILAN \ S7104 \\ OAPYMex	CIMMYT
L_5	M105	MILAN \ S7105 \\ OAPYMex	CIMMYT
L_6	M106	MILAN \ S7106 \\ OAPYMex	CIMMYT
L_7	M107	MILAN \ S7107\\ OAPYMex	CIMMYT
L_8	M108	MILAN \ S7108 \\ OAPYMex	CIMMYT
L_9	M109	MILAN \ S7109 \\ OAPYMex	CIMMYT
L_{10}	M110	MILAN \ S7110 \\ OAPYMex	CIMMYT
T1	**Sids 12**	BUC//7C/ALD/5/MAYA74/ON//1160.147/3/BB/GLL /4/CHAT"S"/6/MAYA/VUL//CMH74A.630/ 4*SXSD7096-4SD-1SD-1SD 0SD	Egypt
T2	**GEMMEIZA 11**	BOW"S"/KVS"S"//7C/SERI82/3/GIZA168/SAKHA61- GM-7892-2GM-1GM2GM-1GM-0GM	Egypt
T3	**M L 1137**	MILAN \ S7137 \\ OAPYMex	Egypt

Results and Discussion

Analysis of variance

The analysis of variance of ordinary and line x testers mating design for all the studied traits are presented in Table (2).

Analysis of variance revealed highly significant for crossesand their partitions; lines, testers and line x testers for all the studied traits except thousand grain weight for line, tester and line x tester in both and across environments and tester for plant high in drought environment, indicating the wide diversity among the genotypes, which is considered adequate for further biometrical assessment.These results are in agreement with those of Abd El-Aty (2002), Abd El-Atyand Katta (2002), Nour*et al*. (2011) , Kumar *et al.* (2015) and **Al-Tamimi et al (2020)**.

Genetic components

Knowledge of gene action helps in the selection of parents for use in the hybridization programs, also in the choice of appropriate breeding procedure for the genetic improvement quantitative characters.

The estimates of genetic parameters were calculated, for all the studied traits as presented in table (2). The results showed that the non-additive genetic variance were larger than the additive genetic variance σ^2SCA for all the studied traits, suggesting greater importance of non-additive genetic variance in the inheritance of these traits.The GCA varince were lower than SCA varince in terms of all traits evaluated in the research in contrast to **Titan *et al.* (2012).** They used 6 wheat lines and seven testers and they tested 42 F1 combinations for two seasons. Also, **Sharma *et al.* (2006)** stated that σ^2gca variance was of greater importance than σ^2sca for some traits. The difference in the results reported by researchers may be attributed to differences of parental materials used hybridization and to genotype × environments.

The ratio σ^2GCA/ σ^2SCA varies depending on the allele frequencies between parental populations **(Reif*et al*., 2007; Longin*et al*., 2013).** The lines selected from different gene pools had favorable σ^2GCA/ σ^2SCA ratio because of their high GCA effects **(Labate*et al*.,1997).**In this study, low ratios of Ơ^{2}GCA/ Ơ^{2}SCA, Ơ^{2}A/ Ơ^{2}D and These results showed that σ^2GCA/σ^2SCA portion was lower than one and (Ơ^{2}A/ Ơ^{2}D) portion, which is an indicator of dominancy degree, lower than one (Table 2). Hence, it can be seen that non-additive genetic effects are controlling the inheritance of studied traits. **Fellahi*et al*. (2013)** and **EL-Hosary and Abdelwahed (2015)** reported the importance of non-additive gene action for the plant height, number of fertile tillers, thousand kernel weight and kernel yield. They recommended that selection of superior plants should be postponed to later generations due to preponderance of non-additive type of gene actions for all studied traits. Similar results of predominance of non-additive gene action for all studied traits have been reported by **Verma*et al.* (2007)** for wheat. The efficiency of the selection is related with the size of narrow sense heritability in the segregating populations. The heritability degrees were found very low for the traits studied in the research (Table 2).This situation showed that the additive variance is very low in this population and the selection must be applied in the further generations.

This findings proved that in the present study, both non-aditive and additive components are important expression of the studied traits. Similar results were previously reported **by Khalifa*et al* (1998), Abd El-Aty (2000),Abd El-Aty and Katta (2002), EL-Hosary and Abdelwahed (2015) and Al-Tamimi et al (2020**).

Table 2. Analysis of variance for various agronomic traits in line x tester analysis in wheat**.**

S.O.V.	df	Days to heading (days)	Plant height (cm)	No. of spikes /plant	No. of grains /spike	1000-Grain weight (g)	Biological yield/ plant (g)	Grain yield/plant (g)
				Normal irrigation treatment				
Rep	2	41.88**	0.93	8.63	1.88	0.08	2.63	0.74
Crosses (c)	29	11.86**	76.95**	113.21**	246.90**	1.16	7994.06**	368.48**
Line (L)	9	12.62**	47.54**	49.99**	191.17**	0.80	5250.96**	426.54**
Tester (T)	2	2.41*	191.10**	47.56**	1056.14**	1.54	4291.30**	369.38**
L x T	18	12.52**	78.98**	152.12**	184.85**	1.30	9777.03**	339.35**
Error	58	5.81	11.35	2.76	1.23	0.78	7.96	3.92
δ^2_{GCA}		-0.01	**-0.04**	-0.73	1.16	0.00	-33.34	0.54
δ^2_{SCA}		2.24	**22.54**	49.79	61.20	0.17	3256.36	111.81
				Droughttreatment				
Rep	2	7.14	2.01	19.87	0.83	1.03	0.58	4.04
Crosses (c)	29	17.84**	78.07**	228.04**	2877.67**	1.40	2543.49**	268.79**
Line (L)	9	37.09**	124.73**	196.21**	5514.80**	1.02	1708.57**	134.23**
Tester (T)	2	8.01**	0.57	263.81**	1196.94**	1.03	9712.34**	123.94**
L x T	18	9.31**	63.35**	239.98**	1745.86**	1.63	2164.41**	352.16**
Error	58	4.18	6.34	1.76	1.25	1.00	10.28	3.59
δ2GCA		**0.16**	**0.28**	0.00	21.16	0.00	7.09	-1.56
δ2SCA		**1.71**	**19.00**	**1.06**	581.54	0.21	718.04	116.19
				Combined across irrigation treatment				
Irrigation (I)	1	26.45**	576.38**	32688.11**	1328.45**	6.42**	75727.02**	11.55**
Rep/I	4	24.51**	1.47	14.25**	1.36	0.56	1.61	2.39
Crosses (c)	29	6.67**	44.98**	107.02**	1030.96**	0.93	3687.41**	239.83**
Line (L)	10	7.96**	42.82**	59.66**	1925.14**	0.85	2379.14**	180.62**
Tester (T)	2	1.16	106.12**	43.78**	487.82**	2.07	755.49**	357.54**
L x T	18	6.42**	41.69**	135.22**	622.66**	0.89	4550.97**	261.03**
CxI	29	12.90**	57.20**	117.89**	1028.42**	0.76	3257.79**	180.18**
LxI	9	24.00**	67.93**	98.61**	1742.98**	0.32	2094.84**	179.87**
TxI	2	9.27**	85.55**	267.60**	1765.27**	0.51	13248.16**	135.78**
LxTxI	18	7.61**	49.80**	116.84**	618.50**	0.99	3125.66**	183.51**
Error	116	3.29	5.83	1.49	0.82	0.59	6.01	2.47
δ^2_{GCA}		-0.20	0.11	-2.77	-10.22	0.02	-139.44	0.62
δ^2_{SCA}		-0.20	-1.35	3.06	0.69	-0.02	237.55	12.92
δ^2_{GCAxI}		0.24	0.60	-2.58	8.96	0.00	-147.96	1.27
$\delta^2_{SCA\ xI}$		1.44	14.66	38.45	205.90	0.14	1039.88	60.35

*and ** significant at 0.05 and 0.01 respectively

Mean performance of genotypes

Mean performance values of the F_1 crosses for all the studied traits are presented in Table (3). The crosses T_1 x L_2, T_1 x L_8,T_1 x L_9, T_2 x L_5, T_2 x L_7, T_2 x $L_8$and T_3 x L_9 were the earliest flowering date. As the regard to plant height, four of the F_1top crosses T_1 X L_3, T_1 X L_8, T_3 X $L_4$and T_3 X L_6were taller than their parental means. The cross T2xL8 had the highest values for No.of spikes/plant. The parental combination T1xL5 had higherNo. of grains/spike.

The cross T3xL1 were superior in 1000-grain weight. Concerning the grain yield/plant, the cross T2xL1 were higher in the grain yield/plant.The crosses were higher in the grain yield/plant, where the heaviest cross for biological yield/ plant was detected by the cross T1xL3. These results were coincident with these obtained by **Khalifa*et al.*(1998), Abd El-Aty and Katta (2002), Nour*et al.*(2011), Kumar *et al*. (2015) and Rajput and Kandalkar*et al*.(2018).**

Table 3. Mean performance of hybrids (line x tester) for all studied traits.

Cross	**Days to heading (Days)**	**Plant height (cm)**	**No. of spikes /plant**	**No. of grain /spike**	**1000-Grain weight (g)**	biological yield/ plant (g)	**grain yield/ plant (g)**
T1 X L1	102.33	102.83	25.01	62.17	46.67	237.33	50.83
T1XL2	99.83	108.17	17.46	64.17	51.67	292.67	46.33
T1XL3	104.83	111.83	25.06	51.50	56.67	368.17	68.83
T1X L4	102.67	110.00	18.78	68.17	50.00	231.33	42.13
T1XL5	101.17	104.33	19.96	137.67	53.33	252.83	61.83
T1XL6	103.00	101.67	29.29	60.33	46.67	243.50	54.17
T1XL7	103.67	104.17	22.01	58.67	45.00	301.00	44.10
T1XL8	100.83	112.50	18.20	60.33	46.67	266.33	54.17
T1X L9	99.00	103.83	33.36	66.50	56.67	292.00	61.83
T1XL10	101.17	104.33	21.90	56.67	51.67	278.50	55.67
T2 X L1	102.00	104.50	31.03	53.67	48.33	306.33	75.00
T2XL2	103.33	104.83	27.85	67.50	48.33	296.17	56.33
T2XL3	102.83	103.67	21.44	67.00	55.00	262.83	56.17
T2X L4	101.17	106.33	26.58	54.33	40.00	278.67	54.83
T2XL5	100.83	104.17	22.06	84.33	50.00	270.33	56.83
T2XL6	102.33	100.17	17.12	60.33	41.67	245.50	42.00
T2XL7	100.33	108.00	20.28	67.17	40.00	248.50	51.50
T2XL8	100.83	108.00	39.44	51.50	50.00	286.50	53.50
T2X L9	101.83	104.50	16.50	70.33	55.00	241.17	41.50
T2XL10	102.33	103.00	20.14	59.33	48.33	257.00	56.53
T3 X L1	103.33	107.83	23.10	57.67	58.33	322.33	59.00
T3XL2	104.00	109.15	23.25	70.17	55.00	252.83	65.17
T3XL3	101.33	109.33	17.49	63.33	48.33	256.17	53.83
T3X L4	101.17	110.83	22.33	53.33	53.33	310.33	62.50
T3XL5	101.67	103.00	20.65	80.33	46.67	241.67	54.17
T3XL6	103.50	113.50	28.89	51.17	55.00	263.83	55.83
T3XL7	101.67	106.00	19.86	73.83	50.00	267.67	56.00
T3XL8	101.50	103.83	23.60	73.50	45.00	263.00	62.33
T3X L9	100.67	103.33	22.49	49.67	46.67	248.67	51.17
T3XL10	101.67	106.67	24.04	65.17	53.33	307.50	64.17
LSD 5%	2.05	2.73	1.38	1.02	46.67	2.77	1.78
LSD 1%	2.70	3.59	1.81	1.34	51.67	3.65	2.34

Combining ability

General combining ability effects (GCA (ĝi)).

The estimate of general combining ability for parents (lines and testers) are presented in Table (4).

The result illustrated that: the tester 1 was a good combiner for No of grains/ spike and biological yield/ plant. T2 showed good combiner for plant height. T3 was a good combiner for plant height, 1000-grain weight and grain yield/ plant.

Table 4. Estimates of general combining ability effects of parents for studied traits**.**

Parent/Line	**Days to heading (days)**	**Plant height (cm)**	**No. of spikes /plant**	**No. of grains /spike**	**1000-Grain weight (g)**	**biological yield/ plant (g)**	**Grain yield/ plant (g)**
Tester							
1	-0.04	0.22	-0.20	3.29**	0.07	3.34**	-1.62**
2	-0.11	-1.43**	0.94**	-1.78**	-0.21**	-3.72**	-1.19**
3	0.16	1.20**	-0.73**	-1.51**	0.14*	0.38	2.81**
L.S.D. (gi) 5%	0.32	0.43	0.22	0.16	0.14	0.44	0.28
L.S.D. (gi) 1%	0.43	0.57	0.29	0.21	0.18	0.58	0.37
L.S.D. (gi-gj) 5%	0.53	0.71	0.36	0.26	0.22	0.72	0.46
L.S.D. (gi-gj) 1%	0.70	0.93	0.47	0.35	0.29	0.94	0.60
Line							
1	0.66	-1.09	3.07**	-7.49**	0.13	15.64**	6.00**
2	0.49	1.24*	-0.46	1.95**	0.19	7.53**	0.34
3	1.11**	2.13**	-1.98**	-4.72**	0.36*	22.70**	4.00**
4	-0.23	2.91**	-0.74*	-6.72**	-0.20	0.42	-2.45**
5	-0.67	-2.31**	-2.42**	35.45**	0.02	-18.08**	2.00**
6	1.05*	-1.03	1.79**	-8.05**	-0.20	-22.08**	-4.94**
7	-0.01	-0.09	-2.59**	1.23**	-0.48**	-0.63	-5.08**
8	-0.84*	1.97**	3.77**	-3.55**	-0.26	-1.08	1.06**
9	-1.39**	-2.26**	0.81**	-3.16**	0.30	-12.41**	-4.11**
10	-0.17	-1.48**	-1.28**	-4.94**	0.13	7.98**	3.18**
L.S.D. (gi) 5%	0.84	1.12	0.56	0.42	0.35	1.13	0.73
L.S.D. (gi) 1%	1.10	1.47	0.74	0.55	0.46	1.49	0.96
L.S.D. (gi-gj) 5%	1.19	1.58	0.80	0.59	0.50	1.60	1.03
L.S.D. (gi-gj) 1%	1.56	2.07	1.05	0.78	0.66	2.10	1.35

*and ** significant at 0.05 and 0.01 respectively

Also, the results revealed that twoparental lines; L_8, and L_9showed significant negative (ĝi) effects (desirable) for days to heading is essentially a prerequisite in breeding program of a crop.

Regarding to plant height, dwarf plants are more lodging resistant while tall plants are preferred for straw purpose thus preference depends upon the breeding objective. Therefore, the parental lines L_2, L_3, L_4, and L_8 can be considered as good general combiner for tallness as they showed highly significant positive (ĝi) effects, while, L5, L9 and L10 exhibited good combiner for dwarfness as they showed highly significant negative GCA (ĝi) .

For No.of spikes/plant, the parental lines L_1, L_6, L_8 and L_9 showed highly significant positive (ĝi) effects.

With respect to No. of grains/spike parental line L_2,, showed highly significant positive GCA effects, these parents considered as good combiner for this trait.No. of grains/spike is an important yield contributing trait.

For 1000-grains weight, the parental line; L_3 showed highly significant positive (ĝi) effects. 1000 grain weight is an important direct selection criterion for the selection of grain yield, thus significant positive GCA values considered as good general combining ability effects.

Regarding biological yield/ plant and grain yield/plant; three parental lines L_1, $L_3$and L_{10}exhibited highly significant positive (ĝi) effects.These results are in agreement with the earlier studies carried out by **Abd El-Aty and Katta (2002), Akbar *et al.* (2009), Abdel Nour*et al* (2011), Attia*et al.* (2014), Kumar *et al* (2015), Abro et al (2016) and Tabassum and parasad (2017).**

Specific combining ability

The results of specific combining ability effects of top crosses for all the studied traits are presented in Table (5).

Three crosses, T_1 x L_2,T_1 x L_9, and T_3 x L_3 showed significant negative (desirable) Sij effectsfor days to heading, which indicated that one or more of these combinations could be helpful for selecting early maturity wheat lines.

For plant height, five crosses T_1 x L_3, T_1 x L_8, T_2 x L_7, T_2 x L_9 and T_3 x L_6 showed significant positive Sij effects (tall plant),it could be a good combiner for straw production.

For No.of spikes/plant, thetop crosses; T_1 x L_3, T_1 x L_6, T_1 x L_7, T_1 x L_9, T_2 x L_1, T_2 x L_2, T_2 x L_4, T_2 x L_8, T_3 x L_2, T_3 x L_6 and T_3 x L_{10} showed significant positive (desirable) SCA (Sij). These crosses can be used for increasing No. of tillers/plant.

Regarding No.of grains/spike, the crosses; T_1 x L_1, T_1 x L_4, T_1 x L_5, T_1 x L_9, T_2 x L_2, T_2 x L_3, T_2 x L_6, T_2 x L_7, , T_2 x L_9, T_3 x L_1 , T_3 x L_2, T_3 x L_3 , T_3 x L_7, T_3 x L_8 and T_3 x L_{10} exhibited significant positive Sij effects.

Thirteen and fourteen crosses exhibited positive Sij effects for biological yield/ plant and grain yield/plant, respectively. However, the crosses T_1 x L_3, T_2 x L_1, T_2 x L_2, T_2 x L_4, T_3 x L_4 and T_3 x L_6showed highly significant positive Sij effects (desirable) for the mention traits, they consider the best combiner for both traits.

Table 5. Estimates of specific combining ability effects of parents for studied traits.

cross	Days to heading	Plant height	No. of spikes /plant	No. of grains /spike	1000-Grain weight	biological yield/ plant	Grain yield/ plant
T1 X L1	-0.18	-2.45*	-1.17*	1.04**	-0.52	-54.68**	-9.16**
T1XL2	-2.51**	0.56	-5.19**	-6.40**	-0.07	8.77**	-7.99**
T1XL3	1.88*	3.33**	3.93**	-12.40**	0.26	69.10**	10.84**
T1X L4	1.04	0.72	-3.58**	6.27**	0.15	-45.46**	-9.40**
T1XL5	-0.01	0.28	-0.73	33.60**	0.26	-5.46**	5.84**
T1XL6	0.10	-3.67*	4.39**	-0.23	-0.18	-10.79**	5.12**
T1XL7	1.82*	-2.11*	1.50**	-11.18**	-0.07	25.27**	-4.81**
T1XL8	-0.18	4.17**	-8.67**	-4.73**	-0.13	-8.96**	-0.88
T1X L9	-1.46*	-0.28	9.45**	1.04**	0.32	28.04**	11.95**
T1XL10	-0.51	-0.56	0.08	-7.01**	-0.02	-5.84**	-1.50**
T2 X L1	-0.44	0.87	3.71**	-2.39**	-0.07	21.39**	14.58**
T2XL2	1.06	-1.12	4.06**	2.00**	-0.12	19.33**	1.58*
T2XL3	-0.06	-3.18*	-0.83	8.17**	0.38	-29.17**	-2.26**
T2X L4	-0.39	-1.30	3.08**	-2.50**	-0.57	8.94**	2.87**
T2XL5	-0.28	1.76	0.23	-14.67**	0.21	19.11**	0.41
T2XL6	-0.50	-3.52**	-8.92**	4.83**	-0.40	-1.72	-7.48**
T2XL7	-1.44	3.37**	-1.37**	2.39**	-0.29	-20.17**	2.16**
T2XL8	-0.11	1.32	11.42**	-8.50**	0.49	18.28**	-1.98**
T2X L9	1.44	2.04*	-8.56**	9.94**	0.43	-15.72**	-8.81**
T2XL10	0.72	-0.24	-2.83**	0.72	-0.07	-20.28**	-1.07
T3 X L1	0.62	1.57	-2.54**	1.34**	0.58	33.29**	-5.42**
T3XL2	1.46*	0.56	1.13*	4.40**	0.19	-28.10**	6.41**
T3XL3	-1.82*	-0.15	-3.11**	4.23**	-0.64*	-39.93**	-8.59**
T3X L4	-0.66	0.57	0.50	-3.77**	0.42	36.51**	6.54**
T3XL5	0.29	-2.04*	0.50	-18.93**	-0.47	-13.66**	-6.25**
T3XL6	0.40	7.18**	4.53**	-4.60**	0.58	12.51**	2.36**
T3XL7	-0.38	-1.26	-0.13	8.79**	0.36	-5.10**	2.66**
T3XL8	0.29	-5.48**	-2.75**	13.23**	-0.36	-9.32**	2.86**
T3X L9	0.01	-1.76	-0.89	-10.99**	-0.75*	-12.32**	-3.14**
T3XL10	-0.21	0.80	2.75**	6.29**	0.08	26.12**	2.57**
L.S.D. (Sij) 5%	1.45	1.93	0.98	0.72	0.61	1.96	1.26
L.S.D. (Sij) 1%	1.91	2.54	1.28	0.95	0.80	2.58	1.65
L.S.D. (Sij-Skl) 5%	2.05	2.73	1.38	1.02	0.87	2.77	1.78
L.S.D. (Sij-Skl) 1%	2.70	3.59	1.81	1.34	1.14	3.65	2.34

*and ** significant refer to the level of significant at 0.05 and 0.01 respectively

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تقدير القدرة على التالف و الفعل الجينى باستخدام تكنيك السلالة x الكشاف فى قمح الخبز

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اقيمت التجربة لدراسة القدرة على التالف و الفعل الجينى لبعض صفات التبكير و المحصول و مكوناته و ايضا التفاعل مع معاملات الرى. اجرى تقييم 30 هجين بين 3 كشافات و 10 سلالات مستورده حيث تم اتباع تكنيك السلالة x الكشاف. تم تقييم الهجن فى تصميم قطاعات كاملة العشوائية و ذلك تحت معاملتين رى مختلفتين(رى عادى و جفاف) . كان متوسط التباين لمعاملتى الرى و التراكيب الوراثية و تجزئتها (سلالة – كشاف – سلالة x كشاف) معنوى لمعظم الصفات تحت الدراسة. كان تباين القدرة العامة و الخاصة على التالف معنوى فى جميع الصفات تحت الدراسة و الجزء الغير مضيف يتحكم فى اظهار معظم الصفات. كان التفاعل بين معاملتى الرى و جميع مصادر التباين معنوى فى معظم الصفات تحت الدراسة. كانت السلالة رقم 8 اكثر قدرة على التالف للتبكير و طول النبات و عدد السنابل/ النبات و محصول حبوب النبات. اظهرت الهجن T1 x L3, T2 x L1, T2 x L2, T2 x L4T3 x L4 , و T3 x L قدرة خاصة على التالف معنوية و موجبة لصفة محصول النبات البيولوجى و محصول حبوب النبات.