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Developing Local F_1 Hybrids of Sunflower by Extracting the Parental Lines of Introduced Commercial Exotic Hybrids

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Introduction

Iraq with its huge of more than 32 million populations, and GDP growth of approximately 2.7%, generates a major demand for edible oil. Despite being one of the consumers of oilseeds in the world, Iraq's domestic production of edible oil is insufficient to meet these overall needs. As much as of 90% of the edible oil demand is met through imports. Given the large demand in Iraq, there is a huge dependence on raw material imports Annual Statistical Book [1].

Sunflower (Helianthus annuus L.) is the first important oilseed crop in Iraq [2] and one of the most important globally [3]. Develop[ping tomorrow's sunflower cultivation in Iraq will depend upon the interaction among its genetic variabilities and how breeders exploit it, farmers and field management, seed and oil industry, consumers preference and the environmental factors. Whereas, the crop is dominated approximately 21 million hectare all over the world Skoric et al. [4] which presents 78% of the world vegetable oil [5], the cultivated area in Iraq, either in spring or full season as an oil crop not increased than several thousands of hectares [6]. The annual production of sunflower is inadequate for Iraq food industries due to the big gap between the real demands and drastically decreases in seed and area production Annual Statistical Book [1]. The constraints of extending sunflower cultivation may due to

a. The depending on synthetic and open pollinated varieties produced locally in its cultivation.

b. No or less support for farmers and small stack holders.

c. The oldest field management practices, and

d. The unavailable of suited hybrids characterized with high yield potential due to the unstable yield and the stagnating and vulnerability of its industry.

During the early of 1990s, Iraq started to cultivate sunflower commercial hybrids which introduced from Australia, Turkey, then from USA, Spain and France, but sever from the unstable importing according the diverse conditions concerned trading and seed costs. On the other hand, all scientific researchers were determined by the evaluating the introduced hybrids to assess their performance for seed and oil yield to be released for wide cultivation. Sunflower breeders attempt to extract some of these hybrids to breed inbred lined which may recombined for open or synthetic variety developing and suitable for irrigated area in Iraq [6].

Commercial sunflower hybrids usually relies on cytoplasmic male sterility as a female parent (CMS-HA) and fertility restoring as male parent (CMS- RHA) in its genetic base [7-9]. Cytoplasmic male sterility is return to the S-type cytoplasm and free of fertility restorer gene (Rf), whereas, the male parent carrying Nor S-type cytoplasm with the Rf gene (N-RfRf or S-RfRf, respectively) that resulting male- fertile hybrid with S-Rfrf base. Breeding programs all over the world revealed the obtaining inbred lines with the fertility restorer gene by selfing for the commercial hybrids and selection of male – fertile plants which will segregates in the next generation [8]. More than 62 new CMS sources of different origin have been reported.

Estimation of GCA and SCA to identify the additive and non-additive genetic effects in the experimental inbred lines are important for seed and oil content and other metric characters [10-18]. Heterotic patterns must be exploited to develop inbred lines derived from diverse and broad gene pools to replace conventional varieties according to its high yield, pest management, uniformity and self- compatibility [19-23]. The main objective of sunflower breeding program is breed and

developing of local parental lines (male maintainer, female and fertility restorer inbred lines) with desirable traits which utilized for commercial hybrids production. Based on the inheritance of fertility restoration genes, two dominant gene pairs were discovered Reddi et al. [19].

Materials and Methods

Introduction of commercial hybrids and inbred lines production

Developing program of deducing local F_1 hybrids of sunflower by extracting the parental lines from introduced commercial exotic hybrids was started at the late of 1999 at Al-Ishaqi Agricultural Experimental Station, State Board of Industrial Crops; Ministry of Agriculture. Fifty-three commercial sunflower hybrids which introduced from USA, France, Spain and other countries. selfing procedure to derive inbred lines in different generations (S_n) during 1999-2004 (Table 1) was practiced. Several thousands of S_n was evaluated for its agronomic traits, seed yield and its components by cultivation in 2 rows, 5m long and 25cm apart with 4 replications. All S_n lines with law emergence, undesirable characteristics, self-incompatibility, and poor yield potential were eliminated. More than 6500 S_{1-2} inbred lines were introduced in topcross program with Peridovic open pollinated variety to detect the exceeded inbred lines with high general combining ability (GCA) according to Yousif et al. [24] procedure in maize. Induction of artificial male sterility was practiced by gibberellic acid. Six hundred-fifty one inbred lines were exceeded in their GCA. Selfing program was continued to S_5-S_7 generation (Table 2). Exceeded inbred lines were selected according to their morphological traits, agronomic performance and good seed yield.

Table 1: Empirical sunflower hybrids introduced from different sources for Iraqi cultivation during 1990s and used in breeding program to derive inbred lines.

Hybrid Introduced*				
Turkuaz	**Koleda**	**L.G.56-80**	**Tornasol**	**16402**
44402	IBIS	Trenot	Pan-7392*	Paro-7352
S-F-3	C-207	Triumph	Alister	Elasol
Alzan	S- F -2	Volky	Almanzor	44403
Flamme *	Tornasol-1	AS-615	Riasol	Macao
Galb	Pan-7352	Clorias	Medion	Vyp-70
Stiasol	Manon	Primax	113	Emberator
Trmpk-562	F-5	Masten	Renar	Peridovic
Trenor	L.G.56-60	Euroflour*	F6	Stiasol-2
S-F-1	Mekado	Coban*	Vidoc	
Carlos	Gdedor	6402	Alhamz	

*sunflower hybrids which released officially for Iraq cultivation by the National Committee of Registration and Release of Plant Cultivars in Iraq. Database of Agricultural Varieties and Hybrids, NCRRPPV, MoA, Iraq. 2014.

Table 2: Sunflower inbred lines (RHA) derived from introduced empirical commercial hybrids at S_7 generation and carrying N or S type cytoplasm with Rf gene during 1999-2004 at Al-Ishaqi Experimental Station, Iraq.

Fertile Inbred Lines Produced with Good GCA					
Source Hybrid	**No. of Inbred Lines**	**Source Hybrid**	**No. of Inbred Lines**	**Source Hybrid**	**No. of Inbred Lines**
Turkuaz	17	F -5	16	Almanzor	4
44402	9	L.G.56-60	17	Riasol	15
S- F-3	11	Mekado	22	Medion	10
Alzan	16	Gdedor	3	113	1
Flamme *	22	L.G.56-80	18	Renar	14
Galb	14	Trenor	24	F6	14
Stiasol	19	Triumph	29	Vidoc	4
Trmpk-562	21	Stiasol-2	9	Alhamz	11
Trenor	29	Volky	3	16402	9
S- F-1	13	AS-615	12	Paro-7352	11
Carlos	5	Clorias	5	Elasol	7
Koleda	9	Primax	11	44403	16
IBIS	8	Masten	15	Macao	14
C-207	14	Euroflour*	33	Emberator	32
S- F -2	8	Coban*	27	30 inbred lines were lost due to not emergence, animals and fungal diseases damage	
Tornasol -1	14	6402	16		
Pan -7352	7	Tornasol	22		
Manon	16	Pan-7392*	13		
Trmpk-562	21	Alister	41		

Developing of cytoplasmic male sterility lines

Extended program for inducing cytoplasmic male sterility starts in spring 2000. More than 123 lines were derived (from all introduced hybrids) and tested as a source for CMS-HA to develop the parental lines which may utilized for commercial use. Only five CMS-HA sources were discriminated according to its genetic and agronomic abilities. Backcrossing for 5-6 generations in which the non-recurrent parent as an analogue (A- line) with S-type cytoplasm and the recurrent parent was HA inbred (B- line) that carrying the N-rfrf previously selected, tested and improved according to Miller & Vick [8], Miller & Seiler [25].

Extracting restorer fertility lines

Almost all commercial hybrids segregates in F2 and phenotypically the offspring revealed some plants with multi branches. Plants of each hybrid segregate wereselfedwith selection for at least 8-10 generations Miller et al. [9], Miller & Seiler [25].

Hybrid seed production

In this program, the developing process for CMS – HA produced 3 local commercial RHA inbred lines that initially altered into HA inbred lines. The advance step for this program started in full season 0f 2005 to reproduce A and B lines and at

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the same time producing the promise experimental hybrids was investigated in full season of 2008.

Evaluating and testing hybrids performance

During spring and full seasons of 2009, an extended yield trials experiments at Al-Ishaqi Experiment Station, Ministry of Agriculture. 50km-north of Baghdad were carried out. Planting of 40 empirical hybrids in 9 of February and 7 of July in 12 row spacing 75cm apart with 5m long and 25cm between hills in randomized complete block design with 3 replications. Advance 2 yield trials for 11 selected promise hybrids in comparison with Euroflour were conducted in Spring season of 2010 and 2011 by its cultivation in extended plots (10 x 10m) in 2 replications. Field management concerned with soil preparation, fertilizers applications and irrigation was practiced according to the certificated recommendations Abbas et al. [26], Yousif et al. [2]. Data for days to flowering was measured for all plants. Plot-1 whereas 20 plants were harvested for head diameter, plant height, seeds. head^{-1}, fertility percentage, seed partition percentage, and 100 seed weight. Seed yield was measured by harvesting the 4 center rows and converted to kg. ha^{-1}. Least significant difference at p>o.o5 and simple linear correlation among traits under investigation were estimated. Oil seed content was estimated for the best performance hybrids [27-29].

Results and Discussion

Inbred lines production

As a result of any plant breeding program, it is primarily depends on the nature and magnitude of variation present among the germplasm available. Since, the wide phenotypic and genotypic variation among commercial hybrids introduced from different origins, inbred lines produced at early generations reflects the broad variation within and among hybrids. Inbreeding depression was very limited across inbreeding cycles. Seed yield. plant^{-1} ranged between 18.2 -33.1 g at S_{5-7} in comparison with 24.7 – 28.4 g at S_{1-2} (data not shown).

Testing of general combining ability (GCA)

Table 2 reveals the number of inbred lines which exceeded in their GCA within its origin of the commercial hybrid. Testing depend upon the exceeding of the to pcross mean by at least 2 standard errors on the overall mean according to reveals that about 10-12% of all top crosses tested had good GCA within each extracted hybrid. Trenor hybrid gave the highest number of Inbred lines derived, whereas the hybrid 113 gave the lowest (24 and 1 inbred line, respectively). The emphasis of selection was on the seed yield and at least 2 metic characters.

Backcrossing

Only three of five CMS-HA lines (Alister, Emberator Euroflour, Peridovic and Coban) proved its exceeding in its agronomic traits, plant architecture, and seed and oil yield. CMS HA inbred lines which were derived from 3 RHA inbred lines by selfing- selection and presents genotypes having mono-genic fertility restoration. All CMS-HA lines produced successfully with good agronomic traits, high seed and oil content and free of fungal infection. HA inbred lines of Alister, Emberator and Euroflour successes to be maintainer of CMS-HA.

Producing the parental inbred lines

The A-line and its analogue B-line for (Alister, Emberator and Euroflour) were hybridized with 40 of 50 RHA which presents the male-fertile parental lines. At the same time,38 of 50 inbred line from the segregated populations from each commercial hybrid presents the R-line were introduced in hybrid seed production with the Alines (Alister, Emberator and Euroflour). Registration of Alister X F5)Ishaqi 1) and Emb .xMecado (Ishaqi 2) were investigated by the National Committee of Registration, Release, and Protection of Plant Varieties in Iraq (NCRRPPV) as local sunflower hybrids.

Yield trials and evaluation

Statistical analysis for yield trials of 40 empirical and released sunflower hybrid revealed the significant differences of all traits under investigation for spring and full seasons at P>0.05 and/or P>0.01 except the partitioning percentage in full 2009 (Table 3 & 4).

Table 3: Mean of seed yield, its components and growth traits for empirical sunflower hybrids cultivated in Al-Ishaqi Experimental Station during spring of 2009.

Empirical Hybrids	Days to Flowering	Head Diameter (Cm)	Plant Height (Cm)	Seed. Hea^{d-1}	Fertility Percentage	Partition Percentage	100 Seed Weight (G)	Seed Yield (Kg.Ha^{1})
Alister x Trenor	72	21.2	185	1300	97.5	74.2	7.2	2087
Alister x Stiasol	65	22.6	154.3	1294	96.3	71	8	2093
Alister xcalb	75	23	159	1171	97.5	66.9	8.4	2087
Alister x Volky	72	20.9	168.7	951	97.1	72.2	7.4	1673
Alister x Stiasol2	72	22.3	164.3	1049	93.1	78	7.7	2267
Alister x F6	70	21.8	171.7	1242	98.5	74	7.5	2225

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Alister xMecado	72	21.7	175.7	1268	96.5	75.2	6.6	2112
Alister X L.G.56.80	72	22	148.7	1522	90.7	76.2	7.2	2128
Alister X F5) Ishaqi 1)	70	21.3	169.7	1492	98.2	75.6	6.8	2153
Alister xClorias	72	22.9	164.3	1426	91.4	64.5	8.4	2210
Alister x Vyp.70	72	22.3	177.3	1317	96.5	70.9	7	1668
Alister x Trenor2	75	23.3	170.7	952	88	74.6	7	1383
Alister xL.G56.60	72	24	154.3	1120	95.3	71.3	8	2250
Alister x Alister	72	21.6	176.7	1307	97.2	75..0	6.6	2098
Emboutor x Trenor	75	22.1	195	1300	95.8	74.2	7.3	1808
Emb . x Stiasol	75	21.3	187.3	1179	94.7	73.2	8.3	1622
Emb . x Calb	75	21.7	187.3	1477	89.9	75.8	6.8	1518
Emb . xVolky	70	22	168	1056	95	74.4	7	2398
Emb . x Stiasol	72	20.2	170	1276	94	74	7.6	1628
Emb . x F6	75	22.5	167	1180	98.3	82.9	6.7	1778
Emb. xMecado (Ishaqi 2)	72	22.3	147.3	1172	94.3	76	7.7	1827
Emb. x L.G56.60	70	24.2	173.3	1525	83.7	75.7	7.4	2315
Emb . x F5	75	26.3	198.3	1098	98.1	73.3	6.5	2202
Emb . x Vyp.70	72	25.2	167	1085	97.1	71.5	7.8	2470
Emb . x Trenor 2	73	23.5	183	1304	96.4	73.6	7.3	2053
Emb X L.G56.60	70	23.5	172.3	1158	97.5	71.5	7.5	2352
Emb . x Alister	72	20.6	210.3	1339	88.4	71.3	6.8	2279
Euroflou x Trenor	75	25.3	180.7	1134	97.9	72	7.5	1535
Eur. X Clab	75	22.3	166	1258	97.8	69.6	7.4	1392
Eur. X Volky	70	22.7	168	1142	97.5	74.5	6.2	2280
Eur. x Stiasol	75	22.3	167	1327	98	73.7	6	1672
Eur. x F6	79	21.6	182.3	1305	94.2	68.3	5.4	2127
Eur. x Mecado	77	21.9	179.7	1234	98.8	79	6	1710
Eur .X L.G.56.80	72	20.6	147.3	1058	98.5	74.5	7.3	1770
Eur. X F5	77	21.9	174.3	1343	98.9	71.9	7	2228
Eur. X Clorias	70	23.3	178	1511	95.6	70.9	6.7	2193
Eur. x Trenor	70	22.3	184.7	1226	98	70	6	1910
Eur. X Alister	72	22	162.3	1202	95.5	70.7	6.3	1598
Coban	75	23.7	158	1257	93	75.3	7	2252
Flamme	75	22.3	157.3	1472	97.9	69.9	6.7	1813

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Mean	72.78	22.4	171.8	1251	95.46	73.21	7.09	1979
CV%	12.2	8.8	9.24	21.15	7.51	7.22	11.4	7.26
LSD (P>0.05)	3.8	2.28	-			1.997	0.98	
LSD (P>0.01)			14.33	144.54	1.55			405

Table 4: Mean of seed yield, its components and growth traits for empirical sunflower hybrids cultivated in Al-Ishaqi Experimental Station during full season of 2009*.

Empirical Hybrids	Days to Flowering	Head Diameter (Cm)	Plant Height (Cm)	Seed. Head^{-1}	Fertility Percentage	Partition Percentage	100 Seed Weight (G)
Alister x Trenor	45	18.6	167	1099	99.8	76.4	7.5
Alister x Stiasol	45	19.7	160	852	100	75	7.4
Alister xcalb	50	20.2	121	579	61.2	75.7	7.1
Alister x Volky	50	19.8	161.7	1204	99.2	77.7	7.4
Alister x Stiasol2	50	19.4	144.7	1056	96	76	7.8
Alister x F6	50	20.9	161.3	1022	97.1	80.6	6.6
Alister x Mecado	50	20.9	169. 3	1140	98.2	77.1	6.8
Alister X L.G.56.80	50	20.9	139.7	677	95.6	75.3	7.1
Alister X F5)Ishaqi 1)	50	19.5	133	984	99.5	76	7.8
Alister xClorias	50	22.1	151.3	948	98.4	74.3	7.6
Alister x Vyp.70	50	20.8	148	694	90.2	70.8	7.1
Alister x Trenor2	50	19.9	163.3	981	99.2	78.9	6.9
Alister x L.G56.60	50	26.5	133.3	917	99.3	73.4	7.8
Alister x Alister	50	29.1	154.3	2151	100	75.6	7.5
Emboutor x Trenor	50	26.1	137.7	738	90.1	76.2	6.3
Emb . x Stiasol	50	33.1	162	781	80	76.9	7.8
Emb . x Calb	50	20	157.7	1056	100	76.7	8
Emb . xVolky	50	18.5	146.7	1103	99.8	70.4	7.7
Emb . x Stiasol	50	20.6	161.3	1204	98.2	73.5	7.7
Emb . x F6	50	19.1	147	1015	100	76.4	8
Emb . xMecado (Ishaqi 2)	50	19.9	137.3	616	85.3	76	6.9
Emb . x L.G56.60	50	19.5	151.3	1044	100	79.7	7.1
Emb . x F5	50	20.7	170.3	1108	100	74.6	7.5
Emb . x Vyp.70	50	20.2	126	1008	100	75	8.5
Emb . x Trenor 2	50	19.9	157.3	1098	99	80	8.1
Emb X L.G56.60	50	20.4	120.3	731	98.6	74.6	7.8
Emb . x Alister	45	21.1	163	762	77.7	72.7	7.8
Euroflou x Trenor	50	19.8	163.7	896	99.8	75.3	7.5
Eur. X Clab	50	19.4	153.7	1008	92.1	74	8.2
Eur. X Volky	50	19.7	129.o	1031	100	74.3	7.2
Eur. x Stiasol	50	19.9	165.7	545	95.2	75.4	7.4
Eur. x F6	79	21.6	182.3	1306	94.2	68.3	5.4
Eur. x Mecado	50	20.3	122	777	90.6	74.5	6.5
Eur .X L.G.56.80	47	20.4	128.7	936	100	78.7	7.8
Eur. X F5	47	21.9	174.3	1344	98.9	71.9	7
Eur. X Clorias	50	19.6	182	1157	100	80.3	7.9
Eur. x Trenor	50	21.4	119.9	933	99.1	71	6.4
Eur. X Alister	50	19	158	578	88.5	77.3	6.9
Coban	50	18.7	138	677	92.5	80.2	7.1

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Flamme	50	19.7	146.3	1063	99.9	76.2	6.6
Mean	50.94	21	149.5	970.5	95.53	75.57	7.33
CV%	18	5.57	15.13	40.9	6.3	5.31	1.76
LSD (P>0.05)				269		N.S	1.2
LSD (P>0.01)	2.68	3.26	21.4		2.8		

The pooled analysis for the two seasons (Table 5) reflects the high significant differences (P>0.01) for days to flowering, head diameter, plant height, seed. head^{-1}, seed fertility percentage and seed yield. Whereas, partitioning percentage and 100 seed weight were significant at P>0.05. days to flowering ranged 55 to 79 days for Alister x Stiasoland Eur. x F6, respectively. Similarly, for the head diameter when its range was between 19.9-27.2cm, and about 15 of 38 empirical hybrids were in range of the head diameter of the two released hybrids (Coban and Flamme). Plant height of all tested hybrids were favorable for mechanical harvesting and 10 of 38 local hybrids were less value of plant height in comparison with the check hybrids. A wide range of seeds. Head^{-1} (875-1344) reflects the exceeding of 33 and 4 of 38 local hybrid on Coban and Flamme check hybrids. Although, the high significant differences among all hybrids for fertility percentage, almost all hybrids revealed the highself-compatibility and reflected on seed yield which it was between 1356 and 2228kg. ha^{-1}. The two registered local hybrids out yielded 1658kg. ha^{-1})Ishaqi 1)and 1656kg. ha^{-1} (Ishaqi 2) in comparison with the two check hybrids)Ishaqi 1 and Ishaqi 2) which its yielding were 1683 and 1808 kg. ha^{-1} for Flamme and Coban, respectively (Table 5).

Table 5: Mean of seed yield, its components and growth traits for empirical sunflower hybrids cultivated in Al-Ishaqi Experimental Station. Pooled for Spring and full season of 2009.

Empirical Hybrids	Days to Flowering	Head Diameter (Cm)	Plant Height (Cm)	Seed. Head^{-1}	Fertility Percentage	Partition Percentage	100 Seed Weight (G)	Seed Yield (Kg.Ha^{1})
Alisterx Trenor	58.5	19.9	176	1200	98.7	75.3	7.4	1778
Alisterx Stiasol	55	21.2	157.2	1073	98.1	73	7.7	1746
Alister xcalb	62.5	21.6	140	875	79.3	71.3	7.7	1698
Alisterx Volky	61	20.3	165.2	1078	98.2	75	7.4	1607
Alisterx Stiasol2	61	20.8	154.5	1053	94.6	77	7.8	1956
Alisterx F6	60	21.4	166.5	1132	97.8	77.7	7	1787
Alister xMecado	61	21	172.5	1204	97.4	76.2	6.7	1752
AlisterX L.G.56.80	61	21.5	144.2	1099	93.1	75.8	7.1	1821
AlisterX F5)Ishaqi 1)	60	20.4	151.3	1238	98.9	75.8	7.2	1658
Alister xClorias	61	22.5	157.8	1187	94.9	69.4	8	1645
Alisterx Vyp.70	61	21.5	162.7	1006	93.4	70.9	7	1363
Alisterx Trenor2	62.5	21.6	166.8	967	93.6	76.8	7	1356
Alisterx L.G56.60	61	25.3	143.8	1018	97.3	72.4	7.9	1915
Alisterx Alister	61	25.3	165.5	1729	98.6	75.3	7	1656
Emboutor x Trenor	62.5	24.1	166.3	1019	93	75.2	6.8	1628
Embx Stiasol	62.5	27.2	174.7	980	87.3	75	8.1	1385
Embx Calb	62.5	20.8	172.5	1266	94.9	76.3	7.4	1471
Emb xVolky	60	20.3	157.3	1079	97.4	72.4	7.3	1900
Embx Stiasol	61	20.4	165.7	1240	96.1	73.8	7.7	1743
Emb . x F6	62.5	20.8	157	1098	99.2	79.7	7.3	1597
Emb . xMecado (Ishaqi 2)	61	21.1	142.3	894	89.8	76	7.3	1656
Emb . x L.G56.60	60	21.8	162.3	1289	91.8	77.7	7.2	1858
Emb . x F5	62.5	23.5	184.3	1203	99	73.9	7	1709
Emb . x Vyp.70	61	22.7	146.5	1047	98.5	73.2	8	1918
Emb . x Trenor 2	61.5	21.7	170.2	1201	97.7	76.8	7.7	2033
Emb X L.G56.60	60	21.9	146.3	944	98	73.1	7.7	1703

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Emb . x Alister	58.5	20.9	186.7	1051	83	72	7.3	2035
Euroflou x Trenor	62.3	22.6	172.2	1015	98.9	73.7	7.5	1442
Eur. X Clab	62.5	20.8	159.8	1133	98.9	72.8	7.8	1318
Eur. X Volky	60	21.3	148.5	1086	98.8	74.4	6.8	1628
Eur. x Stiasol	62.5	21.1	166.3	936	96.6	74.6	6.8	1523
Eur. x F6	79	21.6	182.3	1305	94.2	68.3	5.4	2126
Eur. x Mecado	63.5	21.1	150.8	1006	94.7	76.8	6.3	1417
Eur .X L.G.56.80	59.5	20.5	138	997	99.3	76.6	7.5	1770
Eur. X F5	77	21.9	174.3	1344	98.9	71.9	7	2228
Eur. X Clorias	60	21.4	165	1334	97.8	75.6	7.3	1647
Eur. x Trenor	60	21.8	152.3	1079	98.6	70.5	6.2	1910
Eur. X Alister	61	20.5	160.2	890	92	74	6.6	1391
Coban	62.5	21.2	148	967	92.7	77.8	7.1	1808
Flamme	62.5	21	151.8	1267	98.9	73	6.6	1683
Mean	61.66	21.71	160.65	1110.74	95.5	74.39	7.21	1782
CV%	10	7	8.21	30.63	6.92	6.32	11.1	17.52
LSD (P> 0.05)						1.354	1.34	
LSD (P> 0.01)	1.96	2.64	22.6	133.51	2.54			496

Table 6: Mean of seed yield, its components and growth traits for empirical sunflower hybrids cultivated in Al-Ishaqi Experimental Station. Pooled analysis for Spring of 2010 and 2011- pooled analysis.

Hybrid	Plant Height (cm)	Head Diameter (cm	Seed. Head^{-1}	100 Seed Weight (g)	Fertility	Partioning	Seed Yield (kg/ ha)	Content (g. kg^{-1})
					Percentage			
A x LG56.60	152.1	24.4	1061	7.7	96	73.3	2021	39.5
A x F5(Ishaqi 1)	162,2	24.6	1317	7.3	96.3	74.8	2439	43.25
A x Clorials	171. 7	21.8	1187	7.9	92.7	70.1	2016	39.4
A x L.G56.80	155.8	21.8	989	7.9	95.9	73.8	2401	40.5
A x A	179.6	25.9	1359	7.1	90	71.8	1688	38.85
E x Mecado (Ishaqi 2)	147.9	21.3	1102	7.6	96.3	75.2	2369	43.82
E xL.G56.60	177	22	892	7	98	73	2099	40.2
E x F6	165,8	21.1	1443	7.7	99	76.2	2450	38.88
E x Trenor	165	21.3	1010	7.7	96.1	75.8	2201	41.43
E x LG56.80	144.1	19.9	1190	7.4	94.4	75.8	2079	39.45
E x F5	188.4	21.1	1228	7.4	95.7	74.8	1996	38.89
Euroflour	159	22.2	1270	7.6	96.9	75.7	2388	43.92
mean	151.1	22.3	1170.7	7.3	95,6	74.2	2179	40.67
CV%	9.12	3.3	12.45	5.17	6.61	8.1	19.5	4.24
LSD (P>0.05)	11.6	2.2	241.32	0.3	NS	NS	199.6	1.2

*A and E means CMS inbred lines derived from Alister and Emberatoras female which hybridized with the restore fertility lines named as its origin extraction.

Table 6 The performance of 11 selected of empirical local hybrids of sunflower in comparison with Euroflour, the check released hybrid reveals the significant differences for Plant height, Head diameter, seed. Head^{-1}, 100 seed Weight, Seed Yield and Seed Oil Content. No significant differences reveald between the check variety and the registered varieties Ishaqi 1 and Ishaqi2 for plant height, seed. Head^{-1} Seed Yield and Seed Oil Content, whereas the Euroflour differed significantly with Ishaqi 1 in Head diameter and100 seed Weight. Ishaqi 1 was exceeded on all hybrids under study including the check variety which reflects the ability of investing it in wide cultivation and decreasing the imports of hybrid seeds, at least for the near future.

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The breeding program reveals the utilization of introduction, screening and extraction of inbred lines to investigate the elite development of parental lines of sunflower, especially when develop it for hybrid seed production using the cytoplasmic male sterility technigues.

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