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INVESTIGATIONS ON FABA BEANS, *Vicia faba* L. 20- SELECTION AND PERFORMANCE OF *Orobanche* TOLERANT MATERIAL UNDER DIFFERENT ENVIRONMENTS

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ABSTRACT

Twenty-four faba bean Orobanche tolerant/resistant genotypes were used for elucidating the effects of selection under 3 locations.

The experiments were conducted under the naturally Orobanche infested fields of Giza-Cairo University (G.CU), Giza-Agricultural Research Center (G.ARC) and Sids Research Station during 2001/2002, 2002/2003 and 2003/2004 seasons.

The selections of each single or all locations for one season or two seasons along with the multiplicated counterparts under insect-free cages for two seasons were evaluated under the three locations during 2003/2004 season.

Genotypes varied significantly under each location and combined over locations for all traits in the first season. Variable magnitudes of genotypic variances were recorded among locations and traits. Locations recorded higher variances followed by genotypes and interaction for all traits

Higher percentages of heritability (more than 0.75) were observed for pod- bearing plants % (G.ARC), seed yield/plant (G.ARC and Sids) and for Orobanche number (G.CU) in the first season. In the second season, higher h^2 *were calculated for pod-bearing plants% and seed yield /plant under G.ARC than those under G.CU.*

Genotypic or phenotypic coefficients of variability were parallel to the extent of variance for pod-bearing plants % and seed yield in the first season and for Orobanche number and dry weight in the second one. The expected progress varied from location to another for improving different traits.

In 2003/2004 season, selections (included selfed seed) varied highly significantly for early counting of Orobanche and host yield components under all locations. However, the variances of Orobanche numbers and dry weight at maturity were only significant under Sids location. Selections as a source of variation in combined analyses were highly significant for all traits. The genotypes x selections interaction in single analyses were significant only for early counting of broomrape, number of seeds and seed yield/host under Sids, number of pods and seeds/host under G.ARC. Thus some selected blends of some genotypes performed better than others particularly under Sids for early Orobanche counting and seed yield. Moreover, the performance differed from location to another and none of the selected materials or genotypes could be recommended as universal variety across all location. The differences between

selections along with selfed seed over all genotypes were obviously for early counting of Orobanche and the productivity of seed yield. Early counting of caged material showed significantly higher number of spikes/host than all selected blends. The bulk selected blend for two seasons significantly surpassed the yield of all specific-location blends and the bulk for one season. All of selected specific-location blends performed reliably under both Giza locations.

It could be concluded that selection for better performance of faba bean under Orobanche was effective in some locations than others. The bulk selected blends across locations behaved better than specific-location selected blends, which strengthen the concept of uniform resistance.

Key words: ***Faba bean, Selection, Orobanche tolerance, Locations effects, Genetic advance, Heritability***

INTRODUCTION

Broomrape (*Orobanche crenata)* is an annual obligatory parasitic plant on faba bean that causes severe losses and may result in crop failure. Yield losses vary according to host genotype, level of parasitism, sowing date, soil moisture and many other factors as reviewed by Abdalla and Darwish (2002). Therefore, the control of broomrape will help to improve the production and stability of faba bean yield. Unfortunately the majority of known control methods do not offer satisfactory results to control this parasitic weed and in some cases the problem tends to be catastrophic. Breeding resistant /tolerant genotypes may provide a reliable measure of production against *Orobanche* (Nassib *et al* 1982, Abdalla 1982, Darwish 1987, Radwan *et al* 1988a and b, Abdalla and Fischbeck 1992b, Abdalla and Darwish 1994, 1996a, 1996b and 1999, Khalil *et al*1994 and Saber *et al* 1999).

Selection of faba bean for resistance/tolerance to *Orobanche* may be effective for upgrading varietal performance (Nassib *et al* 1979, Darwish 1987, Radwan *et al* 1988a, Perrino *et al* 1988, Cubero and Hernandez 1991, Abdalla and Fischbeck 1992, Fadel 1994, Abdalla and Darwish 1996a, Sillero *et al* 1996b, Abdalla and Darwish 1999). However, the performance of selected material fluctuated among environments. The host genotype, environmental conditions and interaction were highly significant sources of variation in faba beans behaviour across broomrape fields (Darwish 1992 and 1996, Attia 1988, Abdalla *et al* 1998).

The *Orobanche* geographic parasitic races/biotypes that have variable parasitic capabilities may represent great obstacles to selection efficiency and stability of tolerant faba bean varieties (Fischbeck *et al* 1986, Darwish 1987, Radwan *et al* 1988b). Therefore, the selection under different environments and variable geographic *Orobanche* populations may affect the performance and the level of tolerance under a wide range of locations that build up the uniform resistance (Abdalla and Darwish 1999).

Thus the present investigation dealt with the effects of selection within different twenty-four *Orobanche*-tolerant faba bean genotypes under different locations for upgrading performance across these environments.

MATERIALS AND METHODS

Materials

Twenty-four faba bean selected genotypes for *Orobanche* tolerance/resistance along with the susceptible variety (Giza 2) were used (Table 1). These genotypes included four recommended improved varieties and 15 selections from these varieties in addition to 5 families selected from Egyptian landraces from the materials of Cairo University (Abdalla and Darwish 1999).

Table 1. Code, pedigree and sources of the investigated genotypes.

No.	Code	Pedigree	*Orobanche* reaction
1	Giza 843	561/2076/85 Sakha x 461/845/83*	Tolerant
2	Misr 1 (667)	Giza 3 x 123A/45/76(667) *	
3	Giza 429	Selection from Giza 402*	
4	Misr 2	Selected from Italian materials (Yousef El-Seddik,Y.S)*	
5	Giza 2	Individual selection from landraces*	Susceptible
6	843/27	Selected families from Giza 843 in 2000/2001 season*	Tolerant
7	843/34		
8	843/41		
9	843/83		
10	843/103		
11	843/180		
12	667/85	Selected families from Misr 1 in 2000/2001 season*	
13	667/88		
14	667/91		
15	667/121		
16	667/124		
17	667/129		
18	667/141		
19	L.377/4 (Y.S)	Individual selection from (Y.S)*	
20	L.377/2 (Y.S)		
21	9 HYTO	Individual selection from Egyptian landraces**	Tolerant
22	18 HYTO		
23	21 HYTO		
24	23 HYTO		
25	24 HYTO		

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Methods

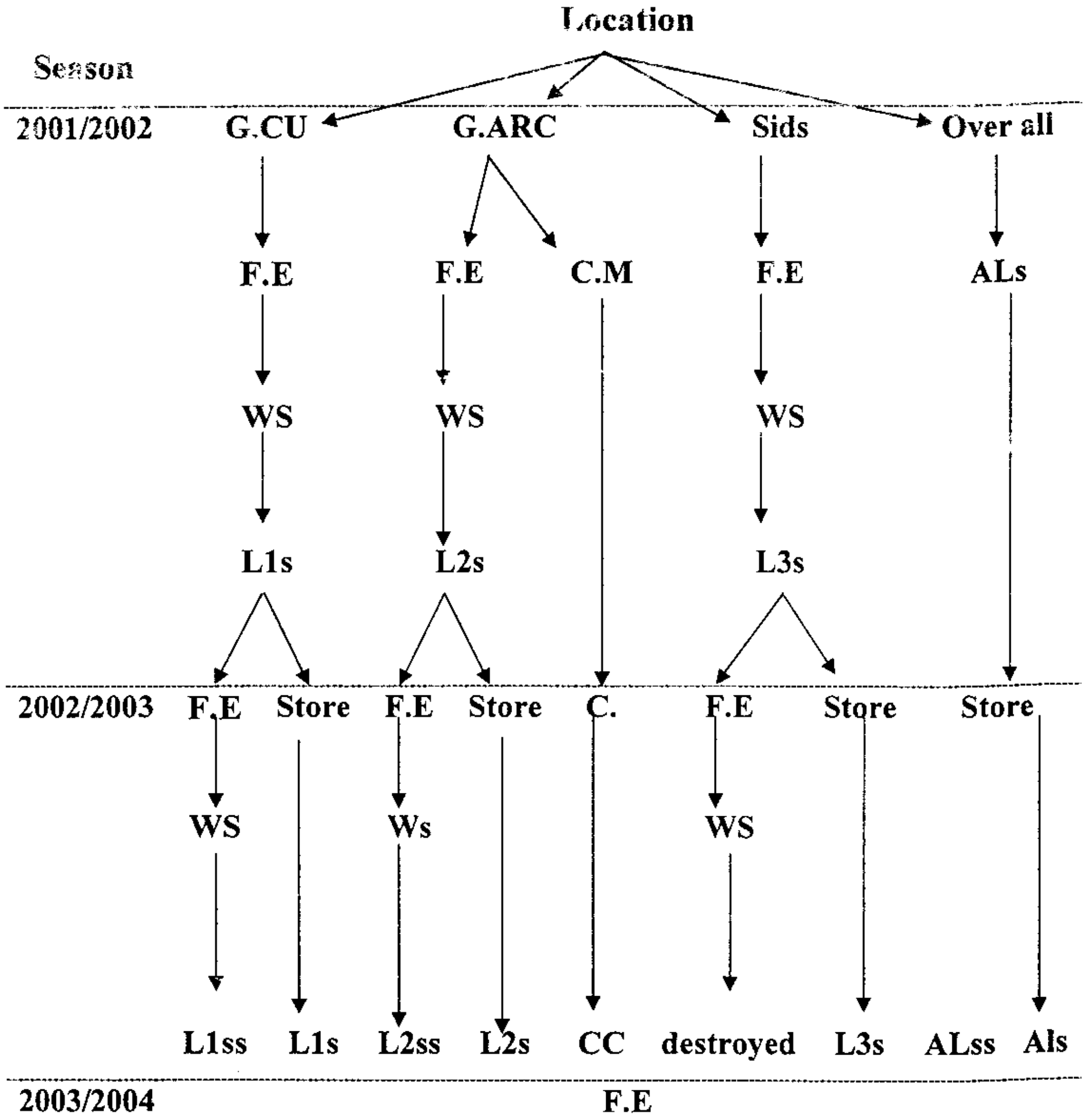
The experiments were conducted under the naturally *Orobanche* infested fields of Giza-Cairo University (G.CU), Giza-Agricultural Research Center (G.ARC) and Sids Research Station (Sids) during 2001/2002, 2002/2003 and 2003/2004 seasons.

In the 1st and 2nd seasons, the 25 genotypes were evaluated under each of the three locations. In each location, a RCBD with 6 replications was conducted. To avoid heterogeneous distribution of the seeds parasite infestation, small plots with more replications were adopted. Thus, each genotype/selection was represented in each replication by two ridges, each was 1.5 m long and 60 cm apart. The seeds were hand planted in one side of the ridge using single-seed hills with 20 cm distances. Normal recommendations of faba bean practices were followed.

At harvest, the bordered plants in each plot were considered for collecting data. The harvested hosts were classified into podless and pod-bearing two categories and the number of plants/each class were determined. The number and the dry weight of *Orobanche* spikes/host as well as seed yield/host were recorded individually. The plot base means were considered for statistical analyses. In such analyses proper transformation, arc sin for pod-bearing plants % and log (x +1) for parasite attributes were used (Darwish 1991b). Due to the early death of Giza 2 susceptible plants in all fields, it was excluded from the analyses of variance.

Selection and blending procedures

The best yielded two host/plants of each genotype in each replicate (as 28.6% of sown plants) were considered for constructing the selected blends either in each location or across all locations in the given season (Fig.1). In this situation, under 1st season, two fixed numbers of seeds were taken from each selected plant belonged to the same genotype for composing two selected blends of the genotype represented each location G.CU, G.ARC and Sids as L1s, L2s and L3s, respectively. One of these blends was used for field evaluation during 2002/2003 season but the other one was stored for 2003/2004-evaluation season. However, another 5 seeds represented each of selected plants belonged to the genotype in all locations were used for forming the selected blend of the genotype over all locations (ALs), which was stored for evaluation during 2003/2004 season.



F.E: Field evaluation, WS: Within selection, C.M: Cage multiplication.

Fig.1. Sequences of experiments during 2001/2002, 2002/2003 and 2003/2004 seasons.

In the second season, the selected blends of each genotype harvested in each location were sown for field evaluation under the same location. Similar experimentation and selection procedures were repeated except for the plants of Sids location that were destroyed near harvest. Thus selections from this trial couldn't be continued. The susceptible genotype (Giza 2) was sown from commercial seeds each experiment.

In 2003/2004 season, the selection of each single or all locations for one season (L1s, L2s, L3s and ALs) or two seasons (L1ss, L2ss and ALss) along with the multiplicated counterparts under insect-free cages for two seasons (CC) of all investigated tolerant genotypes were evaluated under the three locations. In each location the RCBD with 3 replications in split plot arrangement was conducted. Faba bean tolerant genotypes were assigned to main plots and selected blends were distributed in sub-plots. Each sub-plot consisted of 2 ridges; each 1.5 m long and 60 cm apart. Seeds were hand planted at one side of the ridge in single-seed hills distanced 20 cm.

The sowing dates of all experiments were during the second 10 days of November. Recommended cultural practices of faba bean production were adopted.

RESULTS AND DISCUSSION

Variation and performance of selections during 2001/2002 and 2002/2003 seasons

Highly significant variances were recorded for genotypes under each location and combined over locations for all tabulated traits in the first season (Table 2). In this season, variable magnitudes of genotypic variances were recorded among locations and traits. The pod bearing plants % under G.CU showed the highest estimate of variance (508.6), which was as 2 folds and 3 folds as higher of G.ARC and Sids, respectively.

However, variances of seed yield/ plant of G.ARC was the highest (520.66) compared to the other two locations (103.83 and 390.83 in G.CU& Sids, respectively). In spite of genotypes under G.CU showed the highest mean squares for number of *Orobanche* spikes (0.47), broomrape dry weight / host was highest (0.38) in Sids location. This indicates that locations affected variably the traits of tolerant faba bean genotypes. Such influence of locations may be attributed to the environmental changes and/or the geographic-*Orobanche* populations capabilities that differed from field to another (Fischbeck *et al* 1986, Darwish 1987 and Radwan *et al* 1988b).

Table 2. Significance of mean squares due to different sources of variation for studied traits in each location and combined over locations during 2001/2002 and 2002/2003 seasons.

Traits	S.O.V		d.f	2001/2002			d.f	2002/2003	
				G.CU	G.ARC	Sids		G.CU	G.ARC
Pod-bearing plants % [Arc, sin]	Genotype (G)		23	508.63**	278.11**	184.03**	23	324.52ns	165.29ns
	Error		115	180.80	4.99	93.94	115	334.77	71.27
	Combined	Location (L)	2	4167.28*			1	46144.59**	
		Error	15	1240.25			10	365.58	
		Genotype (G)	23	543.15**			23	251.75ns	
		(G) X (L)	46	213.81**			23	238.06ns	
		Error	345	93.24			230	203.02	
Seed yield / plant (g)	Genotype (G)		23	103.83*	520.66**	390.83**	23	155.17*	41.58**
	Error		115	58.56	51.26	151.32	115	94.34	15.90
	Combined	Location (L)	2	12159.49**			1	3231.37**	
		Error	15	387.61			10	100.92	
		Genotype (G)	23	663.59**			23	114.52**	
		(G) X (L)	46	185.34**			23	82.22ns	
		Error	345	87.67			230	55.12	
Number. of *Orobanche*. Spikes/plant Log(x+1)	Genotype (G)		23	0.47**	0.27**	0.26**	23	0.28ns	0.24ns
	Error		115	0.12	0.12	0.11	115	0.20	0.25
	Combined	Location (L)	2	19.03**			1	12.54**	
		Error	15	0.31			10	0.51	
		Genotype (G)	23	0.46**			23	0.26ns	
		(G) X (L)	46	0.27**			23	0.27ns	
		Error	345	0.12			230	0.23	
Orobanche dry weight/plant (g) Log(x+1)	Genotype (G)		23	0.32**	0.30**	0.38**	23	0.21ns	0.33ns
	Error		115	0.10	0.15	0.18	115	0.16	0.34
	Combined.	Location (L)	2	7.52**			1	35.12**	
		Error	15	0.55			10	0.90	
		Genotype (G)	23	0.41**			23	0.27ns	
		(G) X (L)	46	0.30**			23	0.27ns	
		Error	345	0.14			230	0.25	

*&**indicate significant at 5% and 1% levels, respectively.

G.CU= Giza location of Cairo University. G.ARC=Giza location of Agric. Res. Center.

In combined analyses over locations 2001/2002 season, locations recorded higher variances followed by genotypes and interaction for all traits. This proved that the effects of location's conditions were pronounced than those of other sources. The ratios of locations to genotypes variances were 8, 18, 41 and 18 for pod-bearing plants%, seed yield/plant, number of *Orobanche* and *Orobanche* dry weight/plant, respectively.

However, such ratio of location to genotypes (G) x locations (L) interaction was 20, 66, 71, and 25, for the same order. This proved that the location affected the performance of studied faba bean host's traits under *Orobanche* infestation more than genotypic effects or G.L interaction. This is frequently observed in faba bean reaction to *Orobanche* parasitism (Darwish 1987, Radwan *et al* 1988b, Radwan and Darwish 1991, Darwish 1991a and b, Abdalla and Fischbeck 1992, Abdalla and Darwish 1994 & 1998 and Flores *et al* 1996). Such great effect of location may have been, the product of climatic and edaphic changes as well as parasitism differences of broomrape populations and interactions.

In 2002/2003 season the single location analyses revealed significance mean squares of genotypes only for pod-bearing plants % in G.ARC and for seed yield/plant in both locations G.C.U and G.ARC (Table 2). Likewise genotypes as a source of variation in combined analyses over both locations were significant only for seed yield/plant. Moreover, mean squares due to G.L lacked significance for all studied traits. However, locations still offered considerable highly significant variations for all traits, though the two neighboring locations were considered, i.e. G.CU and G.ARC. The insignificance of genotypes attributed the hampering of variation by selection

The performance of studied genotypes showed variable means for traits among locations and seasons (Table 3). The 50 % of grown hosts were lost due to *Orobanche* infestation in the G.ARC trial, which was significantly higher than the other two locations; (≅38%) of season 2001/2002. However, the mean of seed yield/plant was significantly higher under Sids location (37.1 g) than other two Giza locations (18.8 & 28.0 g). This may be due to the highest detected level of infestation (18.5 broomrape/host) in G.CU and 7.8 in G.ARC compared to 2.7 in Sids, respectively.

Table 3. Parameters of phenotypic and genotypic variation of 24 faba bean tolerant genotypes within each location as well as heritability and the percent of genetic advance due to selecting the best 20%.

Trait	S.	Location	Mean*	Range	δ^2g	δ^2ph	h^2	G.C.V%	P.C.V%	Gs
Pod bearing hosts %	2001/2002	G.CU	62.1 a	47.6-85.7	54.64	84.77	0.64	13.49	16.80	8.31
		G.ARC	50.2 b	28.6-71.4	45.52	46.35	0.98	14.92	15.06	9.36
		Sids	63.9 a	50.0-81.0	15.02	30.67	0.49	7.17	10.24	3.80
		Combined	58.8	48.4-75.4	18.30	43.57	0.42	8.35	12.88	3.88
	2002/2003	G.CU	76.9 A	52.4-92.9	14.30	86.60	0.17	5.72	14.07	2.15
		G.ARC	42.7 B	28.6-61.9	15.67	27.55	0.57	9.69	12.85	4.18
		Combined	59.8	42.9-66.7	1.14	23.90	0.05	2.00	9.14	0.33
Seed yield / host (g)	2001/2002	G.CU	18.8 c	10.0-27.0	7.55	17.30	0.44	14.61	22.13	2.54
		G.ARC	28.0 b	9.9-51.4	78.23	86.78	0.90	31.59	33.27	11.76
		Sids	37.1 a	24.4-58.3	63.25	65.14	0.97	21.32	21.64	10.97
		Combined	27.9	19.2-42.7	26.57	47.72	0.56	18.48	24.76	5.38
	2002/2003	G.CU	39.9 A	26.5-45.4	10.14	25.86	0.39	7.98	12.75	2.79
		G.ARC	33.2 B	29.0-40.0	4.28	6.93	0.62	6.23	7.93	2.28
		Combined	36.6	27.0-40.7	2.69	11.80	0.23	4.48	9.39	1.10
Number of *Orobanche* spikes//host	2001/2002	G.CU	18.5 a	5.2-39.3	0.06	0.08	0.75	20.13	23.30	0.29
		G.ARC	7.8 b	1.7-14.2	0.02	0.04	0.54	19.47	26.60	0.16
		Sids	2.7 c	0.0-5.8	0.03	0.04	0.59	34.49	45.08	0.17
		Combined	9.6	4.6-18.1	0.01	0.04	0.25	12.56	25.03	0.07
	2002/2003	G.CU	8.8 B	2.5-20.2	0.01	0.05	0.28	14.81	28.16	0.08
		G.ARC	25.2 A	13.8-44.7	0.00	0.04	0.00	0.00	16.16	0.00
		Combined	16.9	9.7-24.8	0.00	0.02	0.00	0.00	15.55	0.00
Orobanche dry weight/host (g)	2001/2002	G.CU	10.9 b	3.6-22.1	0.04	0.05	0.69	19.34	23.36	0.22
		G.ARC	10.7 b	3.2-21.1	0.03	0.05	0.51	17.94	25.08	0.16
		Sids	4.6 a	0.0-11.2	0.03	0.06	0.52	32.03	44.21	0.19
		Combined	8.8	1.0-16.2	0.01	0.04	0.16	9.71	24.32	0.04
	2002/2003	G.CU	6.6 B	3.2-11.7	0.01	0.03	0.24	13.42	27.18	0.06
		G.ARC	48.1 A	21.5-87.5	0.00	0.06	0.00	0.00	16.16	0.00
		Combined	27.3	14.5-46.2	0.00	0.02	0.01	0.00	14.60	0.00

*Small letters compared means with first season and capital ones for second season

In spite of more than two folds high of *Orobanche* numbers/host in G.CU as recorded in G.ARC, similar dry weight of the parasite/host occurred (≅10.7 g). Therefore, the number of *Orobanche* seemed to be the most effective factor that affected both of pod-bearing hosts and seed yield. Although least number of *Orobanche*/host (2.7) was recorded under Sids location, but similar percentages of pod–bearing plants (≅63.9%) were produced as detected with highest number of *Orobanche* spikes/host (18.5). in G.CU location Thus, the effect of *Orobanche* on faba bean hosts as pod-bearing plants % or seed yield/plant may also be due to aggressiveness of geographic parasite populations and dominated environmental effects in addition to number and dry weight of the parasite.

In the second season less percentages of unpodded hosts (23.1%) corresponded with higher seed yield/plant (39.9 g) and lower parasite number (8.8) and dry weight (6.6 g) were observed in G.CU than G.ARC (57.3%, 33.2 g,25.2 and 48.1 g, respectively). Again the number and dry weight of *Orobanche* seemed to affect the host performance. Needles to report that both trials were carried out in adjacent locations with minor in any environmental differences.

The magnitude of estimated genotypic (δ^2_g) and phenotypic (δ^2_{ph}) variances among the tested genotypes were least in Sids for pod- bearing plants% (15.0 & 30.7), in G.CU for seed yield/plant (7.6 & 17.3) and under G.ARC and Sids for *Orobanche* number (0.02 & 0.03) compared to other location/s in the first season. However, under the conditions of the second season, the G.ARC location gave inferior genotypic variance (δ^2_g) for seed yield (4.28) and parasite (0.00) traits. This trend was true concerning phenotypic variance (δ^2_{ph}) only for pod-bearing plants and seed yield, not for parasite measures. Such inconsistent magnitudes of both δ^2_g and δ^2_{ph} between locations and seasons reflected in different estimates of heritability percentages.

Highest percentages of heritability (more than 0.75) were observed for pod- bearing plants % (G.ARC), seed yield/plant (G.ARC and Sids) and for *Orobanche* number (G.CU) in the first season. In the second season, higher h^2 were calculated for pod-bearing plants% (0.57) and seed yield /plant (0.62) under G.ARC than those under G.CU (0.17 & 0.39 respectively). However, *Orobanche* traits in the G.ARC location lacked genotypic variance.

Genotypic (G.C.V%) or phenotypic (P.C.V%) coefficients of variability were parallel to the extent of variance for pod-bearing plants % and seed yield in the first season and for *Orobanche* number and dry weight in the second one. Such parallism between variance and the coefficients of variability (Table 3) were disturbed in other cases, due to proportionality of means with variances that occurred for number and dry weight of *Orobanche*/host in the first season.

The expected genetic advance due to selecting the top 20% of the genotypes were parallel to estimated heritability and phenotypic variance. Such trend was obvious for studied traits in both seasons except pod-bearing plants % in the first season and seed yield in the second season (Table 3). Pod-bearing plants% recorded descending δ^2_g magnitude 84.8 (G.CU), 46.4 (G.ARC) and 30.7(Sids), whereas corresponding h^2 were 0.64, 0.98 and 0.49, respectively. Such inconsistency between both estimates particularly in the first two locations reflected in similar Gs in both locations for pod-bearing plants%. Likewise estimates of seed yield/plant in the second season showed similar trend. However, in this regard, the expected progress of selection was generally higher in the first season than second one. This may be that the material used in second season was selected from those of the first one.

The genotypic variance in both seasons (Table 3) proved that the practiced selection exhausted the genotypic variance among the investigated genotypes. On the other hand the expected progress varied from location to another for improving different traits. Reliable advances could be expected from selection for pod-bearing plants% in G.CU and G.ARC, seed yield in G.ARC and Sids and *Orobanche* infestation in G.CU. Selection based on combined analyses reflected in less-expected gain than based on single environmental analyses. This may be attributed to the ability of combined analyses in extracting the G.E interaction, which inflated the detected genotypic variance in single location analyses.

Variation and performance of selections in 2003/2004 season

As mentioned, each of the investigated genotypes was represented in third season by seven selections from either each location or bulk of all locations (for one season or two seasons) except Sids in addition to the selfed seeds for two generations from caged materials (Table 4).

Table 4. Significance of mean squares due to different sources of variation of evaluating the eight selections belonged to 24-genotypes under each location and combined over locations for some of studied traits during 2003/2004 season.

Traits	S.O.V	Genotypes(G)	Error	Selections (S).	(G)x(S)	Error
	d.f	23	46	7	161	336
Early counting of *Orobanche* spikes/plant	G.CU	0.27**	0.37	1.10**	0.11**	0.06
	G.ARC	0.85**	0.34	0.31**	0.11 ns	0.14
	Sids	0.23**	0.11	0.24**	0.08 ns	0.07
Late counting of *Orobanche.* spikes/plant	G.CU	0.34**	0.1	0.27ns	0.16ns	0.16
	G.ARC	1.50*	0.77	0.22ns	0.13ns	0.13
	Sids	0.40*	0.20	1.35**	0.14ns	0.13
Orobanche dry weight/plant (g)	G.CU	0.40*	0.18	0.20ns	0.16ns	0.18
	G.ARC	3.00*	1.62	0.35ns	0.20ns	0.22
	Sids	0.40ns	0.25	2.00**	0.15ns	0.16
No. of pods /plant	G.CU	330.80**	147.20	3669.50**	104.90ns	110.80
	G.ARC	199.41*	114.68	1949.35**	50.05**	28.56
	Sids	387.38**	97.67	2087.72**	32.06ns	26.53
No. of seeds/plant	G.CU	2619.50**	1127.10	28964.10**	835.30ns	858.40
	G.ARC	1610.59ns	1107.54	16721.70**	356.70**	269.13
	Sids	400.66**	1516.22	20340.70**	347.85**	233.81
Seed yield/plant (g)	G.CU	1180.93**	517.70	14399.50**	439.90ns	416.20
	G.ARC	1271.3 ns	795.80	9212.70**	257.28ns	249.70
	Sids	1986.30**	887.67	8526.64**	191.57**	137.53

	Combined								
	Locations.	(G)	(G) x (L)	Error	(S)	(S) x (L)	(G) x (S)	(G) x (S)x (L)	Error
df	2	23	46	138	7	14	161	322	1008
Early counting of *Orobanche* spikes/plant	17.646**	0.42**	0.46**	0.16	0.98**	0.33**	0.09ns	0.10**	0.08
Late counting of *Orobanche.* spikes/plant	33.72**	0.75**	0.74**	0.36	0.70**	0.57**	0.14ns	0.14ns	0.14
Orobanche dry weight/plant (g)	110.40**	1.38**	1.20**	0.68	1.49**	0.53**	0.17ns	0.17ns	0.19
No. of pods /plant	22296.90**	276.90**	320.30**	119.90	7126.70**	289.90**	63.25ns	61.87ns	55.28
No. of seeds/plant	122936.61**	2722.92**	2754.93**	1250.29	60973.43**	2526.53**	506.74ns	516.55ns	460.46
Seed yield/plant (g)	5540.21**	1061.64 ns	1663.70**	732.66	29046.77**	1586.28**	287.89 ns	296.35 ns	266.70

Ns,* & ** indicate insignificant, significant at 5% and significant at 1% levels of probability, respectively.

Genotypes significantly varied under each of the three locations for all traits except the early counting of *Orobanche* (at day 95 from sowing) and dry weight of *Orobanche* (at harvest) under Sids location and for seeds and seed yield/plant under G.ARC location. However, genotypes were highly significant source of variation for all traits in combined analyses over locations (Table 4).

Various selections (included selfed seed) varied highly significantly for early counting of *Orobanche* and host yield components under all locations. However, the variances of *Orobanche* numbers and dry weight detected at maturity were only significant under Sids location. On the other hand, the component selections in combined analyses exhibited highly significant mean squares for all traits.

The genotypes x selections interaction in single-location analyses were significant only for early counting of broomrape and number of seeds and seed yield/plant under Sids, number of pods and seeds/plant under G.ARC. Such interactions mean squares of combined analyses over location were insignificant for all traits.

The means of locations showed that G.ARC recorded significantly higher *Orobanche* spikes either in early counting (4.7) or late one (12.6) than other two locations (Table 5). In spite of both G.CU and Sids locations recorded similar early infestation levels (≅1.3), the G.CU showed about 2 folds higher (6.9) as recorded as in Sids (3.7) at late counting. Sids location produced significantly the lowest seed yield/host (29.1 g) than other locations (39.6 and 48.6).

The result proved that some selected blends of some genotypes performed better than others particularly under Sids for early *Orobanche* appearance and seed yield. Moreover, the performance of genotypes differed from location to another and none of the selected materials or genotype could be recommended as universal variety for all locations.

The differences between selections along with selfed seed over all genotypes and selections were obvious for early counting of *Orobanche* and seed yield (Table 5). Early counting of caged material showed significantly higher spikes/host (4.7) than all selected blends. But the late counting of broomrape did not obviously distinguished selfed plants from selected ones. However, similar view like early counting was detected for seed yield which resulted in about quarter yield of open selected blends. Such behaviour of caged multiplicated material could be referred to inbreeding effects. This inbreeding may have uncovered and/or fixed some of recessive genes

Table 5. Performance of the eight selections under each location and combined over locations for some studied traits during 2003/2004 season.

Selections	Early counting of *Orobanche* spikes/host*			Combined.	Late counting of *Orobanche* spikes/host*			Combined	Seed yield/ host (g)			Combined.
	GCU	GARC	Sids		GCU	GARC	Sids		GCU	GARC	Sids	
ALS	1.9 b	4.5 b	1.1 b	2.4 b	7.2ab	16.3a	5.9a	9.8a	52.1ab	49.1a	39.2b	46.8b
L1S	1.6 b	4.1 b	1.6 b	2.4 b	6.2ab	12.1ab	2.6bc	7.0b	50.3b	45.1ac	29.9c	41.8c
L2S	1.3 b	4.6 b	0.9 c	2.3 b	6.7ab	11.9ab	2.3bc	7.0b	54.7ab	41.4cd	26.8c	41.0c
L3S	1.5 b	4.5 b	0.8 c	2.2 b	6.7ab	11.3b	3.9ab	7.3ab	53.9ab	39.4d	26.6c	40.0c
ALSS	1.3 b	3.9 b	1.3 b	2.2 b	5.9b	12.2ab	4.6a	7.5ab	57.1a	46.9ab	46.2a	50.1a
L1SS	1.7 b	4.6 b	1.6 b	2.6 b	6.8ab	10.9b	5.3a	7.7ab	52.2ab	42.1bd	27.0c	40.4c
L2SS	1.8 b	4.4 b	0.8 c	2.3 b	7.3ab	12.4ab	2.3c	7.3ab	54.2ab	40.2cd	27.9c	40.8c
CC	4.8 a	7.1 a	2.2 a	4.7 a	8.6a	13.3ab	3.1c	8.4ab	13.9c	12.9e	8.7d	11.9d
Mean	1.9 B	4.7 A	1.3 B		6.9B	12.6A	3.7C		48.6A	39.6B	29.1C	

- Means followed by the same letter are not statistically differed in the same location.

*Actual data are tabulated but significant differences were estimated from transformed values

-Capital letters indicate significant between location's means.

(Abdalla 1982, Darwish 1991c and Abdalla and Fischbeck 1992). The bulk selected blend for two seasons significantly surpassed the yield of all specific-location blends and the bulk one for one season. Abdalla (1976) found that selected bulks were mostly better yielders than selected unbulked genotypes. All of selected specific-location blends performed reliably under both Giza locations. But under Sids the selected bulk blend for two seasons (ALss) gave significantly the highest yield (46.2 g) followed by corresponding blend of one season (ALs), 39.2 g. None of the specific location selected blends yield better than other under Sids.

It could be concluded that selection for better performance of faba bean under *Orobanche* field was effective in some locations than others. The bulk selected blends across locations behaved better than specific-location selected blends, which strengthen the concepts of heterogeneity and uniform resistance. These concepts were recommended and adopted suggested for building *Orobanche* tolerant faba bean varieties (Abdalla and Darwish 1999 and 2002).

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دراسات على الفول البلدى
٢٠-الإنتخاب لتحمل الهالوك وأداء المنتخبات في البيئات المختلفة

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أجريت التجارب الحقلية لهذة الدراسة فى ظروف العدوى الطبيعية بالهالوك فى ثلاث مواقع (كلية الزراعة-جامعة القاهرة، مركز البحوث الزراعية بالجيزة، محطة بحوث سدس) خلال المواسم ٢٠٠١/٢٠٠٢، ٢٠٠٢/٢٠٠٣، ٢٠٠٣/٢٠٠٤. حيث تم إنتخاب وتقييم منتخبات ٢٤ تركيب وراثى فى كل موقع وكذلك الثلاث مواقع لمدة موسم واحد أو موسمين بالاضافة الى بذورنفس التراكيب الوراثية المنتجة تحت الشباك المانعة للحشرات الملقحه لمدة موسمين فى نفس المواقع خلال الموسم ٢٠٠٣/٢٠٠٤ .

أظهرت النتائج معنوية التراكيب الوراثية فى كل موقع وفوق جميع المواقع لجميع الصفات، كانت المواقع فى التحليل التجميعي عالية المعنوية وأظهرت قيم التباين أعلى قيمة للمواقع تلاها التراكيب الوراثية وتفاعلها مع المواقع.

كانت نسبة التوريث عالية (اكثر من ٧٥ %) للنسبة المئوية للنباتات الحاملة للقرون (الجيزة) والمحصول/نبات (الجيزة، سدس) وأيضا لعدد الهالوك/نبات (كلية الزراعة) فى الموسم الأول فى حين فى الموسم الثاني كانت نسبة التوريث للنسبة المئوية للنباتات الحاملة للقرون ومحصول النبات(الجيزة) اعلى منها فى تجارب كلية الزراعة.

أظهر معامل الاختلاف الوراثي والظاهري طردية مع قيمة التباين للنسبة المئوية للنباتات الحاملة للقرون ومحصول النبات فى الموسم الأول ولصفات الهالوك فى الموسم الثاني وإختلفت قيم التحسين المتوقع بالانتخاب للصفات المختلفة باختلاف المواقع.

أظهرت تجارب التقييم النهائية لكافة المنتخبات والبذور التى تم إكثارها تحت الشباك المانعة للحشرات الملقحة فى الموسم ٢٠٠٣/٢٠٠٤ تباينا عالي المعنوية للعد المبكر للهالوك وكذلك لمحصول النبات فى جميع المواقع. وكان التباين معنويا لعدد ووزن الهالوك عند النضج فقط فى سدس فى حين كان التباين الراجع للمنتخبات عالي المعنوية لجميع الصفات المدروسة فى المواقع وفوق المواقع.

كان التفاعل بين التراكيب الوراثية والمنتخبات معنويا فى التحليل الفردي فقط لصفة العد المبكر للهالوك وعدد البذور ومحصول النبات فى سدس وعدد القرون والبذور فى الجيزة.

دلت النتائج أن بعض المخاليط من بعض التراكيب الوراثية سجلت سلوكا أفضل من البعض الأخر وخاصة فى سدس لصفة العد المبكر للهالوك ومحصول النبات بالإضافة إلى ذلك فقد اختلف السلوك من موقع لأخر كما انه لا يمكن التوصية بأي من المنتخبات لجميع البيئات.

هذا وقد اظهر الخليط المنتخب من أفضل نباتات جميع المواقع لموسمين زيادة معنوية فى المحصول عن تلك المنتخبة لكل موقع على حدة وكذلك أعلى من الخليط الناتج بالانتخاب فى جميع المواقع لموسم واحد.

ومما سبق يتضح أن الانتخاب لتحسين الاداء المحصولى فى الفول البلدي تحت ظروف العدوى بالهالوك يتأثر من موقع لأخر بالاضافة الى تأثيرة على تحسين مستوى الاصابة بالطفيل وان الخليط الناتج من المنتخبات من اكثر من موقع يكون سلوكه افضل من الناتج من موقع واحد.