CONTENTS

LIST OF TABLES AND FIGURES

SUMMARY

This investigation was carried out at Sakha Agricultural Research Station, Agriculture Research Center (ARC), Egypt, during the three growing seasons 2012/2013, 2013/2014 and 2014/2015.

Seven faba bean (Vicia faba L.) genotypes three of them were tolerant to *Orobanche* (Misr 1, Misr 3 and Giza 843) and four were susceptible to *Orobanche* (Sakha 1, Sakha 3, Sakha 4 and Nubaria 3).

A diallel crosses excluding reciprocals was carried out among the genotypes under insect free cage during 2012/2013 season.

In 2013/2014 season, the parents and their F_1 hybrid seeds were sown in a randomized complete block design with three replications under insect free cage. Re-hybridization was made in order to obtain F_1 hybrid seeds, and the F_1 plants were self-pollinated to obtain the F_2 seeds.

In 2014/2015 two field experiments were conducted to evaluate the seven parents and their F_1's and F_2's generations.

The first experiment was planted at *Orobanche* uninfested soil, meanwhile the second experiment was planted at *Orobanche* naturally infested soil.

The F_1, F_2 crosses and their parental genotypes were sown in a randomized complete block design (RCBD) with three replications. Data were recorded as an average of 10,10 and 50 individual guarded plants chosen at random from each experimental for the parents, F_1 and F_2 generations respectively.

An ordinary analysis of variance was first performed. Heterosis was computed as mean squares and as the percentage of F_1 and F_2 means performance from better parent values for individual crosses. The data were genetically analyzed by the procedures developed by Griffing 1956 and Hayman 1954.

The results could be summarized as follows:

1. **Analysis of variance:**

- **F_1 generation:**

The mean squares of the parental genotypes and their crosses were significant for all the studied traits under *Orobanche* infested and uninfested soils. Highly significant mean squares for parents versus crosses were recorded for all the studied traits under both conditions, except for flowering date under both condition and 100-seed weight under infested soil, indicating heterotic effects for these traits.

- **F_2 generation:**

Genotypes mean squares were significant for all the studied traits; also mean squares for parents were significant for all the studied traits except number of branches/plant under infested soil. Parents versus crosses mean squares were significant for the studied traits indicating remaining heterotic effects for these traits, except number of branches/plant under infested soil as well as plant height and 100-seed weight under uninfested soil,

2. **Mean performance:**

- **F_1 generation:**

The parents Sakha 1 and Giza 843 gave the lowest values of flowering date under both conditions, the parents Misr 3 and Giza 843 were the tallest plants and gave the highest values of number of pods/plant, number of seeds/plant and seed yield/plant under infested soil. However the parents Sakha 4 possessed the highest level of infection with high number of *Orobanche*/plant, meanwhile the tolerant parent Misr 3 had the lowest number of *Orobanche*/plant.

The two crosses (Sakha 1 X Giza 843) and (Sakha 4 X Giza 843) were the earliest flowering date under infested soil. The highest number of pods/plant, number of seeds/plant and seed yield/plantwere found in cross (Misr 3 X Giza 843). On the other hand, the lowest mean values of number of *Orobanche*/plant were recorded for the crosses (Sakha 1 X Misr 3), (Misr 3 X Misr 1) and (Misr 1 X Giza 843) these crosses could be considered tolerant to *Orobanche*.

- **F_2 generation:**

The parents Sakha 1 and Giza 843 were the earliest varieties under both conditions, while the Sakha 1 and Sakha 4 were the shortest varieties and the parents Misr 3 and Giza 843 gave the highest values of number of seeds/plant and seed yield/plant under infested soil, also the tolerant parent Misr 3 had the lowest number of *Orobanche*/plant.

The two crosses (Sakha 1 X Giza 843) and (Sakha 4 X Giza 843) were the earliest flowering date under infested soil. The highest number of pods/plant, number of seeds/plant and seed yield/plant were found in cross (Misr 3 X Misr 1). The best crosses, which had the lowest mean values for number of *Orobanche*/plant were (Misr 3 X Misr 1) and (Misr 3 X Giza 843).

3. <u>Combining ability:</u>

a. General combining ability:

- **F_1 generation:**

The parental variety Giza 843 gave significant negative gca effects for flowering date under infested soil. The parental genotypes Misr 3, Misr 1 and Giza 843 had positive and significant gca effects for plant height, number of pods/plant, number of seeds/plant and seed yield/plant under infested soil.

The parental varieties Sakha 1, Sakha 3 and Nubaria 3 exhibited significant gca effects for 100-seed weight under infested soil. The parental varieties Misr 3, Misr 1 and Giza 843 expressed significant negative gca effects (desirable) for number of *Orobanche*/plant.

- **F_2 generation:**

The varieties Sakha 1 and Giza 843 exhibited significant negative gca effects for flowering date under both conditions. The parental varieties Misr 3, Misr 1 and Giza 843 expressed significant positive gca effects for plant height, number of pods/plant, number of seeds/plant and seed yield/plant under infested soil. The parental Misr 3, Misr 1 and Giza843 could be considered tolerant to *Orobanche* which expressed significant negative gca effects for number of *Orobanche*/plant under infested soil.

b. Specific combining ability:

- **F_1 generation:**

The crosses (Sakha 1 X Sakha 4), (Sakha 1 X Giza 843), (Nubaria 3 X Misr 3), (Misr 3 X Misr 1) and (Misr 1 X Giza 843) exhibited significant negative sca effects for flowering date under infested soil. The cross (Sakha 4 X Misr 3) expressed significant positive sca effects for number of pods/plant and number of seeds/plant under infested soil. Five crosses (Sakha 1 X Misr 3), (Sakha 3 X Misr 1), (Sakha 3 X Giza 843), (Sakha 4 X Misr 3) and (Sakha 4 X Giza 843) exhibited significant negative sca effects for number of *Orobanche*/plant under infested soil.

- **F_2 generation:**

gca/sca ratios were higher in magnitude in F_2 than F_1 generation with some exception under both condition (100-seed weight and number of *Orobanche*/plant).

The cross (Sakha 1 X Sakha 4) had significant negative sca effects for flowering date under infested soil. While the cross (Sakha 1 X Sakha 3) expressed significant positive sca effects for number of seeds/plant and 100-seed weight under infested soil. On the other hand the two crosses (Sakha 4 X Misr 1) and (Sakha 4 X Giza 843) had the best desirable sca effects for number of *Orobanche*/plant, which possessed a high level of tolerant to infestation and expressed highly significant negative sca effects.

4. **Heterosis effects:**

- **F_1 generation:**

The cross (Sakha 1 X Giza 843) gave significant negative heterotic effects relative to better parent, for flowering date. The cross (Sakha 3 X Nubaria 3) expressed significant positive heterotic effects relative to better parent for plant height and number of branches/plant. The cross (Nubaria 3 X Misr 3) had significant positive heterotic effects relative to better parent for plant height, number of seeds/plant and seed yield/plant under infested soil.

- **F_2 generation:**

None of the crosses expressed negative heterotic effects relative to better parents for flowering date in F_2 generation. The crosses (Sakha 1 X Nubaria 3), (Sakha 4 X Nubaria 3), (Nubaria 3 X Misr 3) and (Misr 3 X Misr 1) had significant positive heterotic effects for plant height under infested soil. Meanwhile the cross (Nubaria 3 X Misr 1) expressed significant positive heterotic effects under uninfested soil. The cross (Misr 3 X Misr 1) exhibited highly significant positive heterotic effects relative to better parents for number of pods/plant, number of seeds/plant and seed yield/plant under uninfested soil.

5. **Inbreeding depression:**

Significant inbreeding depression was detected in F_2 for most studied traits. Reduction in most estimated traits was observed in F_2 plants with significant inbreeding depression reaching -8.58% for flowering date for cross (Nubaria 3 X Misr 1), 38.79% for number of branches/plant for cross (Sakha 3 X Sakha 4). Also inbreeding depression reached to 28.13, 53.66, 62.19, 67.36 and 12.95% for cross (Sakha 3 X Nubaria 3) for plant height, number of pods/plant, number of seeds/plant, seed yield/plant and 100-seed weight respectively, under infested soil. On the other hand inbreeding depression reached to 69.18% for number of *Orobanche*/plant for cross (Misr 3 X Giza 843) under infested soil.

Genetic components and heritability:

- **F_1 generation:**

1. The additive component (D) was significant for all studied traits under both conditions, except number of branches/plant and seed yield/plant.
2. The dominance genetic component H_1 and H_2 were significant for all studied traits under infested soil except flowering date.
3. The average degree of dominance $(H_1/D)^{0.5}$ was more than unity for number of branches/plant, number of seeds/plant and seed yield/plant under both conditions, while it was less than unity for flowering date under both conditions, for 100-seed weight under uninfested soil and for plant height and number of pods/plant under infested soil.
4. The average frequency of positive vs. negative alleles in parents (H2/4H1) were equal or nearly one quarter (0.25) for all the studied traits under both conditions except number of branches, number of seeds/plant and seed yield/plant under infested soil.

5. The ratio of dominance to recessive alleles (KD/KR) was more than unity for number of branches and 100-seed weight under both conditions, for number of pods/plant, number of seeds/plant and seed yield/plant under uninfested soil and for plant height under infested soil.
6. High to moderate values of heritability in narrow sense were obtained for all the studied traits under both conditions except number of pods/plant, number of seeds/plant and seed yield/plant under uninfested soil.

- **F_2 generation:**

1. Additive genetic variance was significant for all the studied traits under both conditions except number of branches under infested soil.
2. The dominance component H_1 and H_2 were significant for all the studied traits under both conditions.
3. The values of h^2 were significant for all the studied traits except 100-seed weight under both conditions, plant height under uninfested soil as well as number of branches and number of pods/plant under infested soil.
4. The average degree of dominance $(H_1/D)^{0.5}$ less than unity for all the studied traits, except number of branches under both conditions.
5. The ratio $H_2/4H_1$ in the parents were around one quarter (0.25) for all the studied traits except number of branches under both conditions, while for number of seeds/plant, number of pods/plant, seed yield/plant and 100-seed weight under uninfested soil.

6. High to moderate estimates of heritability in narrow sense were found for all the studied traits under both conditions except number of branches under infested soil.

The regression line intersects the wr axis above the origin for flowering date, plant height, number of pods/plant, number of seeds/plant, seed yield/plant and number of *Orobanche*/plant, reflecting partial dominance while, it was below the origin in 100-seed weight reflecting over dominance in F_1 generation under infested soil.

The regression line intersects the wr axis above the origin for all the studied traits revealing partial dominance except 100-seed weight it was below the origin, suggesting over dominance in F_2 generation under infested soil.

The conclusion from the results is as follows:

1. The parents Sakha 1 and Giza 843 gave the lowest values of flowering date under both conditions in F_1 and F_2 generations.
2. The two crosses (Sakha 1 X Giza 843) and (Sakha 4 X Giza 843) were the earliest flowering date under infested soil in F_1 and F_2 generations.
3. The tolerant parent Misr 3 had the lowest number of *Orobanche*/plant under infested soil in F_1 and F_2 generations and the crosses (Sakha 1 X Misr 3), (Misr 3 X Misr 1) and (Misr 3 X Giza 843) had the lowest mean values for number of *Orobanche*/plant so these crosses could be considered tolerant to *Orobanche*.
4. The parental variety Giza 843 gave significant negative gca effects for flowering date under infested soil in F_1 and F_2 generations.
5. The parental varieties Misr 1, Misr 3 and Giza 843 expressed significant negative gca effects desirable for number of *Orobanche*/plant in F_1 and F_2 generations.

6. The cross (Sakha 1 X Giza 843) possessed a high level of tolerant to infestation and expressed highly significant negative sca effects in F_1 and F_2 generations.

7. The cross (Nubaria 3 X Misr 3) had significant positive heterotic effects relative to better parent for plant height, number of seeds/plant and seed yield/plant under infested soil in F_1 generation.