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REGRESSION OF GENOTYPE × ENVIRONMENT INTERACTION FOR SOME JEW'S MALLOW ECOTYPES (*Corchorus olitorius* L.).

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ABSTRACT

The present study was carried out during the two successive summer seasons of 2008 and 2009 at three locations, i.e.; a) farm of Sabahia Horticultural Research Station, Alexandria; b) Kaha (Kalyiobia governorate) Horticulture Research Station; and c) farm of Baramoon Horticultural Research Station, Mansoura, Egypt. Sowing was done on three different dates, i.e., a) mid of April, b) mid of May, and c) mid of June. The genetic materials used in this study included six ecotypes of jew's mallow, which were collected from different regions of Egypt in addition to the "Eskandarany" as a check cultivar. This work was designed to measure regression of genotype × environment interaction of the studied genotypes of Jew's mallow under different locations and sowing dates using Eberhart and Russell's approach (1966). It was found that the seven genotypes of jew's mallow clearly differed in all studied traits. Mean square for fresh leafy yield and its components of the seven genotypes of jew's mallow showed dependence on the environmental mean effects. These results suggested that the genotypes tended to rank differently when grown at different location on different sowing date. The analyses of variance for stability showed highly significant differences among the seven Jew's mallow genotypes for all studied characters. The regression analysis, the (b_i) statistics, was estimated with a significant and larger than one value (i.e., $b_i>1$) in El-Esma'aellyia, Bani Sweef, Sohag, Siwi, and Sharkeia ecotypes for total fresh leafy yield. Such results seemed to indicate that these genotypes could reflect higher response potentials in the mentioned character under the more favorable environment, which was sowing the mentioned genotypes in Kalyiobia on mid of April.

INTRODUCTION

Jew's mallow is one of the leafy vegetables in West Africa and is often stored dry. It is also commonly used in Malaysia, the Philippines, and parts of Latin America, and it is consider food and medicine plant, recently it is exported to Japan. It is the most important leafy vegetable in Egypt, which is cultivated in Egypt, Japan, Korea, and China from March to Nov. (Oomen and Grubben 1978). Appropriate sowing time of various vegetables crops results in higher economic yield without involving extra cost as it helps genotypes to express their full growth potential. In Egypt, Wahba *et al.* (2003) reported that sowing Jew's mallow on the 1st of June gave the highest total yield, vegetative growth, and chemical constituents, while it gave the lowest net leaves weight percentage comparing with sowing on 1st of April and 1st of May. In another study, Abd-Allah and Nasr (2005) suggested that the best date in order to grow Jew's mallow for seed and fresh foliage yields, in Alexandria area, might be on mid May.

The development of cultivars or varieties, which can be adapted to a wide range of diversified environments, is the ultimate goal of plant breeders in crop improvement program. The adaptability of a variety over diverse environments is usually tested by the degree of its interaction with different environments under which it is planted. A variety or genotype is considered to be more adapted or stable one if it has a high mean yield but a low degree of fluctuation in yielding ability when grown under diverse environments. Eberhart and Russell (1966) proposed a model to test the stability of varieties under various environments. They defined a stable variety as having unit regression over the environments (b= 1) and minimum deviation from the regression (S^2d_i = 0). Therefore, a variety with a high mean yield over the environments, unit regression coefficient (b=1) and deviation from regression as small as possible (S^2d_i = 0), will be a better choice as a stable variety.

Previous work on growth and yield of *Corchorus olitorius* used as a vegetable is not enough. Therefore, the present work was designed to measure regression of genotype × environment interaction of the studied genotypes of Jew's mallow under different locations and sowing dates using Eberhart and Russell's approach (1966).

MATERIALS AND METHODS

The present study was carried out during the two successive summer seasons of 2008 and 2009 at three locations, i.e.; a) farm of Sabahia Horticultural Research Station, Alexandria; b) Kaha (Kalyiobia governorate) Horticulture Research Station; and c) farm of Baramoon Horticultural Research Station, Mansoura, Egypt. Sowing was done on three different dates, i.e., a) mid of April, b) mid of May, and c) mid of June. The average air temperature degrees and relative humidity from April up to October have been recorded and illustrated for the three locations in Table 1.

Table 1: Locational and climatic characteristics used for stability analysis of jew's mallow ecotypes

Location	**Sabahia farm (Alexandria)**			**Kaha farm (Kalyiobia)**			**Baramoon farm (Mansoura)**		
Soil texture	coarse clay			Clay loamy			Clay loamy		
pH	8.35			8.70			7.75		
Latitude (N)	31.20			30.16			31.00		
Longitude (E)	29.95			31.12			31.45		
Altitude (m)	6			65			12		
Air temp. (ºC) #	**Max**	**Min**	**Aver.**	**Max**	**Min**	**Aver.**	**Max**	**Min**	**Aver.**
April	24	13	18.5	28	14	21	27	12	18
May	27	16	21	32	17	25	31	15	22
June	29	20	24	35	20	27	34	19	26
July	30	22	26	35	22	28	35	20	26
August	31	23	27	34	22	28	34	20	26
September	30	21	26	33	20	26	33	19	25
October	28	18	23	30	18	23	30	17	22

 # Means both of 2008 and 2009 seasons

The genetic materials used in this study included six ecotypes of jew's mallow, which were collected from different regions of Egypt in addition to the "Eskandarany" as a check cultivar (Abd-Allah, 2006). These genotypes and their sources are presented in Table 2. These genotypes were improved by two mass selection cycles (Abd-Allah, 2009).

Table 2. Sources and local names of jew's mallow genotypes

Genotype	Local names	Local sources in Egypt
Check variety	Eskandarany	Horticultural Research Institute
Ecotype 1	Siwi	Siwa
Ecotype 2	Sharkeia	Sharkeia
Ecotype 3	Sohag	Sohag
Ecotype 4	Minia	Minia
Ecotype 5	Bani sweef	Bani sweef
Ecotype 6	El-esma'aellyia	El-esma'aellyia

Seeds were sown in rows about 20 cm apart and then irrigated. Plants were thinned to 5 or 20 cm between plants for fresh leafy yield or seed yield, respectively. Each experimental unit consisted of 10 rows, each of 4 m in length and 0.20 m apart, i.e., the unit area was 8 m^2. Sowing was done at three dates on mid April, mid May and mid June in 2008 and 2009 summer seasons. A factorial experiment in a randomized complete blocks design of seven genotypes, 3 locations, 2 years, and 3 sowing dates with three replicates was used. Three cuttings were taken from each genotype of jaw's mallow for fresh leafy yield. The first cut was done at 45 days after sowing; meanwhile the second and the third cuts were taken 30 days intervals. All the agricultural practices were followed according to recommendations.

Recorded data:

1. Fresh foliage yield and its components.

In each cut, vegetative measurements were recorded as a mean of 20 randomly taken plants per entry. These characters were: stem length (cm), plant weight (g), leaves weight (g), and number of leaves per plant. Fresh foliage yield was recorded in Kg/plot as the total weight of plants for each cut in each entry and the total yield in kg/m^2 was calculated for the three cuts taken from each entry. Net leaves weight percentage was calculated as leaves weight of 20 plants / total weight of these plants × 100. Leaf area (cm^2) per plant was determined at each cut for each sample by the disk method (Wallace and Munger, 1965).

2- Seed yield and its components.

At the end of the season, the following traits were recorded as an average of 20 randomly taken plants (from rows specially for seed yield ,i.e., without cutting); total seed yield (g/plant), plant height (cm), number of branches/plant, number of pods/plant, number of seeds/pod, pod length (cm), and weight of 1000 seeds (g).

Statistical procedures:

1. The data were combined over sowing dates and locations, using fixed-model analysis. Before combined variance analysis, the data were checked for normal distribution and homogeneity of variances by years and locations. Due to conformity with normal distribution and homogenous variance, transformation was not needed in the analysis of each trait. Statistical analysis of a randomized complete blocks design according to Snedecor and Cochran (1980) was done to find out the significance of the

studied characters and to compare between means by Duncan's multiple range at 0.05% level of significance.

2. The stability parameters suggested by Eberhart and Russell,(1966) were estimated to compare the stability of the genotypes. Environments included in this study of stability were nine environments resulting from different locations (3) and sowing dates (3). Following the concept of stability, the *b*=1 hypothesis was tested. Any significant interaction which includes genotype was accepted as representative of a G × E interaction. If the interaction was significant, then stability analysis was carried out. In the case of non-significant interaction, it is very easy to decide the desired genotype for any trait considered. In deciding which genotype show stability, the first criterion used was significant differences of the regression coefficient (*b*) from one. Any genotype which had a non-significant *b* from one was accepted as stable. A cultivar with a high performance and a non-significant *b* is desired.

RESULTS AND DISCUSSION

The studied genotypes of jew's mallow clearly differed in all studied traits (Table 3).

Table 3: Means performance of fresh leafy yield, seed yield and its components of Jew's mallow genotypes, calculated from the combined data over three sowing dates at three locations and two seasons (2008 – 2009).

Genotypes	Fresh leafy yield and its components													
	Total fresh leafy yield (kg/m^2)		Plant weight (g)		Leaves weight/pant (g)		Net leaves weight (%)		Leaf area/plant (cm^2)		No. leaves/ plant		Stem length (cm)	
Eskandarany cultivar	6.980	cd	32.7	c	11.3	c	34.2	c	783.2	b	24.5	b	42.7	c
El-esma'aellyia ecotype	7.046	cd	34.1	b	10.8	d	31.1	e	727.5	d	24.9	ab	43.4	b
Bani sweef ecotype	7.552	b	35.8	a	12.0	b	32.3	d	785.4	b	25.3	a	43.7	b
Sohag ecotype	8.245	a	33.8	b	12.4	a	35.2	c	756.5	bc	23.4	c	45.2	a
Siwi ecotype	6.257	e	27.9	e	11.8	b	42.3	a	870.0	a	25.4	a	39.4	e
Sharkeia ecotype	7.301	bc	29.0	d	11.2	c	38.8	b	774.3	b	22.7	d	42.1	c
Minia ecotype	6.649	d	27.6	e	10.0	e	35.4	c	739.5	cd	24.6	ab	40.5	d

Genotypes	Seed yield and its components													
	Seed yield /plant (g)		No. of pods /plant		No. of seeds /pod		No. branches/ plant		Plant height (cm)		Pod length (cm)		Weight of 1000 seeds (g)	
Eskandarany cultivar	3.637	cd	30.1	cd	206.8	bc	3.7	ab	204.3	c	9.7	abcd	1.822	b
El-esma'aellyia ecotype	3.810	b	31.5	bc	224.9	a	3.8	ab	209.1	b	9.9	abc	1.835	b
Bani sweef ecotype	3.576	d	34.3	a	214.5	ab	4.0	a	220.2	a	10.2	a	2.012	a
Sohag ecotype	3.969	a	33.0	ab	197.1	cd	3.9	ab	217.2	a	10.1	ab	1.611	c
Siwi ecotype	3.702	bc	26.3	ef	191.8	d	3.5	bc	188.4	e	9.4	cd	1.409	d
Sharkeia ecotype	3.735	bc	24.5	f	199.8	cd	3.4	c	176.3	f	9.2	d	1.319	d
Minia ecotype	3.317	e	28.4	de	203.2	cd	3.6	ab	198.6	d	9.6	bcd	1.772	b

#Duncan's multiple range tests was used to detect the significant differences between treatment means at 5% levels of probability.

Balady Sohag ecotype gave the highest mean values for total fresh leafy yield, leaves weight/pant, stem length, and seed yield /plant. Meanwhile, balady Bani Sweef ecotype had the highest mean values for plant weigh and weight of 1000 seeds. However, balady Siwi ecotype illustrated the highest mean values for net leaves weight and leaf area/plant. Concerning number of leaves/plant of the ecotypes; Bani Sweef, El-Esma'aellyia, Siwi, and Minia did not differ significantly among themselves. All genotypes of jew's mallow shared the same significant for No.of branches/ plant, but Siwi and Sharkeia ecotypes gave the least number of branches. The ecotypes Bani Sweef and Sohag ecotype gave the highest significant values for No. of pods /plant and plant height. Regarding No. of seeds /pod, there was no significant differences among the ecotypes El-Esma'aellyia and Bani Sweef. Eskandarany cultivar and El-Esma'aellyia, Bani Sweef, and Sohag ecotypes had the same pod length. These results are according to Abd- Allah (2006) who evaluated performance and yield potential of nine genotypes of jew's mallow.

Difference locations and sowing dates affected all studied traits of jew's mallow except for seed yield /plant, No. of pods /plant, No. of branches/ plant, pod length, and weight of 1000 seeds (Table 4). Sowing jew's mallow in Kalyiobia on mid of April gave the highest total fresh leafy yield. The highest mean values for plant weight, leaves weight/pant, and No.of leaves/plant were obtained by sowing jew's mallow in Mansoura on mid of May. However, sowing jew's mallow in Mansoura on mid April or June gave the same net leaves weight. Sowing jew's mallow in Alexandria on mid of June had the same leaf area/plant as sowing in Kalyiobia on mid of May. Meanwhile, sowing jew's mallow in Alexandria on mid of June had the highest stem length. Sowing jew's mallow in Alexandria or Kalyiobia on mid of May or June gave the same No. of seeds /pod. In this respect, Wahba *et al.* (2003) reported that sowing Jew's mallow on 1st June, in Alexandria area, had the highest yield and vegetative growth, which differed significantly when compared with sowing on 1st May and 1st April. Also, Abd-Allah and Nasr, (2005) had sown five genotypes of Jew's mallow on mid April and mid May in Alexandria. They found that Jew's mallow genotypes gave higher mean performances for all studied traits by sowing on mid May than that of sowing on mid April. Mean square for fresh leafy yield and its components of the seven genotypes of jew's mallow showed dependence on the environmental mean effects (year, Y; location, L; and sowing date, D), in addition to No.of branches/ plant and plant height as component of seed yield, as their differences may traced back to location and sowing date and from year to year (Table 4).

All traits of fresh leafy yield and its components were significantly affected by the first-order interaction (G × L) and (G × D). As well, the second-order interaction (G × L × D). With respect to seed yield and its components, seed yield and No. of seeds /pod were significantly affected by the first-order interaction (G × D). However, No. of seeds /pod, No. branches/ plant, and plant height were significantly affected by G × L × D. These results suggested that the genotypes tended to rank differently when grown at different location on different sowing date regarding the mentioned characters only, as reported also by Abd El-Moneim and Cocks, (1993).

Complexity arousing from significant G × L interaction or any other interaction with genotype is well known. The year effect on genotypes cannot be controlled, and thus the genotype × year (G × Y) interaction could be ignored for practicality and/or making the situation simpler, so that only the G × L, G × D, and G × L × D interactions are evaluated. Ignoring the G × Y interaction, however, does not solve the above mentioned problem. In the case of genotype × environment (G × E) interaction, a stability analysis was suggested. In a sense, the stability analysis summarizes the G × E (L or D) interaction.

Table 4: Means performance of fresh leafy yield, seed yield and its components of Jew's mallow genotypes, calculated from the combined data over the seven Jew's mallow genotypes in two seasons (2008 – 2009).

Environments		Fresh leafy yield and its components						
Locations	Sowing dates	Total fresh leafy yield (kg/m^2)	Plant weight (g)	Leaves weight/ pant (g)	Net leaves weight (%)	Leaf area/plant (cm^2)	No. leaves/ plant	Stem length (cm)
Alexandria	Mid of April	6.180 c	25.69 f	7.3 f	29.94 e	660.8 e	17.6 g	41.9 de
	Mid of May	7.084 bc	28.99 d	8.6 e	30.00 e	778.6 b	19.5 f	44.7 b
	Mid of June	7.956 b	33.30 c	10.1 d	29.80 e	909.0 a	23.8 d	47.0 a
Kalyiobia	Mid of April	9.448 a	34.59 b	11.7 c	34.09 d	770.6 c	24.2 d	40.9 f
	Mid of May	7.030 bc	27.43 e	9.6 d	35.01 d	914.5 a	27.8 c	42.4 d
	Mid of July	6.786 c	27.93 de	10.3 d	36.77 c	633.2 f	20.8 e	38.0 g
Mansoura	Mid of April	6.490 c	33.61 c	14.4 b	42.70 a	764.0 d	27.8 bc	41.1 ef
	Mid of May	6.737 c	37.18 a	15.4 a	40.53 b	780.4 b	29.7 a	43.6 c
	Mid of June	6.615 c	35.22 b	14.8 b	41.59 ab	778.5 b	28.7 b	42.3 d

Environments		Seed yield and its components						
Locations	Sowing dates	Seed yield /plant (g)	No.of pods / plant	No. of seeds /pod	No. branches/ plant	Plant height (cm)	Pod length (cm)	Weight of 1000 seeds (g)
Alexandria	Mid of April	3.58 a	29.6 a	198.1 cd	3.6 a	241.3 g	9.9 a	1.708 a
	Mid of May	3.74 a	30.9 a	209.0 a	4.0 a	255.4 c	9.6 a	1.758 a
	Mid of June	3.71 a	30.5 a	208.6 a	3.7 a	248.9 e	9.8 a	1.764 a
Kalyiobia	Mid of April	3.63 a	28.7 a	195.1 d	3.7 a	248.0 ef	9.5 a	1.549 a
	Mid of May	3.68 a	30.1 a	212.2 a	3.5 a	264.0 a	9.8 a	1.725 a
	Mid of July	3.70 a	29.4 a	206.8 ab	3.6 a	255.0 c	9.7 a	1.616 a
Mansoura	Mid of April	3.62 a	30.0 a	201.8 bc	3.5 a	246.3 f	9.6 a	1.657 a
	Mid of May	3.77 a	31.5 a	198.3 cd	3.8 a	261.6 b	9.8 a	1.663 a
	Mid of June	3.67 a	30.5 a	201.7 bc	3.7 a	252.0 d	9.6 a	1.707 a

#Duncan's multiple range tests was used to detect the significant differences between treatment means at 5% levels of probability.

Table 5: Mean squares, estimated from the combined analysis for fresh leafy yield, seed yield and its components of the seven Jew's mallow genotypes (2008 – 2009).

Source	d.f.	Fresh leafy yield and its components						
		Total fresh leafy yield	Plant weight	Leaves weight/pant	Net leaves weight	Leaf area/plant	No. leaves /plant	Stem length
Year (Y)	1	22.973 **	16.63 *	12.70 **	4.25	24440.9 *	35.07 **	49.00 **
Location (L)	2	41.510 **	1369.76**	1288.82 **	4313.75 **	3691.8	2259.22 **	524.93 **
Sowing date (D)	2	5.697 **	34.61 **	12.73 **	24.07 *	271379.1**	186.09 **	168.74 **
Y × L	2	8.017 **	29.14 **	9.76 **	1.63	15163.3 *	14.19 **	23.62 **
Y × D	2	0.095	0.13	0.06	0.63	226.8	1.95	0.07
L × D	4	59.488 **	691.91 **	63.26 **	51.95 **	605188.2**	392.20 **	190.61 **
Y × L × D	4	0.085	0.03	0.08	1.29	555.9	0.86	0.04
Genotypes (G)	6	22.237 **	599.44 **	36.32 **	797.46 **	117316.7**	54.19 **	208.37 **
G × Y	6	0.288	0.29	0.37	5.73	987.4	0.42	1.81
G × L	12	15.814 **	262.75 **	48.81 **	334.28 **	186197.6**	133.63 **	121.48 **
G × L × Y	12	0.305	0.67	0.58	7.41	2318.9	0.98	1.88
G × D	12	5.247 **	56.88 **	9.12 **	50.74 **	27944.3 **	24.68 **	8.99 **
G × Y × D	12	0.061	2.01	0.15	4.62	1373.3	0.36	0.27
G × L × D	24	4.542 **	40.43 **	11.65 **	64.06 **	32332.2 **	30.34 **	11.76 **
G × L × Y × D	24	0.071	1.44	0.15	3.65	1448.8	0.45	0.23
Error	252	0.954	4.12	0.69	7.73	3825.6	2.77	3.01

Source	d.f.	Seed yield and its components						
		Seed yield /plant	No. of pods /plant	No. of seeds /pod	No. branches/ plant	Plant height	Pod length	Weight of 1000 seeds
Year (Y)	1	0.0340	55.62	1416.6	2.493	6070.1 **	0.686	0.1789
Location (L)	2	0.0136	37.14	453.7	0.941	1071.8 **	0.421	0.4114
Sowing date (D)	2	0.0013	1.92	151.2	0.069	4614.6 **	0.199	0.4187
Y × L	2	0.4478 **	67.39	2712.1 *	0.689	93.7	0.610	0.2044
Y × D	2	0.0097	0.29	39.0	0.017	2.0	0.040	0.0868
L × D	4	0.0642	1.09	1575.5	0.863	20.2	1.162	0.0999
Y × L × D	4	0.0174	0.11	82.2	0.250	142.3	0.903	0.1169
Genotypes (G)	6	2.2376 **	679.38 **	6787.8 **	2.475 *	13316.0 **	6.631 **	3.3413 **
G × Y	6	0.0151	0.56	167.6	0.031	134.7	0.033	0.2307
G × L	12	0.0596	6.39	927.2	0.466	160.7	0.403	0.1303
G × L × Y	12	0.0241	0.36	34.0	0.450	133.5	0.609	0.0778
G × D	12	0.3003 **	1.98	2475.3 **	0.010	45.8	0.025	0.1582
G × Y × D	12	0.0192	0.10	24.5	0.004	31.7	0.030	0.0499
G × L × D	24	0.0483	6.13	1659.4 **	0.490	344.2 **	0.403	0.0823
G × L × Y × D	24	0.0239	0.36	53.7	0.628	208.1	0.492	0.1157
Error	252	0.0874	39.75	788.0	1.121	135.4	1.719	0.1553

***,** Significant differences at 5% and1% levels of probability, respectively.**

The analyses of variance for stability (Table 6) showed highly significant differences among the seven Jew's mallow genotypes for all studied characters. The two parameters "environment + (genotypes × environment)" and "environment (linear)" showed significant values for all studied characters. These results seemed to confirm those previously noted concerning that all of these characters had detectable environmental influences (Table 3). The significant genotypes × environment (linear) interaction with respect to plant weight and No. leaves/plant indicated that the genotypes regression coefficients were significant (Table 6). Variance due to pooled deviation appeared to be insignificant for all studied characters, suggested that the major component of differences in stability is due to the linear regression and not to the deviations from the linear function, as explained by Rai *et al.,.* (1978).

Table 6: Analysis of variance for the estimated stability parameters, for fresh leafy yield, seed yield and its components of the seven Jew's mallow genotypes, calculated data average over all replication

Source of variation	d.f.	Fresh leafy yield and its components						
		Total fresh leafy yield	Plant weight	Leaves weight/ pant	Net leaves weight	Leaf area/plant	No. leaves/ plant	Stem length
Genotypes (G)	6	22.24 **	172.98 **	36.32 **	797.46 **	117316.7 **	54.2 **	208.4**
Environment + (G×Env.)	4	8.14 **	149.29 **	26.95 **	195.78 **	90080.9 **	97.7 **	222.9**
Environment (liner)	1	55.39 **	929.40 **	476.03 **	1480.58 **	495149.1 **	1076.6 **	358.3**
Genotypes × Env. (liner)	6	1.17	37.21 *	5.12	9.57	7592.1	19.8 *	7.8
Pooled deviation	45	1.18	12.84	2.93	21.53	11379.1	7.1	5.8
Pooled error	126	0.32	199.81	0.23	2.58	1275.2	0.9	1.0

Source of variation	d.f.	Seed yield and its components						
		Seed yield/ plant	No. of pods/ plant	No. of seeds /pod	No. branches/ plant	Plant height	Pod length	Weight of 1000 seeds
Genotypes (G)	6	2.238 **	679.38 **	6787.8 **	5.839 **	13316.0 **	6.631 **	3.3413 **
Environment + (G×Env.)	54	1.603 **	105.82 **	5224.7 **	3.558 **	4853.8 **	11.072 **	0.3584 **
Environment (liner)	1	0.197 **	35.57 **	2105.6 **	2.734 **	1908.9 **	0.981 **	0.2718 **
Genotypes × Env. (liner)	6	0.016	1.08	118.0	0.198	6.6	0.069	0.0230
Pooled deviation	45	0.018	0.77	283.0	0.137	38.9	0.046	0.0171
Pooled error	126	0.029	12.76	297.8	0.184	45.1	0.573	0.0518

***,** Significant differences at 5% and1% levels of probability, respectively.**

Finaly and Wilkinson (1963) and Perkins and Jinks (1968) found that linear response is positively associated with mean performance. Eberhart and Russell (1966), however, emphasized that both linear (b_i) and non-linear (S^2d_i) components of G × E interaction should be considered in judging the phenotypic stability of a particular genotype and their responses were independent from each other. Jain and Pandya (1988) also suggested that the desired genotype in any practical situation is one with high mean performance, desired linear response (b_i) and low non-linear sensitivity coefficients (S^2d_i). If these aspects are controlled by different genetic systems then in that case such desirable genotype may be bred through standard breeding procedures. Further, Samuel *et al.*, (1970) suggested that the linear regression could simply be regarded as a measure of response of a particular genotype which depends largely upon a number of environments, whereas the deviation from regression line was considered as a measure of stability, genotype with the lowest or non-significant standard deviation being the most stable and vice versa. Zubair *et al.*, (2002), suggested that if regression coefficients of the genotypes are not significant different from 1, the stability of these genotypes should be judged upon other two parameters i.e., X and S^2d_i.

In the present investigation, the regression analysis in Table 7, the (b_i) statistics, was estimated with a significant and larger than one value (i.e., b_i>1) in Eskandarany cultivar for No. leaves/plant, and No. of pods /plant, in El-Esma'aellyia ecotype for total fresh leafy yield, leaves weight/pant, net leaves weight, No. leaves/plant, No. of pods /plant, No. of branches/ plant, and plant height, in Bani Sweef ecotype for total fresh leafy yield, plant weight, leaves weight/pant, net leaves weight, leaf area/plant, No. leaves/plant, and weight of 1000 seeds; in Sohag ecotype for total fresh leafy yield, plant weight, leaves weight/pant, leaf area/plant, No. of leaves/plant, and pod length; in Siwi ecotype for total fresh leafy yield, leaf area/plant, stem length, No. of branches/ plant, plant height, and pod length; in Sharkeia ecotype for total fresh leafy yield, net leaves weight, and stem length; and in Minia ecotype for plant weight, leaves weight/pant, stem length, No. of pods/ plant, and plant height.

Table 7: Regression coefficient (b_i) for fresh leafy yield, seed yield and its components of the seven Jew's mallow genotypes.

Genotypes	Fresh leafy yield and its components						
	Total fresh leafy yield (kg/m²)	Plant weight (g)	Leaves weight/ pant (g)	Net leaves weight (%)	Leaf area/plant (cm²)	No. leaves/ plant	Stem length (cm)
Eskandarany cultivar	0.247	0.343	0.880 **	0.950 *	0.821	1.286 **	0.636
El-esma'aellyia ecotype	1.416 *	0.998 *	1.154 **	1.222 *	0.850	1.100 **	0.636
Bani sweef ecotype	1.052 *	1.583 **	1.299 **	1.022 *	1.046 *	1.325 **	0.605
Sohag ecotype	1.070 *	1.609 **	1.233 **	0.852 *	1.092 *	1.338 **	0.923 *
Siwi ecotype	1.271 *	0.460	0.536 *	0.753	1.637 **	0.695 *	1.326 *
Sharkeia ecotype	1.147 *	0.652	0.791 *	1.342 **	0.586	0.413	1.468 **
Minia ecotype	0.798	1.354 **	1.107 **	0.860 *	0.969	0.844 *	1.406 **
Genotypes	**Seed yield and its components**						
	Seed yield/ plant(g)	**No. of pods / plant**	**No. of seeds /pod**	**No. branches/ plant**	**Plant height (cm)**	**Pod length (cm)**	**Weight of 1000 seeds (g)**
Eskandarany cultivar	0.541	1.005 *	0.769	0.185	0.832	0.990	0.403
El-esma'aellyia ecotype	1.738	1.041 *	0.415	1.861 *	1.101 *	1.325	-0.129
Bani sweef ecotype	-0.291	0.974	1.898	1.370	0.843	0.111	2.101 *
Sohag ecotype	1.753	0.803	1.887	1.087	0.946	1.870 *	1.631
Siwi ecotype	0.822	0.370	0.498	1.565 *	1.260 *	1.660 *	1.364
Sharkeia ecotype	1.533	0.897	0.802	-0.081	0.936	0.073	0.587
Minia ecotype	0.904	1.911 **	0.731	1.014	1.082 *	0.973	1.043

***,** Significant differences at 5% and1% levels of probability, respectively.**

Such results seemed to indicate that these genotypes could reflect higher response potentials in the mentioned characters under the more favorable environment for such character. For instance, the more favorable environment for total fresh leafy yield was sowing the mentioned genotypes in Kalyiobia on mid of April. On the other hand, the significantly estimated values of the parameter (b_i) suggested that each of these genotypes seemed to be more adapted, concerning the stated individual characters, to the less favorable environment.

The estimated values of stability parameter (S^2_{di}) are listed in Table 8. The insignificant (S^2_{di}) values indicated the stability of such characters in the seven Jew's mallow genotypes. Becker *et al.*, (1982) considered the deviation from regression (S^2_{di}) as the most appropriate criterion for measuring phenotypic stability in the agronomic sense, because this statistic measures the predictability of genotype reaction to various environments. So, as stated by Eberhart and Russell, (1966), the stable genotype should have b_j=1.0 and S^2_{di}=0.

Table 8: Stability (S^2di) for fresh leafy yield, seed yield and its components of the seven Jew's mallow genotypes.

Genotypes	Fresh leafy yield and its components						
	Total fresh leafy yield (kg/m^2)	Plant weight (g)	Leaves weight/pant (g)	Net leaves weight (%)	Leaf area/plant (cm^2)	No. leaves/plant	Stem length (cm)
Eskandarany cultivar	1.0808	-38.5008	3.2275	5.4204	14261.3 **	17.3871	3.638
El-esma'aellyia ecotype	1.7847	-61.7451	0.1993	2.5943	1250.5 **	2.2029	0.373
Bani sweef ecotype	0.4330	-61.1675	1.2773	16.2484	9699.2 **	0.2064	5.079
Sohag ecotype	1.4442	-61.4124	4.5405	53.4977	1861.2 **	5.1728	1.942
Siwi ecotype	1.3131	-59.0559	2.9905	15.7196	22900.4 **	5.7612	4.812
Sharkeia ecotype	0.8318	-40.2018	4.2160	16.4685	17033.0 **	11.5334	17.968
Minia ecotype	-0.0163	-61.6136	1.8376	22.4564	3170.3 **	1.1454	1.140

Genotypes	Seed yield and its components						
	Seed yield /plant (g)	No. of pods /plant	No. of seeds /pod	No. branches/ plant	Plant height (cm)	Pod length (cm)	Weight of 1000 seeds (g)
Eskandarany cultivar	0.0142	-3.762	60.6 **	-0.021	13.03	-0.140	-0.0070
El-esma'aellyia ecotype	0.0191	-3.766	87.2 **	0.006	0.99	-0.113	-0.0040
Bani sweef ecotype	0.0085	-3.670	156.2 **	0.073	32.13 **	-0.133	0.0042
Sohag ecotype	0.0057	-3.965	248.2 **	0.054	-5.93	-0.154	0.0020
Siwi ecotype	0.0106	-3.426	223.3 **	0.206	27.40 **	-0.170	0.0058
Sharkeia ecotype	-0.0016	-3.345	239.8 **	0.153	28.90 **	-0.160	-0.0091
Minia ecotype	-0.0073	-3.546	191.0 **	-0.023	48.19 **	-0.173	-0.0029

***,** Significant differences at 5% and1% levels of probability, respectively.**

Conclusion

From the above mentioned results it could be concluded that the seven genotypes of jew's mallow clearly differed in all studied traits. Mean square for fresh leafy yield and its components of the seven genotypes of jew's mallow showed dependence on the environmental mean effects. These results suggested that the genotypes tended to rank differently when grown at different location on different sowing date. The analyses of variance for stability showed highly significant differences among the seven Jew's mallow genotypes for all studied characters. The regression analysis, the (b_i) statistics, was estimated with a significant and larger than one value (i.e., b_i>1) in el-esma'aellyia, bani sweef, sohag, siwi, and sharkeia ecotypes for total fresh leafy yield. Such results seemed to indicate that these genotypes could reflect higher response potentials in the mentioned character under the more favorable environment, which was sowing the mentioned genotypes in Kalyiobia on mid of April.

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التفاعل البيئى والوراثى لبعض الطرز البيئية للملوخية

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أجرى هذا البحث خلال الموسمين الصيفيين لعامي ٢٠٠٨ و ٢٠٠٩ على ستة طرز بيئية من الملوخية جمعت من مناطق مختلفة من جمهورية مصر العربية. بالإضافة إلى صنف الاسكندرانى المستنبط بمعهد بحوث البساتين ؛ حيث زرعت هذه التراكيب الوراثية فى ثلاث مواقع مختلفة هى : مزرعة محطة بحوث البساتين بالصبحية (الإسكندرية) ، مزرعة قها (القليوبية) معهد بحوث البساتين ، مزرعة محطة بحوث البساتين بالبرامون (المنصورة). وتمت الزراعة في ثلاث مواعيد زراعة هى : منتصف ابريل ومنتصف مايو ومنتصف يونيو. وقد تم تصميم هذا العمل لدراسة التفاعل البيئى والوراثى لسبعة تراكيب وراثية من الملوخية.

ويمكن تلخيص أهم النتائج فيما يلي:

١- اختلفت السبع تراكيب وراثية للملوخية فيما بينها لكل الصفات المدروسة.

٢- أظهر مجموع مربع المحصول الورقى ومكوناته لكل التراكيب الوراثية للملوخية اعتمادا على التأثيرات البيئية، هذه النتائج تشير إلى أن التراكيب الوراثية تتفاعل مع الظروف البيئية بطريقة متباينة فيما بينها عند زراعتها في مواقع مختلفة ومواعيد زراعة مختلفة.

٣- أظهر تحليل التباين للثبات الوراثى اختلافات معنوية عالية فيما بين التراكيب الوراثية للملوخية لكل الصفات المدروسة.

٤- تبين من تحليل الانحدار ، والذي يقيس أداء التراكيب الوراثية فى البيئات المختلفة ، أن قيمة "b " كانت أكبر من الواحد ومعنوية لصفة المحصول الورقى فى الطرز البيئية بلدى اسماعيلية ، وبنى سيوف ، وسوهاج ، و سيوى ، والشرقية. تدل هذه النتائج على أن هذه الأصناف قد تعكس ارتفاع احتمالات الاستجابة لهذه الصفة فى البيئة المفضلة وهى زراعة هذه الطرز البيئية للملوخية فى القليوبية فى منتصف ابريل.

قام بتحكيم البحث

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