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EVALUATION OF SOME LOCAL AND EXOTIC LENTIL GERMPLASM FOR YIELD, YIELD COMPONENTS AND SEED QUALITY TRAITS

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ABSTRACT

Four field experiments were conducted at Gemmieza (Gharbia Governorate) and Mallawy (El-Minia Governorate) Research Stations, ARC during 2007/2008 and 2008/2009 seasons to evaluate 29 exotic and Egyptian lentil genotypes for maturity, yield, yield components, seed protein content, carbohydrates and electrical conductivity. There was a wide variation in yield and yield components. Results indicated that Sinai 1 and FLIP 96-59L genotypes were the earliest in flowering, but Sinai 1 was the earliest in maturity. The genotype 86591 produced the tallest plants (50cm), while FLIP 2003-54L and Giza 51 genotypes produced the largest number of branches/plant. FLIP 2003-54L, Giza 51, XG96–S-39 and FLIP 2003-57L gave the greatest number of pods and seeds/plant, the highest seed yield/plant, as will as seed and straw yields/fed, out yielding the check cultivar, Giza 9 by 49.3, 41.0, 32.8 and 27.9 %, respectively. However the heaviest weight of 100- seeds was recorded by Sinai 1, surpassing all tested genotypes in both locations. Genotypes Giza 51, 89503, Sinai 1 and Giza 4 gave the highest protein content recording 28.75, 28.7, 28.5 and 28.19 %, respectively. Results also revealed the existence of wide variation among genotypes in carbohydrate and electrical conductivity. Significant and positive associations were detected between seed yield per fed and each of days to maturity, plant height, number of branches, number of pods and seeds/plant, seed yield/plant, 100–seed weight, and straw yield per feddan.

Key words: ***Lentil, Genotypes, Yield , Seed quality.***

INTRODUCTION

Lentil (*Lens culinaris* Medikus) is grown in different agro-ecological conditions over the world and ranks 5th among the world's food legumes. It is the second important food legumes in Egypt after faba bean. It is considered a cheap source of protein especially in the diet of poor people. Moreover, its seeds possess a considerable amount of vitamins A and B, as well as iron, phosphorus and calcium. In addition, it provides nutritionally rich crop residues for animal feed (Nordblom and Halimeh 1982) and plays a key role in maintaining productivity of the soil, particularly through biological nitrogen fixation (Saxena 1981). The cropped area to lentil in Egypt has declined drastically since 1980 (Hamdi and EL-Assily 1995). The cultivated area in 2008/2009 season was about 1908 feddan and average seed yield was 4.9 ardab/fed. Increasing lentil production is one of the major targets of the agricultural policy that could be achieved by increasing both the cultivated area and productivity. Consequently, evaluation of a large number of exotic and local lentil germplasm for detecting early maturing genotypes of high yield potential and good seed quality is an important goal of the lentil breeding program.

Several researchers have reported a wide variability for yield, yield components and seed quality of lentil. For example, a wide range of seed protein content (18.6 -30.2 %) was found when testing 1853 lentil accessions at ICARDA (Erskine and Witcombe1984).In smaller lentil populations, seed protein content in 34 lentil germplasm ranged from 22.1 to 26.9% (Hamdi *et al* 1991). Ezzat *et al* (2005) found a range of seed protein content of 18.5 - 25.5% and a wide variability for yield and yield components.

Introducing exotic lentil materials is a matter of great importance for widening the genetic variability of lentil germplasm in Egypt, since the local landraces have a narrow genetic base (Hamdi and Rabeia 1990).

Evaluation of exotic germplasm under Egyptian conditions should be made before exploit such germplasm. Therefore, the objective of this study was to evaluate some exotic and local lentil genotypes to identify early maturing, high yielding genotypes with high seed protein content and adapted to Egyptian conditions.

MATERIALS AND METHODS

A total of 29 exotic and Egyptian lentil genotypes were used in this study. The exotic materials comprised 18 accessions were kindly supplied by (ICARDA). The origin and pedigree of these genotypes are given in Table (1) .The Egyptian cultivar Giza 9 was used as a check. Four field experiments were conducted at Gemmieza (Lower Egypt) and Mallawy (Middle Egypt) Research Stations, ARC, during 2007/2008 and 2008/2009 seasons. Physical and chemical analyses of the experimental soils (Table 2) were performed according to Jackson (1970). Genotypes were grown in a randomized complete block design with four replications. Each plot was 3.0 × 1.8m having 6 rows 30 cm apart (5.4m^2). Planting was done in November in both seasons and locations. Fertilizer was applied at the rate of 30kg P_2O_5/fed and 15 kg N /fed prior to planting. All other agronomic practices were applied as recommended. Number of days from sowing to 50 % flowering and 90% maturity were recorded on plot basis. At harvest, plant height, number of branches/plant, number of pods and seeds/plant, seed yield/plant and straw yield /plant was recorded on 10 random guarded plants taken from each plot. 100 -seed weight was averaged over three 100–seed counts from each experimental plot. Seed and straw yields/feddan were determined from the four central rows of each plot (3.0 × 1.2 = 3.6 m^2). The following seed quality traits were assessed at the laboratory of seed Technology Dept., ARC, Giza, Egypt: 1- Total seed protein content (calculated by multiplying the total nitrogen by 6.25) 2-Total seed carbohydrate content according to (AOAC 1990) 3-Electrical conductivity

Table 1. Origin and pedigree of the investigated lentil genotypes.

No.	Genotype	Origin	Pedigree
1	86591	ICARDA	Accession No. ILL71664
2	88522	Pakistan	Accession No.ILL19836
3	FLIP89-60L	ICARDA	ILL4225 x IL43
4	FLIP96-27L	ICARDA	ILL6212 x ILL298
5	FLIP96-59L	ICARDA	ILL6212xILL298
6	FLIP97-31L	ICARDA	UJ88 286Lx ILL6205
7	FLIP2000-17L	ICARDA	ILL6783x ILL 6238
8	FLIP2000-18L	ICARDA	ILL5588x ILL 7010
9	FLIP2003-37L	ICARDA	ILL723x ILL7163
10	FLIP2003-38L	ICARDA	ILL723 x ILL 7554
11	FLIP2003-54L	ICARDA	ILL 7716 x ILL88527
12	FLIP2003-57L	ICARDA	ILL7617 x ILL 91516
13	XG96-S-39	Egypt	ILL8008 x ILL8006
14	XG98-6-1	Egypt	Selection from hybrid line
15	XG98-8-1	Egypt	Selection from hybrid line
16	XG98-10-1	Egypt	Selection from hybrid line
17	Sinai 1	Argentina	Selection from Argentina variety Precoz, early maturing
18	Giza 4	Egypt	Family 119 x family 174
19	Giza 9	Egypt	Wide spread cultivar
20	Giza 51	ICARDA	Selection from FLIP84 – 51L
21	89503	Pakista	Accession No. ILL 7723
22	ILL7163	Pakistan	ILL 1 x ILL 2573
23	FLIP95-51L	ICARDA	Accession No.ILL7707
24	FLIP96-19L	ICARDA	ILL245x ILL883
25	FLIP96-98L	ICARDA	ILL2580 x ILL5748
26	FLIP99-23L	ICARDA	H/9/83 x Giza370
27	XG98-1-1	Egypt	Selection from hybrid line
28	XG98-3-2	Egypt	Selection from hybrid line
29	XG98-9-1	Egypt	Selection from hybrid line

Table2. Physical and Chemical properties of the experimental soils at Gemmieza and Mallawy Research Stations in 2007/2008 - 2008/2009 seasons.

Soil properties		Gemmieza		Mallawy	
		2007/2008	2008/2009	2007/2008	2008/2009
Physical analysis	pH	8.1	7.9	7.90	8.20
	Sand %	23.42	16.84	19.90	30.50
	Silt %	24.95	28.75	32.60	30.00
	Clay %	51.63	54.41	47.50	39.50
Soluble anions (meq/ 100gm) soil	$CO3^{-}$	Nil	Nil	Nil	Nil
	$HCO3^{-}$	1.70	1.90	2.20	1.25
	Cl^{-}	1.15	1.30	2.00	0.90
	$SO4^{--}$	3.35	3.13	0.94	0.76
Soluble cations (meq/ 100gm) soil	Ca++	1.60	1.70	1.30	0.50
	Mg++	1.80	1.60	2.10	0.30
	Na+	2.70	2.80	1.60	1.80
	K+	0.33	0.41	0.14	0.31
	Total N%	17	18	19	11
	Available P, ppm	33	31	16.80	12.11

RESULTS AND DISCUSSION

Combined analysis of variance over the seasons and locations revealed significant differences among genotypes for all studied traits. The values of mean squares of sources of variance (season, location and genotype) as well as their interactions for all studied traits are presented in Table (3). Most of mean square values were significant for all sources of variance. These results indicated the importance of season, location and genotype for all studied traits. According to the absolute values of mean squares, the effect of season was more important than the other factors for days to maturity; whereas, the effect of location was more important than other factors for days to flowering, plant height, no. of branches/plant, 100- seed weight and seed yield /fed. The effect of genotypes was the most important on number of pods and seeds/plant and seed yield/plant. Interestingly, the effect of season × location interaction was more important than other factors in straw and biological yield/plant.

Table 3. Mean squares of lentil studied traits as affected by season, location, genotype and their interactions.

source of variance	d.f	Mean Squares											
		Day to flowering	Day to maturity	Plant height	no. of branches/plant	no. of pods/plant	no. of seeds/ plant	Straw yield/plant	Seed yield/plant	100-Seed weight	Seed yield Ard/fed	Straw yield t/fed	Biological yield /fed
Season(S)	1	0.18	1459**	495.50**	2.57**	71553**	52020**	0.62	44.90**	0.12	0.03	2.48**	2.40**
Location (L)	1	9101**	0.02	22778**	108.4**	31746**	17764**	11.61**	12.50**	35.59**	315.31**	11.21**	0.29
Genotype (G)	28	47.74**	97.70**	98.20**	3.09**	1134**	1425**	7.08**	7.90**	1.29**	6.85**	1.55**	2.73**
S×L	1	4714**	1.14	1495.50**	0.37	86519**	91364**	13.45**	87.90**	0.01	65.42**	34.83**	21.23**
S×G	23	11.16**	17.20**	27.50**	0.04	85.20	64.20	0.10	0.16	0.03	0.81**	0.03	0.06
L×G	28	10.53**	0.69	55.60**	1.43**	351.9	532.8**	3.57**	1.67	0.32**	2.35**	0.40	0.72
L×S×G	28	17.94	0.59	44.70**	0.09	98.00	81.70	0.06	0.46	0.03	0.65**	0.02	0.07
Error	342	0.94	0.85	6.30	0.12	56.00	218.9	0.44	0.43	0.04	0.09	0.07	0.07

* significant and ** highly significant

(E.C): to evaluate the potential of field emergence of seedling estimated according to (ISTA 1985). These traits were estimated for all genotypes at each location but in only one season (2008/2009). The statistical analysis of variances was performed for all traits in each season and combined analysis over the two seasons and two locations was done according to Gomez and Gomez (1984). Simple correlation coefficient was calculated among all studied traits.

Phenological and morphological traits

Days to flowering and maturity, plant height and number of branches /plant for all genotypes over seasons at both locations are given in Table (4). Narrow range among genotypes was obtained for both days to flowering and maturity at both locations; however, it is clear that Sinai 1 and FILP 96–59L genotypes were the earliest in flowering. The overall mean of days to 90% maturity was140 days, Sinai 1 was the earliest in maturity with 128 days. Earliness in flowering and maturity of Sinai 1 was previously reported (Hamdi *et al* 2002 and Ezzat *et al* 2005). The overall average of plant height and number of branches/plant were 44 cm and 4.1, respectively. The genotype 86591 produced the tallest plants (49.8cm) followed by FLIP 2003–54L, G 98–8–1, G98–10–1 and FLIP 96–19L (47 cm) over all seasons and locations. Therefore, these genotypes could be considered suitable for mechanical harvest. Also, there was a significant variation among studied genotypes concerning number of branches/plant (Table 4). Genotype FLIP 2003–54L produced the largest number of branches/plant followed by Giza 51, XG96–S–39 and FLIP 2003–57L. Plants of FLIP 96–59L gave the lowest number of branches/plant at both locations. Plant height and number of branches/plant are important traits since they reflect plant vigor that leads to high yield (Erskine and Goodrich 1991) and their variability would be helpful for selecting parents to be used in crossing programs. These results are in harmony with those reported by Esmail *et al* (1994), Selim (2000), Ibrahim (2001), Hamdi *et al* (2003), Ezzat *et al* (2005) and Ibrahim (2009) who observed variability in plant height and number of branches/plant in lentil.

Yield and yield components

Average seed yield and yield components over seasons at the two locations (Table 5) revealed that there was a wide range in number of pods and seeds/plant, seed yield/plant and straw yield /plant. FLIP 2003–54L, Giza 51, XG96–S–39 and FLIP 2003–57L genotypes showed the highest number of pods, seeds, seed yield/plant and straw yield /plant in both locations. Average yield/plant of these genotypes exceeded the check cultivar Giza 9 by 75.4, 54.2, 43.6 and 38%, respectively. High seed yield/plant of these genotypes was mainly due to the high number of pods

Table 4. Average days to 50% flowering and 90% maturity, plant height and number of branches / plant for twenty nine lentil genotypes evaluated at Gemmieza and Mallawy Research Stations in 2007/2008 and 2008/2009 season.

No.	Genotype	Days to 50% flowering			Days to 90% maturity		
		Gemmieza	Mallawy	Over all mean	Gemmieza	Mallawy	Over all mean
1	86591	69.1	79.0	74.0	140.7	140.7	140.7
2	88522	71.6	80.5	76.0	139.7	140.2	140.0
3	FLIP89-60L	68.0	76.7	72.3	138.7	138.3	138.5
4	FLIP96-27L	70.7	76.6	73.6	141.2	141.1	141.1
5	FLIP96-59L	65.3	74.0	69.6	137.0	137.0	137.0
6	FLIP97-31L	67.0	74.6	70.8	139.5	138.7	139.1
7	FLIP2000-17L	70.7	80.5	75.6	141.0	141.3	141.1
8	FLIP2000-18L	67.7	76.3	72.0	140.6	140.2	140.4
9	FLIP2003-37L	72.6	78.1	75.3	140.5	141.2	140.8
10	FLIP2003-38L	70.7	79.5	75.1	139.2	139.5	139.3
11	FLIP2003-54L	68.6	77.6	73.1	140.8	140.8	140.8
12	FLIP2003-57L	69.8	79.8	74.8	140.0	140.2	140.2
13	XG96-S-39	69.0	77.8	73.4	140.1	140.3	140.2
14	XG98-6-1	73.5	80.3	76.9	142.1	142.0	142.0
15	XG98-8-1	70.5	78.2	74.3	141.5	141.8	141.6
16	XG98-10-1	68.6	78.1	73.3	140.0	139.3	139.6
17	Sinai 1	66.5	75.2	70.8	128.1	127.8	128.0
18	Giza 4	67.6	77.1	72.3	139.5	139.3	139.4
19	Giza 9	67.8	76.1	72.0	138.1	138.3	138.2
20	Giza 51	67.8	75.3	71.6	139.2	139.3	139.3
21	89503	69.2	76.6	72.9	140.3	140.3	140.3
22	ILL7163	66.3	76.8	71.6	140.1	140.5	140.3
23	FLIP95-51L	68.7	78.2	73.5	140.5	140.7	140.6
24	FLIP96-19L	68.2	75.1	71.6	140.5	140.7	140.6
25	FLIP96-98L	68.5	78.5	73.5	139.5	139.5	139.5
26	FLIP99-23L	64.6	78.1	71.3	139.0	139.0	139.0
27	XG98-1-1	66.1	77.5	71.8	140.5	140.5	140.5
28	XG98-3-2	67.6	77.8	72.7	140.0	140.0	140.0
29	XG98-9-1	69.7	79.0	74.3	140.0	138.6	139.3
Average		68.7	77.5	73.1	139.6	139.5	139.6
L.S.D 0.05		1.1	0.8	0. 7	0.9	1.0	0.6

Tabe. 4. Cont.

No.	Genotype	Plant height (c m)			Number of branches/ plant		
		Gemmieza	Mallawy	Over all mean	Gemmieza	Mallawy	Over all mean
1	86591	41.6	58.1	49.8	2.4	4.9	3.6
2	88522	35.7	55.6	45.6	3.5	4.4	4.0
3	FLIP89-60L	40.3	52.5	46.4	3.8	4.3	4.1
4	FLIP96-27L	42.0	49.3	45.6	3.1	4.7	3.9
5	FLIP96-59L	34.1	45.6	39.8	2.0	4.1	3.0
6	FLIP97-31L	39.8	48.1	44.0	2.3	4.1	3.2
7	FLIP2000-17L	34.1	49.3	41.7	3.7	4.7	4.2
8	FLIP2000-18L	38.0	48.1	43.0	3.5	4.7	4.1
9	FLIP2003-37L	35.7	53.1	44.4	3.9	4.5	4.2
10	FLIP2003-38L	31.6	53.1	42.3	3.8	4.6	4.2
11	FLIP2003-54L	41.7	51.2	46.5	4.6	5.3	5.0
12	FLIP2003-57L	37.5	48.7	43.1	4.3	4.9	4.6
13	XG96-S-39	39.5	49.3	44.4	4.3	5.1	4.7
14	XG98-6-1	35.0	52.5	43.7	3.7	4.4	4.1
15	XG98-8-1	40.6	53.7	47.1	2.9	4.6	3.8
16	XG98-10-1	38.3	55.6	47.0	3.9	4.6	4.3
17	Sinai 1	29.2	46.3	37.8	2.8	4.2	3.5
18	Giza 4	37.6	51.8	44.7	3.7	4.4	4.0
19	Giza 9	39.3	50.6	45.0	3.6	4.6	4.1
20	Giza 51	39.7	50.6	45.1	4.5	5.2	4.8
21	89503	31.8	51.2	41.5	3.3	4.5	3.9
22	ILL7163	34.5	51.8	43.1	4.0	4.5	4.3
23	FLIP95-51L	36.3	48.7	42.5	2.7	4.2	3.4
24	FLIP96-19L	41.1	51.8	46.5	3.9	4.3	4.1
25	FLIP96-98L	35.8	53.7	44.8	3.1	4.2	3.7
26	FLIP99-23L	38.0	54.3	46.1	3.9	4.3	4.1
27	XG98-1-1	38.7	51.8	45.3	4.2	4.2	4.2
28	XG98-3-2	33.2	48.7	41.0	4.1	4.8	4.5
29	XG98-9-1	40.1	51.8	46.0	4.2	4.3	4.3
Average		37.3	51.3	44.3	3.6	4.4	4.1
L.S.D 0.05		2.1	2.8	1.7	0.2	0.4	0.2

Table 5. Average number of pods, seeds, straw yield and seed yield/ plant and 100-seed weight for twenty nine lentil genotypes evaluated at Gemmieza and Mallawy Research Stations in 2007/ 2008 and 2008/2009 seasons.

	Genotype	Number of pods/plant			Number of seeds/plant			Straw yield/plant (g)		
		Gemmieza	Mallawy	Over all mean	Gemmieza	Mallawy	Over all mean	Gemmieza	Mallawy	Over all mean
	86591	30.5	66.6	48.6	33.8	71.3	52.6	3.4	5.4	4.4
	88522	37.9	60.5	49.2	46.8	64.6	55.7	3.6	3.9	3.8
	FLIP89-60L	44.4	57.0	50.7	53.3	62.0	57.6	3.8	3.5	3.7
	FLIP96-27L	34.0	65.0	49.5	38.4	69.6	54.0	3.5	5.0	4.3
	FLIP96-59L	20.8	39.1	29.9	26.8	45.3	36.0	3.0	2.5	2.7
	FLIP97-31L	28.4	40.8	34.6	30.9	47.4	39.1	3.3	2.6	2.9
7	FLIP2000-17L	41.0	64.6	52.8	51.3	69.1	60.2	3.7	4.8	4.2
8	FLIP2000-18L	36.9	64.5	50.7	45.5	68.6	57.1	3.6	4.6	4.1
9	FLIP2003-37L	45.9	60.9	53.4	55.8	65.1	60.4	3.9	4.1	4.0
10	FLIP2003-38L	43.6	62.0	52.8	52.8	66.6	59.7	3.8	4.2	4.0
11	FLIP2003-54L	75.4	70.6	73.0	81.8	73.8	77.8	4.6	6.3	5.4
12	FLIP2003-57L	54.1	67.1	60.6	69.1	72.3	70.7	4.3	5.8	5.1
13	XG96-S-39	57.5	67.5	62.5	70.5	72.4	71.4	4.4	5.8	5.1
14	XG98-6-1	43.0	59.4	51.2	52.3	64.5	58.4	3.8	3.8	3.8
15	XG98-8-1	32.8	64.0	48.4	38.0	68.3	53.1	3.5	4.5	4.0
16	XG98-10-1	46.1	63.0	54.6	56.5	67.6	62.1	4.0	4.3	4.1
17	Sinai 1	31.5	51.8	41.6	36.4	57.0	46.7	3.6	2.9	3.2
18	Giza 4	42.6	59.1	50.9	51.6	63.6	57.6	3.7	3.7	3.7
19	Giza 9	39.4	62.6	51.0	48.5	66.9	57.7	3.7	4.2	3.9
20	Giza 51	59.4	69.0	64.2	72.0	73.5	72.8	4.4	6.1	5.2
21	89503	35.8	61.1	48.4	41.9	66.0	53.9	3.6	4.1	3.8
22	ILL7163	48.5	61.3	54.9	61.8	66.1	63.9	4.1	4.1	4.1
23	FLIP95-51L	31.1	47.6	39.4	35.6	52.0	43.8	3.4	2.6	3.0
24	FLIP96-19L	47.0	55.1	51.1	58.0	60.4	59.2	4.0	3.2	3.6
25	FLIP96-98L	34.4	54.6	44.5	39.6	58.8	49.2	3.5	3.1	3.3
26	FLIP99-23L	47.6	55.9	51.8	59.3	61.5	60.4	4.1	3.4	3.7
27	XG98-1-1	53.6	49.0	51.3	68.4	55.6	62.0	4.2	2.7	3.5
28	XG98-3-2	49.3	65.4	57.3	63.1	70.5	66.8	4.2	5.1	4.7
29	XG98-9-1	51.9	58.8	55.3	65.4	63.3	64.3	4.2	3.7	3.9
Average		42.9	59.4	51.2	51.9	64.3	58.1	3.8	4.1	4.0
L.S.D 0.05		15.0	8.6	8.7	18.9	7.8	10.3	0.5	0.7	0.4

Table 5. Cont.

No.	Genotype	Seed yield / plant (g)			100-seed weight (g)		
		Gemmieza	Mallawy	Over all mean	Gemmieza	Mallawy	Over all mean
1	86591	1.28	2.17	1.73	1.89	3.08	2.48
2	88522	1.71	1.61	1.66	2.16	2.80	2.48
3	FLIP89-60L	2.22	1.44	1.83	2.31	2.71	2.51
4	FLIP96-27L	1.51	2.11	1.81	2.06	3.01	2.54
5	FLIP96-59L	1.20	0.77	0.98	1.94	2.50	2.22
6	FLIP97-31L	1.24	1.09	1.16	1.80	2.23	2.01
7	FLIP2000-17L	1.90	2.07	1.98	2.18	3.00	2.59
8	FLIP2000-18L	1.69	2.04	1.86	2.14	3.00	2.56
9	FLIP2003-37L	2.26	1.65	1.95	2.28	2.80	2.54
10	FLIP2003-38L	2.14	1.72	1.93	2.23	2.86	2.54
11	FLIP2003-54L	3.61	2.67	3.14	2.73	3.34	3.03
12	FLIP2003-57L	2.70	2.23	2.47	2.50	3.09	2.79
13	XG96-S-39	2.81	2.33	2.57	2.55	3.14	2.84
14	XG98-6-1	2.11	1.58	1.84	2.21	2.79	2.50
15	XG98-8-1	1.42	1.92	1.67	2.06	2.94	2.50
16	XG98-10-1	2.28	1.85	2.07	2.28	2.94	2.61
17	Sinai 1	1.37	1.25	1.31	3.70	3.38	3.54
18	Giza 4	2.06	1.50	1.78	2.20	2.73	2.46
19	Giza 9	1.79	1.79	1.79	2.18	2.89	2.53
20	Giza 51	2.93	2.60	2.76	2.91	3.21	3.06
21	89503	1.63	1.68	1.65	2.11	2.84	2.48
22	ILL7163	2.43	1.71	2.07	2.35	2.85	2.60
23	FLIP95-51L	1.33	1.23	1.28	1.91	2.43	2.17
24	FLIP96-19L	2.30	1.41	1.85	2.31	2.66	2.49
25	FLIP96-98L	1.53	1.27	1.40	2.10	2.63	2.36
26	FLIP99-23L	2.32	1.43	1.87	2.34	2.70	2.52
27	XG98-1-1	2.65	1.25	1.95	2.48	2.49	2.48
28	XG98-3-2	2.52	2.15	2.33	2.39	3.05	2.72
29	XG98-9-1	2.57	1.48	2.02	2.43	2.73	2.58
Average		2.06	1.72	1.89	2.30	2.86	2.58
L.S.D 0.05		0.89	0.16	0.45	0.25	0.10	0.14

Table 6. Average seed yield (ardab/fed), straw yield (t/fed) and biological yield (t/fed) for 29 lentil genotypes evaluated at Gemmieza and Mallawy Research Stations in 2007/2008 and 2008/2009 seasons

NO.	Genotype	Seed yield (ardab/ fed)†			Straw yield (t/ fed)			Biological yield(t/ fed)		
		Gemmieza	Mallawy	Over all mean	Gemmieza	Mallawy	Over all mean	Gemmieza	Mallawy	Over all mean
1	86591	3.797	3.773	3.785	0.950	2.044	1.497	1.558	2.647	2.102
2	88522	4.114	2.850	3.482	1.218	1.511	1.364	1.876	1.967	1.921
3	FLIP89-60L	4.775	2.746	3.761	1.354	1.417	1.386	2.118	1.857	1.987
4	FLIP96-27L	3.887	3.616	3.752	1.105	1.954	1.529	1.727	2.532	2.130
5	FLIP96-59L	3.582	2.121	2.852	0.901	0.776	0.839	1.474	1.116	1.295
6	FLIP97-31L	3.760	2.209	2.984	0.919	1.105	1.012	1.520	1.458	1.489
7	FLIP2000-17L	4.435	3.571	4.003	1.269	1.932	1.601	1.978	2.504	2.241
8	FLIP2000-18L	4.097	3.499	3.798	1.181	1.924	1.552	1.837	2.484	2.160
9	FLIP2003-37L	4.910	3.063	3.986	1.366	1.533	1.449	2.152	2.023	2.087
10	FLIP2003-38L	4.735	3.120	3.927	1.335	1.668	1.501	2.093	2.167	2.130
11	FLIP2003-54L	6.646	4.590	5.618	2.260	2.419	2.339	3.323	3.153	3.238
12	FLIP2003-57L	5.732	3.890	4.811	1.711	2.121	1.916	2.628	2.744	2.686
13	XG96-S-39	5.843	4.150	4.996	1.809	2.171	1.990	2.744	2.835	2.789
14	XG98-6-1	4.605	2.831	3.718	1.297	1.509	1.403	2.034	1.962	1.998
15	XG98-8-1	3.875	3.398	3.636	1.052	1.848	1.450	1.673	2.391	2.032
16	XG98-10-1	4.975	3.236	4.106	1.389	1.779	1.584	2.185	2.297	2.241
17	Sinai 1	3.852	2.380	3.116	1.046	1.295	1.171	1.663	1.676	1.669
18	Giza 4	4.538	2.802	3.670	1.286	1.491	1.389	2.012	1.940	1.976
19	Giza 9	4.340	3.186	3.763	1.262	1.721	1.492	1.957	2.231	2.094
20	Giza 51	6.368	4.245	5.306	1.860	2.350	2.105	2.879	3.029	2.954
21	89503	4.000	3.077	3.539	1.123	1.555	1.339	1.763	2.047	1.905
22	ILL7163	5.517	3.094	4.306	1.433	1.619	1.526	2.315	2.114	2.215
23	FLIP95-51L	3.833	2.260	3.046	1.002	1.201	1.102	1.616	1.563	1.589
24	FLIP96-19L	5.387	2.570	3.979	1.399	1.343	1.371	2.261	1.754	2.007
25	FLIP96-98L	3.960	2.521	3.241	1.105	1.304	1.204	1.739	1.707	1.723
26	FLIP99-23L	5.307	2.605	3.956	1.417	1.386	1.402	2.267	1.803	2.035
27	XG98-1-1	5.618	2.331	3.974	1.636	1.280	1.458	2.535	1.653	2.094
28	XG98-3-2	5.530	3.640	4.585	1.487	1.997	1.742	2.372	2.580	2.476
29	XG98-9-1	5.569	2.782	4.176	1.528	1.464	1.496	2.419	1.909	2.164
Average		4.744	3.109	3.927	1.335	1.645	1.490	2.094	2.143	2.118
	L.S.D 0.05	0.380	0.170	0.211	0.248	0.259	0.180	0.252	0.262	0.183

† 1 Ardab = 160 kg , 1 Feddan = 4200 m^2

and seeds/plant. Concerning seed size, Sinai 1 had the heaviest weight of 100– seeds (3.54 g) surpassing all tested genotypes.

Regarding, seed and straw yields/fed, (Table 6), result showed that genotype FLIP 2003–54L surpassed all other genotypes in seed yield/fed at both locations followed by Giza 51, XG96–S–39 and FLIP 2003–57L. Percent increases of these four genotypes over locations were 49.3, 41.0, 32.8 and 27.9%, respectively compared with Giza 9. The superiority of these promising genotypes in seed yield/ fed could be attributed to their high number of pods, seeds and seed yield/plant. In addition, the last four genotypes had the highest straw yield/fed, surpassing Giza 9 by 56.8, 41.1, 33.4 and 28.5 %, respectively. Results are in agreement with those obtained by Ezzat *et al* (2005), Shabaan and Morsy (2005) and Hamdi *et al* (2008). These promising genotypes were also superior in most of other traits.

Seed quality

The overall means of seed protein and carbohydrate content and electrical conductivity (EC) traits for all tested lentil genotypes are presented in Table (7). Results revealed that the genotypes significantly differed with respect to the studied traits. The E.C. trait had the widest range of 16.68–93.84, followed by carbohydrates and seed protein (%) with a range of 51.3–63.4 and 17.94–28.75, respectively. Four genotypes: Giza 51, 89503, Sinai 1 and Giza 4 gave the highest protein content of 28.8, 28.7, 28.5 and 28.2%, respectively. These genotypes surpassed the check Giza 9 by 6.1, 6.0, 5.8 and 5.5% respectively. Therefore, these genotypes could be used in crossing program as a source of good seed quality. On the other hand, the seeds of genotypes (ILL 7163 and FLIP 2000–18L) produced the highest carbohydrate content. Also the results showed wide variation in E.C. trait among tested genotypes. Since the conductivity test is measuring of electrolytes leached from the seed soaked in water low seed conductivity value is an indicator of good seed viability Powell (1986). Therefore, genotypes FLIP 96–19L and FLIP 96–98L had a good seed viability (E.C value 16.68 and 18.11) respectively, comparing with the local check variety Giza 9 (E.C.= 93.84).

Correlation analysis

Coefficients of phenotypic correlation among all studied traits over seasons and locations are shown in Table (8). The results showed that there was significant and positive correlation between seed yield/fed and each of days to 90%maturity (r =0.281*), plant height (r =0.262*), no. of branches (r =0.917**), no. of pods /plant (r =0.965**), no. of seeds/plant (r =0.943**), seed yield/plant (r =0.963**), 100- seed weight (r =0.988**), straw yield/plant (r =0.576**), straw yield/fed (r =0.982**) and biological yield/fed (r =0.998**). Positive correlation between seed yield and yield components was most important relationships to lentil breeder. Therefore selection for these traits would improve the productivity of lentil

Table7. The overall mean of seed protein content, carbohydrate and electrical conductivity (EC) of lentil genotypes tested at two locations in 2008/2009 season.

No.	Genotype	Seed protein content (%)	Carbohydrate (%)	E.C. umhos/g
1	86591	23.50	52.90	49.76
2	88522	18.76	56.10	44.78
3	FLIP89-60L	21.13	54.60	36.94
4	FLIP96-27L	22.31	53.10	41.76
5	FLIP96-59L	24.25	53.70	37.28
6	FLIP97-31L	19.94	61.40	59.51
7	FLIP2000-17L	21.50	57.20	46.93
8	FLIP2000-18L	17.94	63.40	37.73
9	FLIP2003-37L	24.69	53.20	46.85
10	FLIP2003-38L	18.38	56.80	46.49
11	FLIP2003-54L	21.30	59.50	47.66
12	FLIP2003-57L	22.69	53.00	56.99
13	XG96-S-39	18.75	59.10	25.28
14	XG98-6-1	19.94	62.80	93.00
15	XG98-8-1	26.60	52.50	41.87
16	XG98-10-1	25.18	54.70	33.44
17	Sinai 1	28.50	51.30	31.33
18	Giza 4	28.19	53.40	86.87
19	Giza 9	22.69	54.30	93.84
20	Giza 51	28.75	55.10	48.56
21	89503	28.70	53.60	62.05
22	ILL7163	18.80	64.60	47.02
23	FLIP95-51L	23.50	53.90	48.56
24	FLIP96-19L	21.50	56.90	36.93
25	FLIP96-98L	20.30	53.70	16.68
26	FLIP99-23L	25.66	51.90	18.11
27	XG98-1-1	20.03	53.00	80.12
28	XG98-3-2	18.75	52.60	45.30
29	XG98-9-1	21.30	53.40	50.73
Average		22.54	54.89	48.70
L.S.D 0.05		0.82	1.27	6.86

Table 8. Phenotypic correlation coefficient between all tested traits for lentil genotypes evaluated at two locations in 2007/2008 and 2008/2009.

NO.	Trait	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Days to 50% flowering	0.482**	0.156	0.226	0.260	0.226	0.283*	0.181	-0.059	0.115	0.211	0.188	-0.272*	0.076
2	Days to 90% maturity		0.568**	0.280*	0.307*	0.294*	0.306*	0.303*	-0.536**	0.278*	0.280*	0.281*	-0.348**	0.256
	Plant height			0.174	0.312*	0.256	0.260	0.257	-0.228	0.241	0.267*	0.262	-0.029	-0.041
4	No. of branches				0.964**	0.982**	0.838**	0.952**	0.522**	0.927**	0.906**	0.917**	-0.178	0.192
5	No. of pods/plant					0.984**	0.911**	0.980**	0.556**	0.956**	0.960**	0.965**	-0.116	0.155
6	No. of seeds/plant						0.878**	0.972**	0.537**	0.956**	0.931**	0.943**	-0.148	0.146
7	Seed yield/plant (g)							0.929**	0.545**	0.925**	0.968**	0.963**	-0.085	0.124
8	100-seed weight (g)								0.547**	0.991**	0.979**	0.988**	-0.127	0.162
9	Straw yield/ plant (g)									0.546**	0.581**	0.576**	0.260	-0.109
10	Straw yield (t/fed)										0.968**	0.982**	-0.112	0.172
11	Biological yield(t/fed)											0.998**	-0.097	0.162
12	Seed yield (ardab/ fed)												-0.102	0.165
13	Seed protein content (%)													-0.578**
14	Carbohydrate (%)													—

crop. These results are in agreement with those obtained by Saraf *et al* (1985), Hamdi *et al* (1991), Sanjai kumar and Bajpai (1993), and Shabaan and Morsy (2005). On the other hand seed protein content had significant negative correlation with days to 50% flowering (r = - 0.272*) and 90% maturity (r = - 0.348**) . These relations indicating that high seed protein content related with early flowering and maturity of genotypes. Also highly negative correlation was found between days to 90% maturity and straw yield /plant (r = - 0.536**). Negative correlation occurred between seed protein content and carbohydrate content % (r = - 0.578**) indicating that genotype has high carbohydrate content will have low seed protein content. Correlation analysis showed that the relationships among E.C and all studied traits were found to be non- significant, so they were discarded from the results.

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تقييم بعض التراكيب الوراثية المحلية والمستوردة من العدس للمحصول ومكوناتة وصفات جودة البذور.

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قسم بحوث المحاصيل البقولية–معهد بحوث المحاصيل الحقلية–مركز البحوث الزراعية

أقيمت أربعة تجارب حقلية بمحطتى بحوث الجميزة (محافظة الغربية) وملوى (محافظة المنيا) التابعتين لمركز البحوث الزراعية – بهدف تقييم بعض التراكيب الوراثية المحلية والمستوردة من العدس مقارنة بالصنف جيزة ٩ وذلك للمحصول ومكوناتة و صفات الجودة للبذور تحت الظروف المصرية فى موسمى ٢٠٠٨/٢٠٠٧ , ٢٠٠٩/٢٠٠٨. و أظهرت النتائج أن التركيبين الوراثيين فيليب ٩٦-٥٩ ل وسيناء١ كانا الأبكر فى التزهير و الصنف سيناء١ كان الأبكر فى النضج، وأعطى التركيب الوراثى ٨٦٥٩١ أعلى متوسط لطول النبات (٥٠ سم)على مستوى الجميزة وملوى ،أختلفت التراكيب الوراثية المختبرة معنوياً فى صفة عدد الأفرع / نبات حيث أعطى التركيبين الوراثيين فيليب ٢٠٠٣- ٥٤ ل،جيزة٥١ أعلى عدد أفرع / نبات وسجلت التراكيب الوراثية فيليب ٢٠٠٣- ٥٤ ل،جيزة٥١ ، آكس چى ٩٦ – آس – ٣٩ ، فيليب ٢٠٠٣- ٥٧ ل أعلى قيم لعدد القرون و البذور ومحصول البذور للنبات ومحصول البذور وكذا القش للفدان فى كل من الجميزة وملوى متفوقة بذلك فى محصول البذور للفدان على الصنف المحلى جيزة ٩ بنسبة ٤٩.٣، ٤١.٠، ٨. ٣٢ ، ٢٧.٩٪ على التوالى ،وأظهرت النتائج أيضاً تفوق التراكيب الوراثية جيزة٥١ ، ٨٩٥٠٣، سيناء ١ ، جيزة ٤ فى نسبة البروتين فى البذرة حيث بلغت نسبة البروتين بها حوالى ٢٨.٧٥، ٢٨.٧، ٢٨.٥، ٢٨.١٩٪ على التوالى ، وأوضحت النتائج وجود أختلافات معنوية واسعة بين التراكيب الوراثية فى كل من صفة نسبة الكربوهيدرات فى البذرة ومعامل التوصيل الكهربائى للبذرة . وأظهرت النتائج أيضاً وجود ارتباط معنوى بين محصول البذور للفدان وبين كل من عدد الأيام للنضج ، وطول النبات ، عدد الأفرع وعدد القرون والبذور/ نبات ومحصول النبات ووزن ال١٠٠ بذرة والمحصول البيولوجى و القش.

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