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PERFORMANCE OF SIX FABA BEAN GENOTYPES UNDER FREE AND *Orobanche* INFECTED SOILS.

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ABSTRACT

Five faba bean (Vicia faba L.) genotypes i.e. X-1714, X- 1720, X- 1671, Misr 1 and Giza 843 (tolerant to Orobanche) compared with Giza 40 cultivar (susceptible) were evaluated on an Orobanche naturally infested soil and an Orobanche free soil at Giza Research Station, Agricultural Research Center , in 2008/2009 and 2009/2010 seasons. Results revealed the superiority of X-1714 and X-1720 in number of pods/plant , number of seeds/plant and seed yield/ plant on the Orobanche - free soil, mean white X- 1714 and X- 1720 were superior in number of branches/plant, pods/plant, seed yield of plant and number of seeds/plant on the Orobanche-infested soil. Giza 40 possessed a high level of infestation with the highest number and dry weight of Orobanche spikes/ m^2 .The two tolerant genotypes X – 1714 and X- 1720 had the low number of Orobanche followed by Misr 1 under infested soil. Results of chemical compositions revealed significant differences among genotypes under the two soils. Four genotypes X- 1714, Giza 843, X-1671 and Misr 1 gave higher values of protein, carbohydrates and phenols, respectively, while Giza 40 gave the lowest values. SDS-PAGE revealed differences among genotypes, where some bands appeared in the tolerant genotypes and dis appeared in the susceptible one. Only the two isozymes (Esterase and Peroxidase) showed differences among genotypes in the locus and numbers of the isozyme, where some bands were noticed only in the tolerant genotypes compared with the susceptible cultivar. Results showed the superiority of X 1714 in Orobanche and therefore this genotype is recommended for breeding to tolerant Orobanche .

Key world: ***Faba bean, Orobanche, Yield, Chemical composition, SDS-PAGE, Isozymes.***

INTRODUCTION

Faba bean (*Vicia faba* L.), is most important annual legume (Leguminosae) in Egypt. The majority ofEgyptions depend on faba bean seeds as a source of protein. The crop is generally included in the crop rotation and has succeeded to keep the Egyptian soil fertile and productive through biological N_2-fixation. The national faba bean acreage over the last three years (2007-2009) was 196,000 feddan with an average productivity of 9.23 ardab/feddan (1 ardab = 155 kg).

Orobanche spp. is root holophrastic plants causing severe yield and quality losses in a wide range of dicotyledonous crops. As most contemporary methods aimed at controlling *Orobanche* have resulted in limited success, the search for tolerant genotypes and understanding the tolerance mechanisms are considered important.

The parasitic weed (*Orobanche crenata* Forsk) is a major pest of faba bean (*vicia faba* L.) in Egypt. For example, in Behera Governorate (North Delta), Zaitoun *et al.*(1991) reported that the percentage of *Orobanche* infestation amounted to 65.5% of faba bean cultivated area, with a total yield losses of about 19,000 tons.

The Food legume breeding program, FCRI, ARC resulted in releasing three cultivars (Giza 429, Giza 843 and Misr 1) having a higher level of resistance to *Orobanche* (Khalil *et al* 1994, Attia 1998, Saber *et al* 1999 and 2001)

The evaluation of tolerant materials under *Orobanche* -infested and *Orobanche*-free fields was investigated by Darwish *et al* (1999) Abdalla and Darwish (2002) Morsy and Attia, (2002) Abdalla *et al* (2006) Darwish *et al* (2007) Abbes *et al* (2007) and Abdalla and Darwish (2008). They concluded that there were significant differences in among genotypes most traits under study.

The present investigation aimed to: 1) Study the performance of susceptible and tolerant genotypes to *Orobanche* in free and infested soils. 2) Study the chemical and biochemical factors in the *Orobanche* tolerant genotypes compared with a susceptible cultivar.

MATERIALS AND METHODS

The present investigation was conducted at Giza Research Station, ARC, Egypt in 2008/09 and 2009/10 seasons to study the performance of five *Orobanche* tolerant faba bean genotype (X-1714, X-720, X-1671, Misr 1, and Giza 843) under both *Orobanche*-free and *Orobanche*-naturally infested soils compared with Giza 40 (susceptible to *Orobanche)* . The Pedigree and reaction of the materials used to *Orobanche* are shown in Table (1).

Table 1. Pedigree and reaction to *Orobanche* of six faba bean genotypes

Genotype	Pedigree	Reaction to *Orobanche*
x-1714	G.667x(G.429xG.843)	Tolerant to *Orobanche*
x-1720	G.667x(G.843xBPL536)	Tolerant to *Orobanche*
x-1671	G.667x Composite 16	Tolerant to *Orobanche*
Misr 1	G.3x 123A/45/76	Tolerant to Orobanche
Giza 843	561/2076/85x 461/845/83	Tolerant to Orobanche
Giza 40	An individual plant selection from Repay 40	Susceptible to Orobanche

A Randomized Complete Block Design (RCBD) with three replications was used, in both infested and *Orobanche* - free soils. The experimental plot consisted of three ridges 3 m long, 60 cm apart , with single seeded hills, 20 cm apart on both sides of ridges. Cultural practices were applied as recommended. At harvest ten guarded plants were taken at random from each experimental plot. The following data were recorded.

Agronomic traits

plant height (cm), number of branches/plant, number of pods/plant, number of seeds/plant, seed yield /plant (g), 100-seed weight (g) , number of *Orobanche* spikes and dry weight of *Orobanche* spikes (g/m^2) were recorded at maturity of faba bean plants for all accession, except the susceptible check variety Giza 40.In Giza 40, *Orobanche* spikes were collected just when its plants stated to death, and their data were recorded immediately.

Chemical and biochemical factors

SDS-protein electrophoresis

Sodium dodecyle sulphate polyacrylamide gel electrophoresis (SDS-PAGE) procedure was carried out according to Laemmli (1970). Protein bands were visualized by staining the gel with 0.25% Coomassie Brilliant Blue R-250. Protein band sizes were determined by comparisons with the high molecular weight protein marker. Leaf samples were taken from free and infested plants 75 days after planting.

Phenols:

Total phenols was determined by using Folin-Denis reagent according to the method of Swain and Hillis (1979). Leaf samples were taken from free and infested plants 75 days after planting.

Isozyme electrophoresis

Native polyacrylamide gel electrophoresis (Native-PAGE) technique was used to characterize the isozyme fingerprints of faba bean genotypes such as esterase (Est), glutamate oxaloacetate transaminase (GOT) and 6-phosphogluconate dehydrogenase (6-PGDH) according to Jonathon and Wendel (1990), peroxidase (Px) according to Graham *et al.* (1964). Isozyme fractionation was performed on vertical slab (19.8 cm x 26.8 cm x 0.2 cm) using gel labconco electrophoresis apparatus. Leaf samples were taken from free and infested plants 75 days after planting.

Chemical composition analysis

Protein and carbohydrate percentages were determined according to the procedures outlined by (AOAC, 2000). Percentage of protein was

obtained by multiplying nitrogen percentage by 6.25 as stated by Sadasiuam and Manickam (1996).

Statistical Analysis

Statistical analyses were performed using the SPSS software (version 7.5 for windows) and as outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Agronomic traits

The mean performance of six faba bean genotypes under *Orobanche*-infested and free soils is presented in Table (2). Results showed significant differences among genotypes for plant height, number of branches/plant, number of pods/plant, number of seeds/plant, seed yield /plant, number and dry weight of *Orobanche* spikes under infested soil. On the other hand plant height and 100-seed weight were insignificant. However, significant differences were found among genotypes for plant height, number of branches/plant, number of pods/plant, number of seeds/plant, seed yield /plant, and 100-seed weight were observed under *Orobanche*- free soil.

***Orobanche*- free field**

The genotype x-1714 recorded the highest values of number of pods/plant, (26.9), number of seeds/plant,(83.3) seed yield /plant, (67.2), x-1671 recorded the tallest plants (104), Misr1 recorded the highest number of branches/ plant,(4.4), x-1720 recorded the highest heaviest (81.9) of 100 seeds, under free soil.

***Orobanche*- infested field**

The tolerant genotype x-1714 had the best number of branches/plant, (5.0), number pods/plant, (22.2), seeds/plant (66.5), and seed yield /plant (55.8) followed by x- 1720 under infested soil .

These findings are clearly supported by those obtained by (Nassib *et al* 1979, Abdalla 1982, Radwan *et al* 1988, Cubero and Hernandez 1991, Abdalla and Fischbeck 1992, Attia, 1998, Abdalla and Darwish 1999, Saber *et al*., 1999, 2001 and Abd El-Wahab 2007) who reported that faba bean genotypes differed from each other in their yield and yield components regarding *Orobanche* infestation.

Number and dry weight of *Orobanche* spikes/ m^2

Results in Table (3) showed that Giza 40 cultivar possessed the highest level of infestation with high number and dry weight of *Orobanche* spikes/ m^2 . The two tolerant genotypes , x – 1714 and x- 1720 had the lowest number of *Orobanche* spikes followed by Misr 1 . Moreover, x-1714

Table 2. Performance of the six studied faba bean genotypes under *Orobanche* –infested and - free soils in 2008/2009 and 2009/2010 seasons.

Genotype	Plant height (cm)						No. of branches /plant					
	Infested			Free			Infested			Free		
	2008/9	2009/10	Combined	2008/9	2009/10	Combined	2008/9	2009/10	Combined	2008/9	2008/10	Combined
x-1714	108.00	96.67	102.3	106.33	101.00	103.7	5.5	4.53	5.0	3.67	3.13	3.4
x-1720	109.67	103.33	106.5	102.33	98.33	100.3	5.17	4.05	4.6	3.67	3.33	3.6
x-1671	100.33	100.00	100.2	106.67	101.30	104.0	4.10	3.93	4.0	3.20	3.87	3.6
Misr 1	104.33	97.67	101.0	95.00	95.00	95.0	4.27	4.73	4.5	4.20	4.53	4.4
Giza 843	102.33	100.00	101.2	98.33	90.00	94.2	5.13	4.00	4.6	3.40	4.03	3.7
Giza 40	71.67	70.0	70.8	98.67	88.33	93.5	0.0	0.0	0.0	3.47	3.93	3.7
LSD $_{0.05}$	**6.07**	**7.46**	**4.32**	**6.95**	**9.75**	**5.81**	**N.S**	**N.S**	**0.48**	**0.82**	**0.71**	**0.47**

Table 2.Cont.

Genotype	No. of pods / plant						No. of seeds / plant					
	Infested			Free			Infested			Free		
	2008/9	2009/10	Combined	2008/9	2009/10	Combined	2008/9	2009/10	Combined	2008/9	2009/10	Combined
x-1714	22.33	22.67	22.2	28.00	25.8	26.9	65.33	67.67	66.5	86.33	80.33	83.3
x-1720	22.33	18.50	20.4	25.33	27.00	26.1	65.33	54.33	59.8	78.67	81.67	80.2
x-1671	20.60	17.00	18.8	21.67	21.67	21.7	58.50	49.67	54.1	64.67	63.67	64.2
Misr 1	17.13	15.60	16.4	20.67	19.67	20.2	48.60	45.67	47.1	61.67	59.33	60.5
Giza 843	17.00	13.67	15.3	21.33	17.33	19.1	47.00	44.00	45.5	62.67	50.33	56.5
Giza 40	00.00	00.00	00.0	27.00	23.67	25.3	00.00	00.00	00.0	81.67	71.33	76.5
LSD $_{0.05}$	**3.50**	**4.16**	**2.50**	**4.19**	**5.67**	**3.16**	**4.55**	**11.60**	**5.74**	**12.31**	**17.61**	**9.78**

Table 2.Cont.

Genotype	Seed yield / plant (g)						100-seed weight (g)					
	Infested			Free			Infested			Free		
	2008/9	2009/10	Combined	2008/9	2009/10	Combined	2008/9	2009/10	Combined	2008/9	2009/10	Combined
x-1714	55.33	56.33	55.8	70.33	64.00	67.2	84.68	83.25	84.9	81.38	79.70	80.5
x-1720	55.00	46.00	50.5	64.33	67.00	65.7	84.12	84.62	84.4	81.76	81.94	81.9
x-1671	49.67	41.00	45.3	52.67	51.67	52.2	84.98	82.48	83.7	81.5	81.13	81.4
Misr 1	40.67	35.67	38.2	48.67	46.67	47.9	83.67	78.20	80.9	78.92	78.58	78.7
Giza 843	39.33	36.33	37.8	51.00	41.00	46.0	83.71	82.70	83.2	81.41	81.38	81.4
Giza 40	00.00	00.00	00.0	51.17	45.33	48.0	00.00	00.00	00.0	63.23	63.66	63.4
LSD $_{0.05}$	4.16	9.60	4.82	9.72	14.64	7.99	N.S	N.S	N.S	2.90	4.10	2.28

Table 3. Number and dry weight of *Orobanche* spikes under infested soils during 2008/09 and 2009/10 seasons.

Genotype	No. of *orobanche* /m^2			*Orobanche* dry weight(g/m^2)		
	2008/9	2009/10	Combined	2008/9	2009/10	Combined
x-1714	28.33	33.00	30.67	150.33	104.00	127.17
x-1720	35.00	27.17	31.35	186.33	112.33	149.33
x-1671	54.00	50.00	52.60	256.00	158.33	207.17
Misr 1	32.67	39.33	36.00	118.33	151.33	134.81
Giza 843	32.0	49.67	40.83	174.33	143.00	158.67
Giza 40	143	113.67	128.33	295.33	233.67	264.50
C.V%	54.9	58.4	56.6	33.2	40.8	36.0
LSD $_{0.05}$	N.S	N.S	39.26	N.S	N.S	51.60

genotype recorded the lowest dry weight of *Orobanche* spikes followed by Misr1. The sinilay results were obtained by Morsy and Attia. (2002) and Abbes *et al* (2007).

Chemical analysis

The mean performance of the studied faba bean genotypes under *Orobanche* - infested and *Orobanche* - free field conditions is presented in Table 4 and (5). The results showed significant differences among genotypes in protein, carbohydrates and phenols. The percentage of protein, carbohydrates and phenols were Sinai from the higher in the *Orobanche* - free field than thase in the *Orobanche* - infested field.

The susceptible cultivar (Giza 40) gave the lowest values for all studied traits, while the tolerant genotypes (x-1714, Giza 843, X-1671 and Misr 1) gave the highest values for protein, carbohydrates and phenols, respectively. It could be concluded that seeds from *Orobanche* – free field were better than those of *Orobanche* – infested field and had higher protein content.

These findings are clearly supported by those obtained by (Frejnage1998, Megahed 2000, Morsy and Attia 2002).

SDS-PAGE of protein band pattern

Leaves of six genotypes were collected 75 days after sowing to determine protein and isozyme electrophoresis. Twelve samples representing plants from free and infested soils were analyzed. Results of protein band patterns are shown in Table (6). The total number of bands was 25 bands, 21 of which were polymorphic (%). Molecular weight of these bands ranged from 22.20 to 452.63 kDa.

It was clear that number of bands was more in the tolerant genotypes compared with the susceptible one. There were 9 bands at molecular weight 120, 118.75, 114.70, 88.45, 87.14, 67.65, 59.85, 58.89 and 36.20 kDa that can be considered positive markers.

Some bands only appeared in the tolerant genotypes cultivated in infected soil. These bands at molecular weights 452.63, 334.13, 234.34, 120.0, 118.75, 88.45, 73.05, 43.80 and 36.20 kDa. Some bands appeared in tolerant genotypes in both soils, these bands at molecular weights 334.13, 96.48, 89.63, 73.05 and 43.80 kDa.

Isozyme band patterns

Isozyme electrophoresis of twelve faba bean plant samples representing *Orobanche* - free and infested soils were analyzed. Their patterns are shown in Fig. 1 and Tables (7 and 8). Results can be summarized as follows :

1- **Peroxidase (Px):** This isozyme showed complex patterns of expression. Four loci showing four zones of activity produced by

Table 4. Protein and carbohydrates content of the six studied faba bean genotypes under *Orobanche* –infested and –free fields in 2008/09 and 2009/10 seasons.

Genotype	Protein (%)						Carbohydrates (%)					
	Infested			Free			Infested			Free		
	2008/09	2009/10	Combined	2008/09	2009/10	Combined	2008/09	2009/10	Combined	2008/09	2009/10	Combined
x-1714	26.07	26.33	26.20	26.74	26.88	26.81	63.37	63.25	63.31	64.92	66.24	66.24
x-1720	22.76	23.44	23.10	23.34	24.57	23.96	63.05	63.71	63.38	63.32	62.42	62.87
x-1671	25.06	25.46	25.26	26.53	26.53	26.53	64.03	64.84	64.43	64.43	67.13	66.15
Misr 1	24.14	23.86	24.00	25.38	25.96	25.67	64.27	65.66	64.96	66.22	63.79	65.01
Giza 843	25.51	26.96	26.23	25.06	25.89	25.47	62.56	64.68	63.62	64.73	63.33	64.03
Giza 40	0.00	0.00	0.00	22.90	24.12	23.51	0.00	0.00	0.00	65.41	64.43	64.92
$LSD_{0.05}$	**1.104**	**1.284**	**0.793**	**1.187**	**1.726**	**0.981**	**1.333**	**1.517**	**0.945**	**1.842**	**1.912**	**1.243**

Table 5. Phenols of the six studied faba bean genotypes under *Orobanche* –infested and freefields over the two seasons 2008/09 and 2009/10.

Genotype	Phenols					
	Infested			Free		
	2008/09	2009/10	Combined	2008/09	2009/10	Combined
x-1714	90.19	91.48	90.83	88.00	88.64	88.32
x-1720	56.68	56.44	56.56	51.23	53.76	52.49
x-1671	69.97	71.42	70.69	69.53	67.92	68.73
Misr 1	57.97	59.16	58.56	54.06	52.86	53.46
Giza 843	75.42	78.46	76.94	69.55	66.26	67.91
Giza 40	39.05	40.24	39.64	37.17	35.64	36.40
$LSD_{0.05}$	**1.498**	**1.329**	**0.938**	**1.081**	**1.393**	**0.825**

Table 6. SDS-PAGE of total proteins extracted from the leaves of the six faba bean genotype.

Band No.	MW	Genotype											
		Giza 40		Misr 1		x-1714		x-1720		Giza843		x-1671	
		Infested	Free	Infested	Free	Infested	Free	Infested	Free	Infested	Free	Infested	Free
1	452.63	-	-	-	-	-	-	+	-	-	-	-	+
2	390.26	-	+	-	-	-	-	-	-	-	+	-	-
3	334.13	-	-	-	-	+	-	-	+	-	-	+	+
4	234.34	-	-	-	+	-	+	-	-	+	-	-	-
5	142.26	+	-	-	-	-	-	-	+	-	-	-	-
6	120.00	-	-	-	-	-	-	+	-	-	-	-	-
7	118.75	-	-	+	-	-	-	-	-	-	-	-	-
8	114.70	+	-	-	-	-	-	-	-	-	-	-	-
9	109.02	+	+	+	+	+	+	+	+	+	+	+	+
10	100.43	+	+	-	-	-	-	-	-	+	+	-	-
11	96.48	-	-	+	+	+	+	-	-	-	-	-	+
12	92.17	-	+	+	+	+	+	+	+	-	+	+	+
13	89.63	-	+	-	+	-	-	-	+	+	+	-	-
14	88.45	-	-	-	-	-	-	-	-	-	-	+	-
15	87.14	-	-	-	-	-	-	-	-	-	-	-	+

Table (6). Cont.

Band No.	MW	Genotype											
		Giza 40		Misr 1		x-1714		x-1720		Giza 843		x-1671	
		Infested	Free	Infested	Free	Infested	Free	Infested	Free	Infested	Free	Infested	Free
16	86.23	+	+	+	+	+	+	+	+	+	+	+	+
17	84.00	+	+	+	+	+	+	+	+	+	+	+	+
18	79.04	-	-	+	-	-	-	-	-	-	+	-	-
19	73.05	-	-	-	-	+	+	-	-	-	-	-	-
20	67.65	-	-	-	-	-	-	-	-	-	+	-	-
21	59.85	-	-	-	-	-	-	-	-	-	-	-	+
22	58.89	-	-	-	+	-	-	-	-	-	-	-	-
23	43.80	-	-	-	-	+	+	+	+	+	-	+	-
24	36.20	-	-	-	-	-	-	-	-	-	-	+	-
25	22.20	+	+	+	+	+	+	+	+	+	+	+	+
Total		7	8	8	9	9	9	8	9	8	10	9	10

+= present bands -= absent bands

Table 7. Peroxidase (Px) extracted from the leaves of the six faba bean genotype.

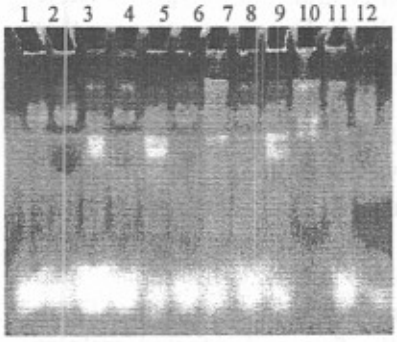
R.F	Genotype											
	Giza 40		Misr 1		x-1714		x-1720		Giza843		x-1671	
	Infested	Free	Infested	Free	Infested	Free	Infested	Free	Infested	Free	Infested	Free
0.121	-	-	+	+	+	+	+	+	+	+	+	+
0.220	+	+	+	+	+	+	-	+	+	+	-	+
0.273	+	+	+	+	+	+	+	+	+	+	+	+
0.317	-	-	+	-	-	-	-	-	-	-	-	-
0.360	-	-	+	-	-	-	+	+	+	-	-	-
0.382	-	-	-	-	+	-	-	-	-	-	-	-
0.410	-	-	-	+	-	+	-	+	-	-	+	+
0.457	+	+	+	-	+	-	-	-	-	+	-	-
0.571	-	-	-	-	-	-	-	-	+	-	-	-
0.575	-	-	-	-	-	-	-	-	-	-	+	-
0.581	-	-	-	-	+	-	-	-	-	-	-	-
0.621	-	-	-	+	-	-	-	-	-	-	-	-
0.755	-	-	-	-	-	-	-	-	-	-	-	+
0.767	-	-	-	-	-	-	-	-	-	-	+	-
0.789	+	+	+	+	+	+	+	+	+	+	-	-
0.873	+	+	+	+	+	+	+	+	+	+	+	+

+= present bands -= absent bands

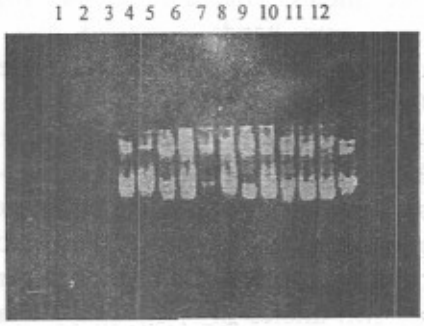
Table 8. Esterase (Est) extracted from the leaves of the six faba bean genotype.

R.F	Genotype											
	Giza 40		Misr 1		x-1714		x-1720		Giza843		x-1671	
	Infested	Free	Infested	Free	Infested	Free	Infested	Free	Infested	Free	Infested	Free
0.051	-	-	-	+	-	-	-	-	-	-	-	-
0.076	-	-	-	-	-	-	+	+	-	-	+	+
0.159	+	+	+	+	+	+	+	+	+	+	+	+
0.236	+	+	+	+	+	+	+	+	+	+	+	+
0.299	-	-	-	-	-	-	-	+	-	-	+	+
0.318	-	-	+	+	+	+	-	-	+	+	-	-
0.369	-	-	-	-	-	-	+	-	-	-	-	-
0.471	-	-	-	-	-	-	-	-	-	-	+	-
0.548	-	-	-	-	+	+	+	-	-	-	+	-
0.624	-	-	-	+	-	-	-	-	-	-	-	-
0.758	+	+	+	+	+	+	+	+	+	+	+	+
0.860	+	+	-	+	+	+	+	-	+	+	+	-

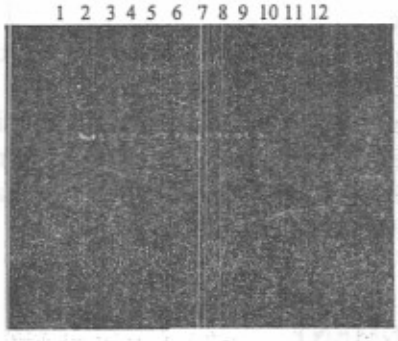
+= present bands -= absent bands



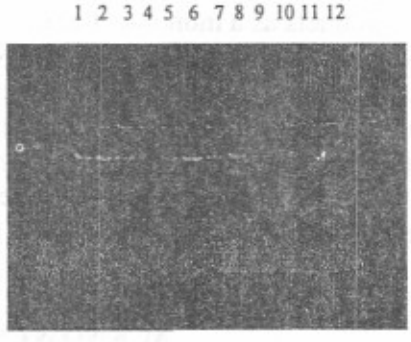
Peroxidase (Px)



Esterase (Est)



Glutamate oxaloacetate transferase (GOT)



6- phosphogluconate dehydrogenas (6- PGD)

Wherase:

1= G 40 infested, 2= G 40 free, 3= M 1 infested, 4= M 1 free, 5= x- 1714 infested, 6= x- 1714 free,
7= x- 1720 infested, 8= x- 1720 free, 9= G.843 infested, 10= G.843 free, 11= G.1671 infested and
12= G.1671 free

Fig. 1. Zygograms of four isozyme systems investigated in six faba bean genotypes under *Orbanche* - infested and *Orbanche* - free fields.

two alleles. This isozyme was a monomer and heterozygote (Table). Some bands appeared only in the tolerant genotypes that cultivated in the infested soil. these bands at R.F 0.382, 0.571, 0.675, 0.621 and 0.767.

2- **Esterase (Est):** Six zones of activity of this isozyme were detected. Est 1, Est 2, Est 3, Est 4 and Est 5 showed a monomer heterozygote represented by two alleles in some samples. Est 2 was exhibited as monomer homozygote represented as a dimmer homozygote locus with two alleles. Est 6 showed a monomer heterozygote represented by two alleles in some samples and one allele in the others. There wse differences between performance the free and infested soils as well as among the cultivars (Table 8). Some bands appeared only in the tolerant genotypes that cultivated in the infested soil, these bands at R.F 0.051, 0.076, 0.299, 0.318, 0.369 and 0.471.

3- **Glutamate oxaloacetate transferase (GOT):** Three zones of activity of this isozyme were detected. These are, GOT 1, GOT 2 and GOT 3 in three loci. All the three loci were made up of diallelic products as a monomer homozygote .

4- **phosphogluconate dehydrogenase (6- PGD):** Three zones of activity of this isozyme were detected. Those were 6- PGD 1, 6- PGD 2 and 6- PGD 3 in three loci. All the three loci were made up of diallelic products as a monomer homozygote. There were no significant differences were faba bean between the free and infested soils. Similar results have been reported by Abd El-Maksoud *et al* (2006)

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أداء ستة تراكيب وراثية من الفول البلدى فى الأرضى الخالية والمصابة بالهالوك.

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أجريت هذا البحث تحت ظروف أرض موبوءة وأخرى خالية من الهالوك بمحطة بحوث الجيزة – مركز البحوث الزراعية خلال موسمي ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ وذلك بهدف دراسة سلوك بعض التراكيب الوراثية للفول البلدي في كلا التربتين. وقد اشتملت الدراسة علي خمسة تراكيب وراثية تتحمل الإصابة بالهالوك (هجين ١٧١٤، ١٧٢٠، ١٦٧١، مصر ١و جيزة ٨٤٣) مقارنة بالصف الحساس للإصابة (جيزة ٤٠). قد أوضحت النتائج تفوق الهجينين ١٧١٤و ١٧٢٠ في صفات عدد الفرون/نبات وعدد البذور/نبات ومحصول بذور النبات فى الأرض الخالية من الهالوك، كما تفوق نفس الهجينان في صفات عدد الفروع/نبات، عدد الفرون/نبات، عدد البذور/نبات، ومحصول بذور النبات تحت ظروف الأصابة بالهالوك. كما انخفض عدد ووزن شماريخ الهالوك /م٢ على التراكيب (هجين١٧١٤ وهجين١٧٢٠ و مصر١) مقارنة بالصنف جيزة ٤٠.

و أظهرت النتائج وجود اختلافات معنوية للصفات الكيميائية و البيوكيميائية بين التراكيب الوراثية تحت الدراسة في كلا التربتين (الخالية والموبؤه)، وقد سجلت على الترتيب التراكيب الوراثية هجين ١٧١٤ و جيزة ٨٤٣ و هجين ١٦٧١ و مصر ١ أعلي قيم لنسبة البروتين، الكربوهيدرات والفينولات، في حين سجل الصنف جيزة ٤٠ أقل القيم لكل الصفات المدروسة. أظهرت نتائج تحليل التفريد الكهربي للبروتينات وجود اختلافات بين التراكيب الوراثية حيث تميزت التراكيب الوراثية المتحملة للإصابة بالهالوك بوجود بعض الحزم والتي لم تظهر في الصنف الحساس. أما بالنسبة للمشابهات الإنزيمية فقد أظهر كلا من البيروكسيديز والاستيريز اختلافا واضحا بين التراكيب الوراثية في موقع وعدد المشابه الإنزيمي حيث ظهرت بعض الحزم فى التراكيب الوراثية المتحملة ولم تظهر فى الصنف الحساس . أوضحت النتائج أن الهجين ١٧١٤ كان أفضل التراكيب الوراثية في تحمله للهالوك، لذا فان هذه الدراسة توصي باستخدام هذا الهجين في برامج تربية الفول البلدي المقاومة للهالوك.