SUMMARY

Cowpea pod borer (*Etiella zinckenella*) is considered one of the most destructive insects which causes great annual yield loss to cowpea in Egypt and different parts of the world. Using cultivars resistant to cowpea pod borer will help in reducing the environmental pollution because the amount of insecticides which are usually used in controlling this insect will be much less. In addition, this will help in reducing the harmful residual effect of the insecticides on the human beings.

The objective of this research was to study the inheritance and nature of resistance to the cowpea pod borer to obtain genetic information which will be useful in designing breeding programs for resistance of cowpea to this insect.

The research program of this study was conducted at the Faculty of Agriculture at Moshtohor, Department of Horticulture, using the wire screen house and the "Preservation and Utilization of Primitive Germplasm" Laboratory, during the successive seasons of 1993, 1994 and 1995 years.

Parental Genotypes:

The following cultivars/line were used in this research.

1. Carolina Cream: seeds of this cultivar were obtained from Dr. Richard L.Fery, U.S Vegetable Laboratory, Agriculture Research Service, South Carolina. This cultivar is known for its pod-resistance factor which prevent penetration of cowpea curculio into pods.
2 - Balady: seeds of this cultivar were obtained from the Egyptian local market.

3 - Ezmirely: seeds were obtained from the local market in Egypt.

4 - Mo2: This forage cowpea line was selected from forage cowpea population in Aswan, Upper Egypt.

Plants of all cultivars/line were selfed for two years before starting this research.

Crosses:

The following crosses were performed in the summer of 1993:

1 - Coralina Cream x Balady.

2 - Balady x Carolina Cream.

3 - Ezmirely x Carolina Cream.

4 - Mo2 (forage line) x Carolina Cream.

During the summer of 1994, seeds of parental cultivars/line and F1 were planted to obtain F2 seeds and to repeat the crosses performed in 1993.

Artificial Rearing of the Insect:

Green pods infested with *E. zincrenella* were obtained from an infested field and kept in wire cages (50 x 50 x 50 cm) covered at the bottom with thin layer of uncompact soil to allow the larvae to pupate in the soil after leaving the pods at the final stage of development. The pupal coccons were then collected and kept in another wire cages with a piece of cotton saturated with 10% sucrose and hanged at the upper side of the wire cage to allow the adults to feed after emerging from the coccons. The
adults were then classified to males and females and were allowed to lay eggs on green cowpea pods of the cultivar (Cream 7), which was not one of the parental cultivars, for two days. After laying eggs on such pods, the pods were placed in wire cages and kept at room temperature (29 ± 3 c°) till egg hatching and larval exit out of the pods. The previously mentioned pods were used as a source for the 2nd instar larvae which were used in the artificial infestation of the detached pods in the bioassay experiment. In addition, these pods were used to obtain enough adults (males and females) which were used in the artificial infestation of plants in the screen house experiment, following the method mentioned before.

Wire screen House Experiment:

On June 1, 1995, seeds of parental cultivars / line, F1, and F2 were planted in the wire screen house to evaluate the individual plants for resistance to cowpea pod borer. The wire-screen house was 14 x 42m and divided to individual separate rooms each was 6 x 6 m. The experimental design used in conducting this experiment was randomized complete block with 3 replicates. Three rooms were assigned randomly to each cross. Each room contained one row for each of the parents and their F1 plants, and five rows for F2 plants. Ten seeds were planted on one side of ridges with one seed per hill 35 cm apart. Spraying the plants with insecticides was stopped two weeks before entering the flowering stage. The following measurements were recorded:

1- Measurements of Resistance:

The plants of the different populations were evaluated for their resistance to E. zinnenella using three criteria:
(a) Number of infested pods/plant.
(b) Number of larval exit holes/pod.
(c) Percentage of infested seeds/pod.

2- **Expected components of Resistance** :

(a) Quantitative Components :

   1- Pod wall thickness
   2- Seed coat thickness.
   3- Number of pod hairs.
   4- Length of pod hairs.
   5- Total fibers content of green pods.

(b) Qualitative components.

The qualitative components of resistance were recorded only for the different population of the cross Mo2 (forage line) x Carolina Cream due to the obvious differences between the parents respecting to these components. The qualitative components were as follows :

1- Flowers color
2- Green pod color.
3- Pod shape

**Bioassay Experiment**

Before the artificial infestation which took place in the wire-screen house, one green pod with 7cm long was obtained from each of the individual plants of the different populations of the cross Carolina Cream x Balady and Balady x Carolina Cream, and sent to the “Preservation and Utilization of Primitive Germplasm” laboratory. Each pod was placed inside a one-kilogram plastic jar. Three 2nd instar larvae were placed on
each pod. Then, the jars were covered with muslin and kept at room temperature $(29 \pm 3^\circ)$°. The artificially infested pods inside the jars were examined 3 days after the artificial infestation. The experimental used in conducting this experiment was randomized complete block with 3 replicates. The following measurements were recorded

1- Number of alive larvae.
2- Number of infested seeds/pod.

The data collected from both experiments were subjected to proper statistical genetic analysis. The final results can be summarized as follows:

1- Significant difference were observed between the different parental cultivars/line concerning resistance to $E. zinckenella$:

a) When using number of infested pods per plant as a criterion, cultivar Carolina Cream had the highest degree of resistance (.33) followed by the forage line Mo2 (0.92), cv. Balady (1.25), and cv Ezmirely (2.25).

b) When using number of holes per pod, the cultivar Carolina Cream was ranked as the highest resistant cultivar (0.37) followed by the forage line Mo2 (0.81), cv. Ezmirely (1.19) and cv. Balady (1.25).

c) When using percentage of infested seeds per pod as a criterion for the resistance to $E. zinckenella$, the cultivar Carolina Cream were the best (4.5%) followed by the forage line Mo2 (17.83%), cv. Ezmirely (21.58%) and cv. Balady (22.41%).

2 - Resistance to the cowpea pod borer was inherited quantitatively. There was no evidence for the presence of maternal effect on the inheritance of this character.
3. The nature of dominance of resistance to this insect ranged from partial dominance to complete dominance for the high level of resistance in the different crosses.

4. The broad sense heritability (BSH) for resistance ranged from low to above intermediate in the different crosses when evaluating the resistance by the different criteria.

5. Significant differences were observed between the different parental cultivars/line concerning the expected quantitative components of resistance.

6. The different quantitative components of resistance were inherited quantitatively.

7. When using cv. Carolina Cream as the female parent in the crosses, pod wall thickness showed partial dominance toward thick pod wall, while when using it as a male parent, an overdominance for the thick pod wall was noted, indicating the presence of maternal effect on the inheritance of this character.

8. The nature of dominance for seed coat thickness ranged from complete dominance to overdominance for the thick seed coat.

9. Concerning number of pod hairs, the dominance ranged from partial dominance to almost complete dominance for the small number of pod hairs.

10. Maternal effect on the inheritance of pod hair length was detected.

11. The inheritance of the total fibers content of the green pods was affected by a maternal effect.

12. There was a transgressive segregations in the F2 populations concerning the resistance to *E. zinckenella* when plants were evaluated using the different criteria in the different crosses. This indicated that
the parental cultivars/line possess different genes controlling resistance
to the insect.

13- Concerning flower color the plants in the F2 of the cross Mo2 x Carolina Cream segregated to 7 white : 6 pale purple : 3 purple. It was hypothesized that flower color was found to be controlled by two gene pairs: P: causes dominance of the purple flower color over the white flower and M: modifies the purple flower color to white color. The presence of factor P as a homozygous recessive will result in removing the effect of factor M and factor P. Based on these theory the plant with white flower color will be P-MM, that with pale purple color will be P-Mm, and that with purple color P-mm.

Concerning pod color, plants in the F2 population of the cross Mo2 x Carolina Cream segregated to the ratio 3 Green : 1 pale Green. This indicated that pod color was controlled by one gene pair G with dominance to the green color over the pale green.

The plants in the F2 population of the cross Mo2 X Carolina Cream segregated according to its pod shape to 3 round : 1 flat, indicating that pod shape was controlled by one gene pair. The round section type was dominant over the flat section type.

14- The evaluation for resistance in the laboratory using the detached pods (Bioassay) followed the same trend as the evaluation for resistance in the screen house. In addition, there were highly significant correlations between the measurements of resistance used in both experiments. These results indicated the high efficiency of the bioassay in evaluating the plants for their resistance to E. zinckenella.

15- There was significant negative correlation between pod wall thickness and resistance to cowpea pod borer in some crosses.
16- A significant negative correlation was detected between number of pod hairs and resistance in some crosses.

17- There was a significant positive correlation between length of pod hairs and resistance in some crosses.

18- A significant negative correlation was observed between total fibers content of the green pods and resistance to *E. zinckenella* when evaluating the resistance at the laboratory.

19- There was a significant linear relationship between the mutual effect of the different quantitative components and resistance to the cowpea pod borer.

20- Highly significant association was found between flower color and resistance to *E. zinckenella*. The high resistance seemed to be associated with the white flower color, while the high susceptibility was associated with the purple flower color.

21- No significant association was found between resistance to *E. zinckenella* and either pod color or pod shape.