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Relationship Among Yield Components and Selection Criteria for Yield Improvement in Safflower *Carthamus tinctorious* L.

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Abstract: Thirteen safflower mutants along with parental varieties and Mexican Lines were studied for variability, heritability, genetic advance and coheritability in irrigated and drought stress condition. Genotypic and phenotypic variances were highest for height and number of seed in capitulum. Whereas the maximum genotypic and phenotypic coefficients of variability were found in number of capitulum and number of seed in capitulum. Heritability estimates ranged from very low to high. Maximum heritability of 0/94 in irrigated condition was obtained for 100 seed weight and 0/711 in drought condition was obtained for capitulum diameter. In irrigated condition high heritability for capitulum weight, days to 50% flowering and days to maturity and in drought stress condition for number of seed in capitulum, days to 50% flowering and days to maturity with high genetic advances was obtained that these traits could be improved through mass selection. Coheritability estimates indicated that in irrigated condition selection for 100 grain weight, capitulum weight, number of seed in capitulum and in drought stress condition selection for stem diameter, capitulum diameter, 100 seed weight and number of seed in capitulum would improve the yield.

Key words: Coheritability, safflower, PCC, GCV, genetic advance, heritability in board sence

INTRODUCTION

Safflower is an important crop which is used for oil. India, Ethiopia and Iran are the countries with longest tradition of safflower growing as an oil plant (Tuncturk and Ciftci, 2004). Development of oil seeds has an important role in provide of requisite edible for country people. Iran is one of the origin areas of safflower as a drought and salt tolerant crop. Therefore safflower can be a suitable alternative crop for cultivation in marginal areas (Pasban, 2004). Yield improvement can be achieved by selecting for yield or their components, by through improvement of morphological and physiological traits and by factors that reduce yield losses sequential component. Analysis of crop yield has been widely applied for identification components that can be used as selection criteria. Different researches show an active interest in the components of yield that means that plant breeders don't ignore them as selection criteria. Yield components breeding for enhancing of the grain yield would be most effective if components involved were highly heritable, genetically independent or positively correlated and physiologically unrelated or related in a positive manner (Bleidere, 2002). Introduction of genetic variability is prerequisite for the evaluation of high yielding varieties. Induced mutation has been extensively used for creating new genetic variation in crop plant (Aslam Javad *et al*., 2003). The Present study was under taken to find the genetic variability characters association and contribution of yield contributing characters on grain yield and thereby to establish appropriate plant attributes for selection to Improve the yield status of fine safflower varieties in irrigated and drought stress condition.

MATERIALS AND METHODS

Seed of safflower (*Carthamus tinctorius* L.) var. Zarghan 279 having 11% moisture contents were exposed to 0, 80, 100, 150 and 200 Gy doses of Co^{60} gamma rays Irradiated seeds along with parental variety and Mexican line were sown in field in two condition: irrigated and drought stress condition. drought tolerant, earliness and high yield were used as the basis of selection of plants in M_1 generation until M_5 generation. 13 mutant lines (stabilized in M_4 generation) along with the parental variety and Mexican line were grown in M_5 generation (2004-5) in a randomized-block design with four replication in irrigated and drought stress condition. A random sample of five plants from each plot was used for taking observations on different characteristics. Then genetic variability and coheritability was subjected to statistical analysis in usual manner. This study was conducted in Agriculture Medicine and Industrial Research Institute of Karaj, Iran.

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RESULTS AND DISCUSSION

Genetic variability: Understanding of genetic variability is very essential for attempting any breeding program. Genotypic and phenotypic variance were high for height (40/74 and 46/04) in irrigated and (28/10 and 50/165) in drought stress condition Followed by number of seed in cupitulum with values of (35/89 and 106/45) in irrigated and (48/22 and 76/32) in drought stress condition. Phenotypic variances were greater as compared of genotypic variances for all the traits indicating the influence of environmental effects.

Genotypic (δ^2g), phenotypic (δ^2p) and environmental (δ^2e) variances, Genotypic Coefficients of Variation (GCV), Phenotypic Coefficient of Variation (PCV), heritability in broad sence (h^2b) and genetic advances (% of mean) for the characters in two condition under study are presented in Table 1. GCV in irrigated and drought stress condition ranged from 0/0076 to 0/1485 and 0/0082 to 0/1839 whereas PCV ranged from 0/0089 to 0/256 and 0/0107 to 0/2297, respectively. Among the studied characters in irrigated condition highest gcv was obtained in number of seed in capitulum and capitulum weight. The estimates of PCV were generally higher than those of GCV, thus high genetic coefficient of variability induced through gamma-rays for capitulum weight and number of seed in capitulum provides wide basis for genetic improvement in safflower. Since the efficiency of selection would depend upon the magnitude of variability that is heritable and caused by genetic factors the higher values. Therefore, heritability accompanied by high genetic advance for the characters studied should be quite valuable. In this study, heritability estimates in irrigated condition were found to be high for 100 seed weight (0/94), capitulum diameter (0/765), height (0/885), capitulum weight (0/63), days to 50% flowering (0/72) and days to maturity (0/69) and in drought stress condition and capitulum diameter (0/71), number of seed in capitulum (0/64), stem diameter (0/62), capitulum weight (0/51), height (0/56) days to flowering (0/615) and days to maturity (0/59). Genetic advance at 5% selection Intensity ranged (0/277) to (35/88) and (0/06) to (16/09) for irrigated and drought stress condition for stem diameter and days to maturity, respectively. Heritability (h^2b) estimates were relatively higher for almost all the characters studied. Although high heritability estimates have been found to be helpful in making selection of superior genotypes on the basis of phenotypic performance. Johnson *et al.* (1995) suggested that heritability estimates along with genetic advance were more useful in predicting the effect of selecting the best individual. High heritability with high genetic advance was recorded for height, capitulum weight, days to 50% flowering and days to maturity in irrigated condition and was recorded for height, stem diameter, capitulum diameter, number of seed in capitulum, days to 50% flowering and days to maturity. Parasad *et al.* (2001) states that the characters with high value of gcv and heritability accompanied by high genetic advance indicating that they might be transmitted to their hybrid progenies and therefore phenotypic selection based on these characters would be effective.

Coheritability: In irrigated condition coheritability values of yield and capitulum diameter, number of seed in capitulum, capitulum weight and 100 seed weight were positive and high whereas in drought stress condition coheritability values of yield and capitulum diameter were positive and high, yield with number of seed in capitulum and capitulum weight were moderate and yield with 100 seed weight was negative (Table 2). Negative coheritability for certain character pairs indicated that they are not be expected in selection

Table 1: Estimates of genotypic, phenotypic and environmental variability, genotypic and phenotypic coefficient of variation (GCV and PCV), heritability (h^2b) and genetic advances (% of mean) (GI) in two condition

	VG		VP		VE		PCV		GCV		HB		GI	
	Irrigated	drought	Irrigated	drought	Irrigated	drought	Irrigated	drought	Irrigated	drought	Irrigated	drought	Irrigated	drought
H	40/74	28/103	46/037	50/164	5/289	22/061	/063	/07536	/059	/05641	8851%	56%	15/85	10/47
SD	1288%	/018	1/4923	/0287	1/3635	/01075	/0859	/0488	/0252	/0386	/086	628%	/277	/06
NC	153%	0/144	1005%	0/888	/085	/744	22%	/1537	/08589	/0619	152%	/1621	/127	403%
CD	2/69	3/5169	3/526	4/9417	83%	1/4247	/0648	/0836	/0567	/07052	765%	7116%	3/79	4/176
NSC	35/89	48/29	106/45	76/32	70/56	27/41	/256	2297%	/1485	/1839	337%	641%	9/179	1/06
CW	289%	0/32	4576%	0/623	168%	305%	173%	/2279	1378%	1627%	63%	51%	12/48	2%
100 SW	/1639	0/24	1739%	/10255	1739%	/078	999%	/07723	/0969	/0378	94%	239%	1/035	665%
Y	2956%	0/2956	7866%	1/4376	7866%	1/142	124%	/1874	/0761	/0589	3758%	21%	8799%	665%
OC	4078%	0/5934	4/9815	6/617	4/5738	6/0336	/0807	/094	/0231	/0323	08186%	/0896	1/0765	1/565
D%50F	4/4	5/54	6/142	9	1/74	3/46	/0089	/011	/0076	/0086	716%	6115%	11/61	14/61
DM	13/5	6/098	19/59	10/33	6/0857	4/2373	/0142	/0107	/01189	/0082	6937%	59%	35/88	16/09

VG: Genotypic Variance, VP: Phenotypic Variance, VE: Environmental Variance, PCV: Phenotypic Coefficient of Variation, GCV: Genotypic Coefficients of Variation, HB: Heritability, H: Height, SD: Stem Diameter, NC: No. of Capitulum, CD: Capitulum Diameter, NSC: No. of Seed in Capitulum, CW: Capitulim Weight, 100 SW: 100 Seed Weight, Y: Yield, OC: Oil Content, D 50%, F: Days to 50% flowering, DM: Days to Maturity

Table 2: Coheritability estimates for 11 characters in two condition

	Condition	H	SD	NC	CD	NSC	CW	100 SW	Y	OC	D 50%F
SD	1	0/519									
	2	0/082									
NC	1	-0/51	0/013								
	2	1/71	-0/121								
CD	1	0/518	0/675	0/214							
	2	1/48	2/591	0/56							
NSC	1	0/406	1/21	0/402	1/57						
	2	1/052	0/882	0/785	0/631						
CW	1	0/671	1/85	0/35	1/8	0/466					
	2	1/018	1/044	0/858	0/756	0/686					
100 SW	1	1/45	-1/43	-0/2	3/053	1/094	0/163				
	2	1/36	-1/48	-23/79	0/234	0/137	0/874				
Y	1	0/332	0/76	-0/068	1	1/376	1/194	1/275			
	2	-1/502	0/139	0/139	1/777	0/706	0/676	-3/82			
OC	1	0/23	-0/314	-0/395	4/66	-0/63	0/72	0/9390	0/0582		
	2	0/94	0/033	3/806	0/286	-9/42	-3/33	0/646	-0/557		
D 50%F	1	0/41	0/695	0/75	1/208	0/676	0/51	0/19	1/0276	-0/058	
	2	0/868	5/02	0/727	0/956	1/968	0/132	0/069	-0/629	-4/199	
DM	1	0/143	0/96	-1/046	-1/093	0/055	0/154	1/42	1/293	-2/028	0/81
	2	0/739	-0/1596	0/535	0/767	0/287	0/656	1/65	0/511	-0/056	0/652

1 = Irrigatd, 2 =Drought, H: Height, SD: Stem Diameter, NC: Number of Capitulum, CD: Capitulum Diameter, NSC: Number of Seed in Capitulum, CW: Capitulim Weight, 100 SW: 100 Seed Weight, Y: Yield, OC: Oil Content, D 50% F: Days to 50% Flowering, DM: Days to Maturity

experiments for one character. In contrast, high and positive joint inheritance between certain character pairs suggests that significant improvement in one of them can be obtained by practicing selection for other one. 100 seed weight and height in two condition have positive and high coheritability but 100 seed weight and stem diameter in two condition have negative and high coheritability and also capitulum weight and stem diameter have positive and high coheritability. On the other hand in irrigated condition high and positive coheritability were observed for number of seed in capitulum with capitulum diameter and stem diameter, between capitulum weight and capitulum diameter, 100 grain weight with capitulum weight and number of seed in capitulum, between oil content and capitulum diameter, days to flowering with capitulum diameter and yield and between days to maturity with 100 seed weight and yield. This indicates that selection for 100 grain weight, capitulum weight, number of seed in capitulum and capitulum diameter would improve the yield in irrigated condition. In drought stress condition high and positive coheritability were observed between height with number of capitulum diameter, stem diameter, number of seed in capitulum and stem diameter, between number of seed in capitulum with days to maturity, between yield with capitulum diameter and between oil content with number of capitulum. This indicates that selection for stem diameter, capitulum diameter, height. One hundred seed weight and number of seed in capitulum would improve the yield in drought stress condition.

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