بسم الله الرحمن الرحيم

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THE EFFECT OF *Varroa jacobsoni* INVASION ON SOME BIOLOGICAL ASPECTS OF HONEYBEE AT SHARKIA GOVERNORATE

Thesis

Submitted in Partial Fulfillement of the Requirements for Master Degree of Science IN

ZOOLOGY

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وأوحى ربك إلى النحل أن اتخذى من الجبال بيوتاً ومن الشجر ومما يعرشون * ثم كلى من كل الثمرات فاسلكى سبل ربك ذللاً يخرج من بطونها شراب مختلف ألوانه فيه شفاء للناس إن فى ذلك لآية لقوم يتفكرون.

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إهداء

عرفاناً منى بالجميل أهدى هذه الرسالة

إلى روح أبى الطاهرة

وإلى أمى الحبيبة واخوتى

وإلى كل أساتذتى

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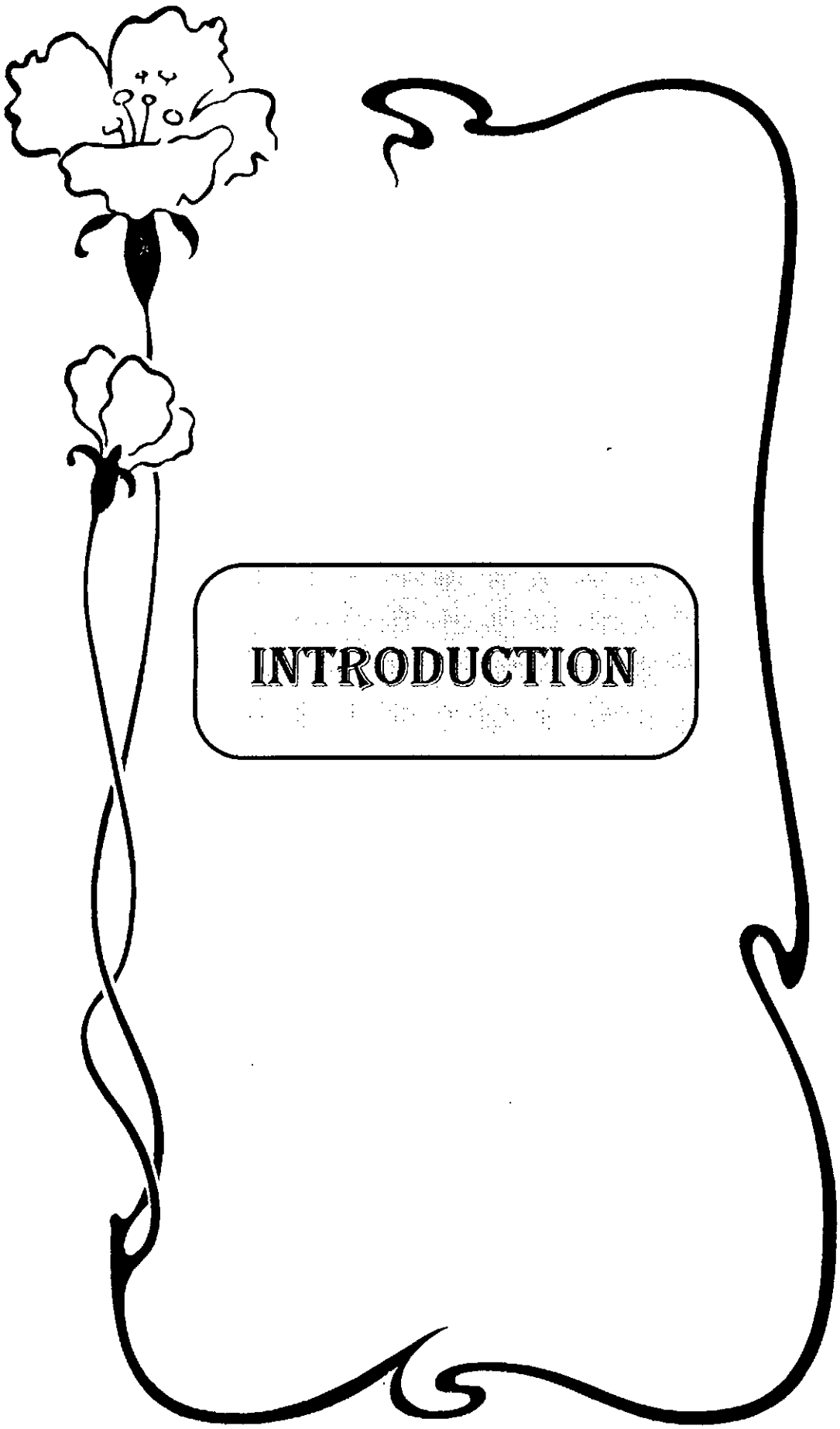

INTRODUCTION

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The broodmite *Varroa jacobsoni* (Acari, Varroidea) is an ectoparasite of honeybee *Apis mellifera* L. This mite was first reported in 1904 on the Asian honeybee *Apis cerana* in Java by **Oudemans (1904)**. It constitutes one of the greatest dangers for modern beekeeping **(Griffiths and Bowman, 1981).** *Varroa* has been introduced world-wide, now it is present in all the continents, except Australia **(Marletto, 1988).** This distructive mite was recorded in Egypt for the first time in 1987 at El-Arish (North Sinai), then spread allover the country and has been found in honeybee colonies in the Nile Delta during 1990 **(Hussein, 1991).**

Nowdays bee journals in almost every country seem to have carried articles on *Varroa,* and readers may have been puzzled at the apparently sudden corruption of this mite in different parts of the world **(Crane, 1978).** *V. jacobsoni* has been shown to spread over vast areas in a short time causing damage to apiaries, particularly when no control measures have been applied **(Yakobson *et al.*, 1986).**

Drones, workers and even queens transmit the parasite from one coloney to another. Also the apiculturists play a role in the transmission of *Varroa* by transferring of frames from hive to another **(Pierre and Paul. 1994).**

Delfinado and Baker (1974) made a description of both female and male *Varroa* and they reported that the female is large, brown, hairy species. Gnathosoma small, completely hidden beneath dorsal plate. Body length is 1135 μm and width 1666 μm. They also, reported that the male

had an oval body, broadest at coxa IV area. Gnathosoma as in female, body length 800 μm and width 706 μm. The males of *Varroa jacobsoni* are haploid, exhibit neoteny, and have shorter developmental phases and life span than females and do not fight at mating nor feed as adult **(Ramirez, 1987)**.

Delfinado *et al.* (1983) presented scanning electro micrographs (SEM) of mites infesting honeybees and hives to show readers the appearance of these pests and to increase general interest of beekeepers and apiary inspectors in the parasitic mites of honeybee.

Liu, (1988); Liu and Ying-shin (1990) and Nuzzaci *et al.* (1993) examined the structure, distribution, and types of sensory hairs on the palptarsus of females *V. jacobsoni* by Scanning electron and phase contrast micrescopy. They reported that the two large peg-like setae with apical pores are chemoreceptors sensilla chaetica and the seven slender, the round tipped setae and stained with crystal violet are considered to be the chemoreceptors sensilla trichodae. They also discussed the possible function of these sensilla.

Liu and Ying-Shin (1990) examined by means of SEM the structure of the female pretarsus. They reported that it consists of two main parts, a cuticular basal stalk and an extrudable, membranous ambulacral pad, the cornicle. They also reported that, the cornicle when fully extruded and expanded, becomes a bilobed sucker, and when deflated, the entire caruncle is retracted into the basal stalk. **Akimov and Yestrebtsov (1990)** and **Ramirez and Jollyana (1991)** suggested that the ambulacrum of the adult females *Varroa*, *Euvarroa* and probably of

Tropilaelaps is not a sucker or a sticky pad but a structure with protactile claw-like sclerites as shown by SEM analysis, contrary to the common belief. These claw-like sclerites may work to grasp the hairs of the bee and allow the mites to move rapidely on the adult bees and other substrata. They also reported that, immature stages of *Varroa* and *Euvarroa* do not seem to have ambulacral claw-like projections as those found in the adults.

Bautz and Coggins (1992) examined the female *Varroa jacobsoni* by means of SEM and reported that, the flat ventral surface was composed of a series of plates, a unique respiratory structure and different types of setae. They also mentioned that legs of this mite appeared to be modified from ectoparasitism and the mouth parts are well modified for its diet of bee haemolymph.

Delfinado and Baker (1984) described the nymphal stages (protonymph and deutonymph) of *V. jacobsoni* for the first time and adult male was redescribed. Also morphological characters for accurate recognition of these developmental stages were figured and discussed as well as significant features found in nymphal stages that provide further support for assigning *V.jacobsoni* separated family status.

Akimov and Piletskaya (1985) reported that females of *V. jacobsoni,* a parasite of a honeybee lay eggs of different quality, that eggs are classified according to their size and degree of development into 3 groups: small, average and large. The authors also illustrated that an early (at the larval stages) morphological differentiation between females and males can be detected.

Haragsim and Samsinak (1986) presented a detailed taxanomic description of the developmental stages of female and male mites. They reported also that the female develops from egg into larva, nymph I and nymph II. No deutonymph II has been found in the development of the males, so it is assumed that, like in some other parasitic mite species, this stage is missing. They have been concluded from the morphology of the mouth parts that the adult male can not parasitize the pupae nor adult bees and that it doesn't take in food during its short life.

Hendrson *et al.* (1986); Ramirez and Otis (1986) and **Marletto (1988)** explained that *Varroa jacobsoni* life cycle can be divided into five phases: the first one on adult bees and the other four in the brood combs and they summerized the five phases in a worker bee cell as follows:

Phase I: Post mating, feeding on adult bees (drones or workers).

Phase II: Searching for brood cell of the correct stage, penetration into larval food and inactivation (duration from days 7-9 of immature bee development).

Phase III: Reactivation and feeding on bee larva, prepupa, and/or pupa, vitellogenesis and laying of the first two eggs (Duration: from 0-90 hours after engorging of larva and cell capping).

Phase IV: Feeding on pupa: vitellogenesis and laying of the other eggs. (Duration: from 90 hours after cell capping untill emergence of adult bee).

Phase V: Maturation and mating (Duration: from 240 hours after cell capping to emergence of adult worker bee).

Mautz *et al.* (1986) documented the existence of different embryonic stages of the honey bee mite *Varroa jacobsoni* Oudemans 1904. The outstanding peculiarity of *Varroa's* development is domonstrated by the fact that primarily a six-legged, and latter an eight-legged immobile embryo is formed, from which finally a mobile protonymph originated. A mobile and free living six-legged larva does not occur and this contrasts to the development in related mite species.

Akimov and Yastrebtsov (1988) described in details the oocytes ripening processes, blastulation, gastrulation and organogenesis.

Infantidis (1988) and Moretto *et al.* (1991) reported that the reproduction and population growth in the *Varroa* mite is a complex phenomenon that is affected by several factors, such as:

a. The parasite (age, physiological condition, sperm reserve in the spermatheca).
b. The host (bee species or race, ontogenetic stage, age and sort of the parasitized brood, seasonal condition of the bee coloney).
c. The possibility that the females adult mite be found in the sealed bee brood.

LeConte *et al.* (1990) observed that the optimum temp. for development of the mite *V. jacobsoni* was between 32.5 and 33.4°C which corresponds to the brood temperature of *Apis mellifera* L. They also observed that above 36.5°C, reproduction of *Varroa* females was significantly reduced, and above 38°C mites began to die without reproduction. Jumps of temperature was unfavourable to the development of the mites.

Harizanis (1991) reported that no mites entered queen cells in lightly infested colonies. More mites entered queen cells in heavy infested colonies that contained no worker or drone brood.

Boot *et al.* (1993) studied the invasion of *Varroa* mites into honeybee brood cells in an observation hive using combs with cell openings at one side only. They found that mites invaded worker cells from 15-20h preceding cell capping, whereas they invaded drone cells from 40-50h preceding capping and observed also that the larger number of mites were generally found in drone cells, when compared to worker cells, and this may be due to the longer period of mite invasion into drone brood.

Steiner *et al.* (1994) reported that initiation of oocyte development in *V. jacobsoni* depends on whether the female enters the brood cell of *Apis mellifera* before operculation and subsequently sucks heamolymph from a late fifth instar bee larva. They also made a timetable for the first gonocycle showing its duration in worker and drone host cells. About 70h after capping of the bee brood cell, the first egg is laid containing a nearly complete protonymph that hatch within the next day.

Marine (1979) observed that a high death rate of bees was recorded, with a rate of 20 mites per 100 bees, the coloney was considered to be doomed, if no measure was taken to control the infestation. The bee larvae and nymphs would not develop into normal adults capable of carring out their duties in the bee coloney. Bees emerging from such nymphs would often be deformed, weak and die soon. With very high

infestation, disorder would occur in the life of the coloney and bees would often leave the hive and die.

De Jong and De Jong (1983) studied the longevity of normal and infested Africanized honey bees *A. mellifera* and they found that *Varroa* uninfested bees lived an average of 27-6 days, infested bees lived only 13-6. Bees, infested with two or more mites lived 8-9 days. The number of mites per bee was significantly negative correlated with longevity and appeared not to be merely a secondary result of reduced adult weight.

Kovac and Crailsheim (1988) investigated longevity, duration of hive-bound period and foraging period of worker bees, infested or not infested with *V.jacobsoni* during their pupal development. They found that shortening life span depend on the extent of infestation and season. No influence could be shown on flight activity.

Needham (1988) reported that the damage by the mite has already taken two forms, which is respresting the sale and movement of bees, and the real destruction or weakening of colonies by feeding of mites.

Varroa is like getting the AIDS virus, despite active monitoring of bees, despite productive legislation restricting importation, despite repeated works by beekeepers in many countries invaded by *Varroa* and despite being forewarned of the threat to beekeeping and agriculture. This ectoparasitic mite, has caused severe damage to beekeeping in every country where it has been introduced. No country which has become infested with *Varroa* has been able to eleminate or cradicate it. Without doubt, this mite is the most serious problem the U.S. beekeeping industry has faced **(Susan and Timothy, 1988)**.

Gyorgy (1989) and **Romaniuk *et al.* (1991, 1993)** found out that bee colonies which were not treated died within 3-4 years of the disease, while treated ones were debilitated. This new host-parasite relationship has not yet become balanced and therefore resulted in severe losses everywhere.

Guermant *et al.* (1990) noted that the varroasis spread very rapidely, provoking, the death of about 60% of the colonies within a few months. The global percentage of infestation developed with the multiplication factor of two in 35 days and four in 70 days.

Jelinski (1990) observed that the nest with living wasps in Swarzeds (Poland) was destroyed. He found three adult females of *Varroa jacobsoni* on larvae of *Vespa (Paravespula) vulgaris.* It was the first record of the occurrance of *V.jacobsoni* in *V. (p.) vulgaris* coloney in Poland.

Romaniuk and Wieslaw (1993) found that, life span of augustowska queen in treated colonies was 458 days in control untreated 376 days, in carnica queens 618 and 513 days and in caucasian 769 and 523 days respectively. They found also that the mean life span of queen in treated colonies was 645 days and in untreated colonies was shortened by 191 days.

Daly *et al.* (1988) measured 23 lengths and 25 angles on forewing and 3 lengths on the hind leg of Africanized bees infested with *Varroa jacobsoni.* They reported that all such lengths exhibit a negative regression and the net effect of parasitism on the the exoskeleton appeared minor in