Egyptian J. Desert Res., **53**, No.1, 19-30 (2003)

Yield and its Components of Diverse Lentil Genotypes Grown Under Different Edaphic and Climate Conditions

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Eighteen lentil genotypes of diverse origin (including Sinai-1 as check variety) were evaluated in two locations differing mainly in soil, water supply and climatic conditions. These were Fayoum (sandy loam soil and surface irrigation) and Maryout (calcareous soil depending on rainfall). During the two experimentation seasons (2000/2001 and 2001/2002), using a randomized complete blocks design with three replicates, the genotypes were tested for variation, performance and suitability for growing under these stress and control (non-stress) environments.

Significant genotypic differences were detected for all recorded traits of each season and combined data over seasons at both locations which may due to their different genetic background. Combined data revealed that season fluctuations, especially at Maryout, had marked effect on performance of the tested lentil genotypes. Mean perfomance of all traits except number of branches/plant, number of seeds/pod and seed protein content were higher under non-stressed (at Fayoum) than under stressed conditions (at Maryout).

Heritability estimates were the highest in seed protein content (96.75%) at Fayoum, number of pods/plant (83.8%) at Maryout and days to 50% flowering (>93%) at both locations. The other traits showed moderate (at Fayoum) to high (at Maryout) estimates. Minor discrepancies between phenotypic and genotypic coefficients of variability were observed suggesting the importance of genetic causes of variation in most studied traits and provide a chance for improving these materials by selection.

The tested genotypes were varied in their interaction with the prevailing environmental influences and exhibited different responses. Most genotypes outyieled the check variety “Sinai-1”. The Argentinean type (no.17) produced the highest yields, 688.1 and 302.3 kg/Fed. at Fayoum and Maryout, respectively. These genotypes followed by no. 16 and 15 as well as no. 5 and

14 (for non-stress) and followed by no. 16, 7 and 8 are recommended for growing under environmental stress conditions.

Keywords: *Lentil, Variability, Heritability, Interaction, environmental Stress.*

Due to the lack of water resources in Egypt, it is estimated that the cultivated area that depends on River Nile is about 3% of the total area. In order to sufficiently produce the Egyptian food needs, wise and strict policies of water use should be applied. Within these cultivated area, lentil crop (*Lens culinaris*, Medik) is going to be competitive with other more beneficial winter crops. Alternative rainfed regions must, therefore, be suggested for its production. Lentil has stably occupied a constant land area (about 70000 Fed.) until 1975/1976. However, the area has gradually decreased and reached only about 5000 Fed. in 2000/2001. The average seed yield has increased from 624 kg/Fed. in 1950s to 704 kg/Fed. in 2000/2001 (Anonymous, 2001).

Lentil provides nutritionally rich organic residues and plays a key role in maintaining soil productivity particularly through biological N_2 fixation (Saxena, 1988). Therefore, there is a special need for growing legumes such as lentil in rotations with cereal crops at rainfed regions. The lentil - cultivated area in these regions is still low and reached only about 902 Fed. (average of 1993 to 1999). Silim *et al.* (1993) found strong linear relationships between yield and moisture supply for 25 diverse lentil lines grown in northern Syria.

Lentil is a moderately drought resistant crop and is grown mainly for human consumption. Fisher and Maurer (1978) noted that quantification of drought tolerance should be based on seed yield under limited moisture conditions even in the absence of an understanding of specific mechanisms of tolerance. A few accessions of cultivated lentil have been identified as being adapted to drought (Hamdi *et al*, 1992) due to their early flowering date. Turner *et al.* (1996) reported that lentil has considerable potential for drought tolerance through osmotic adjustment. Another source of drought tolerance was also identified in wild lentil (Hamdi and Erskine, 1996). Bayoumi (2003) suggested that only one cycle of single plant selection was sufficient for improving lentil mean productivity and its drought tolerance.

This investigation aimed to explore the variations among eighteen diverse lentil genotypes. Genetic parameters i.e. σ^2_g, σ^2_{Ph}, PCV %, GCV % and broad sense heritability (h^2 %) are estimated under normal and rainfed conditions from combined data over two successive seasons.

MATERIALS AND METHODS

From a world collection germplasm, eighteen lentil (*Lens culinaris*, Medik.) genotypes were chosen and used in this study. These included Syrian, Indian, Argentinean and Egyptian varieties in addition to 14 newly bred elite lines obtained by International Center for Agricultural Research in the Dry Areas (ICARDA) breeding program were chosen and used in this study. Such genetic materials were previously screened from 73 local and exotic varieties or lines under rainfed conditions of Maryout through Desert Research Center breeding program. The origin and name or pedigree of the eighteen genotypes used are visualized hereinafter (Table 1).

TABLE (1). Name, pedigree and origin of lentil international elite lines tested.

No.	Name or pedigree	Origin	No.	Name or pedigree	Origin
1	**ILL 4400**	Syria	10	ILL 5671 / ILL 6209	ICARDA
2	ILL 262 / ILL 445	ICARDA	11	ILL 5989 / ILL 6199	ICARDA
3	ILL 289 / ILL 701	ICARDA	12	ILL 6002 / ILL 6435	ICARDA
4	ILL 28 / ILL 851	ICARDA	13	ILL 6199 / ILL 5845	ICARDA
5	PKVL - 1 ILL7558	India	14	ILL 468 / ILL 5845	ICARDA
6	ILL 5582 / ILL39	ICARDA	15	ILL 5582 / ILL 5845	ICARDA
7	ILL 6199 / ILL 5582	ICARDA	16	UG 88 – 286 / ILL 6205	ICARDA
8	ILL 6199 / ILL 6198	ICARDA	17	Siluima Inta ILL 8109	Argentina
9	ILL 4606 / ILL 5671	ICARDA	18	Sinai -1*	Egypt

ICARDA : International Center for Agricultural Research in the Dry Areas
* Newly released Egyptian variety developed by pure line selection from the Argentinean variety Precoz (Hamdi *et al*, 2002).

These genotypes were grown in two successive winter seasons (2000/2001 and 2001/2002) at Maryout rainfall and Fayoum irrigated environments. Under rainfed conditions with one supplemental irrigation at sowing date (16/11/2000 and 25/11/2001) by the available agricultural drainage water (average ECe 3.3 dSm^{-1}), soil of the experimental site characterized as sandy clay loam texture with pH 7.8, ECe 4.2 dSm^{-1} and calcareous (41.5 Ca CO_3). The precipitated rain amount during each of the two growing seasons was 120.4 and 188.3 mm, respectively at Maryout (North Western Coast). At Fayoum sowing performed in the 2^{nd} week of Nov. in both seasons at Fac. Agric. Experimental Farm where, soil was sandy loam texture with pH 7.76 and ECe 3.2 dSm^{-1} and surface irrigation from River Nile water (EC 0.7 dSm^{-1}). Each experiment at both locations was laid out in a randomized complete blocks design with three replicates and the plot size was 4.5 m^2 (1.5 x 3 m) and 9.6 m^2 (2.4 x 4 m) in the first and second seasons, respectively. Seeding rate was 25 kg/Fed. in rows 30 cm apart and 10 cm between hills, two plants/hill.

During growing season, number of days to 50% flowering (Da. Fl.) was recorded in both seasons at the two locations. At harvest, twelve guarded plants from each experimental plot were taken to determine plant height (Pl. Ht.), number of branches/ plant (Br./Pl.), number of pods/ plant (pods/Pl.), number of seeds/pod (S./pod), seed index (SI.) and seed yield/ plant (Yl./Pl.). Seed yield/feddan (Yl./Fed.) was calculated on plot mean basis. Seed protein percentage (Prot. %) was estimated by using Kjeldahl's method as described in A.O.A.C. (1985).

Data were subjected to the combined analysis of variance after seasonal homogeneity F test for each environment, as outlined by Steel and Torrie (1980). Duncan's multiple range test (Duncan,1955) was used to verify the significance of mean performances for all traits recorded. Difference between the tested lentil genotypes were better investigated if their respective genetic variance was presented as percent from their phenotypic responses through estimating of broad sense heritability (h^2) computed according to the method proposed by Johnson *et al*. (1955). Also, these variances were better evaluated as percentages from the mean value of each trait i.e. genotypic (GCV) and phenotypic (PCV) coefficients of variation to predict a valuable aim of selection.

$$GCV = (\sqrt{\sigma^2 g} \; / \bar{x}) * 100 \text{ and } PCV = (\sqrt{\sigma^2 ph} \; / \bar{x}) * 100$$

Where: $\sigma^2{}_{g.}$, $\sigma^2{}_{Ph}$ are the genotypic and phenotypic variances, respectively and $\bar{x}$ is the mean performance of each trait (Singh and Chaudhary, 1995).

RESULTS AND DISCUSSION

Mean squares of each season at both locations (irrigated conditions at Fayoum and rainfed environment at Maryout) revealed significant differences for all recorded traits. Also, combined data over seasons showed highly significant genotypic variances for all studied traits at each location (Table 2). These results confirmed the varied genetic background of the tested materials. At Fayoum, combined data shows that seasons were a significant source of variation in performance of number of branches/plant, number of pods/plant, number of seeds/pod and seed protein content. Meanwhile, all recorded traits except pods/plant and seeds/pod had seasonal differences under Maryout rainfed conditions. Consequently, it could be concluded that climate fluctuations across seasons especially the amount and distribution of rainfall, significantly affected the performance of the tested lentil germplasm concerning most studied traits. The sensitivity of lentil genotypes to environmental effects is well known and previously reported by Ashour and Abd El-Haleem (1995), Selim (1995), Ezzat *et al.* (1999) and Hamdi *et al* (2002).

TABLE (2). Mean squares due to sources of variation for recorded traits in both seasons and combined over them A) at Fayoum location B) at Maryout location

Season	2000/2001		2001/2002		Combined			
	Geno.	Error	Geno.	Error	Seasons	Geno.	S x G	Error
DF / Traits	17	34	17	34	1	17	17	68
A) at Fayoum location								
Pl. Ht.	29.42**	3.71	35.09**	6.71	127.18	55.51**	9.015	5.205
Da. Fl.	383.5**	13.01	337.5**	4.987	1.815	717.8**	2.697	9.035
Br. / Pl.	6.09**	0.488	2.797**	0.373	4.445*	6.935**	1.948**	0.430
Pods/Pl.	88.36**	5.57	88.8**	11.01	47.17*	805.3**	229.9**	28.29
S./Pod	0.0525**	0.0062	0.2102**	0.0081	0.859*	0.208**	0.055**	0.007
SI	0.567**	0.052	1.753**	0.065	1.389	1.97**	0.349**	0.058
Yl. / Pl.	0.211**	0.025	0.584**	0.023	0.326	0.654**	0.140**	0.024
Prot. %	25.62**	0.084	21.70**	0.092	1.10*	46.87**	0.598**	0.089
Yl./Fed.	1312.8**	252.3	1209.44**	172.94	311.61	2210.1**	311.13	212.53
B) at Maryout location								
Pl. Ht.	10.81**	1.07	10.22**	1.30	65.18**	19.98**	1.091	1.19
Da. Fl.	230.2**	1.64	211.9**	1.58	30.08*	431.6**	10.57**	1.614
Br. / Pl.	2.00**	0.07	1.96**	0.08	5.567*	3.742**	0.224**	0.075
Pods/Pl.	31.48**	2.00	36.95**	1.88	4.771	66.14**	2.295	1.938
S. / Pod	0.092**	0.016	0.099**	0.009	0.023	0.159**	0.032**	0.012
SI	0.386**	0.012	0.412**	0.023	0.701*	0.751**	0.047**	0.018
Yl. / Pl.	0.093**	0.016	0.149**	0.017	0.144**	0.232**	0.009	0.0165
Prot. %	13.99	0.174	2.787**	0.210	13.238**	10.44**	6.394**	0.194
Yl./Fed.	943.1**	166.1	1514.8**	168.6	144.47**	2321.2**	93.931	167.4

*and ** : Denote significance at 0.05 and 0.01 levels of probability, respectively.

Table (3) represents character means for each season and combined data over seasons as well as their genetic parameters under each location. Mean performance of all traits except number of branches/plant, number of seeds/pod and seed protein content were higher at Fayoum irrigated location than Maryout rainfed conditions.

Combined analysis is more efficient in the extraction of genetic parameters due to its ability in minimizing genotypes x environment interaction. Abdalla *et al* . (1982) and Bakheit and Mahdy (1987) recommended multi seasons / locations for reliable estimates of genetic effect. So, phenotypic and genotypic variances with their coefficients of variability and broad sense heritability for all studied traits are calculated on the base of combined data and given in Table (3). The gain of selection would be depending on the high heritability percentages as obtained for seed protein content (96.75%) and days to 50% flowering (94.51%) at Fayoum location and days to 50% flowering (93.85%) and number of pods / plant

(83.8%) at Maryout environment. All other recorded traits also showed relatively high h^2 % descending to 53.17% for seeds / pod at Maryout and 50.11% for pods / plant at Fayoum conditions. It was noted that heritability values for most studied traits estimated at Maryout were higher than the corresponding ones at Fayoum. In this concern Bayoumi (2003) reported that heritabilities in broad sense under drought stress conditions were high for mean productivity and days to flowering and moderate for plant height and seed yield/plant.

TABLE (3). Mean characters for seasons and combined over seasons as well as their genetic parameters under each location

Seasons		Pl. Ht.	Da. Fl.	Br./Pl.	Pods/Pl.	S./Pod	SI	Yl. / Pl.	Prot.%	Yl./Fed.
A) at Fayoum location										
Means	2000/2001	31.68 a	101.9 a	5.37 b	37.82 a	0.93 b	4.13 a	1.70 a	28.99 b	462.38 a
	2001/2002	33.86 a	101.7 a	5.78 a	32.13 b	1.05 a	3.90 a	1.81 a	29.19 a	444.20 a
	Combined	32.77	101.8	5.57	34.98	0.99	4.01	1.76	29.09	453.68
Genetic parameters	σ^2 g	7.75	119.2	0.83	95.9	0.03	0.27	0.09	7.71	3164.9
	σ^2 Ph	14.22	126.1	1.77	191.4	0.05	0.43	0.15	7.97	5618.9
	h^2 %	54.48	94.51	47.03	50.11	52.58	63.56	57.75	96.75	56.33
	GCV %	8.50	10.72	16.36	28.00	17.38	12.68	17.05	9.43	12.40
	PCV %	11.51	11.03	23.85	39.55	22.52	15.90	22.01	9.59	16.52
	RD%	26.15	2.81	31.40	29.20	22.82	20.25	22.54	1.67	24.94
B) at Maryout location										
Means	2000/2001	29.28 b	94.39 b	5.71 b	20.17 a	1.59 a	3.36 a	1.05 b	30.97 a	234.2 b
	2001/2002	30.83 a	95.44 a	6.16 a	20.59 a	1.62 a	3.20 b	1.33 a	30.02 b	261.5 a
	Combined	30.06	94.92	5.94	20.38	1.61	3.28	1.19	30.49	247.8
Genetic parameters	σ^2 g	3.15	70.18	0.59	10.64	0.02	0.12	0.04	1.97	371.2
	σ^2 Ph	4.31	74.78	0.71	12.70	0.04	0.15	0.05	2.54	512.2
	h^2 %	79.13	93.85	82.47	83.80	53.17	80.92	73.11	77.56	72.48
	GCV %	5.78	8.83	12.91	16.01	9.09	10.46	16.23	4.63	7.77
	PCV %	6.76	9.11	14.21	17.49	12.47	11.63	18.98	5.30	9.13
	RD%	14.50	3.07	9.15	8.46	27.11	10.06	14.49	12.64	14.90

Means within column followed by the same letter are not significantly different at $P \leq 0.05$ level of Duncan's multiple range test

RD % : The relative difference between PCV% and GCV% = [100 (PCV-GCV)] / PCV

Although increasing productivity is the ultimate goal of the breeding program, heritability estimates do not present in the entire picture. The phenotypic and genotypic variances must be taking into consideration as well. The coefficient of variability (phenotypic or genotypic) is a relative measure of variation, in contrast to the standard deviation, which are the same units of the observations. Since it is the ratio of two averages and independent on the unit of the measurement used, it is, therefore, a good basis for comparing the extent of variation between different characters with different scales. From combined analysis over the two growing seasons, estimates of phenotypic and genotypic coefficients of variation were relatively high for number of pods/plant, seeds/pod and seed yield/plant at Fayoum location and for number of pods/plant and seed yield / plant under Maryout rainfed conditions. While, the estimates were relatively low for all other recorded traits. The relative difference (RD%) between phenotypic and genotypic coefficients of variation as criteria of non-heritable effects reached the maximum magnitude for number of branches / plant (31.4%), followed by number of pods / plant, plant height and seed yield / Fed. at Fayoum normal conditions. Meanwhile, it was generally smaller at Maryout environment and the higher effects detected for number of seeds / pod (27.11%) followed by seed yield / Fed., seed yield / plant and plant height. The obtained results confirmed the above heritability values detected for such traits (Table, 3). In general, there was no great discrepancy between phenotypic and genotypic coefficient of variability suggesting a small effect of environmental factors on most studied characters. These results are in agreement with those recorded by Afiah and Moselhy (2001).

The interaction between the studied genotypes and seasons prevailed at the two areas under study resulting in the phenotypic features that were designated as mean of all the studied characteristics in Table (4). From such data, it is quite obvious that yielding capacity for all tested genotypes ranged from 688.1 kg and 302.3 kg for Argentinean genotype (number 17), 227.4 kg to 256.6 kg for the genotype number 8 and 339.9 kg to 223.4 kg for the genotype number 3 at Fayoum and Maryout conditions, respectively. Eight genotypes (no. 12-17, 5 and 4) at Fayoum and nine ones (no. 11-17, 8, 7 and 5) outyielded the check variety “Sinai 1”.

It is important to note that the tested genotypes were varied in their interaction with the environmental factors and exhibited different responses to the different soil and climatic influences available in both locations. Some of them failed in their response to the better conditions at Fayoum and consequently produced higher yield at Maryout (under stress) than that of Fayoum (Lines 7 and 8) or similar yields at both locations (Line no. 11). These three genotypes had higher numbers of branches/plant and seeds/pods at Maryout than the corresponding ones at Fayoum (Table 4). On the other hand, some other genotypes showed good response to the better conditions at Fayoum and produced more than twice (no. 5, 14, 15, 16, 17 and 18) or about twice (no. 2, 4, 12 and 13) compared to those of Maryout. Superiority of these genotypes at Fayoum was due to their relative advantages in number of pods/plant, seed index and seed yield/plant (for all genotypes) in addition to number of branches /plant (for genotypes no. 2, 14, 17 and 18). The remainder genotypes, i.e. no. 1, 3, 6, 9 and 10 exhibited moderate response to environmental factors prevailing at Fayoum, where they yielded about 1.3 times of Maryout yield, due to their superiority in number of pods/plant (except no.9) as well as seed index and seed yield /plant (for all genotypes) in addition to number of branches for genotypes no. 1, 6 and 9).

Contrary to non-responding genotypes, both highly and moderately responding ones (which yielded more at Fayoum) showed higher numbers of seeds/pod at Maryout than at Fayoum (Table 4). These results reflected the importance of number of pods/plant and seed index followed by number of branches as effective yield contributors more than number of seeds/pod and should be used as criteria for selection in future lentil improvement program. The later selection would be practiced among and within these genotypes particularity under stress environment depending upon seed yield and its three effective components, i.e., pods/plant, branches/plant and seed index as they showed high heritability (more than 80%) and low non-heritable variation (lower than 10%) at Maryout. Simmond (1991) reported that selection under non-stressed conditions may not be the best approach to increase yield. Breeding progress for yield improvement may be enhanced if abiotic stresses in the target environment are included during selection (Banziger *et al.*, 1999). The aforementioned results revealed that at Fayoum (or non-stressed conditions) genotype no. 17 followed by 16 and 15 as well as no. 5 and 14 are well adapted, while at Maryout (or stressed environment) genotype no. 17 followed by no. 16, 7 and 8 are recommended. Similar findings in other lentil genotypes were recorded by Hamdi *et al.* (1995).

The check variety, Sinai-1 and the two lines 3 & 17 seemed to be the earliest genotypes under Maruout rainfed conditions while the two lines 17 & 16 followed by Sinai-1 and line number 2 were earlier than all other tested genotypes at Fayoum location. El-Karamity (1996) reported that Precoz variety was the earliest variety followed by Giza 370 and Giza-9. Also, Hamdi *et al.* (2002) found that Sinai-1 was earlier than Giza-9 by 21, 7 and 28 days at North, South and rainfed Egyptian areas, respectively. The superiority of genotype (17) in yield due to number of pods/plant, number of seeds/pod and seed index, in addition its early flowering, may help to expand the cultivated area of lentil in Egypt.

TABLE (4). Mean performance of all traits recorded (combined data over seasons)

G	Pl. Ht.		Da.Fl		Br./Pl		Pods/Pl	
	Fay	Mar	Fay	Mar	Fay	Mar	Fay	Mar
1	32.47 $^{c-f}$	31.33 ^{bc}	88.50 ^{cb}	97.17 ^{fg}	5.45 $^{d-f}$	5.75 ^{gh}	36.98 $^{b-e}$	22.68 ^{bc}
2	33.91 $^{a-d}$	32.20 ^{ab}	87.33 ^{de}	87.17 ^{ij}	4.70 $^{f-h}$	5.62 $^{h-j}$	38.70 $^{b-d}$	18.37 ^{gh}
3	28.09 ^{h}	25.19 ^{h}	109.17 ^{a}	81.67 ^{k}	5.37 $^{d-f}$	4.65 ^{k}	24.99 $^{g-i}$	20.37 ^{ef}
4	34.59 $^{a-c}$	29.10 ^{ef}	109.67 ^{a}	89.50 ^{i}	6.75 ^{b}	6.28 ^{e}	40.47 $^{a-c}$	17.12 ^{hi}
5	33.55 $^{a-d}$	32.94 ^{ab}	91.83 ^{c}	92.83 ^{h}	7.77 ^{a}	5.68 $^{g-i}$	43.06 ^{ab}	21.90 $^{c-e}$
6	31.15 $^{e-g}$	31.79 ^{b}	109.13 ^{a}	85.67 ^{j}	5.17 $^{d-g}$	5.77 ^{gh}	32.81 $^{d-f}$	17.68 ^{gh}
7	30.77 $^{f-h}$	29.35 ^{ef}	109.83 ^{a}	103.33 ^{bc}	4.21 ^{hi}	6.62 ^{cd}	24.40 ^{hi}	13.22 ^{j}
8	31.72 $^{d-g}$	27.81 ^{g}	109.83 ^{a}	100.00 ^{de}	4.93 $^{e-g}$	5.95 ^{fg}	29.71 $^{f-h}$	21.12 $^{c-e}$
9	30.32 $^{f-h}$	26.33 ^{ef}	110.50 ^{a}	97.67 ^{ef}	4.81 $^{d-h}$	7.68 ^{a}	19.82 ^{i}	25.57 ^{a}
10	32.04 $^{d-f}$	29.40 ^{ef}	110.33 ^{a}	106.33 ^{a}	5.53 ^{de}	5.38 ij	36.33 $^{c-e}$	21.23 $^{c-e}$
11	31.82 $^{d-g}$	31.01 ^{bc}	109.33 ^{a}	101.83 ^{cd}	3.58 ^{i}	5.58 $^{h-j}$	22.72 ^{i}	22.07 $^{b-d}$
12	34.58 $^{a-c}$	33.32 ^{a}	110.17 ^{a}	106.83 ^{a}	6.83 ^{b}	6.32 ^{de}	40.83 $^{a-c}$	23.63 ^{b}
13	34.29 $^{a-d}$	30.07 $^{c-e}$	109.33 ^{a}	95.00 ^{gh}	5.93 ^{cd}	6.50 $^{c-e}$	35.94 $^{c-e}$	15.75 ^{i}
14	33.02 $^{b-e}$	28.72 ^{fg}	109.33 ^{a}	105.33 ^{ab}	6.37 ^{bc}	6.77 ^{bc}	38.78 $^{b-d}$	17.70 ^{gh}
15	35.92 ^{a}	29.60 $^{d-f}$	103.83 ^{b}	99.33 $^{d-f}$	5.39 $^{d-f}$	5.32 ^{j}	46.05 ^{a}	20.62 ^{de}
16	33.85 $^{a-b}$	33.41 ^{a}	85.00 ^{e}	86.33 ^{j}	6.70 ^{b}	4.95 ^{k}	40.65 $^{a-c}$	25.32 ^{a}
17	35.39 ^{ab}	27.83 ^{g}	84.50 ^{e}	82.83 ^{k}	6.40 ^{bc}	7.02 ^{b}	46.36 ^{a}	23.52 ^{b}
18	34.15 $^{a-d}$	31.19 ^{bc}	85.17 ^{de}	79.67 ^{k}	4.42 ^{gh}	4.95 ^{k}	30.99 $^{e-g}$	18.97 ^{fg}

G	S./Pod		SI		Yl. / Pl.		Prot. %		Yl./Fed.	
	Fay	Mar	Fay	Mar	Fay	Mar	Fay	Mar	Fay	Mar
1	1.00 ^{de}	1.67 ^{bc}	3.83 ^{gh}	2.99 ^{fg}	2.06 ^{bc}	1.17 $^{d-f}$	29.71 ^{ef}	30.38 ^{ef}	396.50 ^{h}	245.95 $^{d-f}$
2	1.07 $^{b-d}$	1.77 ^{ab}	4.16 $^{d-f}$	3.37 ^{e}	2.15 ^{b}	1.05 $^{f-h}$	29.74 ^{e}	30.68 ^{e}	446.56 ^{fg}	234.02 $^{f-h}$
3	1.13 $^{a-c}$	1.48 $^{e-h}$	3.93 ^{fg}	3.52 $^{c-e}$	1.82 ^{de}	0.94 ^{h}	29.37 ^{f}	30.12 ^{fg}	339.93 ^{jk}	223.42 ^{h}
4	1.15 ^{ab}	1.45 $^{f-i}$	4.07 $^{e-g}$	3.43 ^{de}	2.05 ^{bc}	1.08 $^{e-h}$	32.55 ^{a}	31.82 ^{c}	454.25 ^{f}	237.38 $^{e-h}$
5	1.07 $^{b-d}$	1.47 $^{f-i}$	4.35 $^{b-e}$	3.13 ^{f}	2.23 ^{ab}	1.14 $^{d-g}$	31.64 ^{b}	31.26 ^{d}	586.38 ^{c}	243.60 $^{d-g}$
6	0.89 ^{f}	1.82 ^{a}	3.38 ^{i}	3.03 ^{fg}	1.58 ^{fg}	1.07 $^{f-h}$	26.73 ^{i}	29.36 ^{hi}	385.24 ^{hi}	236.54 $^{e-h}$
7	0.94 ^{ef}	1.65 $^{b-d}$	3.63 ^{hi}	2.94 ^{g}	1.57 ^{fg}	1.38 ^{bc}	26.66 ^{i}	28.67 ^{jk}	243.43 ^{k}	267.47 ^{bc}
8	0.66 ^{h}	1.61 $^{c-e}$	3.45 ^{i}	3.47 ^{de}	1.19 ^{i}	1.27 ^{cd}	30.20 ^{d}	30.45 ^{ef}	227.35 ^{k}	256.55 ^{cd}
9	0.70 ^{gh}	1.86 ^{a}	3.07 ^{j}	2.75 ^{h}	1.26 ^{hi}	1.00 ^{gh}	26.08 ^{j}	28.27 ^{k}	376.29 ^{h}	228.80 ^{gh}
10	0.96 ^{ef}	1.87 ^{a}	4.00 ^{fg}	3.07 ^{fg}	1.72 $^{c-e}$	1.07 $^{f-h}$	25.07 ^{k}	28.91 ^{k}	369.86 ^{i}	235.70 $^{e-h}$
11	0.78 ^{g}	1.66 ^{bc}	3.40 ^{i}	2.52 ^{i}	1.42 ^{gh}	1.23 $^{c-e}$	30.72 ^{c}	32.43 ^{b}	252.04 ^{k}	252.68 ^{cd}
12	0.97 $^{d-f}$	1.65 $^{b-d}$	4.39 $^{b-d}$	3.03 ^{fg}	1.94 ^{cd}	1.23 $^{c-e}$	31.67 ^{b}	34.26 ^{a}	484.12 ^{e}	252.17 ^{d}
13	1.04 $^{c-e}$	1.52 $^{d-g}$	4.79 ^{a}	3.79 ^{a}	1.85 ^{de}	1.29 ^{cd}	27.26 ^{g}	28.91 ^{ij}	567.50 ^{d}	258.23 ^{cd}
14	1.03 $^{c-e}$	1.38 ^{hi}	4.49 ^{bc}	3.56 $^{b-d}$	1.94 ^{cd}	1.20 $^{d-f}$	31.08 ^{b}	33.90 ^{a}	582.08 ^{cd}	249.65 ^{de}
15	1.15 ^{ab}	1.39 $^{g-i}$	4.38 $^{b-d}$	3.69 ^{ab}	2.18 ^{ab}	1.08 $^{e-h}$	31.44 ^{b}	31.82 ^{c}	659.70 ^{b}	236.87 $^{e-h}$
16	1.16 ^{ab}	1.34 ^{i}	4.21 $^{c-f}$	3.51 $^{c-e}$	2.066 ^{bc}	1.50 ^{b}	27.50 ^{g}	29.72 ^{gh}	670.25 ^{b}	279.08 ^{b}
17	1.20 ^{a}	1.57 $^{c-f}$	4.55 ^{ab}	3.56 $^{b-d}$	2.344 ^{a}	1.73 ^{a}	29.42 ^{ef}	30.15 ^{fg}	688.09 ^{a}	302.28 ^{a}
18	1.00 ^{de}	1.07 ^{j}	4.18 $^{d-f}$	3.07 ^{fg}	1.90 $^{c-e}$	0.97 ^{h}	26.76 ^{hi}	27.71 ^{l}	436.61 ^{g}	226.28 ^{h}

Means within column followed by the same letter (s) are not significantly different at $P \leq 0.05$ level of Duncan's multiple range test

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المحصول ومكوناته لبعض تراكيب العدس المتباينة النامية تحت ظروف أرضية ومناخية مختلفة

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تم تقييم ١٨ تركيب وراثي من العدس بما فيها صنف المقارنة "سيناء١" في موقعين مختلفين في ظروف التربة وماء الري والمناخ، وهما: تربة رملية طميية وري سطحي من مياه النيل في الفيوم، وتربة جيرية معتمدة علي الأمطار مع إعطاء رية تكميلية عند الزراعة من مياه الصرف الزراعي في مريوط بالساحل الشمالي الغربي للبلاد . ونفذت التجارب خلال موسمي الدراسة في تصميم القطاعات الكاملة العشوائية بثلاث مكررات، وذلك لاختبار سلوك التراكيب الوراثية المختلفة ومناسبتها للنمو تحت ظروف الإجهاد البيئي من عدمه.

دلت النتائج علي أن هناك اختلافات معنوية بين التراكيب الوراثية في كلا الموسمين وأيضا التحليل التجميعي للسنين في كل موقع وذلك بسبب الاختلافات الوراثية بين التراكيب، أشار التحليل التجميعي أيضا إلي اختلافات معنوية وخصوصا في مريوط بالنسبة لسلوك هذه التراكيب المختلفة . كان متوسط أداء كل الصفات ماعدا صفة عدد الفروع للنبات وعدد البذور/ قرن ومحتوي البذرة من البروتين اعلي في منطقة الفيوم (لا يوجد إجهاد) عن منطقة مريوط (تحت ظروف الإجهاد).

تقديرات معامل التوريث كانت عالية لمحتوي البروتين بالبذرة (٩٦,٧٥%) في الفيوم ولعدد القرون / نبات (٨٣,٨%) في مريوط ، وكذلك عدد الأيام حتى تزهير ٥٠% (اكبر من ٩٣%) في كلا الموقعين. أما باقي الصفات فقد أظهرت تقديرات متوسطة في الفيوم ومرتفعة في مريوط . كما لوحظ أن كان هناك فروقا صغيرة بين قيم معامل الاختلاف الوراثي والمظهري في معظم الصفات المدروسة مما يدل علي أهمية التأثيرات الوراثية علي هذه الصفات والتي تفيد في ممارسة الانتخاب داخل هذه التراكيب.

أظهرت التراكيب المختبرة تفاعلات مختلفة مع العوامل البيئية وبالتالي كانت استجاباتها مختلفة . معظم السلالات كانت أعلا محصولا من صنف المقارنة "سيناء ١" وكانت السلالة رقم ١٧ هي الأعلى محصولا ٦٨٨,٠٩ ، ٣٠٢,٢٨ كجم/ف بالفيوم ومريوط علي الترتيب، يليها السلالات أرقام ١٦ ، ١٥ ، ٥ ، ٤ في الفيوم (عدم الإجهاد) السلالات ١٦ ، ٧ ، ٨ في مريوط (تحت ظروف الإجهاد) لذا يمكن التوصية بالاستفادة منها في الزراعة مباشرة تحت الظروف المشابهة لكل من منطقتي الدراسة أو إدخالها في برامج التربية المناسبة.