Salwa Akl

بسم اللّه الرحمن الرحيم

مركز الشبكات وتكنولوجيا المعلومات

قسم التوثيق الإلكتروني

Salwa Akl

جامعة عين شمس

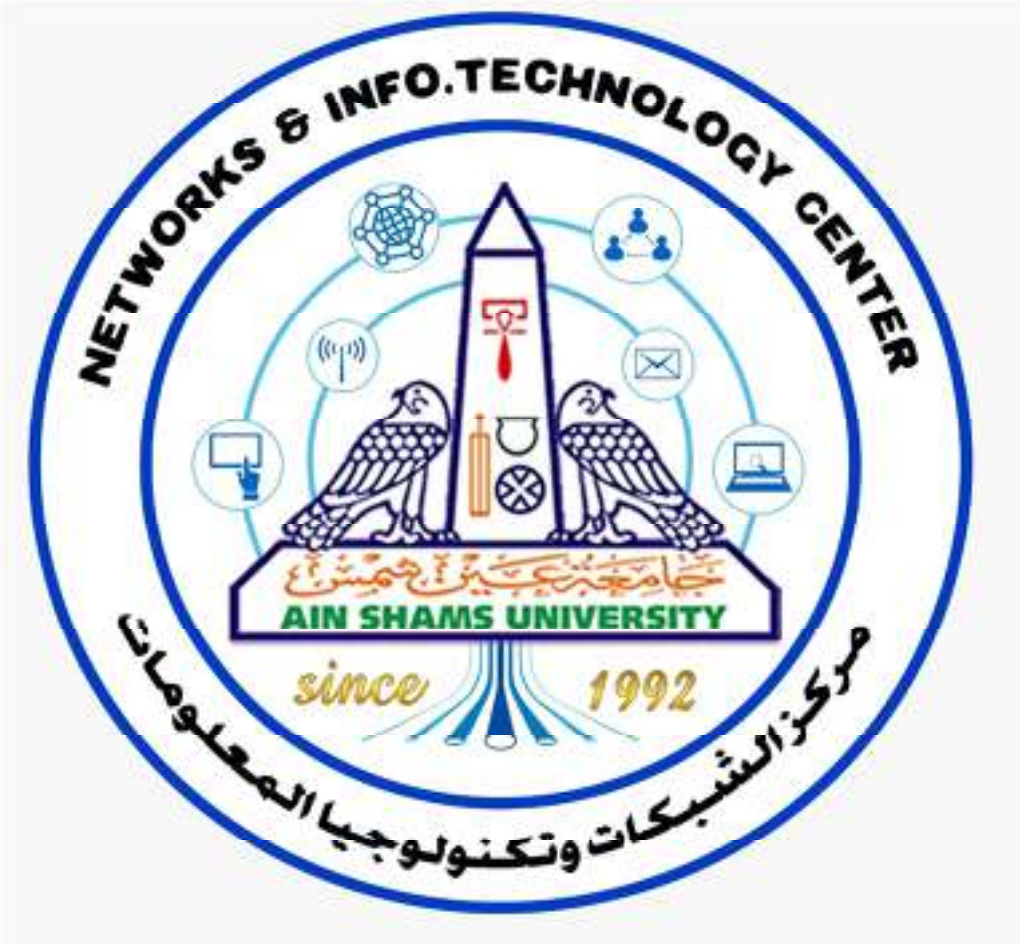
التوثيق الإلكتروني والميكروفيلم

قسم

نقسم باللّه العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

Salwa Akl



بعض الوثائق الأصلية تالفة
وبالرسالة صفحات لم ترد بالأصل

BIOLOGICAL AND ECOLOGICAL STUDIES ON THE CITRUS LEAF MINER *PHYLLOCNISTIS CITRELLA* STAINTON

BY

SEHAM MOHAMED EL-MAHDY MOHAMED
B. Sc. (Agric.) Cairo university, 1990

THESIS

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APPROVAL SHEET

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ABSTRACT

Under laboratory conditions, certain biological aspects of the Citrus Leaf Miner (CLM), *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) were studied on Sour Orange seedlings (*Citrus aurantium* L.) throughout spring, summer and autumn seasons. When *P. citrella* was reared on Sour Orange seedlings, significant differences were attained in different seasons between pre-oviposition period, oviposition period, Fecundity, daily oviposition rate, longevity of females, incubation period, larval and pupal durations as well as life cycles of males and females. Larvae reared in summer, pupated in significantly shorter time than those developed in autumn and spring. Sex ratio was 1 male: 1.17 females. Individuals reared in summer completed their life cycles in significantly shorter period.

The occurrence of different stages of *P. citrella* on unsprayed citrus trees of Navel Orange, Mandarin and Lime cultivars at three Governorates were studied during 1995-1996 and 1996-1997. The three evaluated citrus species; Navel Orange, Mandarin and Lime had demonstrated to be acceptable hosts for this pest with preference to infest Lime. Eggs, larvae and pupae were nearly prevailed between April to December on Navel Orange and Mandarin. On Lime, these stages nearly remained all the year round. The host and the availability of tender flushes evidently influenced the numbers of peaks of different stages of CLM. The maximum abundance of different stages took place throughout autumn and summer. *P. citrella* underwent seven and six annual overlapping generations during both years, respectively on different cultivars. On Lime, additional three generations were occurred. The most favorable temperature and relative humidity for the prevalence of various stages was 14-30 °C. and 36-75 %, respectively. Daily-mean relative humidity was the most weather factor influencing the population of various stages. Day-maximum temperature and night-minimum temperature influenced the activity of immatures under certain conditions (autumn and summer). Those weather factors simultaneously were responsible for about 15.9-96.6 % of the variability in the total population.

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CONTENTS

INTRODUCTION

Citrus is a traditional and very important crop in Egypt. It is one of the major crops grown for cousume and export. The total area is 355518 feddans, representing about 35.3% of the cultivated area of Egypt. The major varieties are Oranges (covering about 34.7 % of the total citrus area), Mandarins (23.3%), Lemons (9.6 %), and other varieties (about 32.4%).

Scale insects and mealy bugs are probably the most serious pests of citrus in Egypt. Other insect pests include the Mediterranean fruit fly, aphids, and whiteflies. Citrus leaf miner, *Phyllocnistis citrella* Stainton was also added on the list of main pests of citrus.

The small leaf mining moth, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) or the citrus leaf miner (CLM) was first described from Calcutta, India by Stainton in 1856. It is a serious pest of citrus and related Rutaceae, and some related ornamental plants (Kalshoven 1981 and Beattie 1989). In Egypt, citrus recently has been invaded by this pest which was first discovered during summer of 1994 in El-Sharkia & Ismalia Governorates. Then, it spread rapidly throughout most of the citrus growing areas. Its population had increased geometrically and within the last 6 - 7 years it became among the important pests of citrus in Egypt (Sharaf El-Din, 1999). Also, it was simultaneously observed in most countries of the world (Heppner 1993).

The presence of the citrus leaf miner in Egypt is another "puzzle" in the continuous introduction of exotic pests. It is believed that the CLM adults entered Egypt on air currents from a neighboring country (ies). This belief is based on the fact that despite strict domestic quarantine

measures, the insect spread to all citrus growing regions in Egypt in a little more than one year. It is also suspected that the trade of citrus plants from regions to other regions of Egypt was increased, and thus the leaf miner was introduced with plant material from those regions, thus, the infestation of most Governorates in Egypt are possibly the result of moving infested plant material from colonized areas, or may be due to a combination of human involvement and natural dispersion.

In Egypt, Eid (1998) found that *P. citrella* is distributed in most Governorates. He collected pupae and larvae of *P. citrella* from citrus orchards from Upper Egypt (Giza , Fayoum, Beni-Suef, Minia, Assuit, Sohag and Aswan), Delta region (Kalubia, Dakahlia, Gharbia, Behira, Alexandria, Mersa Matrouh, Kafr El-Sheikh, Sharkia and Damietta) and North and South Sinai.

The leaf miner is an indirect pest, affecting mostly photosynthesis through reduction of leaf surface area. Immediately upon hatching, CLM larvae bore through the leaf epidermis and begin ingesting cell sap by lancing leaf cells with their sharp mandibles. Larvae usually feed on the cells of lower epidermis, making serpentine mines and remain protected by the waxy cuticle of the leaf. The damaged area turns into a chlorotic patch which may become necrotic, resulting in leaf curling and serious injury. Knapp *et al.* (1995) in Florida found that usually only one leaf mine is present per leaf but heavy infestation can have 2 or 3 mines per leaf; up to 15 mines per leaf have been found on large leaves. Succulent branches of green shoots, axillary and apical buds also may be attacked by leaf miners. Larvae of *P. citrella* also have been observed on small immature fruit in various areas recently infested by CLM,

including Florida, the Bahamas, Cuba, Honduras, and Mexico (Knapp *et al.* 1994).

The purpose of this study is to provide with some information relative to the invasion of Egypt by the citrus leaf miner (CLM), *Phyllocnistis citrella*. Many problems raised due to the scarcity of detailed information on biology, ecology of the pests in the main citrus areas in Egypt. Also, there are lack quantitative data on relationships between pest densities and weather factors. Further information is needed to enhance biological control, as well as to import exotic parasitoids and predators of major pests.

Researchers and growers alike are very conscious about finding out a rapid and efficient solution to these problems. Many local studies and surveys of infestation are now under way. Thus, this research would be focused on the main following items:

(1) - Some biological studies on *Phyllocnistis citrella* Stainton in order to contribute brief description of different life stages and their behavior as well as to evaluate the duration of CLM stages.

(2) - Some ecological studies on this pest to contribute a better knowledge on the seasonal occurrence of immature stages (under the effect of temperature and relative humidity) on three cultivars (Navel Orange trees "*Citrus sinensis* var. *Washington*", Common Mandarin "*C. reticulata*" and Lime "*Citrus aurantifolia*").

PART ONE

BIOLOGICAL STUDIES

REVIEW OF LITERATURE

The biology of CLM has been reported on by many researchers, including Latif and Yunus (1952), Badawy (1967), Beattie (1989), Berrie and Mohyuddin (1990), Heppner 1993 and Knapp *et al.* (1995) who stated that adults are active from dusk to early morning and apparently oviposit in the evening and in the first hours of the morning. Copulation occurs 14-24 hours after emergence and oviposition follows. Adults generally live 2-12 days, but have been reported to live as long as 20 days. Females deposit from 36 to 76 eggs over their lifespan, averaging 48 eggs per female. Oviposition predominates near the midrib on the underside of small, folded emerging leaves. Eggs also are laid on tender or succulent stems. Egg eclosion occurs after 2-10 days. Larvae have 4 instars. Duration of the larval period can be as brief as 5 days, but has been reported to require as much as 20 days under cool conditions. Upon completion of larval feeding, the third instar generally mines in a straight line toward the leaf margin where the molt to the fourth instar (the prepupa) occurs. Pupation occurs in a white cocoon within the pupal chamber formed on the edge of the leaf. Pupal duration is 6 to 22 days. Total generation time can fluctuate between 13-52 days depending on temperature, with the following stage-specific developmental times: 2-10