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Short Communication

Evaluation of germplasm collection of safflower (*Carthamus tinctorius and C. oxycantha*) in dryland conditions of Iran

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Knowles [1] denoted that the Middle East as the center of origin for cultivated safflower. Ashri [2] divided this center of orgin in to three regions: Iran, Afghanistan, Near East and Turkey.

The objective of this study was to determine the variability among a germplasm collection in Iran for yield and some other characters in dryland conditions, to determine the grouping of genotypes in different clusters and to identify the desirable parental genotypes for exploitation in crossing programme between cultivated genotypes as well as cultivated ones with wild genotypes of safflower aimed at improving seed yield for the dryland conditions of Iran.

Plant materials consisted of 150 genotypes of *Carthamus tinctorius* and 19 Iranian genotypes of *Carthamus oxycantha*. 85 out of *C. tinctorius* genotypes received from ICARDA (International Center of Agricultural Research in Dryland Areas) had different origins and 65 genotypes were Iranian materials. All the genotypes were planted on 24 October 1997 in the farm of Agricultural Research Station of Sararood in the west of Iran. The non-parametric method of K-means clustering with Euclidean distance was used for classification of genotypes [3]. The number of clusters was determined by Ward method of hierarchical cluster analysis. The result of cluster analysis can contribute directly to development of classification schemes [4].

Based on K-means cluster analysis, all the genotypes were classified into 4 groups with different number of genotypes in each cluster (Table 1). The *C. tinctorius* genotypes from ICARDA and Iran were scattered in different clusters, each cluster having genotypes of different origins. But in cluster II with 24 members, 22 genotypes were the ICARDA genotypes and only two genotypes (Unknown-1 and 32-8) belonged to Iranian collection. Three genotypes of *C. tinctorius*

Table 1. Distribution of 169 genotypes of *Carthamus* into four clusters

Cluster	No. of genotypes	Name of genotypes
1	53	CW4440, DINGER, GIRARD, HARTIMAN, KINO76, LESAF14, CYPRUS- SLOCAL, SAFFIRE, SYRIAN, THORI78, YENCIE, 209287, 250538, 250539, 252041, 199874, 250338, 250536, 250537, 250540, 250599, 250600, 250601, 251462, 251982, 251982, 252984, 253396, 253564, 258417, 260618, 283790, 301048, 301055, 304472, 307112, 514632, 537600, 537683, S-6-48, LRV-51-51, LRV-51-20, S-6-48, LRV-55-292, S-6-604-1, RINCONDA-1, DINSER, YENCIE, LRV-55-56, GOLE SEFIC ESFAHAN, 79-7, 79-26, 79-41
II	24	DINGER118, 307060, GILA, LESAF176, S-541-2, 5209-C, SIND DH, WORLD BALK, 250835, 198290, 199885, 199887, 210834, 248624, 250184, 250596, 250842, 251988, 253522, 253528, 537598, SEL. FROM S-541, UNKNOWN-1, 32-8
III	57	CYPROBREGON, CW74, OKREC, S-541, US10, 250838, 199885, 209299, 250195, 250840, 251268, 253763, 258409, 304462, 306909, 306924, 307014, 407610, 537599, 537631, 537636, 537648, SYRIAN II, 295, LRV-51-31, 279, LRV-55-65, 697, LRV-290, LRV-55-67, LRV-55-277, S-7-V-60, CH-353, ASETERIA, UNKNOWN-2, ZARGHAN LOCAL, CH-65, 3147, SYRIAN, NAMELESS, 32-14, 79-14, 79-15, 7-17, 79-20, 79-27, 79-31, 79-38, 79-39, 79-40, 79-45, 79-46, 79-47, 79-53, 79-56, 79-57, 79-58
IV	35	248373, SYRIAN I, LRV-55-296, 31-22, 32-13, 32-15, 79-18, 79-25, 79-29, 79-30, 79-32, 79-33, 79-49, 79-50, 79-52, 79-59, 79-63, 79-64, 79-65, 79-66, 79-67, 79-68, 79-69, 79-70, 79-71, 79-72, 79-73, 79-74, 79-75, 79-76, 79-77, 79-78, 79-79, 79-80, 79-81

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Table 2. Mean, range, coefficient of variation and correlation with seed yield per plant for seven characters in four clusters

Character (with abbreviaiton and unit)	Cluster No.	Mean	Range	CV%	Correlation with SY/P
Seed yield per plot	I	213.42	24.0- 260.0	15.42	-
	II	313.12	270.0-468.0	14.51	-
	III	137.26	100.0-175.0	16.60	-
	IV	53.09	18.0-87.0	39.16	-
Plant height (cm)	I	86.46	67.0-102.0	8.70	–0.093
	II	87.04	76.0-102.0	6.73	0.030
	III	88.84	67.0-112.0	10.52	–0.048
	IV	62.40	30.0-97.0	36.52	0.588**
200-seed weight	I	6.62	4.6-8.2	16.92	0.077
	II	7.01	4.6-8.6	12.23	–0.002
	III	5.76	3.4-9.0	21.70	0.136
	IV	3.56	1.6-9.0	53.08	0.363*
No. of heads per plant	I	21.31	10.0-32.0	21.25	0.161
	II	22.25	13.0-30.0	18.24	–0.066
	III	17.14	9.0-26.0	23.92	0.321*
	IV	18.80	10.0-34.0	26.81	0.116
No. of seeds per head	I	17.21	14.0-21.0	1.00	0.117
	II	19.25	15.0-25.0	11.27	0.446*
	III	16.88	12.0-23.0	14.04	0.219
	IV	17.66	14.0-21.0	11.49	0.231
Days to flowering	I	213.23	209.0-217.0	0.98	–0.054
	II	212.83	209.0-217.0	0.87	0.201
	III	214.86	210.0-220.0	0.83	–0.200
	IV	219.23	212.0-225.0	1.41	–0.416*
Days to physiological maturity	I	235.69	233.0-240.0	0.62	–0.132
	II	236.04	234.0-240.0	0.61	0.527*
	III	235.50	232.0-242.0	0.83	–0.035
	IV	235.69	232.0-239.0	0.67	–0.036

* and ** significant at 5% and 1% level respectively

(Yencie, Syrian and S-6-48) were common between ICARDA and Iranian materials. Cluster analysis classified both of Yencie and S-6-48 in the first cluster. But two genotypes of Syria were placed in different clusters. Further study in these genotypes showed that Syrian genotype received from ICARDA had yellow and red flowers but the genotype received from Iran had yellow flowers, also there were differences among other characters indicating that these two Syrian genotypes have different origin. In general it was found that this method of cluster analysis has been effective in classification of present genotypes.

Out of 35 Iranian genotypes (*C. oxycantha*), 19 wild genotypes were placed into cluster IV and 16 cultivated safflower genotypes (*C. tinctorius*) were also placed in this cluster. Mean seed yield/plant, plant height and 200-seeds weight in this cluster is lower than in other clusters (Table 2). Existence of different genotypes from different origins in the same cluster suggested that there may be some degree of ancestral relationship between such genotypes.

Safflower fly is the common and important pest in safflower. In the present study it was observed that all the *C. tinctorius* genotypes were infested by this pest but wild types (*C. oxycantha*) showed very little infestation. Wild genotypes are also more resistant to water stress as compared to cultivated genotypes. So inter-specific hybridization between *C. tinctorius* and *C. oxycantha* can be usedful in a breeding programs at least for these two characters. Similarly variation within cluster IV is more than that in other clusters.

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