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SUMMARY

The genetic system and types of gene effects controlling resistance of faba bean (*Vicia faba* L.) to the devastating root parasite *Orobanche crenata* were analyzed in a 10-parent diallel cross among local cultivars with variable levels of resistance. Measures of resistance were divided into two categories: the first category included characters related to the parasitic plant and involved the dry weight and number of *Orobanche* spikes per host plant, the second category comprised measures related to the host plant which involved relative yielding ability under infestation (seed yield, number of seeds and pods per plant). Two successive cycles of phenotypic directional selection were performed for relative seed yield per host plant to that of the most resistant cultivar Giza-843 under heavy natural infestation with broomrape. The first cycle of selection was applied to 17 F₂ populations that exceeded Giza-843 in seed yield per plant under infestation using single plant selection where the top yielding five plants among the 120 segregates of each population were selected (an intensity of 4.17%). The second cycle of selection was applied to the F₃ selected families of the 17 populations where the top yielding family among the five F₃ families of each population were selected (an intensity of 20%). Responses to selection for the main character as well as the correlated responses in the other characters were measured at the F₃ and F₄ generations.

The results of the genetic analyses of the 10-parent diallel cross were as follows:

1. The mean dry weight of *Orobanche* spikes per host plant were under the control of genes with mainly dominance effects with a major gene or gene complex differentiating the most susceptible

parental cultivar Giza-2 from the other nine parents. The narrow-sense heritability estimate was quite low being 0.19.

2. Genes with mainly dominance effects were involved in the control of number of broomrape spikes per host plant with two parents exhibiting non-allelic gene interaction. Over-dominance was operating for resistance with a low narrow-sense heritability estimate of 0.21.
3. The relative seed yield per host plant to that of the most resistant cultivar Giza-843, were under the control of both additive and dominance gene effects with the former being greater in magnitude than the later. Partial dominance for greater relative seed yield per plant was operating with the estimate of narrow-sense heritability being quite high reaching 0.75.
4. The relative number of seeds per host plant was controlled by genes with additive and dominance effects with the former being much larger in magnitude than the later. Non-allelic gene interaction was operating and dominance was partial for greater relative seed yield per plant under infestation. The narrow-sense heritability was high being 0.78.
5. Number of pods per host plant under infestation was under the control of genes with mainly dominance effects. Over-dominance was operating for greater number of pods per host plant with a low narrow-sense heritability of 0.27.
6. Seed yield per host plant was strongly correlated with both number of seeds per plant ($r= 0.92, p < 0.01$) and number of pods per plant ($r= 0.95, p < 0.01$) under infestation. Meanwhile, seed yield per host plant was negatively correlated with broomrape spikes per host plant ($r= -0.37, p < 0.05$) but not with number of broomrape spikes per host plant ($r= -0.09, p < 0.05$). Number of seeds per host

plant was also negatively correlated with dry weight of broomrape spikes per host plant ($r = -0.35$, $p < 0.05$).

The results of the selection program were as follows:

1. Positive responses to selection for seeds per host plant under infestation were obtained in the F₃ selections of all of the 17 populations which were significant in 14 populations. The responses ranged from 11.6 to 33.0% of the population mean with an average of 22.7%. Twelve F₃ selections displayed means of seeds per host plant greater than the most resistant cultivar Giza-843 by 11.4 to 71.2%. The parent-offspring segregation ($b_{F_2F_3}$) was moderately high being 0.60 ± 0.06 confirming the high heritability of this character.
2. Responses to the second cycle of selection were uniformly positive and significant in the 17 F₄ populations which ranged from 12.9 to 37.8% of the population mean with an average of 22.8%. Fifteen of the 17 selections out-yielded the most resistant cultivar Giza-843 under infestation by up to 95.2%. Three outstanding F₄ selections displayed almost double seed yield per plant of that of Giza-843. The parent-offspring segregation for this character $b_{F_3F_4}$ was quite high being 0.91 ± 0.08 .
3. Negative correlated responses to selection for relative seed yield per host plant were obtained in the dry weight of *Orobanche* spikes per host plant in the 17 F₃ selection which averaged -30.55% of the population mean and in the 17 F₄ selections which averaged -30.7% of population mean.
4. Concurrent negative responses to selection for relative seed yield per host plant were obtained in number of *Orobanche* spikes per

- host plant which averaged -27.8% of the population mean for F4 selections.
5. Positive correlated responses to selection were obtained in number of seeds per host plant under infestation which averaged 24.1% of the population mean in the F3 selections and 23.7% of the population mean in the F4 selections. Fourteen of the 17 F4 selections exceeded the most resistant cultivar Giza-843 in seed yield per plant.
 6. Selection for relative seed yield per host plant under infestation resulted in positive correlated responses in mean number of pods per plant which averaged 19.8% of the population mean in the F3 selections and 20.7% of the population mean in the F4 selections. Ten out of the 17 F4 selections displayed greater numbers of pods per plant under infestation than the most resistant cultivar Giza-843.
 7. The fact that the negative correlated responses in the dry weight of broomrape spikes per host plant (averaged -30.55% in F3 and -30.7% in F4) were greater than the direct responses in seed yield per plant (22.7% in F3 and 22.8% in F4) argued for resistance rather than tolerance.