

BIOLOGICAL AND ECOLOGICAL STUDIES ON  
CERTAIN PARASITOIDS OF CORN BORERS

By

MAHMOUD MAHAMED EL-SAIED SALEH

A thesis submitted in partial fulfilment  
of  
the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Agricultural Science  
(Entomology)

Department of Plant Protection  
Faculty of Agriculture  
Ain Shams University

1992

Approval Sheet

BIOLOGICAL AND ECOLOGICAL STUDIES ON  
CERTAIN PARASITIDS OF CORN BORERS

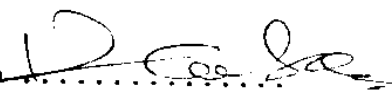
By

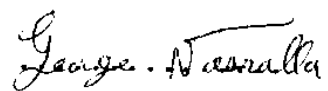
MAHMOUD MOHAMED EL-SAIED SALEH

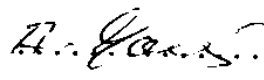
B.Sc. Agriculture (Entomology) 1976

M.Sc. Agriculture (Entomology) 1986

This thesis for Ph.D. degree has been  
approved by:

Prof. Dr. Hussien Samir Abdul Rahman Salama   
Prof. of Entomology, National Research Center

Prof. Dr. George Nosralla Rizk   
Prof. of Economic Entomology, Fac. of Agric,  
Ain Shams Univ.

Prof. Dr. Ahmed Ali Gomaa   
Prof. of Economic Entomology, Fac. of Agric,  
Ain Shams Univ.

Date of examination: 14 / 7 / 1992.



In the name of Allah, the Greatful, the Merciful.  
Peace and blessings be upon Mohamed, the prophit  
of Allah. May Allah accept this work for his sake  
and benifit anyone who reads it.

## A C K N O W L E D G E M E N T

My grateful thanks are due to Prof. Dr. Gamil B. El-Saadany and Prof. Dr. Ahmed Ali Gomaa , Professors of Economic Entomology, Faculty of Agriculture, Ain Shams University for suggesting the problem, kind help, positive effort in supervising the work and continuous encouragement.

Deepest thanks and gratitude to Prof. Dr. Fayez N. Zaki, Professor of Entomology, National Research Center for providing the facilities of the research and his vital guidance and indispensable support .

The author is also indebted to Prof. Dr. Leslie C. Lewis and Dr. John J. Obrycki, Department of Entomology, Iowa State University, Iowa, U.S.A. for their invaluable help and keen effort in directing the experiments in U.S.A.

Ultimate thanks and gratitude to my colleagues in Pests and Plant Protection Department, National Research Center.

BIOLOGICAL AND ECOLOGICAL STUDIES ON  
CERTAIN PARASITIDS OF CORN BORERS

By

MAHMOUD MOHAMED EL-SAIED SALEH

B.Sc. Agriculture (Entomology) 1976

M.Sc. Agriculture (Entomology) 1986

Under the Supervision of: Prof. Dr. Gamil Burhan El-Din El-Saadany

Prof. Dr. Ahmed Ali Gomaa

Prof. Dr. Fayez Nazir Zaki

**Abstract**

Biological and ecological studies serving the mass rearing and field utilization of the ectolarval parasitoid Bracon brevicornis and the egg parasitoid Trichogramma nubilale in suppressing the corn bores were carried out in Egypt and U.S.A.

Studies on B. brevicornis included biological aspects of the parasitoid on the host larvae of Ostrinia nubilalis, the attraction of the parasitoid to the kairomones of O. nubilalis and Sesamia cretica larvae as well as the sex pheromone of O. nubilalis. A simple and economic technique for mass rearing the parasitoid on the host larvae of O. nubilalis has been achieved. A method for

preserving the parasitoid adults for up to 18 weeks has been given. The interaction between *B. brevicornis* and the pathogenic microsporidium *Nosema pyrausta* was also studied. Several field release studies were conducted aiming to evaluate and enhance the role of *B. brevicornis* in the biological control of corn borer larvae either during the hibernation or the active season. The parasitoid showed considerable efficiency in suppressing the larvae of *O. nubilalis* as well as *S. cretica* in the field. The application of the kairomone of *S. cretica* larvae or the molasses (10%) enhanced the efficiency of the released parasitoids in the field.

Studies on *T. nubilale* revealed that the infection with the microsporidium *N. pyrausta* had some adverse effects on the parasitoid development. It reduced the number and the body size of the parasitoids as well as their efficiency in suppressing the European corn borer in the field. The combined effect of the egg parasitoid and the microsporidium in suppressing the European corn borer was studied. The parasitoid was more effective than the microsporidium in the field.

## CONTENTS

	Page
I. INTRODUCTION .....	1
II. REVIEW OF LITERATURE .....	4
1. <u>Bracon brevicornis</u> .....	4
2. <u>Trichogramma nubilale</u> .....	17
3. <u>Nosema pyrausta</u> .....	18
III. MATERIALS AND METHODS .....	21
1. Studies on <u>Bracon brevicornis</u> .....	22
1.1. Biology of <u>B.brevicornis</u> on <u>O.nubilalis</u> larvae .....	22
1.1.1. Progeny production .....	22
1.1.2. Progeny body size .....	22
1.1.3. Optimal parasitoid-host-time ratio .	23
1.1.4. Effect of crowding on the parasitoid egg deposition .....	24
1.1.5. Effect of the sex ratio of parasitoid parents on the egg deposition and the sex ratio of their progeny .....	24
1.1.6. Effect of mating on the parasitoid egg deposition and progeny production	25
1.2. Mass rearing technique for <u>B.brevicornis</u>	25
1.3. Attraction of <u>B.brevicornis</u> adults to kairomones and a sex pheromone .....	29
1.4. Storage of <u>B.brevicornis</u> .....	30
1.5. Field release of <u>B.brevicornis</u> .....	30
1.5.1. Rate of parasitism by <u>B.brevicornis</u> on hibernating corn borer larvae ..	31



	Page
1.5.2. Effect of host population density on the rate of parasitism .....	32
1.5.3. Effect of frequency of release on the rate of parasitism .....	33
1.5.4. Effect of different rates of release on parasitism .....	33
1.5.5. Effect of kairomones on parasitism	34
1.5.6. Effect of molasses on the activity of <u>B.brevicornis</u> .....	34
1.5.7. Parasitism by released <u>B.brevicornis</u> wasps on active corn borer larvae in growing maize plants .....	35
1.6. The impact of <u>Nosema pyrausta</u> on <u>B.</u> <u>brevicornis</u> .....	36
2. Studies on <u>Trichogramma nubilale</u> .....	37
2.1. Preference and suitability of <u>N.pyrausta</u> - infected <u>O.nubilalis</u> eggs for parasitism by <u>T.nubilale</u> .....	37
2.2. Combined effect of <u>T.nubilale</u> and <u>N.</u> <u>pyrausta</u> in suppressing <u>O.nubilalis</u> larvae in corn fields .....	39
IV. RESULTS .....	41
1. Studies on <u>Bracon brevicornis</u> .....	
1.1. Biology of <u>B.brevicornis</u> on <u>O.nubilalis</u> larvae .....	41
1.1.1. Progeny production .....	41

	Page
1.1.2. Progeny body size .....	45
1.1.3. Optimal parasitoid-host-time ratio .	48
1.1.4. Effect of crowding on the parasitoid egg deposition .....	52
1.1.5. Effect of the sex ratio of parasitoid parents on the egg deposition and the sex ratio of their progeny .....	54
1.1.6. Effect of mating on the parasitoid egg deposition and progeny production	57
1.2. Attraction of <u>B.brevicornis</u> adults to kairomones and a sex pheromone .....	60
1.3. Storage of <u>B.brevicornis</u> .....	63
1.4. Field release of <u>B.brevicornis</u> .....	63
1.4.1. Parasitism by <u>B.brevicornis</u> on hibernating <u>O.nubilalis</u> and <u>S.cretica</u> larvae in stored corn stalks .....	63
1.4.2. Effect of host population density on parasitism by <u>B.brevicornis</u> .....	67
1.4.3. Effect of frequency of release on parasitism by <u>B.brevicornis</u> .....	72
1.4.4. Effect of rate of release on the rate of parasitism .....	75
1.4.5. Effect of kairomones on the rate of parasitism .....	78
1.4.6. Effect of molasses on the rate of parasitism .....	78

	Page
1.4.7. Rate of parasitism by <u>B.brevicornis</u> on active larvae of <u>S.cretica</u> in growing maize plants.....	82
1.5. The impact of <u>Nosema pyrausta</u> on <u>B. brevicornis</u> .....	84
2. Studies on <u>Trichogramma nubilale</u> .....	87
2.1. Preference and suitability of <u>N.pyrausta</u> -infected <u>O. nubilalis</u> eggs for parasitism by <u>T.nubilale</u> .....	87
2.2. Efficacy of <u>N.pyrausta</u> -infected <u>T.nubilale</u> wasps in parasitizing <u>O.nubilalis</u> eggs in the field .....	91
2.3. The combined effect of <u>T.nubilale</u> and <u>N.pyrausta</u> in suppressing <u>O.nubilalis</u> in the field .....	95
V DISCUSSION .....	99
VI SUMMARY .....	111
VII REFERENCES .....	119
ARABIC SUMMARY .....	

## LIST OF TABLES

	Page
1. Host range and geographical distribution of <u>B. brevicornis</u> .....	5
2. The tested P (parasitoid females)-H (host larvae)- T (exposure time in days) ratios to determine the optimal ratio(s) for rearing <u>B. brevicornis</u> on <u>O. nubilalis</u> .....	23
3. Numbers of <u>B. brevicornis</u> progeny produced from <u>O. nubilalis</u> larvae at certain rates of parasitoid eggs per host larva .....	42
4. Body dimensions of <u>B. brevicornis</u> females produced from <u>O. nubilalis</u> larvae at different rates of parasitoid eggs per host larva .....	46
5. Numbers of <u>B. brevicornis</u> eggs laid on <u>O. nubilalis</u> larvae at different ratios of parasitoid (P)- host (H) - exposure time in days (T) .....	50
6. Effect of crowding of <u>B. brevicornis</u> wasps and <u>O. nubilalis</u> larvae on the parasitoid egg deposition .....	53
7. Effect of the sex ratio of <u>B. brevicornis</u> parents on the egg deposition and the sex ratio of their progeny .....	55
8. Egg deposition and progeny production of mated and unmated <u>B. brevicornis</u> females .....	58
9. Numbers of <u>B. brevicornis</u> adults attracted to kairomones of <u>O. nubilalis</u> and <u>S. cretica</u> larvae .....	61

	Page
10. Numbers of <u>B. brevicornis</u> adults attracted to sex pheromone of <u>O. nubilalis</u> .....	61
11. Effect of storage period on the survival rate and the fecundity of <u>B. brevicornis</u> adults .....	64
12. Parasitism by <u>B. brevicornis</u> wasps released on <u>O. nubilalis</u> and <u>S. cretica</u> larvae in stored corn stalks .....	66
13. Natural parasitism by <u>B. brevicornis</u> on two larval populations of <u>O. nubilalis</u> in stored corn stalks in Dakahlia .....	68
14. Parasitism after releasing <u>B. brevicornis</u> wasps on three populations of <u>O. nubilalis</u> larvae in stored corn stalks in Dakahlia .....	69
15. Effect of frequency of releasing <u>B. brevicornis</u> wasps on <u>O. nubilalis</u> larvae in corn stalks .....	73
16. Parasitism by released <u>B. brevicornis</u> wasps on hibernating <u>O. nubilalis</u> larvae in stored corn stalks at different rates of release .....	76
17. Effect of kairomones from certain larval species on parasitism by <u>B. brevicornis</u> on <u>O. nubilalis</u> larvae in stored corn stalks .....	79
18. Effect of molasses on parasitism by <u>B. brevicornis</u> on <u>O. nubilalis</u> larvae in stored corn stalks .....	80
19. Parasitism by released <u>B. brevicornis</u> wasps on larval population of <u>S. cretica</u> in a corn field in Giza .....	83

20. Effect of <u>N. pyrausta</u> infection on some biological aspects of <u>B. brevicornis</u> as well as the weight of <u>O. nubilalis</u> host larvae .....	85
21. Comparison of <u>T. nubilale</u> parasitism and adult emergence between <u>N. pyrausta</u> infected and uninfected <u>O. nubilalis</u> eggs .....	88
22. Comparison of body dimensions of <u>T. nubilale</u> females emerging from <u>N. pyrausta</u> -infected and uninfected <u>O. nubilalis</u> eggs .....	89
23. Effect of <u>N. pyrausta</u> infection on the weight of <u>O. nubilalis</u> eggs .....	90
24. Rate of parasitism by <u>N. pyrausta</u> -infected and uninfected <u>T. nubilale</u> wasps on <u>N. pyrausta</u> -infected and uninfected <u>O. nubilalis</u> eggs after 2 and 5 days of releasing the parasitoids in the field .....	92
25. Rate of parasitism by <u>N. pyrausta</u> -infected and uninfected <u>T. nubilale</u> wasps on <u>O. nubilalis</u> eggs after 2 and 5 days of releasing the parasitoids in the field .....	93
26. Numbers of <u>O. nubilalis</u> larvae and lengths of tunnels in corn plants after applying <u>T. nubilale</u> in combination with <u>N. pyrausta</u> in the field .....	96

## LIST OF FIGURES

	Page
1. Oviposition dish (20 cm in diameter) used in the rearing of <u>B. brevicornis</u> on <u>O. nubilalis</u> .....	28
2. The method of collecting the emerged adults of <u>B. brevicornis</u> from the parasitized larvae .....	28
3. Numbers of <u>B. brevicornis</u> progeny produced from <u>O. nubilalis</u> larva at certain rates of parasitoid eggs per host larva .....	43
4. Regression of numbers of <u>B. brevicornis</u> eggs per <u>O. nubilalis</u> larvae Vs. percentage of parasitoid adults emerging from these larvae .....	44
5. Body size (multiplication of length X width in mm) of <u>B. brevicornis</u> females produced from <u>O. nubilalis</u> larvae at different rates of parasitoid eggs per host larva .....	47
6. Regressions of number of <u>B. brevicornis</u> progeny produced from <u>O. nubilalis</u> larvae and the body size of these progeny Vs. number of parasitoid eggs per host larva. The vertical line passes the maximum quantity and the best possible quality (indicated by body size) of produced parasitoids .....	49
7. Numbers of <u>B. brevicornis</u> eggs laid on <u>O. nubilalis</u> larvae at different rates of P (parasitoid females) -H (host larvae) -T (parasitization time in days) ..	51