Performance, Correlation and Path Coefficient Analysis for Sixteen Lines of Safflower under Different Environmental Locations

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ABSTRACT

This study was conducted at the three different locations: Shalakan, Kalubia Governorate; Maryout, Alexandria Governorate; and Ras Sudr South Sinai Governorate, during the two successive growing seasons 2012/2013 and 2013/2014 to study the performance of 16 genotypes of safflower and the correlation coefficient between every pair of the studied traits and path coefficient analysis. Results illustrated that differences among genotypes are highly significant within each season and over the two seasons (combined analysis) under the three locations for all studied traits. The lines; 3, 7 and 15 exhibited the best performance in both growing seasons and their combined data under the three locations for seed yield and most yield components. Thus, these lines could be used in breeding programs for improving safflower seed yield over a wide range of environments. Seed yield /plant was positively and significantly correlated with each of number of branches /plant, number of capitula / plant, number of seeds / capitula and 1000 - seed weight at the three locations and seed oil content at the two locations; Maryout and Shalakan, indicating that the breeder can utilize such correlated response to obtain high seed yielding genotypes through selection for one or more of these traits. Results of path coefficient analysis showed that number of branches /plant and number of seeds/ capitula at different locations proved to be the major seed yield contributors. Thus the breeders should take into consideration these traits as selection criteria for safflower yield improvement under these target locations especially both traits are positively and significantly correlated with seed yield/plant.

Key words: Safflower, *Carthamus tinctorius* L, Genotypes, Locations, Correlation, path coefficient analysis.

INTRODUCTION

Safflower is considered as one of the alternative oil crops, particularly in the dry and semi dry lands due to its tolerance to drought and salinity. Safflower can also be grown successfully on soils with poor fertility and in areas with relatively low temperatures (Koutroubas and Papakosta, 2005). In crude safflower oils, triglycerides are the main constituents, making up about 92-99%. Interest in safflower cultivating as a source of edible oil (cooking, salad and margarine) has been stimulated since it is the identification of polyunsaturated essential fatty acids (PUEFA) which is claimed to offer diverse nutritional and therapeutic advantages. High quality edible oil and general concern about this matter made safflower as an important crop for vegetable oil. Safflower genotypes varied significantly in seed yield and its attributes and oil percent Eslam (2003) Ahmed *et al*. (2005) Camas *et al*. (2007), El- Far *et al.* (2010) Abd El- Lattief (2012), Ali and Mahmoud (2012), Forouzan *et al*. (2014) and Behnan *et al.* (2016). Evaluation of relationships among traits in safflower indicated that positive and significant relationships among seed yield and plant height, number of capitula/plant, number of branches/ plant, number of seed/ capitula, 1000-seed weight and oil content Mathur *et al*. (1978), Omidi Tabrizi (2001), Tuncturk and Ciftci (2004), Eslam *et al*. (2010) and Abd El- Lattief (2012). On the other hand, path coefficient analysis allows an effective means of partitioning correlation coefficients into inidirectional pathway and alternate pathways. This analysis permits a critical examination of specific factors that produce a given correlation and can be successfully employed in formulating an effective selection strategy. Thus, identifying traits that can be used as selection criteria help the breeder in selection for favourable and stress conditions. In several studies, the greatest positive direct and indirect effects on seed yield variation was expressed by number of capitula/plant, number of branches/ plant, number of seed/ capitula and 1000-seed weight (Mathur *et al*. (1978), Omidi Tabrizi (2001), Eslam *et al*. (2010) and Abd El- Lattief (2012). The main objectives of this work were: (1) studying performance of 16 new improved lines of safflower under three locations. (2) Estimating correlation among some agronomic traits and the relative importance of traits contributing to safflower seed yield variation under the three

locations to detect selection criteria that could be used in safflower yield improvement.

MATERIALS AND METHODS

The field work of the present investigation was carried-out at three locations; 1- Maryout Research Station, Desert Research Center (South Alexandria with about 31 km between longitude 29°47′ and 15°27′ E and latitudes 31°00′ and 18°37′ N), 2- Ras Sudr Research Station, Desert Research Center (South Sinai Governorate, Egypt) and 3- the Experimental Farm of the Faculty of Agriculture, Ain Shams University, at Shalakan, Kalubia Governorate, Egypt during the two successive growing seasons (winter) 2012/2013 and 2013/2014. The objective was to study the performance of 16 genotypes of safflower and the correlation coefficient pairs of studied traits and path coefficient analysis. The genetic materials used in this study consisted of 16 new improved lines of safflower which were introduced from International Center for Biosaline Agriculture (ICBA) and supported by Plant breeding unit, Plant Genetic Resources Department, Desert Research Center (DRC), Egypt. Safflower grains were sown on the second week of November in the two seasons. The experimental design used in each season for each location was randomized complete block design with three replicates; each plot consisted of three rows. Each row was three m in length and 50 cm wide. Hills were spaced at 20 cm within rows and one plant was left per hill. The other cultural practices were followed as recommended for safflower production in each region. Mechanical and chemical analysis of soil for the three locations are shown in Table (1).

Monthly means of maximum temperature degrees (^{0}C), relative humidity (%) and Amount rainfall (mm) at the three locations during the two successive growing seasons for the three locations are shown in Table (2). At harvest, plant height (cm), Number of branches /plant, number of capitula / plant, number of seeds / capitula, 1000 - seed weight (g) and Seed yield /plant (g) were recorded on 10 competitive individual plants for each genotype in each plot. A bulk grain sample of about 10 g per plot was randomly taken from the ten harvested plants and used for estimating seed oil content % by Soxhlet apparatus, according to A.O.A.C. (1995). Statistical analysis was performed for each season then; combined analysis for both seasons was carried out after doing the homogeneity test according to Gomez and Gomez (1984). L.S.D was computed to compare differences among means at 5% level. The correlation coefficient between every pair of the studied traits and path coefficient analysis were computed for 16 genotypes according to Dewey and Lu (1959) under the three locations during the two successive growing seasons.

RESULTS AND DISCUSSION

Analysis of variance and mean performance

The analysis of variance for all studied traits are presented in Table (3). Results illustrated that differences among genotypes (G) are highly significant within each season and over the two seasons (combined analysis) under the three locations for all studied traits. These results revealed presence of sufficient genetic variability among genotypes regarding the studied traits.

Table 1: Mechanical and chemical analysis of experimental soil at the experimental locations (Maryout,Ras Sudr and Shalakan).

Constituents	Ras Sudr	Maryout	Shalakan
Mechanical analysis			
Clay %	15.33	23.26	58.00
Silt %	20.48	21.67	31.00
Sand %	64.19	55.07	11.00
Texture	Sandy loam	Loamy clay	Clay
Chemical analysis			
pH	7.39	7.8	7.98
EC ds/m	8.54	3.3	2.88
Ca^{++} Cations (meq/L)	21.21	10.7	3.00
Mg^{++}	10.86	2.43	1.00
Na^{+}	48.04	19.3	2.35
K^{+}	5.62	0.56	0.55
Cl^{-} Anions (meq/L)	43.8	22	1.60
$Co3^{--}$	…	…	--
$HCo3^{-}$	10.85	5.2	0.70
$SO4^{--}$	25.2	5.8	4.90

Table 2: Monthly mean of maximum temperature degrees (^{0}C), relative humidity (%) and Amount rainfall (mm) at the three locations during the two successive growing seasons 2012/2013 and 2013/ 2014.

	Ras Sudr			Maryout			Shalakan		
Month	**T.† (C°)**	***R.H %**	**Rainfall (mm)**	**T.† (C°)**	***R.H %**	**Rainfall (mm)**	**T.† (C°)**	***R.H %**	**Rainfall (mm)**
				2012/2013					
Nov.	22.48	90.56	0.46	17.27	68.47	49.80	23.60	64.00	0.00
Dec.	16.97	89.42	8.65	14.11	67.15	23.00	21.40	48.00	0.00
Jan.	14.92	92.58	9.79	13.26	67.06	52.00	17.40	64.00	8.90
Feb.	17.75	94.79	2.69	14.39	69.02	44.50	20.10	49.00	0.00
March	21.55	77.94	2.88	17.18	69.53	22.22	23.80	48.00	0.00
April	24.60	64.90	0.02	14.73	59.91	13.00	27.40	40.00	0.00
May	29.11	67.18	0.00	20.21	55.92	12.00	33.30	47.00	0.00
				2013/2014					
Nov.	23.46	72.04	0.00	19.80	64.33	21.00	26.50	64.00	0.00
Dec.	19.16	75.89	0.04	15.50	66.67	60.90	19.60	52.00	0.10
Jan.	18.37	76.04	3.06	14.20	61.33	39.10	18.30	67.00	0.10
Feb.	17.64	63.28	5.11	14.67	66.33	59.30	20.80	68.00	8.20
March	19.02	68.86	2.37	16.13	62.33	3.60	21.60	50.00	0.30
April	24.97	62.87	0.00	18.70	61.33	5.00	28.30	50.00	0.60
May	31.43	64.99	0.00	22.13	57.67	6.20	33.1	45.00	0.00

Table 3: Mean squares of combined analysis of variance under the three locations during the two successive growing seasons 2012/2013 and 2013/ 2014 for the studied traits of safflower genotypes.

Source of variation (S.O.V)	**Seasons(S)**	**Genotypes (G)**	**G x S**	**Error**
d.p	**1**	**15**	**15**	**62**
		Maryout		
Seed yield / plant	30.32*	1044.25**	3.1	5.76
Plant height (cm)	107.87**	316.85**	16.21**	5.63
Number of branches /plant	0.7	53.52**	0.31	0.78
Number of capitula / plant	2.77	134.36**	5.82	5.06
Number of seeds / capitula	1.19	96.15**	1.04	6.1
1000 - seed weight (g)	5.4	94.70**	0.67	3.57
Seed oil content %	84.45**	13.06**	0.18	1.43
		Ras Sudr		
Seed yield / plant	2.03	661.04**	5.59	4.72
Plant height (cm)	9.15	188.10**	12.53*	6.3
Number of branches /plant	0.43	27.53**	0.65	1.29
Number of capitula / plant	3.12	148.13**	0.2	8.32
Number of seeds / capitula	0.16	113.53**	4.78	14.82
1000 - seed weight (g)	10.25	83.42**	2.9	9.13
Seed oil content %	98.01**	9.49**	0.34	1.50
		Shalakan		
Seed yield / plant	1132.31**	692.51**	18.76**	5.26
Plant height (cm)	472.59**	1228.65**	23.10**	5.96
Number of branches /plant	12.65**	96.23**	4.07**	1.28
Number of capitula / plant	654.38**	99.73**	14.73**	2.83
Number of seeds / capitula	1350**	304.51**	30.51**	5.94
1000 - seed weight (g)	600.85**	44.73**	13.64**	3.94
Seed oil content %	87.36**	9.76**	0.17	1.69

*, ** denote significant differences at 0.05 and 0.01 probability levels, respectively.

Mean squares of seasons (S) were highly significant for all studied traits at Shalakan location, seed yield/plant and plant height at Maryout location and seed oil content at Maryout and Ras Sudr. However, the interaction between seasons and genotypes (S x G) are also highly significant for all traits at Shalakan location and plant height at Maryout and Ras Sudr locations. These results are in line with those mentioned by (Eslam (2003); Ahmed *et al.* (2005); Camas *et al.* (2007); El- Far *et al.* (2010); Abd El-Lattief (2012); Ali and Mahmoud (2012); Forouzan *et al.* (2014) and Behnan *et al*.(2016) whose found highly significant differences between safflower genotypes, seasons and genotypes x seasons interaction.

The mean values of the studied genotypes for seed yield/ plant and its related agronomic traits in each of the two growing seasons and their combined data under the three locations are shown in Tables (4 to 10). The results reveal that safflower genotypes greatly differed in their response under the three locations in both growing seasons and their combined data. For seed yield/plant (Table, 4) general means over the two seasons were 41.29, 29.14 and 21.03g at Shalakan, Maryout and Ras Sudr locations, respectively. The differences in seed yield between these locations might be due to the wide changes in weather and soil conditions (Tables, 1 and 2). The line 15 had the highest means of seed yield under the three locations in both seasons and combined data followed by the line 3 under the three locations and the line 7 under Shalakan and Maryout locations in both seasons and their combined data. On the other hand, the line 13 had the lowest mean value under the three locations in both seasons and combined data. The high yielding capability of these lines are primarily due to their superiority in number of branches /plant, number of capitula/ plant and number of seeds/ capitula under the three locations in both seasons and combined data. Generally, the lines 3, 7 and 15 exhibited the best performance in both growing seasons and their combined data under the three locations for seed yield and most yield components. Thus, these lines could be used in breeding programs for improving safflower seed yield over a wide range of environments.

With respect to plant height (Table, 5), the mean values of genotypes over the two seasons were 113.70, 65.55 and 49.29 cm at Shalakan, Maryout and Ras Sudr locations, respectively. The two lines 3 and 4 were the tallest among all genotypes under the three locations in both seasons and combined data followed by the line 16 at Shalakan location in both seasons and their combined data. While, the line 11 was the shortest in plant height under the three locations in both seasons and combined data.

Concerning number of branches /plant (Table, 6), the mean values of genotypes over the two seasons were 14.82, 10.93 and 8.35 at Shalakan, Maryout and Ras Sudr locations, respectively. The two lines 3 and 15 exhibited the highest mean values for this trait under the three locations in both seasons and their combined data.

Regarding number of capitula/ plant (Table, 7), the mean values of genotypes over the two seasons were 37.26, 26.94 and 21.37 at Shalakan, Maryout and Ras Sudr locations, respectively. The line 15 had the highest mean number of capitula/ plant under the three locations in both seasons and combined data followed by the two lines 3 and 7 under the three locations in both seasons and their combined data.

For the number of seeds/ capitula (Table, 8) the mean values of genotypes over the two seasons were 50.98, 36.75 and 27.97 at Shalakan, Maryout and Ras Sudr locations, respectively. The lines 3 followed by 7 and 15 gave the highest values for no. of seeds/ capitula under the three locations in both seasons and their combined data.

As shown in Table (9) means of 1000- seed weight of genotypes were 41.81, 30.45 and 23.39g at Shalakan, Maryout and Ras Sudr locations, respectively. The two lines 14 and 15 recorded the highest mean value for this trait under the three locations in both seasons and their combined data followed by the line 9 at Shalakan location in both seasons and their combined data.

With respect to seed oil content % (Table, 10), the mean values of genotypes over the two seasons were 31.59, 29.71 and 25.79 % at Ras Sudr, Shalakan and Maryout locations, respectively. The differences in seed oil content (%) between these locations may be due to the changes in soil (EC ds/m and texture) and weather conditions (Tables, 1 and 2). The two lines 15 and 8 had the highest means of seed oil content under the three locations in both seasons and combined data followed by the line 9 at Maryout and Ras Sudr locations in both seasons and their combined data and the two lines, 12 at Ras Sudr location in both seasons and their combined data.

Phenotypic correlation coefficients

Phenotypic correlation coefficients estimated between different pairs of the studied traits at the three locations; Maryout, Ras Sudr and Shalakan are presented in Table (11).

The interrelationship between seed yield /plant and each of number of branches /plant, number of capitula / plant, number of seeds / capitula and 1000 - seed weight were positive and highly significant at the three locations and correlation between other studied traits seed oil content at the two locations; Maryout and Shalakan, indicating that the breeder can utilize such correlated response to obtain high seed yielding genotypes through selection for one or more of these traits.

Table 11: Values of simple phenotypic correlation coefficients between different pairs of traits recorded under the three locations during the two successive growing seasons in safflower

	1	2	3	4	5	6	7
Maryout							
1- Seed yield / plant		-0.08	0.91**	0.71**	0.73**	0.59**	0.55*
2- Plant height (cm)			0.08	-0.13	-0.07	0.04	-0.21
3- Number of branches /plant				0.72**	0.71**	0.48	0.55*
4- Number of capitula / plant					0.80**	0.33	0.35
5- Number of seeds / capitula						0.4	0.26
6- 1000 - seed weight (g)							0.12
7- Oil content %							
Ras Sudr							
1- Seed yield / plant		0.34	0.89**	0.72**	0.71**	0.64**	0.37
2- Plant height (cm)			0.29	0.13	0.51*	0.1	-0.12
3- Number of branches /plant				0.71**	0.80**	0.56*	0.52*
4- Number of capitula / plant					0.71**	0.29	0.37
5- Number of seeds / capitula						0.45	0.36
6- 1000 - seed weight (g)							0.27
7- Oil content %							
Shalakan							
1- Seed yield / plant		0.11	0.90**	0.61*	0.89**	0.54*	0.55*
2- Plant height (cm)			0.1	0.13	0.2	-0.23	-0.22
3- Number of branches /plant				0.5	0.83**	0.47	0.49
4- Number of capitula / plant					0.64**	0.38	0.61*
5- Number of seeds / capitula						0.33	0.41
6- 1000 - seed weight (g)							0.24
7- Oil content %							

*, ** denote significant differences at 0.05 and 0.01 probability levels, respectively.

Similar results were reported by Mathur *et al*. (1978), Omidi Tabrizi (2001), Tuncturk and Ciftci (2004), Eslam *et al*. (2010) and Abd El- Lattief (2012) who found one or more positive significant correlation coefficient between seed yield and each of number of branches /plant, number of capitula / plant, number of seeds / capitula and 1000 - seed weight in safflower.

Other associations between pairs of traits revealed that, plant height gave positive significant correlation with number of seeds/ capitula at Ras Sudr location only. Regarding number of branches /plant, positive and significant correlation coefficients were found with each of number of seeds/ capitula at the three locations, number of capitula/ plant and seed oil content at the two locations; Maryout and Ras Sudr and 1000 - seed weight at Ras Sudr location. Number of capitula/ plant showed positive and significant correlations with each of number of seeds/ capitula at the three locations and seed oil content at Shalakan location. For number of seeds/ capitula exhibited insignificant correlations with each of 1000 - seed weight and seed oil content at the three locations. Also, 1000 - seed weight showed insignificant correlation with seed oil content at the three locations.

Path coefficient analysis

The traits, i.e., number of branches /plant, number of capitula/ plant, number of seeds/ capitula and 1000-seed weight which exhibited positive significant correlation with seed yield/plant were used in path coefficient analysis to detect the relative importance of each trait to seed yield/plant variation at phenotypic level at the three locations.

The direct and indirect effects of the four yield attributes are shown in Table (12). The data revealed that the direct effect of number of branches /plant on seed yield/plant was positive and high at the three locations. The indirect effect of number of branches /plant was low via number of capitula/ plant at Shalakan and Maryout locations, *via* number of seeds/ capitula at Maryout and and Ras Sudr locations and *via* 1000-seed weight at Shalakan location. Also the indirect effects for this trait were relatively low *via* number of capitula/ plant and 1000- seed weight at Ras Sudr location. Meantime, the indirect effect of this trait was moderate *via* number of seeds/ capitula at Shalakan location.

Number of capitula/ plant showed positive and moderate direct effects for seed yield/plant at Ras Sudr location, while it was low at Shalakan and Maryout locations.

Table 12: Phenotypic path coefficient analysis of seed yield/plant and its contributes characters under the three locations in safflower.

Source of variation	Maryout	Ras Sudr	Shalakan
Number of branches /plant vs. Seed yield/plant			
Direct effect	0.699	0.653	0.409
Indirect effect via number of capitula /plant	0.036	0.187	0.019
Indirect effect via number of seeds / capitula	0.083	-0.088	0.387
Indirect effect via 1000 - seed weight (g)	0.920	0.139	0.084
Total	0.91	0.89	0.90
Number of capitula /plant vs. seed yield/plant			
Direct effect	0.049	0.263	0.039
Indirect effect via number of branches /plant	0.503	0.464	0.205
Indirect effect via number of seeds / capitula	0.094	-0.078	0.298
Indirect effect via 1000 - seed weight (g)	0.063	0.072	0.068
Total	0.71	0.72	0.61
Number of seeds / capitula vs. seed yield/plant			
Direct effect	0.118	-0.111	0.466
Indirect effect via number of branches /plant	0.496	0.522	0.339
Indirect effect via number of capitula /plant	0.039	0.187	0.025
Indirect effect via 1000 - seed weight (g)	0.076	0.112	0.059
Total	0.73	0.71	0.89
1000 - seed weight (g) vs. seed yield/plant			
Direct effect	0.191	0.248	0.179
Indirect effect via number of branches /plant	0.336	0.366	0.193
Indirect effect via number of capitula /plant	0.016	0.076	0.015
Indirect effect via number of seeds / capitula	0.047	-0.049	0.154
Total	0.59	0.64	0.54

The indirect effects of number of capitula/ plant were low via number of seeds/ capitula at Maryout and Ras Sudr locations and via1000-seed weight at the three locations. Also the indirect effect for this trait was moderate via number of branches /plant and number of seeds/ capitula at Shalakan location. On other hand, the indirect effects of number of capitula/ plant were high via number of branches /plant at Maryout and Ras Sudr locations.

The direct effect of number of seeds/ capitula was positive and high for seed yield/plant at Shalakan location, while it was relatively low at Maryout and Ras Sudr locations. The indirect effects of number of seeds/ capitula were low or relatively low *via* number of capitula/ plant and 1000-seed weight at the three locations. Also the indirect effect for this trait was moderate *via* number of branches /plant at Shalakan location and high at Maryout and Ras Sudr locations for the same trait.

The direct effect of 1000-kernel weight was positive and moderate for seed yield/plant at the three locations. The indirect effects of this trait *via* number of capitula/ plant and number of seeds/ capitula were low at the three locations. However, the indirect effects of this trait via number of branches /plant were moderate at the three locations.

The components of the total seed yield variation determined directly and jointly by each factor are presented in Table (13). At the Maryout location, the main sources of plant yield variation in order of importance were the direct effect of number of branches /plant (48.86 %) and its joint effects with each of 1000-seed weight (12.82 %), number of seeds/ capitula (11.71 %) and number of capitula/ plant (4.93 %) as well as the direct effect of 1000-seed weight (3.65 %). The total contribution of the four traits was 86.95 %, while the residual effect assumed to be about 13.05 % of the total phenotypic variation of seed yield.

At Ras Sudr location, the main sources of plant yield variation in order of importance were the direct effects of number of branches /plant (22.58 %) and its joint effect with 1000-seed weight (13.10 %), number of capitula/ plant (12.35 %) and number of seeds/ capitula (11.57) as well as the direct effect of 1000-seed weight (6.13 %) and number of capitula/ plant (5.90 %). The other joint effects contributed to total seed yield variation were joint effect of number of capitula/ plant with number of seeds/ capitula (4.13 %), number of capitula/ plant with 1000-seed weight (3.77 %) and number of seeds/ capitula with 1000-seed weight (2.47 %). It is apparent that the four traits and their interaction amounted to 83.24 % of the whole yield variation while, the residual effect amounted to 16.76%.

Table 13: Phenotypic components (direct and joint effects) in percent of seed yield/plant variation under the three locations in safflower.

Source of variation	C.D	RI %	C.D	RI %	C.D	RI %
Number of branches /plant (X1)	0.49	48.86	0.23	22.58	0.17	16.73
Number of capitula /plant (X2)	0.00	0.24	0.06	5.90	0.00	0.15
Number of seeds / capitula (X3)	0.01	1.39	0.01	1.23	0.22	21.72
1000 - seed weight (g) (X4)	0.04	3.65	0.06	6.13	0.03	3.20
(X1) x (X2)	0.05	4.93	0.12	12.35	0.02	1.60
(X1) x (X3)	0.12	11.71	0.12	11.57	0.32	31.64
(X1) x (X4)	0.13	12.82	0.13	13.10	0.07	6.88
(X2) x (X3)	0.01	0.93	0.04	4.13	0.02	2.33
(X2) x (X4)	0.01	0.62	0.04	3.77	0.01	0.53
(X3) x (X4)	0.02	1.80	0.02	2.47	0.06	5.51
Residual	0.13	13.05	0.17	16.76	0.10	9.72
Total	1.00	100.00	1.00	100.00	1.00	100.00

C.D: Coefficient of determination RI%: Relative importance

At Shalakan location, the main sources of plant yield variation in order of importance were the direct effect of number of seeds/ capitula (21.72 %) and its joint effect with number of branches /plant (31.64 %) and 1000-seed weight (6.88 %) and the direct effect of number of branches /plant (16.73 %) and 1000-seed weight (3.20 %). The other joint effects contributed in total seed yield variation were joint effect of number of capitula/ plant with number of seeds/ capitula (2.33 %) and number of seeds/ capitula with 1000-seed weight (5.51 %). The total effect of four traits was (90.28 %) and the residual was (9.72 %).

From the previous mentioned results, it was found that, number of branches /plant and number of seeds/ capitula at different locations proved to be the major seed yield contributors. Thus the breeders should take into consideration these traits as selection criteria for safflower yield improvement under these target locations. Similar results were obtained by (Mathur *et al*. (1978), Omidi Tabrizi (2001), Eslam *et al.* (2010) and Abd El- Lattief (2012).

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الملخص العربي

السلوك وتحليل الأرتباط ومعامل المرور لستة عشر سلالة من القرطم تحت مواقع بيئية مختلفة

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أجريت هذه الدراسة في ثلاث مواقع مختلفة هي، شلقان بمحافظة القليوبية، مريوط بمحافظة الاسكندرية وراس سدر بمحافظة جنوب سيناء خلال الموسمين الزراعيين 2012/2013, 2013/2014 وذلك بهدف دراسة متوسط السلوك وطبيعة العلاقات التى تربط بين الصفات المحصولية المختلفة وتحليل معامل المرور لستة عشر سلالة مستوردة من محصول القرطم.

وقد أظهرت نتائج الدراسة المتحصل عليها مايلي:

وجود اختلافات عالية المعنوية بين التراكيب الوراثية في كلا من موسمي الزراعة والتحليل التجميعي لهما تحت الثلات مواقع. كما تفوقت السلالات ٣، ٧، ١٥ علي جميع السلالات الاخري في محصول البذور ومعظم مكوناته خلال موسمي الزراعة وعلي مستوي التحليل التجميعي للموسمين وبالتالي يمكن استخدام مثل هذة السلالات في برامج تحسين محصول القرطم علي مدي واسع من البيئات.

وجد تلازم موجب ومعنوي بين محصول البذور للنبات الفردي وكل من صفات عدد الافرع/ نبات، عدد الثمار/ نبات، عدد البذور/ ثمره ووزن الالف بذرة بالمواقع الزراعية الثلاث ومحتوي البذور من الزيت بموقع شلقان ومريوط وبالتالي فالانتخاب لصفة أو أكثر من تلك الصفات سوف يؤدي للحصول على تراكيب وراثية عالية المحصول.

أوضحت نتائج تحليل معامل المرور أن صفتي عدد الافرع/ نبات وعدد البذور/ ثمره كانتا أكثر الصفات مساهمة في تباين محصول البذور للنبات الفردى تحت مواقع الزراعة المختلفة، لذا ينبغى على المربي أخذهما في الاعتبار كمعايير للانتخاب عند تحسين محصول البذور في القرطم تحت المواقع البيئية المستهدفة خاصة وأن هاتين الصفتين ارتبطتا ايجابيا ومعنويا مع صفة محصول البذور للنبات الفردي.