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Evaluation of Safflower Germplasm by Some Agronomic Characteristics and Their Relationships on Grain Yield Production in the Cold Dry Land of Iran

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ABSTRACT

The main breeding objective in rainfed condition is selecting high performance safflower lines. Traits that are correlated with the grain yield may be useful for indirect selection. 100 exotic and indigenous safflower pure lines were studied in the Dryland Agricultural Research Institute during 2002-2003. There was a considerable variation regard to all characteristics under studying in the spring planting. Observed range for plant height, number of heads per plant, days to flowering, number of seeds per head, hundred kernel weight, grain yield, oil percent and ratio of seed to hull were, 31.66 (cm), 9.42, 22, 30.01, 2.89 (gr), 799.41 (kg/ha), 11 and 0.77, respectively. Results of correlation studies showed that only number of seeds per head and plant height have recognizable correlation with grain yield and genetic gains may be achieved in the future by augmenting number of seeds per head while increasing plant height of safflower in cold drylands of Iran.

Key Words: *Carthamus tinctorius*; Correlation; Morphological traits; Rainfed

INTRODUCTION

Edible oil production has been a high priority in Iranian agriculture in recent years because of increasing demand for domestic consumption and a huge burden on national economy for meeting this demand through imports. Cold dry lands occupy over three million hectares of arable lands across Iran. Cropping system is devoted to wheat/pasture in this region and oilseed crops in rotation have not been defined (Ministery of Jihad-e-Agriculture, 2002). It seems that no oilseed crop is well adapted than safflower to the low rainfall and stress conditions of cold drylands (Rashid *et al.,* 2002). There is a significant variation in local landraces of safflower along with high adaptation to different condition in Iran (Alizadeh, 2003; Pourdad & Beg, 2003). The main breeding objective in drylands is drought resistance and is used as criterion in the stress conditions. Direct selection in terms of grain yield is the simplest way but various agents affect yield. Further more, heritability of grain yield is diminished under stress conditions that makes genetic gain very low (Blum, 1985). Traits that are correlated with the grain yield may be useful for indirect selection. The efficiency of using a trait as a selection criterion depends on its heritability and genetic correlation to plant performance (Falconer, 1989). We lack however, reports of these trait's heritability and genetic correlations to grain yield, and therefore of their suitability as indirect selection criteria in safflower. More over, most to the previous studies measuring genetic variation and correlations in these traits have been conducted at only one location without stress condition. Our breeding program aims at selecting high performance safflower lines in this region. Hence, there is a need to evidence the extent and type of relationship between agronomic characters.

MATERIALS AND METHODS

One hundred exotic and indigenous safflower pure lines from origin of India, Iran, Pakistan, Spain and USA were evaluated in Dryland Agricultural Research Institute (DARI) located in North West of Iran (Maragheh) during 2002-2003. Pure lines were derived through self-pollination of individual plants of each genotype. Soil type was Rajal Abad Fine Mixed Mesic Calcixerollic Xero Chrepts and total precipitation in the region was 367mm during growing season. Spring and winter planting as a simple lattice design were used and in both cases trials were managed without irrigation and using 50 kg/ha N in planting time and 30 kg/ha P in autumn from origin of amonium nitrate and super phosphate, respectively. The seeding rate was 70 seeds/m^2. Plots consisted of 6 rows each 5 m in length and spaced 30 cm apart. The characters recorded on a plot basis, were grain yield (GY) in kg/ha; days to flowering (DF) as number of days from planting time to 50% flowering; plant height (PH) in centimeter taken at the time of flowering, Hundred kernels weight (HKW) in gram; number of heads per plant (NH) at maturity time; number of seeds per head (NS) as average of five randomly selected heads, the ratio of seed to hull (S/H) as average of ratio in five seeds after 24 h wetting and oil content (OP) of air dried seed in percent. Statistical

analysis was conformed using MSTATC and SPSS package.

RESULTS AND DISCUSSION

In the winter seeding trial, all genotypes were lost due to poor germination and cold damage in the late autumn. However, some plants passed winter successfully, that was mainly due to no germination in autumn and conservation of seeds in soil until spring (as prison or Entezary). Similar results have been reported for winter planting of safflower in cold dry lands of the country (Alizadeh, 2002; 2003; 2004). In spring planting trial, there was a considerable variation with regard to all characteristics under study (Table I). Significant variation in terms of all studied characteristics is a vluable source for selection among accessions and other breeding purposes, as well. All of the studied traits have specific merits in dry land condition, individually. NH, NS and TKW are yield components and would increase grain yield. PH as a biomass index reflex root growth that is essential in drought resistance of plant. The advantage of early flowering provide a escape mechanism by avoiding hot and dry weather during critical reproductive stage which is presented in the end season. S/H and OP are direct criteria in oil production of genotypes.

Significant differences were found between at least two genotypes in terms of all studied characteristics, separately (Table II). Superior genotypes were identified for further investigation. However, we looked for traits that have significant correlation with seed yield in dryland condition.

Correlation results are presented in Table III. Only NS had significant correlation with grain yield and correlation of PH with GY was near to significant level. However, Omidi (2000) and Deharo *et al.* (1991 reported different results. Differences were related to different materials and conditions, especially they studied some cultivars under without stress condition that provided different relationships. Negative correlation between NS and HKW on one hand and NS with NH on the other hand were common in every condition (Omidi, 2000). Negative correlation between DF and grain yield is reasonable

Table I. Descriptive statistics obtained in some characteristics of 100 safflower genotypes

	Plant Height (cm)	No. of Heads/plant	Days to flowering	No. of seeds/head	Hundred kernel weight(gr)	Grain yield (kg/ha)	Oil percent	Ratio of seed/hull
Max.	70	12.64	124	40.17	5.41	958.18	34.02	1.49
Min.	38.34	3.22	102	10.16	2.52	60.94	23.02	0.72
Range	31.66	9.42	22	30.01	2.89		11	0.77
Mean	52.53	5.56	108.39	23.33	3.59	602.88	29.17	1.07
STDEV[a]	5.6712	1.2312	3.7643	5.3041	0.6395	153.5647	1.8354	0.1436
Genotypic Var.	0.511	0.013	0.279	0.308	0.008	85.77	0.343	0.0002

[a] Standard deviation

Table II. Analaysis of variance for some agronomic traits in the accessions of safflower during 2002-2003

Source of variation	df	MS						
		Plant Height	No. of Heads/plant	Days to flowering	No. of seeds/head	Hundred kernel weight	Grain yield	Ratio of seed/hull
Rep	1	22.445	4.351	6.125	104.589	0.293	528.123	0.281
Blocks/Rep	18	51.839	3.708	-	-	-	113700.8	0.019
Treat (unadj.)	99	68.936**	2.812**	28.534**	56.267**	0.818**	39557.92	0.041**
Treat (adj.)	99	64.324	3.032	-	-	-	45267.97**	0.041
Error	81	11.847	1.22	0.693	26.67	0.034	14635.42	0.018

** significant at the 0.01 level

Table III. Phenotypic correlations between some agronomic traits of safflower

	Plat Height	No. of Heads/plant	Days to flowering	No. of seeds/head	Hundred kernel weight	Ratio of seed/hull	Grain yield
Plat Height	1.000						
No. of Heads/plant	0.121	1.000					
Days to flowering	0.582**	0.100	1.000				
No. of seeds/head	0.172	-0.332**	0.055	1.000			
Hundred kernel weight	-0.264**	-0.046	-0.495**	-0.393**	1.000		
Ratio of seed/hull	0.215*	-0.072	0.254	0.142	-0.360**	1.000	
Grain yield	0.125	0.005	-0.109	0.390**	-0.072	-0.017	1.000

* and ** Correlation is significant at the 0.05 and 0.01 level respectively (2-tailed).

relationship in dryland conditions because longer cycle genotypes suffer late season heat and drought stress.

It is concluded that genetic gains in grain yield may be achieved in the future by augmenting number of seeds per head while increasing plant height of safflower in cold drylands of Iran.

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