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# SUMMARY

## I. Ecological Studies:

### I.1. Incidence of land snails infested different crops at Gharbia, Dakahlia and Kaliubia Governorates:

The aim of this study is to determine land snails species infested different plant hosts of the three surveyed Governorates i.e. Gharbia, Dakahlia and Kaliubia. It was found five species of terrestrial snails belonging to order Stylommatophora, these species were: the glassy clover snail: *Monacha cantina* (Muller), the small sand snail: *Helicella vestalis* (Muller), the brown garden snail *Eobania vermiculata* (Muller), the conical snail *Cochlicella acuta* (Muller) and amber snail *Succinea putris* (Linnaeus).

#### I.1.1) Incidence of land snails at Gharbia Governorate:

Incidence were conducted at two counties belonging to Gharbia Governorate. Results revealed that four land snails species (*Monacha cantiana*, *Helicella vestalis*, *Eobania vermiculata* and *Succinea putris*) were found in Samannoud and Zefta counties, Gharbia Governorate. *M. cantiana*, *H. vestalis* and *E. vermiculata* were found in Samannoud county, while *M. cantiana*, *S. putris* and *E. vermiculata* were found in Zefta county. The glassy clover snails, *M. cantiana* were found with high density on all host plants. Regarding the brown garden snails *E. vermiculata* were recorded with moderate

numbers in all host plants in the two counties. On the other hand, *H. vestalis* and *S. putris* were found with low numbers.

### **I.1.2. Incidence of land snails at Dakahlia Governorate:**

Incidence were carried out in four localities belonging to two counties at Dakahlia Governorate. Results revealed that three land snail species were found in certain localities. These species were: *M.cartusiana*, *E.vermiculata* and *S.putris*. The glassy clover snails *M.cartusiana* was found in all crops and counties with high population and sometimes with moderate population. Regarding *E.vermiculata* was found with moderate numbers. As for *S.putris* it found with low numbers. It can be arranged these snails according to the levels of infestation as follows *M.cartusiana*, *E.vermiculata* and *S.putris*.

### **I.1.3. Incidence of land snails at Kaliubia Governorate :**

Incidence were conducted at Kaliubia Governorate revealed that four herbevous land snails species were found associated with different plant hosts. These species were: *M.cartusiana*, *E.vermiculata*, *H.vestalis* and *Cochlicella acuta*.

Regarding *M.cartusiana* was found with high numbers, *E.vermiculata* was found with moderate numbers. As for *H.vestalis* and *C.acuta* were found with low numbers. It can be arranged these snails according to the levels of infestation as follows; *M.cartusiana*, *E.vermiculata*, *H.vestalis* and *C.acuta*.

## **I.2. Population dynamics**

### **I.2.1. Population dynamics of *M.cantiana* on certain fruit crops at Gharbia Governorate:**

Seasonal population fluctuations of *M.cantiana* was studied on apple, pear, peach in Meet-Badr Halawa, Samannoud, as well as navel orange and mandarine in Sonbat, Zefta Gharbia Governorate during two successive years of 1999/2000 and 2000/2001. Results revealed that the initial infestation of *Monacha cantiana* on apple, pear, peach, navel orange and mandarine beginning in January with a relatively low population densities (5.0, 7.0); (2.0, 3.0), (4.0, 5.0); (1.0, 2.0) and (4.0, 6.0) snails per sample size during the two tested growing seasons 1999/2000 and 2000/2001, respectively. After then numbers of snails were slightly increased to reach its maximum values in April (50.0, 59.6); (38.2, 48.8); (40.0, 50.4); (35.0, 43.6) and (45.2, 54.6) for the tested crops during the two growing seasons respectively. Generally the population density of *M.cantiana* was obviously increased during spring months (April, May and June) as compared with population density during the other seasons (summer, autumn and winter).

### **I.2.2. Population dynamics of *M.cartusiana* on certain field crops at Dakahlia Governorate.**

Seasonal population fluctuation of *M.cartusiana* was studied on Egyptian clover, broad bean and wheat in Kafr Awad, Aga, as well as maize and cotton in El-Rahmania, Meet-Ghamer during two successive growing seasons of 1999/2000 and 2000/2001 in Dakahlia Governorate. The initial infestation

of *M.cartusiana* on Egyptian clover beginning during October with a relatively low population densities (7.2, 10.0) snails per sample size (0.25cm<sup>2</sup>) during the two tested growing seasons, respectively, while on broad bean and wheat during December with a low numbers of population densities of (2.1, 3.2) and (1.9, 2.5) snails per sample size (0.25cm<sup>2</sup>) during the two successive growing seasons, respectively. The highest values of snail numbers on Egyptian clover were recorded in May (79.2, 82.3) snails/sample during the two tested growing seasons, respectively and the populatin decreased after then to reach (56.8, 68.2) snails/sample size (0.25cm<sup>2</sup>) during the two tested seasons, respectively. The infestation of cotton and maize beginning after emergency seedlings with a low numbers of snails and slightly increased or decreased until aestivated in July where the environmental conditions did not suitable for their active. General mean of population density on Egyptian clover, broad bean, wheat, maize and cotton during 1999/2000 season were 29.97, 10.9, 7.72, 5.76 and 4.26 respectively, while the parallel values during 2000/2001 season were 41.27, 17.18, 10.41, 8.72 and 7.03 snails per sample size, respectively.

### **I.2.3. Population dynamics of the land snail *Monacha cartusiana* on certain vegetables at Kaliubia Governorate:**

Seasonal population dynamics of *M.cartusiana* was studied on pea, cabbage and lettuce in Kafr Ragab, Kafr Shukr as well as okra and tomato in Kafr El-Hag Esa during two



successive growing seasons of 1999/2000 and 2000/2001 in Kaliubia Governorate. The initial infestation of *M.cartusiana* was appeared in the beginning of September on cabbage and lettuce with a relatively low numbers of (2.1, 2.3) and (3.9, 7.4) snails per the quadrat sample size of 50 x50cm during the two growing seasons of 1999/2000 and 2000/2001, respectively. While on pea, the initial infestation was recorded in October with moderate values of population density (15.4, 18.9) snails per sample size in the two successive seasons, respectively. Regarding the initial population densities of *M.cartusiana* on okra and tomato beginning in February with moderate values of population densities (9.8, 15.2) and (18.5, 29.3) snails per sample size during the two tested successive growing seasons, respectively.

The population densities beginning to increased in April where gave (84.8, 105.5); (53.3, 74.4), (76.9, 93.6); (23.2, 34.8) and (39.2, 56.4) snails per sample for pea, cabbage, lettuce, okra and tomato during the two successive growing seasons 1999/2000 and 2000/2001, respectively. Generally the population density of *M.cartusiana* was obviously increased during spring months (March, April and May) as compared to low or moderate values of population density during the other seasons (winter, autumn and summer).

### **I.3. Daily movement and directions of land snail *M.cartusiana* under field conditions:**

The aim of this study is to determine the distances and directions which preferred by *M. cartusiana* snails in cultivated and fallow lands. Results showed that the snail did not prefer any direction in the cultivated land it moved in all directions (North, South, East and West). While in the fallow land it moved in the North direction only. The distances increased by passing the time. The snail moved during the two first days in cultivated and fallow land ranged from 0.5 and 6m. in North. The highest percent more of snail moved toward North direction while the lowest percent moved toward East directions where recorded 11% and 5.7% in the first day, respectively.

## **II. Biological Studies:**

### **II.1. Number of clutches and eggs laid by *Monacha cantiana* during the breeding season under laboratory conditions:**

Number of clutches, eggs and clutch size were determined for the land snails *M. cantiana* during the breeding seasons under laboratory conditions. Results revealed that the snail *M. cantiana* laid its eggs during three months past half months started from November 2000, until mid-February, 2001. Generally mean number of clutches, eggs and clutch size laid by *M. cantiana* were 1.4, 56 and 40.42 eggs, respectively.

## **II.2. Number of clutches and eggs laid by *H.vestalis* during the breeding season under laboratory conditions:**

The results revealed that *H.vestalis* snail laid its eggs during two months past half month started from December, 2000 until mid February, 2001. Generally mean number of clutches, eggs and clutch size during the egg laying period were 1.32, 35.7 and 27.36 eggs, respectively.

## **II.3. Incubation period, hatchability, hatching period and oviposition period for the two land snail *M.cantiana* and *H.vestalis* under laboratory conditions:**

Incubation period, hatching period, hatchability and oviposition period for the two land snails species, *M. cantiana* and *H.vestalis* were studied under laboratory conditions. Results showed that the period which eggs took place to complete embryonic development (14 and 18) days for *M. cantiana* and *H.vestalis*, respectively. On the other hand the hatching period were 2 and 2.5 days for the two snail species, respectively. The hatchability of two species were reached 97.70% and 90.27%, respectively.

## **II.4. Growth rate of the two land snails *M.cantiana* and *H.vestalis* feeding on cabbage leaves under laboratory conditions**

This study was carried out under laboratory condition to determine the growth rate of the two land snails *M. cantiana*

and *H.vestalis* as indicated by weight, shell diameter and gastropod length.

The results revealed that the growth rate as indicated by snail weight of *M.cantiana* was rapid than the other snail *H.vestalis* during the period from May to June where the snail weight was increased from 19.75 to 90.00mg and 12.90 to 33.00mg for *M.cantiana* and *H.vestalis*, respectively. The parallel values of shell diameter and gastropod length were (5.55, 6.83) and (4.16, 6.70)mm. for *M.cantiana* and *H.vestalis*, respectively.

### **III. Control studies:**

#### **III.1. Mechanical methods:**

##### **III.1.1. Effect of some materials used as barriers on reducing population density of *M.cantiana* snails**

This field trials were conducted to evaluate 12 materials as barriers on reducing the population density of these snails subsequently damage caused by the snails. Results revealed that; A) oven ash gave the highest general mean reduction 75.3, while plastic sheets gave the lowest one 11.3. B) Pimpernel leaves, cauliflower seeds powder and cabbage seeds powder gave 100, 100 and 100% general mean reduction, while radish seeds powder gave the lowest one 48.4%, respectively. Finally C) Copper sulphate gave the higher

general mean reduction 100% while greasy gave 90.5% general mean reduction, respectively.

### **III.1.2. Effect of unslacked lime barriers on preventing *M.catiana* snail from invading the neighbouring.**

The results showed that the reduction percentages of the unslacked lime barriers after two days were 77.3 and 67.26 for the barriers between pea/clover and clover/mandarine, respectively. But the reduction percentages were decreased in the end of the experiment period to reach 35.71 and 41.82% respectively.

### **III.1.3. Effect of different attractive materials used in attractiveness *M.catiana* snail under field conditions:**

This study was conducted to chose the suitable attractive materials which can be used in snail control program under field conditions. Results revealed that yeast powder, molas and vanelia were the most effective materials than the other materials which reached: yeast powder (116.5 snails), molas (110 snails) and vanelia (67.9 snails). It can be reported that yeast powder was more suitable material for attractive land snails while vanelia the lowest one in this respect.

## **III.2. Chemical control:**

### **III.2.1. Control of land snails by certain plant seeds powders.**

#### **III.2.1.1. Effect of certain plant seeds powders, on *M.cartusiana* snail under laboratory conditions:**

The effect of certain plant seeds powders were applied as poisonous baits against *M.cartusiana* snails under laboratory conditions. Results revealed that all tested materials failed to exhibited any molluscicidal activity with all concentrations during the first three days. Mortality percentages of the tested materials after 28 days were as follows: cauliflower 80%, Egyptian leek 70% cabbage 62%, parsley 56%, anise 48%, nigella 26%, wormwood 24%, chicory 22% and bitter apple 20% respectively. Regarding the general mean of mortality percentages, it noticed that cauliflower gave the highest toxic potential (36) while bitter apple gave the lowest one (10.3) for the highest concentration (40%).

#### **III.2.2.2. Molluscicidal activity of certain plant seeds powders against *M.cartusiana* snails under field conditions:**

The molluscicidal activity of nine plant seed powders were evaluated as poisonous baits against *M.cartusiana* infested Egyptian clover field. Results revealed that the tested materials can be arranged descendingly according its molluscicidal activity as follows: cauliflower, Egyptian leek, cabbage, parsley, anise, nigella, wormwood, chicory and bitter apple where gave mean reduction percentages (18.08, 15.25, 13.26, 9.46, 6.48, 4.86, 4.17, 3.56 and 3.06%), respectively. It's obvious that cauliflower proved to be the

most effectiveness while bitter apple gave the lowest reduction percentages against *M.cartusiana* under field conditions where gave 36.17 and 6.13% reduction, respectively.

### **III.2.2. Control of land snails by different pesticides:**

#### **III.2.2.1. Effect of some biocides against *M.cartusiana* snail under laboratory conditions:**

The effect of four biocides namely, Diple 2x , Bio clean, Diple-NT and Ecotch-bio were studied with different concentration (1.5, 3, 6, and 12%) as poisonous baits against *M.cartusiana* snails under laboratory conditions. Results illustrated that Ecotch-bio failed to exhibited any molluscicidal activity during the experiment period (21 days). Regarding the rest biocides, it noticed that the mortality percentages increased by increasing concentrations and exposure periods. After 7 days, mortality% for biocides as Diple 2x, Bioclean, Diple-NT were (12, 22, 36, 84), (8, 14, 30, 68) and (0, 6, 10, 20) for concentrations (1.5, 3, 6 and 12%), respectively. The mortality % reached its maximum value in the end of the experiment period where gave 97,94 and 32% for Diple 2x, Bioclean and Diple-NT, respectively. The results assured that Diple-2x and Bio clean have the highest effect on *M.cartusiana* while Diple-NT was the lowest one.

#### **III.2.2.2. Efficacy of certain nematicides against *M.cartusiana* snails (juvenils and adults) under laboratory conditions:**

The effect of four nematicides namely, aldicarb, oxamyl, phenamiphos and carbofuran were studied on different stages (juveniles and adults) of *M.cartusiana* snails as poisonous baits under laboratory conditions. Results revealed that all tested nematicides failed to exhibited any molluscicidal activity against juveniles or adults one day post treatment. Mortality percentages were increased by the time elapsed and by increasing the concentrations. The adult stage was more susceptible than juveniles. Mortality percentages different from compound to another where reached (22,84); (10,64); (6,54) and (4,44) for the two stages (juveniles and adults) on the highest concentration (5%) for aldicarb, oxamyl, phenamiphos, and carbofuran after 7 days post treatment, respectively. Aldicarb was more active than the other compound (oxamyl, phenamiphos and carbofuran) where reach mortality percentages 15 days post treatment for the highest concentration (26, 100%); (12,80%), (8,68%) and (6, 56%) for the juveniles and adults respectively.

#### **III.2.2.3. Efficacy of certain nematicides against *M.cartusiana* snails under field conditions:**

The effect of above mentioned nematicides were tested as poisonous baits with two concentrations (5.0and 2.5%) under field conditions at Kafr Awad, Dakahlia Governorate during the growing seasons 2001/2002. Results revealed that the initial effect of aldicarb exhibited the highest reduction percentages, while carbofuran gave the lowest one where reached (26.2,



10.5%) and (11.8, 4.8%) for the two tested concentrations, respectively. The tested nematicides can be arranged descindingly according to general mean of reduction percentages as follows, aldicarb (60.7, 32.6), oxamyl (48.7, 26.6), phenamiphos (40.1, 20.8) and carbofuran (32.5, 16.7) for the two concentrations (5, 2.5%), respectively.