Testing Three Statistical Criteria to Screening S3 Families by Reciprocal Recurrent Selection in popcorn

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ABSTRACT

Afield experiment was conducted in fall season 21 /7/2016 to screen 100 top crosses ,which is represented S3 generation, derived from popcorn population AGR-2, After one cycle of reciprocal recurrent selection(RRS). The genotypes AGR-2 and Suror used testers and evaluated with top crosses of , with control Varity . The experiment was carried out using 10x10 partial balance lattice design with two replications. The data were recorded on 50% pollen shedding and silking , ear height,plant hight, number of leaves and leaf area index, ear pants, number of kernesl row ear^{-1} , kernels pere row^{-1}, kernels plant^{-1}, grain wight, grain yield plant^{-1}, and popping expansion.. Three statistical criteria for screening were used, First, standard error, the second is to duplicate standard error value and the third criteria using standard division value. All the values statistical criteria **were** added to total mean. The results were showed a significant differences among in this study . Results of screening which according to first criteria, were included two groups , the first one consisted of 19 progenies, was well of performance to grain yield and popping expansion, second group was consisted of 10 progenies, which reveled well expansion popping and others traits. The results of second criteria were revealed tow group, first one include10 progenies which is had the best of performance for grain yield and expansion popping while, another group include 8 progenies were well performance of popping expansion. The third criteria which is indicated that the 14 progenies were the best popping expansion and three progenies superior in in grain yield per plant.

Ky words: evaluation, Tester.S3 families, popping expansion.

اختبار ثلاثة معايير احصائية لغربلة عوائل الجيل الثالث للذرة الشامية بعد دورة واحدة من الانتخاب التكراري المتبادل

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المستخلص

نفذت تجربة حقلية في ٢١ /٧ / ٢٠١٦ لغربلة ١٠٠ هجين قمي للذرة الشامية ، تمثل عوائل الجيل الثالث والمنتخبة من التركيب الوراثي AGR- 2 ، بعد دورة واحدة من برنامج التكراري المتبادل . ادخلت الاباء وصنف الشامية السرور المستخدم ككشاف للسلالات المستنبطة للمقارنة. نفذت التجربة باستعمال التصميم الشبكي البسيط والموزون جزئيا وبمكررين . درست صفات ٥٠% تزهير ذكري وانثوي ، ارتفاع النبات سم-١ ، عدد اوراق النبات-١ ودليل مساحة الورقة، عدد عرانيص النيات-١ ، عدد صفوف العرنوص، عدد حبوب الصف . عدد حبوب النبات ، وزن الحبة غم -١ وحجم الانفلاق . استخدمت ثلاث معايير احصائية لتقييم العوائل المدروسة. استعمل الخطأ القياسي كمعيار اول التقييم ، فضلا عن مضاعفة قيمة الخطأ القياسي كمعيار ثاني للتقييم. واستخدم الانحراف القياسي كمعيار ثالث للتقييم. اضيفت اقيام المعايير الثلاثة الى المعدل العام، باستثناء صفتي التزهير الذكري والانثوي . اظهرت النتائج وجدود اختلافات معنوية بين الهجن القمية لجميع معايير الغربلة. اشارت النتائج، تفوق ١٩ هجين قمي في صفتي الحاصل وحجم الانفلاق فضلا عن تفوقها في عدد من الصفات الاخرى ، والمجموعة الثانية اشتملت على ١٠ هجن قمية متفوقة معنويا في حجم الانفلاق دون حاصل النبات وفق المعيار الاول . اظهرت نتائج المعيار الثاني تميز مجموعتين معنويا على باقي الهجن القمية. اشتملت الاولى على ١٠ هجن قمية متفوقة في حاصل النبات وحجم الانفلاق وبعض الصفات الاخرى والثانية اشتملت على ٨ هجن قمية تفوقت معنويا في حجم الانفلاق. اشارت نتائج المعيار الثالث تميز ١٤ هجين قمي معنويا في صفتي الحاصل وحجم الانفلاق فضلا عن عدد من الصفات المدروسة.

كلمات مفتاحية،غربلة ، كشاف ، عوائل لجيل الثالث ،حجم الانفلاق

INTRODUCTION

To development (*Zea mays* everta) in Iraqi agricultural sector, it must be entrance genetic materials from developed countries in production like Argentina, Brazil, USA, and others countries that adapted to the Iragi environment. The Previous studies had showed that there is well acclimatization some genotype, to Iraq environment despite the narrow genetic basis (12and 28). The results of recent studies, especially at the developed countries were clarified, the production of this crop, in some of countries like ; Argentina and Brazil, indicated that this crop has in developing in both productivity and expansion popping. For the purpose of advancement of the productivity in popcorn to the quality and quantity, must be depending on basis genetic marital which highest variation in different traits . First stage to obtaining superior genotyp is testing general combining ability after S3 generation and determination hybrid vigor for inbred after S7.In addition that its possibility exploitation efficiency of reciprocal recurrent selection to concentration favorable genes possible to increased the grain yield and popping in new progenies from popcorn (18, 16,9, 6 and 5). The evolution of S3 families by selfing and crossing with a broad-based genetic tester revealed the highest combining ability genotyps . Several studies have confirmed the efficacy of this method in screening third-generation families (14, 15and 22). One of the main objective of in the reciprocal recurrent selection between two groups of pop corn ,which have high grain yield and expansion popping (3) . Both of traits have negative correlation. The breeders were suggested to produce the single cross and looking about their parents the produced of parents to give the highest potential for grain yield and expansion of popping in there companion(19, 20, 21, 22 and 23). Popping expansion is increased 50% percent to the single hybrids compared with open pollinated varieties (18). It was possible to improve the relationship between highest grain yield and popping expansion by single crosses hybrids that will compared with the synthetic varieties and open pollination varities (25 and 17). The objective of this study were evaluate top cross performance as a function of popping expansion and grain yield and estimate best statistical criteria that more suitable for screening progenies .

MATERIAL AND METHODS

One hundred of S3 families developed from the Argentinean commercial genotype AGR-2 through three self- pollinated generation. The local synthetic popcorn variety Al- Suror was used as a tester to the whole of the progenies. Experiment studies were conducted in fall season in 18 /7 / 2016 at Al- Latifyia. Resrarch Station. Agricultural Directorate/ Min.of Sci and Tech.Iraq, to estimate general combining ability between of the progenies and select progeny , which has high general combing abiliuty (GCA) of 100 top crosses by one cycle by reciprocal recurrent selection(RRS) .The experiment was conducted useing (10 x10) partial balance lattice design with two replications. Each of the top cross was planted in tow rows. The row length was 5 m and the distance between rows0.70m and entries the rows 0.20m, The DAP fertilizers content(N: P (27:27) with 400 kg ha $^{-1}$were added to the soil during field preparation. the **urea** fertilizers(46%N) was added 2time. during elongation stag and other before anthesis. Atrazine Herbicide at a rate 6 kg. ha^{-1} was added before emergence, 6 kg.ha^{-1}of diazenon was applied to protect from attack of *Sesamia cretica*. The data were recorded on 10 plants randomly, 5 plants from each row. The data was collected days of 50% tasseling(DT) , days of 50% silking(DS) , plant hight cm(PH) , ear hight cm(EH), leaves number (LN), leaf area index(LAI) , number ear per plant^{-1} (NEP) , number of row ear^{-1} (N RE) , number of kernel ear $^{-1}$ (NRE) , number of kernel plant^{-1} (NKP), grain Wight(GW) , grain yield(GY) and expansion popping (EP). EP was measured by placing 50 g in microwave oven (modelVMO- G42LB DENKA) using special bag for popping , at 1000 w, for 2.50 min.The popping volume wase measure in a 1000 mL graduated cylinder. It was determined as the ratio between the volume of the popped kernel and the grain weghit was taken from the mid- basal part of the ear, at 14% moisture level (8,2 and 10). three Statistical Criteria were used for screening third-generation families, Standard Error, Double the standard error value and standard division. The variance, standard deviation, standard error and coefficient of variance were calculated according to the Singh and **Chaudary (24**)fomula

$$. \quad S^2 = \frac{\sum X^2-(\sum X)^2/n}{n-1}$$

$$SD = \sqrt{\frac{\sum X^2-(\sum X)^2/n}{n-1}}$$

$$E = \frac{SD}{\sqrt{n}}$$

$$CV\% = \frac{SD}{\bar{y}} X100$$

Where. $S^2 = variance$, SD = standard division, SE = standardError, CV = coefficient of variance , n= umber of top cross,

ȳ= total mean

The values of the three criteria were subtracted from the total mean of both male and female parents , Then the top cross was selected, which is less than the total mean. and this continuslly for all traits under this study , the values of the three criteria were added to the total mean, top crosses were selected which exceeded the total mean according to each criterion. The screening process to the first criteria was contend two groups, first one consisted from 19 top crosses that which gave well performance in the grain yield and popping volume and some traits, another group consist 10 top cross that good performance in popping expansion and some traits except grain yield. The second criteria was revealed tow groups, first one include 10 top crosses that well performance in the grain yield , popping expansion and some other traits , another group include 8 top crosses were superior at the popping expansion only and some other traits. The third criterion had produced 14 top crosses supreiored in the popping volume as will as good performance for some other traits.

RESULTS AND DISCUSSION

Result revealed significant differences among S3 families. Progenies were divided into three groups. The number of superior progenies according to the first criteria shows in Table 1. The results shows that The progenies were scored superiority in percentage 48 , 52, 51, 50, 50, 49, 43, 40, 49, 42, 43, 43 and 37% for all traits with overall mean respectively. While percentage of progenies decreased under the third criteria presented 14, 9, 14, 8, 15, 8, 21, 11. 14, 18, 20, 14, and 14% respectively (Table 1.).

First criteria

Results in Table2 shows two groups of progenies, first one included 10 progenies, which is presented in Table2. 4, 5, 6 ,15, 56, 67, 91, 95, 96, 98, Superiored in performance to the popping volume and some other traits except grain yield, the popping volume ranged from 1250 (progeny 4) to 800 (progeny 91 and 96) mL

g^{-1}. The progeny 4 showed highest value of popping volume 1250 mLg^{-1} As well as 6 traits tasseling and silking days, plant high leaves number ,leaf area index, kernel row^{-1} respectively . The progeny 5 was revealed well evaluated in field to the all traits except grain yield and grain wight. The results were exhibited that progeny 91 had best behavior to the some of traits , while progenies 4, 6, 15, 67 were superior in 7 traits. Progeny 56 was significant in 5 traits ,while progenies 95, 96, and 98 significant in popping volume. All progenies were revealed significantly higher than their parents (Al- Suror and AGR-2) in popping volume(14).

Another group include 19 progenies significantly superior in grain yield and popping volume and some other traits (table 3).The popping volume ranged from1400 mL g^{-1}(progeny 55) to 800 mL g^{-1}(progeny45) respectively, with total mean 767.77 mL g^{-1} (11) , while grain yield plant ranged from 227.26 g(progeny 100) to 139.00 g (progeny 74) respectively. The results was indicated that progeny 20 scored superiority in all traits except number of row ear, but the progeny73 scored superiority in all traits except number of leaves , leaf area index and ear per plant. While the progenies 14, 64 and 66 were scored superiority in all the traits except number of kernel row and grain weight , number of leaves and number of row ear^{-1} , number of leaves and grain wight respectively. The progenies 13, 63 and 82 were scored in 9 traits. The progenies 24 and 62 have well performance in 8 traits, while traits 9, 27, 45 and 78 showed well evaluated ,when compared with total mean for each trait, while progenies 28, 55, 74, 99 and 100 were scored superiority in 6 traits. In agreement with present results (1 and 9). All progenies were revealed higher significantly than their parents Al- Suror and AGR-2 population in EP and Gy.

Second criteria

Result in Table 4 reveal two groups according this scale, first one include 10 progenies that good performance in grain yield and popping volume. The popping volume is ranged from1400 mL g^{-1}(progeny 55) to 900 (progenies14, 27 and 74) mL g^{-1} respectively, compared with total mean 788.54 mL g^{-1} . this results were agreement with other studies (4 , 7 and 10).

Grain yield plant^{-1} ranged from 227.26 -74gm (progeny 100 and 74) respectively . The progeny 14 scored preponderance in all traits except number of kernel rows ear and grain yield, but the second progeny 66 that which is scored preponderance in 10 traits except number of laves LAI and grain weight. Progenies 62 and 87 were scored preponderance in 9 traits, while progeny 27 had well performance under field conditions in 7 traits, the progenies 55 and 74 were revealed a highest performance in 6 traits . while the progenies 28, 99 and 100 were scored high significant to the 5 traits. All progenies were revealed highest significantly than their parents Al- Suror and AGR-2 population in both EP and Gy this study was corresponding with the previous study (24).

The second group is shows in Table 5, include 8 progenies which scored preponderance in popping volume and some traits except grain yield. Popping volume is ranged from 1250) to 950 mL g^{-1}to the progeny 4 and 56 respectively . The progeny 69 was revealed good performance in all traits except number of laves, LAI , ear plant $^{-1}$ and number of kernel row^{-1}. The screening process were showed that 8 progenies 4, 5, 6, and 15 had well evaluated in the filed environmental conditions for 8 traits in each one, while progenies 65, 67 and 56 wer higher significant in 7, 6 and 5 traits, respectively . this results was corresponding with other studies (6 and 10). All progenies were revealed higher significantly compared with their parents Al- Suror and AGR-2 genotypes in EP .

Third criteria

The results were indicated that the number of progenies which is significant superior in the popping trait and another of traits approximately about 14 progenies Table 6. The popping volume ranged from 1400 (progeny 55) to 1000 (progeny 5, 6, 15 and 69) mL g^{-1}. with overall mean 950.76 mL g^{-1} . Grain yield ranged from 277.26 (progeny 100) to 64.35gm (progeny 69) with total mean 156.24gm, in this group , three of progenies were significant in grain yield that which are progeny 66, 99 and 100 scored 176.88, 177.84 and 227.26 gm respectively . The screening process were showed that the progeny 87 was observed a high significant differences in 9 traits, progenies 65, 69 and 100 were revealed significant differences of evaluated in 6 traits with total mean, while progenies 5, 15, 62, 66, 67 and 99 were significant in 5 tratis, the progenies 4, 6, and 55 were scored of superiority in 4 traits ,while progeny was significant in three only of traits . All progenies were revealed higher significantly higher than their parents

Al- Suror and AGR-2 populations in EP . The number of superior characteristics ware decreased so for highest standard deviation value(16).

The results were revealed efficiency of reciprocal recurrent selection program(RRSP) to concentration favorable alleles in their progenies. Results were indicated that the second screening criterion (table 4) was more suitable for this study, it was collected progenies that which is more superiority in tow importance traits such as grain yield and expansion popping and corresponding with 10% selection intensity . The reciprocal recuerrent selection(RRS) is a cyclic of breeders to improve the population and produce the crosses between two genotypes by evaluation of general combing ability(GCA). In this procedure three population from the popcorn were evaluated under central Iraq environmental condition with their parents and the best genotype from each population were selected to gave recombination with the progenies , The screening process of the genotypes , which was selected progenies and improved tow importance traits grain yield and expansion popping.

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Table 1: Number of progenies that superiority for each trait according to the screening criteria used

criteria		DT	DS	PH	EH	LN	LAI	NEP	N RE	NKR	NKP	GY	GW	EP
first	Average + SE	48	52	51	50	50	49	43	40	49	42	43	43	37
Second	Average +2 SE	40	47	47	11	43	42	41	38	44	40	39	38	36
third	Average + SD	14	9	14	8	15	8	21	11	14	18	20	14	14

DT = day of 50% tasseling, DS = day of 50% silking, PH = plant high cm, EH = ear high cm, LN = leaves number, LAI = leaf area index, NEP = number of ear per plant, N RE = number of row per ear, NKR = number of kernel per row, NKP = number of kernel per plant, GY= grain yield, GW = grain weight, EP = expansion popping.

Table 2: Top crosses that represent progenies were superiority in EP and some traits except grain yield according first criteria

Progenies number	DT	DS	PH	EH	LN	LAI	NEP	N RE	NKR	NKP	GY	GW	EP	Number of superior traits
4	59.00b	62.50b	198.76b	95.69	15.27b	2.82b	1.25	15.66	37.16b	698.31	96.51	42.87	1250	٧
5	61.50b	65.25b	191.87b	99.65b	14.00b	3.24b	1.66b	18.00b	36.00b	1036.80b	124.65	40.62	1100	١١
6	59.75b	63.25b	170.92	84.80	12.86	2.28	1.83b	16.88b	33.55b	1019.38b	122.03	39.80	1000	٧
15	63.00b	68.25	211.81b	114.98b	14.85b	2.96b	1.64b	16.00	27.75	710.40	118.38	41.24	1000	٧
56	62.75b	62.25b	171.65	87.98	13.66	2.69b	1.43	15.71	35.00b	769.79	124.02	48.39	950	٥
67	63.50b	68.00	216.91b	100.28b	13.66	2.76b	1.00	16.80b	40.08b	672.00	113.92	44.14	1150	٧
91	64.50	66.75b	197.51b	108.10b	12.00	2.76b	1.13	17.20b	35.00b	680.26	102.12	66.12b	800	٨
95	66.00	70.50	165.14	72.50	13.32	1.85	1.42	13.71	24.14	463.34	78.41	46.8	850	١
96	66.25	69.00	152.50	74.61	12.80	1.90	1.20	16.00	19.66	377.47	84.45	47.51	800	١
98	74.00	77.00	140.61	90.01	8.00	2.20	1.00	12.54	24.76	310.49	88.31	56.32b	850	١
average	63.70	67.43	189.80	97.67	13.80	2.57	1.48	16.01	33.32	787.65	128.76	49.43	747	
Al-Suror	66.00	69.50	209.83	114.16	16.50	3.09	1.61	15.00	31.16	752.67	77.43	41.73	450	
AGR-2	66.75	69.50	193.76	108.67	14.65	2.89	1.50	14.36	34.43	741.622	108.65	43.56	690	
σ^2	13.02	14.27	239.50	226.03	1.75	0.155	0.11	1.59	18.10	54963	1330	34.02	43142	
SD	3.60	4.03	15.48	15.03	1.32	0.39	0.33	1.26	4.25	234.44	36.48	5.83	207.76	
SE	0.36	0.40	1.54	1.50	0.13	0.03	0.03	0.12	0.42	23.44	3.64	0.58	20.77	
AV+SE	63.34	67.83	191.34	99.17	13.93	2.60	1.51	16.13	33.47	811.09	132.45	50.01	767.77	
MINI VAL.	56.50	59.25	140.65	72.50	8.00	1.64	1.00	12.54	12.54	310.51	55.07	66.12	1400	
MAX	74.0	78.5	219.7	143.7	18.8	3.6	2.2	19.3	19.3	1249	227.	29.0	200	

VAL	0		5	8	6	5	7	3	3		31	0	
C.V	5.66	5.98	8.156	9.61	9.61	15.29	22.60	7.88	12.77	29.77	28.43	11.80	27.81

b= mean that progeny had good performance compared with overall mean

Table 3: Top crosses that represent progenies were superiority in EP , GY and some traits according first criteria

Progenies number	DT	DS	PH	EH	LN	LAI	NEP	NRE	NKR	NKP	GY	GW	EP	Number of superior traits
9	64.50	69.25b	192.38b	94.38	13.68	2.50	1.86b	17.33b	28.88	900.80b	177.36	49.42	850	7
13	62.75b	65.00b	185.73	86.91	14.76b	2.40	2.00b	17.00b	36.66b	1241.04b	164.36	43.49	850	9
14	63.50b	67.25b	195.11b	109.72b	15.23b	2.96b	1.86b	16.44b	32.77	969.71b	189.48	44.72	900	11
20	58.50b	63.50b	206.65b	107.51b	14.00b	2.89 b	2.00b	16.00	36.37b	1175.36b	181.28	50.84b	850	12
24	63.25b	65.50b	176.69	82.73	13.25	2.63 b	2.00b	15.81	38.31b	1211.36b	178.13	48.65	850	8
27	63.25b	65.50b	201.76b	106.87b	15.28b	2.36	1.45	15.00	31.25	656.24	144.54	45.03	900	7
28	59.75b	64.00b	170.75	83.63	14.00b	2.22	1.07	16.00	37.00b	579.92	149.43	49.38	1250	6
45	57.75b	59.50b	182.61	89.76	14.47b	2.56	1.46	15.75	36.76b	810.55	154.89	55.56b	800	7
55	63.75b	66.50b	179.40	85.71	13.32	2.96 b	1.86b	15.77	27.33	757.78	143.62	49.69	1400	6
62	60.50b	64.50b	181.65	82.61	12.00	1.90	1.71b	15.26	38.12b	988.26b	155.80	59.22b	1050	8
63	57.50b	59.25b	189.54	91.59	13.66	2.93b	1.55b	16.00	40.12b	962.88b	212.61	50.39b	800	9
64	59.25b	63.75b	207.12b	102.90b	13.66	2.63b	1.81b	15.77	33.66b	955.47b	157.08	51.82b	850	11
66	60.75b	63.00b	203.81b	109.02b	12.44	2.63b	1.64b	17.00b	35.00b	952.00b	176.88	48.56	1050	11
73	59.75b	63.50b	208.22b	110.13b	12.40	2.57	1.43	16.85b	37.74b	889.37b	146.23	62.45b	850	10
74	63.25b	65.50b	186.16	103.71b	12.40	2.16	1.50	15.50	31.62	735.16	139.00	63.18b	900	6
82	63.25b	65.75b	194.69b	96.81	14.44	2.96b	2.00b	15.75	38.81b	1206.21b	193.28	43.25	900	9
87	64.25	69.00	184.61	91.24	13.66	2.82b	1.82b	17.53b	39.22b	1248.95b	141.88	57.03b	1150	7
99	64.50	67.75b	184.17	87.51	13.66	2.31	2.00b	15.33b	29.08	891.59b	177.84	42.27	1100	6
100	66.25	70.00	172.80	89.51	12.00	2.28	2.27b	15.77b	35.12b	1218.15b	227.26	46.89	1050	6
average	63.70	67.43	189.80	97.67	13.80	2.57	1.48	16.01	33.32	787.65	128.76	49.43	747	
Al-Suror	66.00	69.50	209.83	114.16	16.50	3.09	1.61	15.00	31.16	752.67	77.43	41.73	450	
AGR-2	66.75	69.50	193.76	108.67	14.65	2.89	1.50	14.36	34.43	741.622	108.65	43.56	690	

σ^2	**13.02**	**14.27**	**239.50**	**226.03**	**1.75**	**0.155**	**0.11**	**1.59**	**18.10**	**54963**	**1330**	**34.02**	43142
SD	**3.60**	**4.03**	**15.48**	**15.03**	**1.32**	**0.39**	**0.33**	**1.26**	**4.25**	**234.44**	**36.48**	**5.83**	207.76
SE	**0.36**	**0.40**	**1.54**	**1.50**	**0.13**	**0.03**	**0.03**	**0.12**	**0.42**	**23.44**	**3.64**	**0.58**	20.77
AV+SE	**63.34**	**67.83**	**191.34**	**99.17**	**13.93**	**2.60**	**1.51**	**16.13**	**33.47**	**811.09**	**132.45**	**50.01**	767.77
MINI VAL.	**56.50**	**59.25**	**140.65**	**72.50**	**8.00**	**1.64**	**1.00**	**12.54**	**12.54**	**310.51**	**55.07**	**66.12**	1400
MAX VAL	**74.00**	**78.5**	**219.75**	**143.78**	**18.86**	**3.65**	**2.27**	**19.33**	**19.33**	**1249**	**227.31**	**29.00**	200
C.V	**5.66**	**5.98**	**8.156**	**9.61**	**9.61**	**15.29**	**22.60**	**7.88**	**12.77**	**29.77**	**28.43**	**11.80**	27.81

b= mean that progeny had good performance compared with overall mean

Table 4: Top crosses that represent progenies were superiority in EP , GY and some traits according second criteria

Progenies number	**DT**	**DS**	**PH**	**EH**	**LN**	**LAI**	**NEP**	**NRE**	**NKR**	**NKP**	**GY**	**GW**	**EP**	**Number of superior traits**
14	**63.50b**	**67.25b**	**195.11b**	**109.72b**	**15.23b**	**2.96b**	**1.86b**	**16.44b**	**32.77**	**969.71b**	**189.48b**	**44.72**	**900b**	**11**
27	**63.25b**	**65.50b**	**201.76b**	**106.87b**	**15.28b**	**2.36**	**1.45**	**15.00**	**31.25**	**656.24**	**144.54b**	**45.03**	**900b**	**7**
28	**59.75b**	**64.00b**	**170.75**	**83.63**	**14.00**	**2.22**	**1.07**	**16.00**	**37.00b**	**579.92**	**149.43b**	**49.38**	**1250b**	**5**
55	**63.75b**	**66.50b**	**179.40**	**85.71**	**13.32**	**2.96b**	**1.86b**	**15.77**	**27.33**	**757.78**	**143.62b**	**49.69**	**1400b**	**6**
62	**60.50b**	**64.50b**	**181.65**	**82.61**	**12.00**	**1.90b**	**1.71b**	**15.26**	**38.12b**	**988.26b**	**155.80b**	**59.2b**	**1050b**	**9**
66	**60.75b**	**63.00b**	**203.81b**	**109.02b**	**12.44**	**2.63**	**1.64b**	**17.00b**	**35.00b**	**952.00b**	**176.88b**	**48.56**	**1050b**	**10**
74	**63.25b**	**65.50b**	**186.16**	**103.71b**	**12.40**	**2.16**	**1.50**	**15.50**	**31.62**	**735.16**	**139.00b**	**63.18b**	**900b**	**6**
87	**64.25b**	**69.00**	**184.61**	**91.24**	**13.66**	**2.82b**	**1.82b**	**17.53b**	**39.22b**	**1248.95b**	**141.88b**	**57.03b**	**1150b**	**9**
99	**64.50**	**67.75b**	**184.17**	**87.51**	**13.66**	**2.31**	**2.00b**	**15.33**	**29.08**	**891.59b**	**177.84b**	**42.27**	**1100b**	**5**
100	**66.25**	**70.00**	**172.80**	**89.51**	**12.00**	**2.28**	**2.27b**	**15.77**	**35.12b**	**1218.15b**	**227.26b**	**46.89**	**1050b**	**5**
average	**63.70b**	**67.43b**	**189.80**	**97.67**	**13.80**	**2.57**	**1.48**	**16.01**	**33.32**	**787.65**	**128.76**	**49.43**	**747**	
Al-Suror	**66.00**	**69.50**	**209.83**	**114.16**	**16.50**	**3.09**	**1.61**	**15.00**	**31.16**	**752.67**	**77.43**	**41.73**	**450**	
AGR-2	**66.75**	**69.50**	**193.76**	**108.67**	**14.65**	**2.89**	**1.50**	**14.36**	**34.43**	**741.622**	**108.65**	**43.56**	690	
σ^2	**13.02**	**14.27**	**239.50**	**226.03**	**1.75**	**0.155**	**0.11**	**1.59**	**18.10**	**54963**	**1330**	**34.02**	**43142**	
SD	**3.60**	**4.03**	**15.48**	**15.03**	**1.32**	**0.39**	**0.33**	**1.26**	**4.25**	**234.44**	**36.48**	**5.83**	**207.76**	
SE	**0.36**	**0.40**	**1.54**	**1.50**	**0.13**	**0.0**	**0.0**	**0.12**	**0.42**	**23.44**	**3.64**	**0.58**	**20.7**	

	DT	DS	PH	EH	LN	LAI	NEP	NRE	NKR	NKP	GY	GW	EP
						3	3						7
AV+2SE	**62.98**	**6828**	**192.88**	**100.67**	**14.06**	**2.63**	**1.54**	**16.25**	**34.16**	**834.53**	**136.04**	**50.59**	**788.54**
MINI VAL.	**56.50**	**59.25**	**140.65**	**72.50**	**8.00**	**1.64**	**1.00**	**12.54**	**12.54**	**310.51**	**55.07**	**66.12**	**1400**
MAX VAL	**74.00**	**78.5**	**219.75**	**143.78**	**18.86**	**3.65**	**2.27**	**19.33**	**19.33**	**1249**	**227.31**	**29.00**	**200**
C.V	**5.66**	**5.98**	**8.156**	**9.61**	**9.61**	**15.29**	**22.60**	**7.88**	**12.77**	**29.77**	**28.43**	**11.80**	**27.81**

b= mean that progeny had good performance compared with overall mean

Table 5: Top crosses that represent progenies were superiority in EP , GY and some traits according second criteria

Progenies number	**DT**	**DS**	**PH**	**EH**	**LN**	**LAI**	**NEP**	**NRE**	**NKR**	**NKP**	**GY**	**GW**	**EP**	**Number of superior traits**
4	**59.00b**	**62.50b**	**198.76b**	**95.69**	**15.27b**	**2.82b**	**1.25**	**15.66b**	**37.16b**	**698.31**	**96.51**	**42.87**	**1250**	**8**
5	**61.50b**	**65.25b**	**191.87**	**99.65**	**14.00**	**3.24b**	**1.66b**	**18.00b**	**36.00b**	**1036.80b**	**124.65**	**40.62**	**1100**	**8**
6	**59.75b**	**63.25b**	**170.92**	**84.80**	**12.86**	**2.28**	**1.83b**	**16.88b**	**33.55**	**1019.38b**	**122.03**	**39.80**	**1000**	**8**
15	**63.00b**	**68.25**	**211.81b**	**114.98b**	**14.85b**	**2.96b**	**1.64b**	**16.00b**	**27.75**	**710.40**	**118.38**	**41.24**	**1000**	**8**
56	**62.75b**	**62.25b**	**171.65**	**87.98**	**13.66**	**2.69b**	**1.43**	**15.71b**	**35.00**	**769.79**	**124.02**	**48.39**	**950**	**5**
65	**60.75b**	**64.25b**	**185.76**	**92.43**	**12.43**	**1.85b**	**1.00**	**1838b**	**38.00b**	**684.00**	**99.66**	**52.11**	**1150**	**7**
67	**63.50b**	**68.00**	**216.91b**	**100.28**	**13.66**	**2.76b**	**1.00**	**16.80b**	**40.08b**	**672.00**	**113.92**	**44.14**	**1150**	**6**
69	**63.50b**	**66.25b**	**219.74b**	**112.73b**	**12.00**	**2.20**	**1.10**	**19.00b**	**30.00**	**570.00**	**64.35**	**53.73**	**1000**	**10**
average	**63.70b**	**67.43b**	**189.80**	**97.67**	**13.80**	**2.57**	**1.48**	**16.01**	**33.32**	**787.65**	**128.76**	**49.43**	**747**	
AL-souror	**66.00**	**69.50**	**209.83**	**114.16**	**16.50**	**3.09**	**1.61**	**15.00**	**31.16**	**752.67**	**77.43**	**41.73**	**450**	
AGR-2	**66.75**	**69.50**	**193.76**	**108.67**	**14.65**	**2.89**	**1.50**	**14.36**	**34.43**	**741.622**	**108.65**	**43.56**	690	
σ^2	**13.02**	**14.27**	**239.50**	**226.03**	**1.75**	**0.155**	**0.11**	**1.59**	**18.10**	**54963**	**1330**	**34.02**	**43142**	
SD	**3.60**	**4.03**	**15.48**	**15.03**	**1.32**	**0.39**	**0.33**	**1.26**	**4.25**	**234.44**	**36.48**	**5.83**	**207.76**	

SE	**0.36**	**0.40**	**1.54**	**1.50**	**0.13**	**0.03**	**0.03**	**0.12**	**0.42**	**23.44**	**3.64**	**0.58**	**20.77**
AV+2SE	**62.98**	**6828**	**192.88**	**100.67**	**14.06**	**2.63**	**1.54**	**16.25**	**34.16**	**834.53**	**136.04**	**50.59**	**788.54**
MINI VAL.	**56.50**	**59.25**	**140.65**	**72.50**	**8.00**	**1.64**	**1.00**	**12.54**	**12.54**	**310.51**	**55.07**	**66.12**	**1400**
MAX VAL	**74.00**	**78.5**	**219.75**	**143.78**	**18.86**	**3.65**	**2.27**	**19.33**	**19.33**	**1249**	**227.31**	**29.00**	**200**
C.V	**5.66**	**5.98**	**8.156**	**9.61**	**9.61**	**15.29**	**22.60**	**7.88**	**12.77**	**29.77**	**28.43**	**11.80**	**27.81**

b= mean that progeny had good performance compared with overall mean

Table 6: Top crosses that represent progenies were superiority in EP , GY and some traits according third criteria

Progenies number	**DT**	**DS**	**PH**	**EH**	**LN**	**LAI**	**NEP**	**N RE**	**NKR**	**NKP**
4	**59.00b**	**62.50b**	**198.76**	**95.69**	**15.27b**	**2.82**	**1.25**	**15.66**	**37.16**	**698.31**
5	**61.50b**	**65.25b**	**191.87**	**99.65**	**14.00**	**3.24b**	**1.66**	**18.00b**	**36.00**	**1036.80b**
6	**59.75b**	**63.25b**	**170.92**	**84.80**	**12.86**	**2.28**	**1.83b**	**16.88**	**33.55**	**1019.38**
15	**63.00b**	**68.25b**	**211.81b**	**114.98b**	**14.85**	**2.96**	**1.64**	**16.00**	**27.75**	**710.40**
28	**59.75b**	**64.00b**	**170.75**	**83.63**	**14.00**	**2.22**	**1.07**	**16.00**	**37.00**	**579.92**
55	**63.75b**	**66.50b**	**179.40**	**85.71**	**13.32**	**2.96**	**1.86b**	**15.77**	**27.33**	**757.78**
62	**60.50b**	**64.50b**	**181.65**	**82.61**	**12.00**	**1.90**	**1.71**	**15.26**	**38.12b**	**988.26**
65	**60.75b**	**64.25b**	**185.76**	**92.43**	**12.43**	**1.85**	**1.00**	**18 38b**	**38.00b**	**684.00**
66	**60.75b**	**63.00b**	**203.81b**	**109.02**	**12.44**	**2.63**	**1.64**	**17.00**	**35.00**	**952.00**
67	**63.50b**	**68.00b**	**216.91b**	**100.28**	**13.66**	**2.76**	**1.00**	**16.80**	**40.08b**	**672.00**
69	**63.50b**	**66.25b**	**219.74b**	**112.73**	**12.00**	**2.20**	**1.10**	**19.00b**	**30.00**	**570.00**
87	**64.25b**	**69.00b**	**184.61**	**91.24**	**13.66**	**2.82**	**1.82b**	**17.53b**	**39.22b**	**1248.95b**
99	**64.50b**	**67.75b**	**184.17**	**87.51**	**13.66**	**2.31**	**2.00b**	**15.33**	**29.08**	**891.59**
100	**66.25b**	**70.00b**	**172.80**	**89.51**	**12.00**	**2.28**	**2.27b**	**15.77**	**35.12**	**1218.15b**
average	**63.70b**	**67.43b**	**189.80**	**97.67**	**13.80**	**2.57**	**1.48**	**16.01**	**33.32**	**787.65**
Al-Suror	**66.00**	**69.50**	**209.83**	**114.16**	**16.50**	**3.09**	**1.61**	**15.00**	**31.16**	**752.67**
AGR-2	**66.75**	**69.50**	**193.76**	**108.67**	**14.65**	**2.89**	**1.50**	**14.36**	**34.43**	**741.622**
σ^2	**13.02**	**14.27**	**239.50**	**226.03**	**1.75**	**0.155**	**0.11**	**1.59**	**18.10**	**54963**
SD	**3.60**	**4.03**	**15.48**	**15.03**	**1.32**	**0.39**	**0.33**	**1.26**	**4.25**	**234.44**
AV + SD	**60.10**	**71.46**	**205.28**	**112.75**	**15.12**	**2.96**	**1.81**	**17.27**	**37.57**	**1022.09**
MINI VAL.	**56.50**	**59.25**	**140.65**	**72.50**	**8.00**	**1.64**	**1.00**	**12.54**	**12.54**	**310.51**
MAX VAL	**74.00**	**78.5**	**219.75**	**143.78**	**18.86**	**3.65**	**2.27**	**19.33**	**19.33**	**1249**
C.V	**5.66**	**5.98**	**8.156**	**9.61**	**9.61**	**15.29**	**22.60**	**7.88**	**12.77**	**29.77**

b= mean that progeny had good performance compared with overall mean