



# **Studies on the population dynamics of two different insects in a storage ecosystem**

A Thesis

Submitted to the Faculty of Science,  
Ain Shams University, For the award of Ph.D.  
degree in Science (Entomology)

By

**Fawkia Ibrahim Ali Hussein**  
(M.Sc.)

52203

Department of Entomology  
Faculty of Science, Ain Shams University

## **Supervisors**

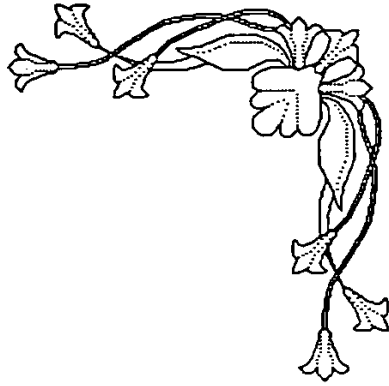
Prof. Dr. Hashim A. Abdel-Rahman  
Prof. of Entomology, Faculty of Sci.,  
Ain Shams University

Dr. Jehan A. Hafez  
Assist. Prof. of Ent., Faculty of Sci.,  
Ain Shams University

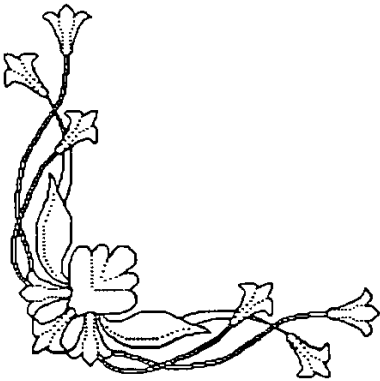
Dr. Said M. Ali  
Assist. Prof. of Ent. Faculty of Sci.,  
Ain Shams University.

Dr. Hoda M. Abdel-Fattah  
Lecturer of Ent., Faculty of Sci.,  
Ain Shams University

CAIRO  
1995



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ







جامعة عين شمس  
كلية العلوم

## **Studies on the population dynamics of two different insects in a storage ecosystem**

### **Supervisors**

**Prof Dr. Hashin A. Abdel-Rahman**

Professor of Entomology, Faculty of Sci. Ain Shams  
University

**Dr. Jehan A. Hafez**

Assist. Prof. of Entomology, Faculty of Sci., Ain Shams  
University

**Dr. Said M. Ali**

Assist. Prof. of Entomology, Faculty of Sci., Ain Shams  
University

**Dr. Hoda M. Abdel - Fattah**

Lecturer of Entomology, Faculty of Sci., Ain Shams  
University

## **Thesis Examination Committee**

**Prof. Dr. Hashim A. Abdel-Rahman**

Prof. of Entomology, Faculty of Science,  
Ain Shams University

**Prof. Dr. Mahmoud H.Ibrahim**

Prof. of Entomology, Faculty of Science,  
Cairo University

**Prof. Dr. Wedad A. Atwa**

Prof. of Entomology and vice-dean, Faculty of Science  
(for girls),  
Al-Azhar University.

## ACKNOWLEDGMENTS

First of all, ultimate thanks to ALLAH for everything he has been giving to me.

The authoress wishes to express her profound, sincere appreciation and gratitude to **Prof. Dr. Hashim A. Abdel-Rahman**, professor and ex- head of the Department of Entomology, Faculty of Science, Ain Shams University for his supervision, valuable suggestions, his encouragement and continuous advice throughout the period of study, and for reading and correcting the manuscript.

Sincere thanks and appreciation are due to **Prof. Dr. Zaki M. Rostom** for his encouragement and kind help in illustrating the figures by computer.

Sincere thanks are also due to **Dr. Mohammad A. Qinawi, Dr. Jehan A. Hafez, Dr. Nadia M. Lotfi and Dr. Suid M. Ali** Assistant Professors of Entomology, Faculty of Science, Ain Shams University, for their interest and encouragement.

I am also indebted with thanks to **Dr. Hoda M. Abdel-Fattah**, Lecturer of Entomology in the same Department, for her encouragement and kind help in the statistical analysis of data.

Thanks are also due the staff members and colleagues in the Department of Entomology, Faculty of Science, Ain Shams University for their sincere help and cooperation.

## Abstract

The present investigation dealt with the study of intra - and interspecific competition in two stored grain insects, *Tribolium confusum* and *Corcyra cephalonica*, in different levels of initial infestation, in a limited storage ecosystem at  $26 \pm 2^{\circ}\text{C}$  and  $50 \pm 5\%$  r.h. for different periods.

It covered the effects of competition in each species and in both species on competitors population growth and population mortality, as well as on grain moisture content and counts and kinds of associated storage fungi.

The population density increased with increasing initial infestation and/or storage period to a certain extent and then sharply decreased. Finally, the population of *T. confusum* vanished; while that of *C. cephalonica* remained alive. Mortality, on the other hand, was very low at the beginning of infestation, but tremendously increased after the population became crowded.

A positive correlation existed between the insect population density and the moisture content of infested media. The increase in moisture content due to insect crowding was usually accompanied by the growth of different species of storage fungi mainly of the genera *Aspergillus* and *Penicillium*.

Key words: *Tribolium confusum*, *Corcyra cephalonica*, population dynamics, intraspecific competition, interspecific competition, population growth, population mortality, storage fungi, moisture content.

## Contents

	Page
I. Introduction.....	1
II. Literature review.....	5
1. Intraspecific and interspecific competition in insect populations in a storage ecosystem.....	5
2. Interaction between stored grain insects, grain moisture content and storage fungi in a storage ecosystem.....	13
III. Materials and Methods.....	
1. Insects and grain used in the present study.....	27
2. Intraspecific competition.....	28
2.1. In <i>Tribolium confusum</i> .....	28
2.2. In <i>Corcyra cephalonica</i> .....	29
3. Interspecific competition.....	30
4. Measurement of grain moisture content.....	31
5. Adjustment of grain moisture content.....	32
6. Mould count assessment.....	33
7. Medium used for culturing storage fungi.....	34
8. Identification of storage fungi.....	35



	Page
9. Statistical analysis of data. _____	35
IV. Results _____	36
1. Intraspecific competition in <i>T. Confusum</i> in a limited storage ecosystem. _____	36
1.1. Effect of initial infestation on population growth. _____	36
1.1.1. Initial infestation 5 pairs. _____	36
1.1.2. Initial infestation 10 pairs. _____	39
1.1.3. Initial infestation 15 pairs. _____	41
1.1.4. Initial infestation 20 pairs. _____	43
1.1.5. Initial infestation 40 pairs. _____	45
1.2. Effect of initial infestation on population mortality. _____	49
2. Intraspecific competition in <i>C. cephalonica</i> in a limited storage ecosystem. _____	53
2.1. Effect of initial infestation on population growth. _____	53
2.1.1. Initial infestation 2 pairs. _____	53
2.1.2. Initial infestation 5 pairs. _____	56
2.1.3. Initial infestation 10 pairs. _____	59

	Page
2.2. Effect of initial infestation on population mortality.....	62
2.3. Effect of initial infestation on weight and fecundity of resultant female moths.....	68
3. Interspecific competition in <i>T. confusum</i> and <i>C. cephalonica</i> in a limited storage ecosystem.....	72
3.1. Effect of combined initial infestation on competitors population growth.....	72
3.1.1. Initial infestation 2+2 pairs.....	72
3.1.2. Initial infestation 5+5 pairs.....	77
3.1.3. Initial infestation 10+10 pairs.....	82
3.2. Effect of combined initial infestation on competitors population mortality.....	87
4. Effect of intra - and interspecific competition in <i>T. confusum</i> and <i>C. cephalonica</i> on the moisture content of infested wheat meal.....	92
4.1. Effect of intraspecific competition in <i>T. confusum</i> .....	92
4.2. Effect of intraspecific competition in <i>C. cephalonica</i> .....	98

	Page
4.3. Effect of interspecific competition in <i>T. confusum</i> and <i>C.cephalonica</i> .....	103
5. Effect of intra - and interspecific competition in <i>T. confusum</i> and <i>C. cephalonica</i> . on associated storage fungi.....	110
5.1.Effect of intraspecific competition in <i>T.confusum</i> on mould count.....	110
5.2.Effect of intraspecific competition in <i>C.cephalonica</i> on mould count.....	115
5.3.Effect of interspecific competition in <i>T.confusum</i> and <i>C.cephalonica</i> . on mould count. —	119
5.4. Kinds of associated storage fungi.....	123
V. Discussion .....	125
VI. Summary .....	138
VII. Literature Cited .....	146
Arabic Summary.....	

# I.Introduction



## **I. INTRODUCTION**

The infestation of stored grain and grain products by insects is a common problem throughout the world. Generally, several species of insects invade stored grain and grain products simultaneously or in close succession. Consequently, competition for food and space affect insect populations, the quality of stored products and its rate of deterioration (Kabir, 1966; Lefkovitch, 1968; Ciesielska, 1975; Le cato, 1975; Abdel Fattah, 1992).

The infestation of these insects with one another and their environment under favourable temperature and grain moisture content usually maximizes biological activity leading to rapid floral and faunal succession and deterioration of grain and grain products (Sinha and Wallace, 1966; Abdel-Rahman 1967, 1969; Abdel-Fattah, 1992).

Intra-and interspecific competition have been brought to be the primary driving force of evolution since Darwin proposed the theory of natural selection. Some ecologists referred intraspecific competition as the major factor controlling population dynamics (Elton, 1947; Nicholson, 1948). Interspecific competition, on the other hand, has been one of the most attractive subjects in ecological researches (Connell, 1983; Schoener, 1983). This is the first and most important step to bridge gap between community ecology and lower levels of

ecological phenomena at the population or the individual level (Toquenaga and Fujii, 1991).

Competing species often adapt different and in some cases, opposite types of resource utilization Nicholson (1954) proposed the two extreme forms of competition when individuals compete for common resources; "scramble" type and "contest" type competitions. The former type occurs when competing individuals have equal access to a common resource. With this mode of competition, all individuals die when the resource is used up. In "contest" type competition, on the other hand, some individuals monopolize the resource, while the others are left with no resource. This concept of "scramble" and "contest" type competitions has been very useful in the study of population ecology; especially when considering the mechanism of population dynamics.

The confused flour beetle, *Tribolium confusum* duval, and rice moth, *Corcyra cephalonica* (Staint) are cosmopolitan pests of stored products and are widely distributed in Egypt. They cause considerable damage to different stored grain and grain products; and may render the grain more susceptible to attack by secondary insect pests and storage fungi. Because of their similar habits, both insects have been regarded as ecological homologues.