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STUDY OF SOME AGRONOMICAL TRAITS IN SOME BREAD WHEAT VARIETIES AND THEIR CROSSES UNDER DROUGHT STRESS

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ABSTRACT: *The present study was conducted in a special farm on three seasons (2009/2010, 2010/2011 and 2011/2012). Seven bread wheat variety employed. Using randomized complete block design. In the first year, parents planted and the crosses among them conducted in half diallel. On the third year (2011/2012), two experiments designed; one had received normal water irrigation, whereas the other one had received water only in two times to tested drought effect on several agronomic characters. Agronomic characters measured for parents and their crosses under normal irrigation and drought stress conditions to determine the best genotypes. The results showed that the parents and crosses were better characters under normal irrigation than drought stress. As for yield characters, parents and crosses indicated less numbers of grains per main spike under drought stress. Finally, parents and crosses had early heading date and maturity date under drought condition.*

Key words: *Bread wheat, normal irrigation, drought stress, half diallel.*

INTRODUCTION

Wheat *(Triticum aestivum L.)* is the first important and strategic cereal crop for the majority of world's populations. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. (FAO STAT, 2013)

Egypt imports about 45% of its wheat requirements. This reflects the size of the problem and efforts needed to increase wheat production. Thus, increasing production per unit area appears to be one of the important factors for narrowing the wheat production and consumption gap. The annual consumption of wheat grains in Egypt is about 14.0 million tons, while the annual local production is about 8.1 million tons / 3.135 million fadan in 2013/2014 (The Agricultural Economics and Statistics Department, Ministry of Agriculture, Egypt, 2014). Efforts of scientists to minimize gab between local consumption and local production are directed towards two ways, i.e. expanding the cultivated wheat area and increasing the wheat productivity per land unit area.

Genetic diversity plays an important role in plant breeding either to exploit heterosis or to generate productive recombinants. The genetic variation among wheat parents is necessary to drive superior progeny from crossing and selection; most of new wheat cultivars have narrow genetic bases. The choice of parents is of paramount importance in germplasm as a pre-requisite for crop improvement programmers. So precise information on the nature and degree of genetic diversity present in wheat collections would help to select parents for evolving superior varieties. For the genetic improvement of this crop, diverse genotypes from the existing germplasms should be selected to be used in further breeding programs.

We conducted this research to study the effect of drought on some agronomical characters in some wheat genotypes.

MATERIALS AND METHODS

The present work was carried out in a special Farm, Shoupra Belola of Village

Minouf, Minufiya during three successive seasons 2009/2010, 2010/2011 and 2011/2012. Seven common wheat varieties were used to establish the experimental materials for this investigation. Name and pedigrees of these seven wheat varieties are presented in Table (1).

Experimental design and cultural practices:

Seven wheat varieties were planted on November 2009. Crosses among the studied varieties were made in first year. Grains were collected and kept for the next year (2010/2011). In this year hybrid grains were planted with the seven parents for propagation. Using randomized complete block design with three replications. The experimental units consisted of raw 1.5 meters long with 20 cm between raw; plants within raw were 10 cm. apart allowing a total of 15 plants per row. Normal agricultural wheat practices were applied as usual for the ordinary wheat fields in the area. On the third year (2011/2012), two experiments were designed; one had received normal water practices, whereas the other one had received water only in two times. The first one at plantation the other had after forty five days to test drought effect on agronomical characters in all tested genotypes, data was recorded as follows:

Measurements:

[1] Plant height (cm)

Plant height was measured as the distance (cm) between soil surface and approximate midpoint of random spikes group; three measurements were rerecorded for each plot.

[2] Main column Spike length (cm)

The average main column Spike length was measured from ten plans.

[3] Number of Spikelets /main column spike

The average number of spikelets / main column spike was measured from ten plans.

[4] Number of spikes /plant

Ten random plants were chosen in each plot and numbers of spikes were counted, and the average was calculated.

[5] Number of grains / main spike

Ten main spikes were collected from ten plants in each plot and threshed to count the number of grains / spike and the average was calculated.

[6] Grain yield /plant (grain)

The average grain yield /plant (grain) were recorded from ten plans.

Table (1): Seven wheat tested varieties and their pedigree.

NO	VARIETY	PEDIGREE
1	Sakha 8	CNO67//sn64/KLRE/3/8156PK 3418-6S-OS-OS
2	Sakha 93	SAKHA92/TR 810328/S8871-1S-2S-OS
3	GIZA 164	KVZ/BUHA"S"//KA1/BBCM33027-F-15M-500Y-0M
4	GIZA 168	M1L/BUC//SERICN93046-8M-OM-OY-OM-2Y-0B
5	SIDS 1	HD2172/PAVON"S"//1158-57MAYA 74"S"SD46-4SD-2SD-1SD-0SD
6	GEMMIEZA 7	CMH74A.630/SX//SERI82/3/AGENTCGM4611-2GM-GM-1GM-0GM
7	GEMMIEZA 9	A1D"S"/HUAC"S"//CMH74A.630/5XCGM4583-5GM-1GM-0GM

[7] 1000-grain weight (gm)

Average weight (in grams) of three random 500-grains samples were taken from each plot and then converted to 1000-grain weight.

[8] Heading date (days)

Heading date was measured as the number of days from planting to day when 50 % of spikes were fully exerted from the flag leaf sheath. Ten plants were randomly selected and measured; the average of ten plants is recorded.

[9] Maturity date (days)

Maturity date was measured as the number of days from planting to day when 50% of spikes were matured. Ten plants were measured; the average of the ten plants was calculated.

Statistical analysis:

-Diallel crosses analysis:

The data were analyzed to test the significance of the twenty one different genotypes and their parents using least significant differences test (LSD). Also, the genotypes mean squares were conducted.

RESULTS AND DISCUSSION

Data presented in Table (2) clearly showed the effect of water stress on several agronomical characters. Concerning plant height (cm) for parents showed height decrease under drought condition such as sids1 it came to be 98.3cm compared with 113.3cm under normal irrigation condition.

As for main column spike length (cm) parents, Sakha 8 and Giza 164 were the tallest parents for tall with average of 15.3 cm under irrigation condition. However Sakha 93 was the tallest parent with average of 9.6 cm under the drought stress. Cross, Gemmieza 7 x Sakha 8 was the tallest cross with average of 15.3 cm under normal irrigation condition. Gemmieza 7 x Sakha 93 and Sids1x Gemmieza 7 were the tallest crosses with average of 10.3 cm under the drought stress.

Regarding number of Spikelets /main column spike parent, Sakha 93 was the highest number of Spikelet's /main Culm spike parent with average of 22 Spikelet under normal irrigation. Giza 164 was the highest number of Spikelet's /main Culm spike parent with average of 16.6 Spikelet under the drought stress. Cross, Sids 1 x Gemmieza 7 was the highest number of Spikelet's /main Culm spike cross with average of 22.3 Spikelet under normal irrigation. Sids 1 x Sakha 8, Gemmieza 7 x Giza 164 and Gemmieza 9 x Sakha 93 were the highest number of Spikelet's / main Culm spike crosses with average of 18 Spikelet under the drought stress.

As for number of spikes / plant, parents Sids 1 and Sakha 8 were the highest number of spikes / plant parents with average of five spikes under normal irrigation. Gemmieza 7 was the highest number of spikes / plant parent with average of four spikes under the drought stress cross, Gemmieza 9 x Giza 164 was the highest number of spikes / plant cross with average of 6.6 spikes under normal irrigation. Sids 1 x Giza 164, Gemmieza 7 x Giza 164, Gemmieza 7 x Giza 168 and Sakha 8x Sakha 93 were the highest number of spikes / plant crosses with average of four spikes under the drought stress.

For number of grains / main spike parents, Sakha 93 was the highest number of grains / main spike parents with average of 94.3 grain under normal irrigation. Giza 164 was the highest number of grains / main spike parent with average of 82.3 grain under the drought stress. cross, Gemmieza 9 x Sakha 93 was the highest number of grains / main spike crosses with average of 93 grain under normal irrigation. Gemmieza 7x Sakha 93 and Gemmieza 9 x Sakha 93 were the highest number of grains / main spike crosses with average of 73.6 grain under the drought stress.

As for grain yield /plant (grain) parents, Sakha 8 was the greatest grain yield / plant parent with average of 362.6 grain under normal irrigation. Giza 168 was the greatest

grain yield / plant parent for yielding with average of 244 grain under the drought stress. Cross, Gemmieza 9 x Giza 164 was the greatest grain yield / plant crosses for yielding with average of 655.3 grain under normal irrigation. Gemmieza 7 x Giza 164 and Gemmieza 9 x Sakha 93 were the greatest grain yield / plant crosses for yielding with average of 218.3 grain under the drought stress.

Table (2): Agronomic characters for seven studied varieties and their crosses under Drought stress and normal irrigation.

Genotype	Plant Height (cm)		Main column spike length (cm)		No. of spikelets / main column spike	
	Normal	Drought	Normal	Drought	Normal	Drought
Sids 1	113.3	98.3	11.3	8.0	21.3	16.0
Sids 1 x Gemmieza 7	110.6	97.0	13.3	9.0	22.3	17.0
Sids 1 x Gemmieza 9	110.0	99.3	14.0	10.3	21.0	14.0
Sids 1 x Sakha 8	113.6	99.0	13.6	8.6	18.0	18.0
Sids 1 x Sakha 93	113.3	97.6	14.3	9.3	16.6	14.3
Sids 1 x Giza 164	108.3	97.0	12.3	8.6	17.3	18.0
Sids 1 x Giza 168	107.3	94.6	14.3	7.6	18.0	15.6
Gemmieza 7	107.6	89.3	14.6	8.3	20.3	15.3
Gemmieza 7 x Gemmieza 9	107.6	87.6	15.3	8.0	17.0	13.6
Gemmieza 7 x Sakha 8	113.0	92.3	15.6	9.3	18.0	16.6
Gemmieza 7 x Sakha 93	106.3	95.6	12.6	10.3	21.3	17.0
Gemmieza 7 x Giza164	108.3	90.3	12.3	9.3	21.0	18.0
Gemmieza 7 x Giza 168	106.0	87.6	11.0	9.3	17.0	18.0
Gemmieza 9	105.6	90.6	12.6	8.6	18.0	12.1
Gemmieza 9 x Sakha 8	105.0	89.3	13.3	8.0	22.0	17.0
Gemmieza 9 x Sakha 93	106.6	86.3	12.3	8.6	18.0	18.0
Gemmiez a9 x Giza 164	107.0	90.3	13.0	9.6	22.0	16.6
Gemmieza 9 x Giza 168	104.3	97.0	14.6	8.3	21.0	16.6
Sakha 8	108.3	90.3	15.3	9.0	21.0	16.3
Sakha 8 x Sakha 93	107.3	90.6	12.6	8.6	18.3	17.0
Sakha 8 x Giza 164	99.60	89.6	14.3	8.3	21.3	17.0
Sakha 8 x Giza 168	101.6	92.0	14.3	8.3	21.6	15.3
Sakha 93	101.6	89.3	12.0	9.6	22.0	13.6
Sakha 93 x Giza164	104.0	91.0	13.3	8.0	19.0	15.3
Sakha 93 x Giza 168	101.0	97.6	13.3	9.3	21.0	16.0
Giza164	114.3	100.6	15.3	8.6	18.0	16.6
Giza 164 x Giza 168	113.3	100.6	14.6	8.3	18.0	17.0
Giza 168	119.3	102.0	14.0	9.3	21.6	14.0
L.S.D 5%	6.8	8.1	3.0	1.5	1.50	1.60
L.S.D 1%	9.7	11.5	4.2	2.1	2.17	2.35
C.V	0.47	0.61	0.59	0.36	0.20	0.29

Table (2): Cont.

Genotype	No. of spikes / plant		No. of grains / main spike		Grain yield / plant (grain)	
	Normal	Drought	Normal	Drought	Normal	Drought
Sids 1	5.0	3.0	41.6	32.0	205.0	64.30
Sids1x Gemmieza 7	5.3	3.0	52.0	32.0	258.3	64.30
Sids 1 x Gemmieza 9	4.0	2.6	52.0	53.0	158.3	113.0
Sids 1 x Sakha 8	5.0	3.0	52.0	49.0	205.0	130.0
Sids 1 x Sakha 93	4.0	3.0	61.6	60.6	176.6	123.0
Sids 1 x Giza 164	4.0	4.0	63.0	49.6	304.6	130.0
Sids 1 x Giza 168	4.6	3.0	62.6	53.0	302.0	148.3
Gemmieza 7	4.6	4.0	55.6	51.6	268.3	196.6
Gemmieza 7 x Gemmieza 9	4.0	3.0	62.0	53.0	306.0	104.6
Gemmieza 7 x Sakha 8	5.0	3.3	92.3	72.6	354.0	205.0
Gemmieza 7 x Sakha93	5.0	3.0	73.0	73.6	355.0	215.0
Gemmieza 7 x Giza 164	6.0	4.0	72.3	62.0	480.0	218.3
Gemmieza 7 x Giza 168	6.0	4.0	73.6	63.6	374.6	190.0
Gemmieza 9	4.0	3.0	83.6	63.0	256.3	111.6
Gemmieza 9 x Sakha 8	6.0	3.3	72.0	72.3	518.3	209.0
Gemmieza 9 x Sakha 93	6.0	3.0	93.0	73.6	431.6	218.3
Gemmieza 9 x Giza164	6.6	2.3	92.6	72.6	655.3	158.3
Gemmieza 9 x Giza 168	5.0	3.0	42.0	34.0	211.6	94.30
Sakha 8	5.0	3.0	83.0	72.3	362.6	142.3
Sakha 8 x Sakha 93	6.0	4.0	55.6	35.6	268.3	176.6
Sakha 8 x Giza 164	6.0	3.0	82.0	50.0	562.6	132.3
Sakha 8 x Giza 168	5.3	3.0	61.6	49.3	305.0	94.30
Sakha 93	4.0	3.0	94.3	80.0	280.0	237.6
Sakha 93 x Giza 164	6.0	3.0	61.0	52.6	305.0	103.3
Sakha 93 x Giza 168	6.0	3.0	62.0	62.6	305.0	180.0
Giza 164	4.0	3.0	93.3	82.3	280.0	162.3
Giza 164 x Giza 168	5.0	3.0	61.6	60.0	245.0	162.0
Giza 168	4.0	3.0	72.6	81.0	225.0	244.0
L.S.D 5%	1.2	1.1	2.90	3.80	44.80	16.60
L.S.D 1%	1.7	1.6	4.20	5.40	63.80	23.70
C.V	0.1	0.4	0.25	0.10	1.600	0.900

Table (2): Cont.

Genotype	1000- grain weight (gm)		Heading date (days)		Maturity date (days)	
	Normal	Drought	Normal	Drought	Normal	Drought
Sids 1	41.0	32.0	106.6	101.6	161.0	155.3
Sids1 x Gemmieza 7	41.0	32.6	110.0	102.0	171.6	121.3
Sids 1 x Gemmieza 9	40.3	36.6	108.0	103.0	163.6	157.0
Sids 1 x Sakha 8	41.0	33.6	110.0	102.3	163.6	158.0
Sids 1 x Sakha 93	39.0	33.3	111.6	103.0	163.0	161.0
Sids 1 x Giza 164	39.0	32.0	115.0	102.3	166.6	158.0
Sids 1 x Giza 168	41.0	33.3	108.0	102.0	172.3	158.0
Gemmieza 7	41.3	31.0	108.3	103.0	171.6	157.6
Gemmieza 7 x Gemmieza 9	41.0	33.3	113.6	103.6	167.0	158.0
Gemmieza 7 x Sakha 8	41.0	31.0	112.0	102.0	174.0	156.6
Gemmieza 7 x Sakha 93	39.0	32.0	108.3	102.0	172.6	156.6
Gemmieza 7 x Giza164	38.6	33.0	107.6	102.6	172.3	162.0
Gemmieza 7 x Giza 168	41.0	38.0	110.3	103.0	173.6	162.0
Gemmieza 9	41.0	32.0	110.0	103.0	165.3	153.0
Gemmieza 9 x Sakha 8	39.0	32.3	110.0	103.3	171.6	163.0
Gemmieza 9 x Sakha 93	39.0	36.6	108.0	103.0	172.3	161.6
Gemmieza 9 x Giza 164	41.0	35.3	108.6	103.6	171.6	158.0
Gemmieza 9 x Giza 168	42.0	35.6	112.0	101.0	172.0	156.6
Sakha 8	42.0	35.3	106.6	103.6	165.3	153.0
Sakha 8 x Sakha93	42.3	34.6	108.0	103.0	170.0	162.0
Sakha 8 x Giza164	38.0	32.0	112.0	102.0	172.0	156.6
Sakha 8 x Giza 168	38.0	32.3	108.3	103.0	168.0	125.6
Sakha 93	38.0	31.6	107.6	103.0	166.6	154.3
Sakha 93 x Giza164	41.0	36.3	107.0	103.3	172.0	157.3
Sakha 93 x Giza 168	38.0	35.0	108.6	102.6	172.0	157.6
Giza 164	41.0	36.6	106.6	103.0	169.0	154.6
Giza 164 x Giza 168	41.6	36.0	109.0	103.0	172.0	158.0
Giza 168	41.3	41.6	108.0	102.3	164.3	153.6
L.S.D 5%	1.62	2.80	2.300	1.400	2.500	21.30
L.S.D 1%	2.30	4.00	3.200	2.000	3.600	30.40
C.V	0.18	0.35	0.160	0.100	0.140	1.200

Regarding 1000-grain weight (gm) parent, Sakha 8 was the greatest 1000-grain weight parent for weight with average of 42 gm under normal irrigation. Giza 168 was the greatest 1000-grain weight parent for weight with average of 41.6 gm under the drought stress.cross, Gemmieza 9 x Giza 168 was the greatest 1000-grain weight crosses for weight with average of 42 gm under normal irrigation. Gemmieza 7 x Giza 168 was the greatest 1000-grain weight crosses for weight with average of 38 gm under the drought stress.

At the same time, all studied varieties and their crosses appeared as one would expect in their reposed to water stress and normal irrigation conditions .All of them showed early and fewer days for heading.

For maturity date (days), parent Sids1 was the earliest parent for maturing with average of 161 days under normal irrigation. Gemmieza 9 and Sakha 8 were the earliest parents for maturity with average of 153 days under the drought stress cross, Sids 1 x Sakha 93was the earliest cross for maturity with average of 163 days under normal irrigation. Sids 1 xGemmieza 7 was the earliest cross for maturity with average of 121.3 days under the drought stress. Thus there were marked differences among genotypes in maturity date and also varied in their response from condition to condition.

In general, the mean values of the normal irrigation condition were found to be relatively better than that of drought stress in all studied traits under investigation. This could be attributed to drought stress recorded during the season of agriculture of the wheat, which affected the maturity date and maturity stages resulting instability in wheat yield. Also, the yield reduction of wheat under drought stress is associated with a less number of grains per spike and smaller grain size.

Variation and interaction with two different conditions:

The analysis of variance of each condition for all studied traits under control water and drought stress are presented in Table (3). Normal irrigation was found to be significant for all studied traits. Genotypes and the resultant crosses were found to be highly significant for all traits studied at the two different conditions indicating the wide diversity between the parental genotypes that used in the present study. These results are in harmony with those previously obtained by, Khan *et al.* (2000), Hamada (2003) Salem (2009), Akbar *et al*. (2010) and Seleem and Koumber (2011).

Parents were found to be either significant or highly significant for all traits studied at the two different conditions. Similar results were detected by, Hamada (2003), Moussa and Morad (2009) and Seleem and Koumber (2011).

Parents and crosses were found to be highly significant for plant height, number of spikes per plant and heading date at the two different conditions. For number of spikelets per main column spike, spike length, 1000-grain weight, maturity date and number of grains per spike, the estimated values of Parent, and crosses were found be highly significant at normal irrigation while, significant only at the drought stress condition.

Results showed that genetic constitution of crosses as well as their parents is widely different and the crosses had a wide range of genetic variability. Also, the interaction of genotypes with the two different conditions were found be highly significant for all studied traits indicating that these genotypes were inconsistent from condition to another. The interactions of the two conditions with parents were found to be significant for all studied traits except for spike length and number of grains per spike.

In addition results indicated that crosses with the two different locations were found to be significant for 1000-grain weight and grain yield .this indicating the influence of two different conditions on genotypes and traits. Further it was observed that all genotypes responded to drought stress in different ways.

TABLE 3

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دراسة بعض الصفات المحصولية لبعض أصناف قمح الخبز والهجن الناتجة منها تحت ظروف إجهاد الجفاف

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الملخص العربى

أجريت هذه الدراسة باستخدام سبعة أصناف قمح محلية والهجن الناتجة منها (سخا ٨ ، سخا ٩٣ , جيزة ١٦٤ , جيزة ١٦٨ , سدس ١ ، جميزة ٧ , جميزة ٩) تحت ظروف الجفاف مقارنة بظروف الري المتبعة في القمح وتم إجراء التجارب في مزرعة خاصة لثلاث مواسم متتالية. في الموسم الأول تم عمل تهجين بينها باستخدام طريقة التهجين في اتجاه واحد.في الموسم الثاني تم زراعة السبعة أصناف و ٢١ هجين بغرض الإكثار . في الموسم الثالث ٢٠١٢/٢٠١١ تم زراعة السبعة أصناف و ٢١ هجين تحت (١) الري العادي الطبيعي (٢) تحت ظروف الجفاف باستخدام ريه الزراعة وريه أخرى بعد ٤٥ يوم من الزراعة وذلك في قطاعات كاملة العشوائية في ثلاث مكررات . تم أخذ القياسات المحصولية علي الأصناف المزروعة تحت الظروف الطبيعة وظروف الجفاف لتحديد أفضل التراكيب الوراثية المتحملة للجفاف والمرتفعة الإنتاجية . وجد أن النتائج المتحصل عليها من الأصناف والهجن تحت ظروف الري العادي أفضل بكثير من المتحصل عليها تحت ظروف الجفاف . أظهرت الأصناف والهجن تحت ظروف الجفاف عدد أقل من الحبوب في السنبلة الرئيسية منها تحت ظروف الري العادي. الأصناف والهجن تحت ظروف الجفاف تتميز بالتبكير في ميعاد التزهير وميعاد نضج الحبوب .

كلمات استرشادية: قمح الخبز, ظروف الرى العادى, ظروف الجفاف, التهجين الغير رجعى

Table (3): Mean square estimates of ordinary analysis for all studied characters.

S.O.V.	d.f.	Plant height(cm)		Main column spike length(cm)		No. of Spikelets/main column spike		No. of spikes / plant	
		Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought
Rep.	2	1.35	2.86	1.32**	0.53	0.75	4.08**	0.15	0.01
Genotypes	26	773.86**	30.24**	8.58**	4.65**	6.37**	8.58**	74.30**	65.97**
Parent	6	69.93**	14.83**	9.58**	7.21**	4.28**	9.15**	69.17**	78.04**
Crosses	20	814.52**	20.68**	8.07**	3.92**	6.56**	7.33**	78.23**	61.95**
Par.vs.cr.	1	4603.38**	396.21**	15.28**	6.30**	15.99**	38.32**	3.78	90.04**
Error	70	1.79	0.98	0.10	0.24	0.29	0.49	1.13	0.62

Table (3): Cont.

S.O.V.	d.f.	No. of grains / main spike		Grain yield /plant (gain)		1000-grain weight(gm)		Heading date(days)		Maturity date(days)	
		Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought
Rep.	2	1.65	1.00	0.83	1.44	0.56	4.35	8.56**	1.79*	0.25	4.65
Genotypes	26	8.53**	9.08**	283.54**	268.65**	226.15**	253.13**	9.33**	15.00**	11.87**	1060.17**
Parent	6	13.44**	11.95**	209.48**	322.79**	135.36**	179.31**	21.98**	32.66**	8.17**	109.52**
Crosses	20	7.49**	6.57**	285.90**	257.67**	257.95**	280.21**	6.39**	10.96**	10.40**	1102.80**
Par.vs.cr.	1	2.14	56.62**	738.22**	185.85**	3.04	38.60**	0.07	0.41	77.36**	6563.75**
Error	70	1.39	0.90	0.59	0.55	4.33	2.18	0.47	0.43	0.89	2.32

*, **Significant at 0.05 and 0.01 probability levels respectively.