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# EVALUATION OF TWO ADVANCED TOLERANT GENERATIONS OF FABA BEAN IN BOTH FREE AND HIGHLY INFESTED FIELDS WITH *Orobanche crenata*

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## ABSTRACT

This work was conducted in the experimental farm of Mallawy Agricultural Research Station, Agricultural Research Center, Egypt, during the two successive winter seasons of 2009/2010 and 2010 /2011 to compare the performance of 10 populations of advanced generations of faba bean in two successive cycles of selection under free infested with broomrape (*Orobanche crenata*) and compare the productivity of free fields to that resulted from highly infested fields. Ten populations already evaluated revealed from crosses between five faba bean parents of Giza-843, Giza-429, (57/721/94) Line-3, Line-4 (664/689/94) and Giza 2 and continued to $F_5$ and $F_6$ selected generations. Two cycles of selection were done on 10 $F_5$ and $F_6$ populations that exceeded Giza-843 in seed yield per plant and the results indicated surpassing 6 out of the 10 populations of the $F_5$ and $F_6$ selected families that permit to high performance populations of faba bean. The most outstanding yielding ability of faba bean populations were Giza-843 × G-429, Giza-843 × Line 3, Giza-843 × Line 4, Giza-843 × Giza-2, G-429 × Line 3 and Line 4 × Giza-2 that gave promise for high yield and make a good chance for high yield faba bean cultivars in the future. The results of $F_6$ families were similar to those of $F_5$ families where the performance of faba bean plants under heavily infested fields revealed selected populations of high seed yield that surpassed that of Giza-843 and that was represented in the first five families already mentioned and these six families gave parallel performance under free infested fields exceeded family Giza-429 × Line 4. The performance under both types of fields was clear from the highly decreased values of yield of faba bean plants grown under heavily infested fields.

Then it is rather grow faba bean in free fields than in heavily infested fields in order to attain high productivity of this important crop.

## INTRODUCTION

*Orobanche crenata* is the root parasite weed that produces devastating effects on many legume crops and has become a limiting factor for faba bean production in the Mediterranean region. The breeding for broomrape (*Orobanche*) resistance remains the most promising method of control. Resistance seems to be scarce and complex in nature, being a quantitative characteristic difficult to manage in breeding programs. Prior to the application of modern genetic techniques, it is required to obtain preliminary information concerning the genetic makeup of a given organism. Such information has traditionally been obtained by conventional methods.

Yield tests have to be performed under open field conditions in a highly and homogeneously infested plot. Because of the natural infestation of the parasite, selection between and within lines and/or segregating generations is preferable to the simple average value of any kind of index. Statistical designs should include many repetitions. It is essential to try to modify the statistical distribution rather than use averages. The expected progress in selection will always be slow, as the main characteristics involved resistance

to *Orobanche* and yield per plant that were quantitative from a genetic point of view. In spite of this difficulty, recent results show that it is feasible to combine resistance and yield in the same genotype. The conclusion of Radwan *et al*. (1988) that single plant selection is the most effective method for improving tolerance to *Orobanche crenata* gave support to such kind of work.

Improving faba bean through selection is considered to be most important way to maximize its productivity of faba bean in Egypt. Egyptians are securing an adequate supply of protein in their diet through their consumption of faba bean. Despite the pressing need for greater annual production in order to meet an increasing demand, productivity, the existing cultivars has been lately due mainly to pest attacks of the most devastating among which is the infestation with broomrape (*Orobanche crenata*). Being anoxious root parasite, broomrape represents a major constraint in the main production areas of Middle and Upper Egypt where it causes great losses in seed yield and sometimes a complete failure of the crop in endemic land. Relative resistance of faba bean plant to *Orobanche* as measured by the percentage of seed yield per plant under infestation of that of the most resistant cultivar Giza-843 were found to be under the control of genes with mainly additive effects with partial dominance for greater yield Nagat (2006) and that was in accordance with the conclusions of Khalil *et al*.,1994; Attia 1998 and Saber *et al*., 1999 and 2001. The evaluation of tolerant material under *Orobanche* –infested and *Orobanche* –free fields were investigated fields by Darwish *et al*. (1999); Abdalla and Darwish (2002), Morsy and Attia (2002), Abdalla *et al*. (2006), Darwish *et al*. (2007) and Abdalla and Darwish (2008). They concluded that there were significant differences among genotypes in most traits under study. The objectives of this study are to develop, through selection, faba bean genotypes with increased levels of resistance to broomrape.

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## MATERIALS AND METHODS

The experiments of this study were carried out at Mallawy Agricultural Research Station, ARC, Egypt in two successive winter seasons of 2009/2010 and 2010/2011. Five genotypes of faba bean (*Vicia faba* L.) were used which comprised three local varieties and two advanced breeding lines. The five genotypes were so chosen as to represent a wide range of agronomic traits as well as different levels of resistance to broomrape. The designation numbers of the five genotypes used as well as a brief description of their important characteristics are given in Table 1.

**Table 1. Designation numbers and description of the five faba bean genotypes used as parents in this study:**

| Genotypes | Pedigree | Description |
|---|---|---|
| Giza-843 | Giza-461 × 561/2076/65 | tolerant to *Orobanche* infestation |
| Giza-429 | Single plant of Giza-402 | tolerant to *Orobanche* infestation |
| Line 957/721/94 | Giza-402 × BPL582 | promising for tolerance to *Orobanche* |
| Line 664/689/94 | Giza-402 × 249/802/80 | promising for tolerance to *Orobanche* |
| Giza-2 | Selected from landraces | susceptible to *Orobanche* infestation |

Seeds of five selected $F_5$ families of each of the best 10 populations of the crosses were sown on 1st November in two types of fields, a field heavily infested with *Orobanche crenata* and the other is free against the $F_5$ bulk of each popultion and Giza-2 was used as control. A randomized complete block design with three replications was used. In each block, a plot of eight ridges was assigned to each of the 10 entries; five ridges for the five $F_5$ selected families; one ridge for the $F_5$ bulk; one ridge for the control Giza-2 and another for Giza-843. The five parents were also represented by a plot of one ridge for each parent in each block. Each ridge was two-meter long, 60-cm wide and contained 10 plants spaced 20 cm from each other. Seed yield per plant, degree of infestation, and other attributes were measured. A second cycle of selection was applied in which the best family for yield among the five $F_5$ selected families of each of the 10 populations was chosen to be advanced. In 2010/2011 season, the five parents and the 10 $F_6$ selected families were sown on 1st November as mentioned. Each parental entry was represented in each block with a plot of one ridge. As to the $F_6$ selected families, eight ridges was assigned to each of the 10 entries; five ridges for the five $F_6$ selected families; a ridge for the $F_6$ bulk of that cross, a ridge for the control Giza-2 and another for Giza-843. Each ridge was two-meter long, 60-cm wide and contained 10 plants 20 cm apart. The characters of seed yield per plant (g), number and dry weight of *Orobanche crenata* spikes per plant were measured on individual plant basis throughout the different experiments. Selection differential was measured for each population as the deviation of the mean of selected $F_6$ plants from the $F_6$ population mean. Response to selection was expressed as percentage of change in the mean of the selected families from that of bulked plants of each population.

Data were statistically analyzed according to Sendecor and Cochran (1981) and the means of each treatment were compared using LSD test at both 0.05 level of probability.

## RESULTS AND DISCUSSION

The results of yield of and its components were presented for the bulk and selected $F_5$ and $F_6$ families of each of the 10 populations grown under free infested field while the trait of yield per feddan was compared with those under heavy natural infestation of the parasite *Orobanche crenata* as follows:

**Number of pods per plant:**

Data of number of pods per plant (Table 2) with calculated responses to selection showed significant differences between populations in both bulk and selected $F_5$ and $F_6$ families where all populations of $F_5$ and $F_6$ families attained positive responses which gave promise to families of high number of pods from selection.

The best selected populations of high number of pods per plant under free infestation from $F_5$ were Giza-843 × Line 3, Giza-843 × Giza-2, Giza-429

× Giza-2, Giza-429 × Line 4 and Line 4 × Giza-2 while $F_6$ families included Giza-843 × Giza-429, Giza-843 × Line 3, Giza-843 × Giza-2, Giza-429 × Line 3, Giza-429 × Line 4, Giza-429 × Giza-2 and Line 3 × Line 4. The results obtained were encouraging to continue with six out of the ten populations Giza.843 × Giza -429, Giza-843 × Line 3, Giza-843 × Line 4, Giza-843 × Giza-2, Giza -429 × Line 3 and Giza-2 × Line 3 which they are close to attain the target of this work. Meanwhile, the results obtained from this trait permit for further response to another cycle of selection and they are in accordance with those obtained by Cubero (1983). Cubero and Fernandez (1991) Cubero (1994) Darwish (1996) Darwish *et al*. (1999), Abdalla and Darwish (2002), Morsy and Attia (2002), Abdalla *et al*. (2006), Darwish *et al*. (2007) and Abdalla and Darwish (2008).

**Table 2. Means of number of pods per plant.**

| | $F_5$ bulk | $F_5$ selected | | $F_6$ bulk | $F_6$ selected | |
|---|---|---|---|---|---|---|
| | **Mean** | **Mean** | **response** | **Mean** | **Mean** | **response** |
| **1. Giza.843 × Giza-429** | 29.60 | 31.00 | **4.73*** | 22.93 | 33.10 | **44.33*** |
| **2. Giza-843 × Line 3** | 26.40 | 32.20 | **21.97*** | 22.17 | 34.57 | **55.94*** |
| **3. Giza-843 × Line 4** | 30.00 | 32.60 | **8.67*** | 23.17 | 28.67 | **23.74*** |
| **4. Giza-843 × Giza-2** | 20.87 | 24.20 | **15.97*** | 18.33 | 23.00 | **25.46*** |
| **5. Giza-429 × Line 3** | 27.00 | 29.80 | **10.37*** | 23.33 | 31.33 | **34.29*** |
| **6. Giza-429 × Line 4** | 24.40 | 28.00 | **14.75*** | 16.83 | 23.40 | **39.01*** |
| **7. Giza-429 × Giza-2** | 14.80 | 17.20 | **16.22*** | 12.67 | 16.00 | **26.31*** |
| **8. Line 3 × Line 4** | 13.00 | 14.47 | **11.28*** | 11.00 | 13.00 | **18.18*** |
| **9. Line 3 × Giza-2** | 23.80 | 25.00 | **5.04*** | 23.00 | 25.00 | **8.70*** |
| **10. Line 4 × Giza-2** | 17.20 | 22.00 | **27.91*** | 12.67 | 17.67 | **39.47*** |
| **Mean** | **22.71** | **25.65** | **13.69*** | **18.61** | **24.57** | **31.54*** |
| **LSD at $_{0.05}$** | **1.94** | | | **1.30** | | |

**Table 3. Means of number of seeds per plant.**

| | $F_5$ bulk | $F_5$ selected | | $F_6$ bulk | $F_6$ selected | |
|---|---|---|---|---|---|---|
| | **Mean** | **Mean** | **response** | **Mean** | **Mean** | **response** |
| **1. Giza.843 × Giza-429** | 73.00 | 83.67 | **14.61*** | 82.00 | 90.67 | **10.57*** |
| **2. Giza-843 × Line 3** | 73.67 | 83.67 | **13.57*** | 78.67 | 88.67 | **12.71*** |
| **3. Giza-843 × Line 4** | 77.33 | 84.67 | **9.48*** | 84.33 | 91.67 | **8.70*** |
| **4. Giza-843 × Giza-2** | 57.00 | 65.33 | **14.62*** | 62.33 | 69.33 | **11.23*** |
| **5. Giza-429 × Line 3** | 69.00 | 77.00 | **11.59*** | 76.67 | 83.00 | **8.26*** |
| **6. Giza-429 × Line 4** | 63.00 | 71.33 | **13.23*** | 66.00 | 79.00 | **19.70*** |
| **7. Giza-429 × Giza-2** | 46.67 | 52.00 | **11.43*** | 48.33 | 56.00 | **15.86*** |
| **8. Line 3 × Line 4** | 52.00 | 54.00 | **3.85*** | 51.33 | 57.33 | **11.69*** |
| **9. Line 3 × Giza-2** | 58.00 | 62.67 | **8.05*** | 59.00 | 72.67 | **23.16*** |
| **10. Line 4 × Giza-2** | 52.00 | 60.00 | **15.38*** | 53.67 | 63.00 | **17.39*** |
| **Mean** | **62.17** | **69.43** | **11.58*** | **66.23** | **75.13** | **13.93*** |
| **LSD at $_{0.05}$** | **1.51** | | | **2.38** | | |

**Number of seeds per plant:**

Results of number of seeds per plant presented in **Table 3** showed that all populations of $F_5$ and $F_6$ families attained positive significant responses which gave promise to families of high number of seeds from selection.

The highest seed numbers per plant from $F_5$ selected populations under free infestation with orobanche were Giza-843 × Giza-429, Giza-843 × Line 3, Giza-843 × Giza-2, Giza-429 × Giza-2, Giza-429 × Line 4 and Line 4 × Giza-2 while the most outstanding populations of highest seed number per plant

resulted from $F_6$ selected populations free infestation with orobanche were Giza-843 × Line 3, Giza-429 × Line 4 2, Giza-429 × Giza-2, Line 3 × Line -4, Line 3 × Giza-2 and Line 3 × Line 4. Meanwhile, the results obtained from this trait permit for further response to another cycle of selection and they are in accordance with those obtained by Cubero (1983), Cubero and Fernandez (1991) Cubero (1994) Darwish (1996) Darwish *et al*. (1999), Abdalla and Darwish (2002), Morsy and Attia (2002), Abdalla *et al*. (2006), Darwish *et al*. (2007) and Abdalla and Darwish (2008).

**Seed yield per plant:**

Data of seed yield per plant in Table 4 revealed significant differences between populations in both bulk and selected $F_5$ and $F_6$ families where all populations of $F_5$ and $F_6$ families attained positive responses which gave promise to high yield families from selection.

**Table 4. Means of weight of seeds per plant (yield $_g$).**

| | $F_5$ bulk | $F_5$ selected | | $F_6$ bulk | $F_6$ selected | |
|---|---|---|---|---|---|---|
| | **Mean** | **Mean** | **response** | **Mean** | **Mean** | **response** |
| **1. Giza.843 × Giza-429** | 62.67 | 65.00 | **3.72*** | 72.67 | 75.00 | **3.21*** |
| **2. Giza-843 × Line 3** | 58.00 | 67.00 | **15.52*** | 66.00 | 75.00 | **13.64*** |
| **3. Giza-843 × Line 4** | 63.33 | 67.67 | **6.84*** | 63.33 | 74.67 | **17.90*** |
| **4. Giza-843 × Giza-2** | 40.00 | 51.33 | **28.33*** | 47.00 | 58.33 | **24.11*** |
| **5. Giza-429 × Line 3** | 50.00 | 63.00 | **26.00*** | 66.67 | 71.00 | **6.50*** |
| **6. Giza-429 × Line 4** | 50.00 | 58.00 | **16.00*** | 50.00 | 65.00 | **30.00*** |
| **7. Giza-429 × Giza-2** | 32.67 | 39.00 | **19.39*** | 36.00 | 41.67 | **15.74*** |
| **8. Line 3 × Line 4** | 30.00 | 38.00 | **26.67*** | 30.00 | 38.67 | **28.89*** |
| **9. Line 3 × Giza-2** | 40.00 | 50.00 | **25.00*** | 42.00 | 55.00 | **30.95*** |
| **10. Line 4 × Giza-2** | 30.33 | 44.00 | **45.06*** | 30.00 | 45.00 | **50.00*** |
| **Mean** | **45.70** | **54.30** | **21.25*** | **50.37** | **59.93** | **22.09*** |
| **LSD at $_{0.05}$** | **2.48** | | | **2.25** | | |

The most outstanding selected populations of yield per plant under free infestation from $F_5$ were Giza-843 × Giza-2, Giza-429 × Line 3, Line 3 × Line 4, Line 3 × Giza-2 and Line 4 × Giza-2 while $F_6$ families included Giza-843 × Giza-2, Giza-429 × Line 4, Line 3 × Line 4, Giza-429 × Giza-2, Line 3 × Line 4, Line 3 × Giza-2 and Line 4 × Giza-2. Meanwhile, the results obtained from this trait permit for further response to another cycle of selection and they are in accordance with those obtained by Cubero (1983). Cubero and Fernandez (1991), Cubero (1994), Darwish (1996), Darwish *et al*. (1999), Abdalla and Darwish (2002), Morsy and Attia (2002), Abdalla *et al*. (2006), Darwish *et al*. (2007) and Abdalla and Darwish (2008).

**Seed index:**

Results of seed index for the bulk Table 5 showed significant differences between most populations in both bulk and selected $F_5$ and all $F_6$ families where the seven populations in $F_5$ attained positive responses and all $F_6$ families got positive responses which gave promise to large seed families from selection.The most outstanding selected populations of large seeds per plant under free infestation from $F_5$ were Giza-843 × Giza-429, Giza-843 ×

Giza-2, Giza-429 × Line 3, Giza-429 × Giza-2, Line 3 × Line 4 while all $F_6$ families were positive large seeded. Meanwhile, the results obtained from this trait permit for further response to another cycle of selection and they are in accordance with those obtained by Cubero (1983), Cubero and Fernandez (1991), Cubero (1994), Darwish (1996), Darwish *et al*. (1999), Abdalla and Darwish (2002), Morsy and Attia (2002), Abdalla *et al*, (2006), Darwish *et al*. (2007) and Abdalla and Darwish (2008).

**Table (5). Means of seed index (100 seeds $_g$).**

| | $F_5$ bulk | $F_5$ selected | | $F_6$ bulk | $F_6$ selected | |
|---|---|---|---|---|---|---|
| | **Mean** | **Mean** | **response** | **Mean** | **Mean** | **response** |
| **1. Giza.843 × Giza-429** | 74.67 | 80.67 | **8.04*** | 88.667 | 82.667 | **82.67*** |
| **2. Giza-843 × Line 3** | 78.67 | 79.67 | **1.27** | 84.000 | 77.667 | **77.67*** |
| **3. Giza-843 × Line 4** | 81.33 | 80.00 | **-1.64** | 75.000 | 81.667 | **81.67*** |
| **4. Giza-843 × Giza-2** | 69.33 | 78.67 | **13.46*** | 75.667 | 82.667 | **82.67*** |
| **5. Giza-429 × Line 3** | 72.67 | 82.00 | **12.84*** | 86.667 | 85.333 | **85.33*** |
| **6. Giza-429 × Line 4** | 78.00 | 81.00 | **3.85*** | 75.667 | 82.000 | **82.00*** |
| **7. Giza-429 × Giza-2** | 73.00 | 74.00 | **1.37** | 75.000 | 75.000 | **75.00*** |
| **8. Line 3 × Line 4** | 65.00 | 71.67 | **10.26*** | 58.333 | 67.333 | **67.33*** |
| **9. Line 3 × Giza-2** | 66.33 | 74.33 | **12.06*** | 71.000 | 79.000 | **79.00*** |
| **10. Line 4 × Giza-2** | 64.67 | 70.67 | **9.28*** | 55.667 | 71.333 | **71.33*** |
| **Mean** | **72.37** | **77.27** | **7.08*** | **88.667** | **82.667** | **82.67*** |
| **LSD at $_{0.05}$** | **3.18** | | | **3.18** | | |

**Seed yield per plot:**

Means of seed yield per plot (yield $_{kg}$) presented in Table 6 showed that positive responses to selection in $F_5$ and $F_6$ families which gave promise to high yield families from selection.

The highest selected populations of seed yield per plot under free infestation from $F_5$ that gain 50 % or more of response to selection were Giza-843 × Giza-2, Giza-429 × Line 3, Giza-429 × Line 4, Giza-429 × Giza-2, Line 3 × Line 4, Line 3 × Giza-2 and Line 4 × Giza-2. while $F_6$ families included Giza-429 × Line 4, Line 3 × Line 4, Line 3 × Giza-2 and Line 4 × Giza-2. Meanwhile, the results obtained from this trait permit for further response to another cycle of selection and they are in accordance with those obtained by Cubero (1983), Cubero and Fernandez (1991), Cubero (1994), Darwish (1996), Darwish *et al*. (1999), Abdalla and Darwish (2002), Morsy and Attia (2002), Abdalla *et al*. (2006), Darwish *et al*. (2007) and Abdalla and Darwish (2008).

The choice of rather growing tolerant populations of faba bean in heavily infested fields with orobanche than sowing them in fields free of this dangerous parasite impose to make a comparison of the performances between faba bean populations in both types of fields. The following results show the differences of the productivity of tolerant populations of faba bean in heavily and free infested fields with orobanche for $F_5$ and $F_6$ families and that may help to make the best choice between them.

**Table 6. Means of weight of seeds per plot (yield $_{kg}$).**

| | $F_5$ bulk | $F_5$ selected | | $F_6$ bulk | $F_6$ selected | |
|---|---|---|---|---|---|---|
| | mean | Mean | response | mean | Mean | response |
| **1. Giza.843 × Giza-429** | 4.36 | 3.33 | **30.81*** | 3.67 | 4.50 | **22.72*** |
| **2. Giza-843 × Line 3** | 4.04 | 2.90 | **39.31*** | 3.30 | 4.50 | **36.36*** |
| **3. Giza-843 × Line 4** | 4.40 | 3.17 | **38.93*** | 3.17 | 4.48 | **41.46*** |
| **4. Giza-843 × Giza-2** | 3.42 | 2.00 | **71.00*** | 2.35 | 3.50 | **48.94*** |
| **5. Giza-429 × Line 3** | 4.10 | 2.50 | **64.00*** | 3.33 | 4.26 | **27.81*** |
| **6. Giza-429 × Line 4** | 3.77 | 2.50 | **50.92*** | 2.50 | 3.90 | **56.00*** |
| **7. Giza-429 × Giza-2** | 2.77 | 1.63 | **69.81*** | 1.80 | 2.50 | **38.89*** |
| **8. Line 3 × Line 4** | 2.60 | 1.50 | **73.33*** | 1.50 | 2.32 | **54.67*** |
| **9. Line 3 × Giza-2** | 3.76 | 2.00 | **88.15*** | 2.10 | 3.30 | **57.14*** |
| **10. Line 4 × Giza-2** | 3.12 | 1.52 | **105.67*** | 1.65 | 2.70 | **63.64*** |
| **Mean** | **3.63** | **2.31** | **63.19*** | **2.54** | **3.60** | **44.76*** |
| **LSD at $_{0.05}$** | | **0.17** | | | **0.17** | |

**Seed yield per feddan:**

Data of weight of seeds per feddan (yield $_{ardab}$) in Table 7 for populations grown under heavy and free infested field with orobanche and responses to selection showed significant differences between populations for this trait in both bulk and selected $F_5$ and Table 8 for $F_6$ families where all populations attained positive responses which gave promise to high yield families from selection.

**Table 7. Means of weight of seeds ardab / feddan for $F_5$ populations.**

| | Heavily infested field | | | Free infested field | | |
|---|---|---|---|---|---|---|
| | $F_5$ bulk | $F_5$ selected | | $F_5$ bulk | $F_5$ selected | |
| | Mean | Mean | response | Mean | Mean | response |
| **1. Giza.843 × Giza-429** | 4.34 | 4.92 | **11.79*** | 8.37 | 10.94 | **30.72*** |
| **2. Giza-843 × Line 3** | 2.84 | 4.19 | **32.22*** | 7.30 | 10.12 | **38.63*** |
| **3. Giza-843 × Line 4** | 4.19 | 5.02 | **16.53*** | 7.97 | 11.03 | **38.48*** |
| **4. Giza-843 × Giza-2** | 1.58 | 4.27 | **63.00*** | 5.03 | 8.47 | **68.23*** |
| **5. Giza-429 × Line 3** | 3.41 | 4.27 | **20.14*** | 6.27 | 10.20 | **62.76*** |
| **6. Giza-429 × Line 4** | 2.63 | 3.61 | **27.15*** | 6.30 | 9.60 | **52.38*** |
| **7. Giza-429 × Giza-2** | 0.43 | 1.10 | **60.91*** | 4.13 | 7.20 | **74.21*** |
| **8. Line 3 × Line 4** | 0.35 | 0.75 | **53.33*** | 3.77 | 6.80 | **80.51*** |
| **9. Line 3 × Giza-2** | 2.94 | 3.46 | **15.03*** | 5.10 | 9.50 | **86.27*** |
| **10. Line 4 × Giza-2** | 0.83 | 1.81 | **54.14*** | 3.80 | 7.80 | **105.26*** |
| **Mean** | **2.36** | **3.34** | **29.34*** | **5.80** | **9.17** | **63.75*** |
| **LSD at $_{0.05}$** | | **0.14** | | | **0.76** | |

As for $F_5$ families, the performance of faba bean plants under heavily infested fields revealed selected populations of high seed yield that surpassed that of Giza-843 and that was represented in the first five families of Giza.843 × Giza-429, that its bulk attained the highest yield because it has a multiple system of tolerance to orobanche, Giza-843 × Line 3, Giza-843 × Line 4, Giza-843 × Giza-2, Giza-429 × Line 3 and Line 3 × Giza-2 and these six families gave parallel performance under free infested fields except for family Giza-843 × Giza-2 that was replaced to Giza-429 × Line 3.

In terms of $F_6$ families, the data revealed similar results to those of $F_5$ families where the performance of faba bean plants under heavily infested

fields revealed selected populations of high seed yield that surpassed that of Giza-843 and that was represented in the first five families of Giza.843 × Giza-429, Giza-843 × Line 3, Giza-843 × Line 4, Giza-843 × Giza-2, Giza-429 × Line 3 and Line 3 × Giza-2 and these six families gave parallel performance under free infested fields exceeded family Giza-429 × Line 4.

The rule of the selection criterion was the yield not the response to selection because some high responded families to selection attained less productivity than the yield of Giza-843 that was used as control for both high yield and tolerance to the parasite Orobanche crenata. It was clear that the difference between the two choices did not change faba bean families to be used in both types of fields but there were high differences between the performances under both types of fields that were clear from the highly decreased values of yield of faba bean plants grown under heavily infested fields and then it is rather grow faba bean in free fields than heavily infested fields in order to attain high productivity of this important crop. The results obtained from this trait permit for further response to another cycle of selection and they are in accordance with those obtained by Cubero (1983), Cubero and Fernandez (1991), Khalil *et al.* (1991), Cubero (1994), Darwish (1996), Darwish *et al*. (1999), Abdalla and Darwish (2002), Morsy and Attia (2002), Abdalla *et al*. (2006), Darwish *et al*. (2007) and Abdalla and Darwish (2008).

**Table 8. Means of weight of seeds per feddan (yield $_{ardab}$) for $F_6$ populations.**

| | Heavily infested field | | | Free infested field | | |
|---|---|---|---|---|---|---|
| | $F_6$ bulk | $F_6$ selected | | $F_6$ bulk | $F_6$ selected | |
| | Mean | Mean | response | Mean | Mean | response |
| **1. Giza.843 × Giza-429** | **5.29** | **6.27** | **15.63*** | 9.21 | 11.27 | **22.29** |
| **2. Giza-843 × Line 3** | **5.17** | **7.58** | **31.79*** | 9.30 | 11.27 | **21.15** |
| **3. Giza-843 × Line 4** | **7.05** | **8.12** | **13.18*** | 8.30 | 11.23 | **35.34** |
| **4. Giza-843 × Giza-2** | **2.58** | **4.73** | **45.45*** | 6.80 | 8.80 | **29.41** |
| **5. Giza-429 × Line 3** | **2.06** | **4.52** | **54.42*** | 8.40 | 10.67 | **26.99** |
| **6. Giza-429 × Line 4** | **1.81** | **3.56** | **49.16*** | 8.60 | 9.83 | **14.34** |
| **7. Giza-429 × Giza-2** | **0.48** | **0.88** | **45.45*** | 4.50 | 6.25 | **38.82** |
| **8. Line 3 × Line 4** | **0.40** | **0.59** | **32.20*** | 3.76 | 5.81 | **54.40** |
| **9. Line 3 × Giza-2** | **2.96** | **4.10** | **27.80*** | 7.30 | 8.28 | **13.38** |
| **10. Line 4 × Giza-2** | **0.60** | **1.72** | **65.12*** | 3.57 | 6.80 | **90.64** |
| **Mean** | **2.84** | **4.20** | **32.38*** | **6.97** | **9.02** | **34.68** |
| **LSD at $_{0.05}$** | **0.30** | | | **0.68** | | |

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## تقييم جيلين متقدمين من الفول البلدي متحملين للإصابة بالهالوك في كل من حقول خالية وأخرى عالية الإصابة بالهالوك

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**قسم بحوث المحاصيل البقولية معهد بحوث المحاصيل الحقلية، مركز البحوث الزراعية- الجيزة ، مصر**

أجرى هذا البحث فى المزرعة البحثية لمحطة البحوث الزراعية بملوي خلال موسمين الشتوين 2010 / 2009 و 2010/2011 م لتقييم اداء عشرة عشائر لأجيال متقدمة من الفول البلدي في دورتين متتاليتين من الإنتخاب في الفول البلدي تحت ظروف خالية من الإصابة بالهالوك*Orobanche crenata* . ومقارنة الإنتاجية مع تلك الناتجة من الحقول عالية الإصابة. استخدم في تلك الدراسة عشرة عشائر من الفول البلدي من هجن خمسة آباء من اصناف وسلالات الفول البلدي المحلية ذات مستويات متباينة من المقاومة للهالوك وهي Giza-429؛ Giza-843؛ Line (3) 57/721/94 ؛ Line (4)-664/689/94 والصنف Giza-2 وقد إستمرت حتى الجيلين الخامس والسادس لعشرة عائلات تفوقت على الصنف Giza-843 في المحصول و اوضحت النتائج تفوق سنة من العشائر المقاومة للهالوك ذات إنتاجية عالية هي Giza-843 × Giza-429 و G-843 × Line 3 و Giza-843 × Line 4 ، Giza- Giza-843 × Giza-2 , Line 3, × 429 و Giza-2 × Line 4.، والتي تعتبر واعدة لإستنباط أصناف من الفول البلدي عالية الإنتاج وذات مقاومة للهالوك في المستقبل. كانت نتائج أداء عائلات الجيلين الخامس والسادس تحت ظروف الإصابة بالهالوك كانت متشابهة مع تلك الخاصة بظروف الحقول الخالية من الإصابة من ناحية تفوق ستة عائلات من العائلات العشرة تحت الدراسة المذكورة من قبل وتلك العائلات الستة أعطت أداء متوازي مع ظروف الإصابة مع إضافة العشيرة Giza-429 × Line 4. كان الاداء تحت ظروف طرازي الحقول المصابة والخالية من الهالوك واضحة من القيم المنخفضة لمحصول نباتات الفول البلدي النامية في الحقول المصابة.

وبالتالي توصى الدراسة بزراعة نباتات الفول البلدي في حقول خالية من الهالوك عن زراعة أصناف مقاومة في حقول عالية الإصابة بالهالوك للحصول على إنتاج عالي من هذ المحصول الهام

**قام بتحكيم البحث**

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