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# Preliminary occurrence of the sugar beet leaves looper worm *Scopula donovani* (Lepidoptera: Geometridae) and their predatory insects on sugar beet at Kafr El-Sheikh Governorate , Egypt

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**Abstract:**

The sugar beet leaves looper worm *Scopula donovani* (Distant) (Lepidoptera: Geometridae) was recorded in Europe and caused severe damages to the infested crops. This study represents the first published record of *S. donovani* on sugar beet in Egypt. It was noticed for the first time on sugar beet plants *(Beta vulgaris* L, var. Kram) at the farm of Sakha Agriculture Research Station, Kafr El-Sheikh Governorate, Egypt. during the seasons, 2019/2020. The *S. donovani* insects as well as their associated predators; *Coccinella undecimpunctata* L. (Coleoptera: Coccinellidae), *Scymnus* spp. (Coleoptera: Coccinellidae), *Paederus alfierii* Koch. (Coleoptera: Staphylinidae), and *Chrysoperla carnea* Steph. (Neuroptera: Chrysopidae) and *Syrphus corolla* Fabricius ( Diptera: Syrphidae), were surveyed at seasons 2019/2020 and 2020/2021. The *S. donovani,* larvae started to appear in the 3rd week of Nov. 2019 and peaked at the 3rd week of Mar. 2020 (7 larvae/20 plants). In 2020-2021, the highest number was recorded in mid-January (9 larvae/20 plants). Based on the results of the simple-correlation coefficient, the larvae of *S. donovani* were significant correlation with *C. undecimpunctata*, *P. alferii*, and *Scymnus* spp. and (r) values were 0.5, 0.5, and 0.5, respectively. In the second season, the insect positively correlated with *Scymnus* spp., *S. corolla*, with (r) values of 0.2, 0.06, respectively. Weather factors; temperature, relative humidity, and rainfall had a negative and insignificant effect on the insect population in the first season. Whereas the second season was highly significant with temperature, the combined effect of the studied factors on the insect population density was more pronounced in the second season than in the first one. Where EV% values were 30.8 and 46.3. However, the obtained results are very important in integrated sugar beet management programs to avoid damage to this insect in the future.

## Introduction

The sugar beet leaves looper worm *Scopula donovani* (Distant) (Lepidoptera: Geometridae), geographical distribution within Africa: Congo, Egypt, Gambia, Kenya, Madagascar, Mali, Mauritania, Morocco, Mozambique, Nigeria, South Africa, Sierra Leone, Sudan, Uganda, Zambia and Zimbabwe, the main host

plant is Rice, *Oryza sativa* L. (Sihvonen, 2005).

Fifth instar larvae of *S. donovani* could eat all the leaves parts of sugar beet plants. *Scopula subpunctaria* (Herrich-Schaffer) (Lepidoptera: Geometridae) is one of the most important defoliator insect pests attacking the tea trees in China (Zhang *et al*., 2009 and Hu *et al*., 2010). The 4th and 5th instar larvae of *Scopula subpunctaria* mainly could eat all the leaves (Tao Ma *et al.,* 2019).

Hermann and Legrand (2004) recorded *Autographa gamma* L. (Lepidoptera: Noctuidae) as a major pest of sugar beet in Belgium. Control of sugar beet insect pests could be achieved through optimizing the cultural practices such as beneficial insects inhabiting sugar beet crops, and planting dates (Shalaby, 2001; Abo El-Naga, 2004; Amin *et al.*, 2008; Abou-ElKassem, 2010 and El-Dessouki, 2019).

In Egypt, some insect predators; e.g., coccinellids, Chrysopidae, and staphylinids were surveyed from sugar beet fields (Abo-Saied, 1987; Boraei *et al*. 1993; El-Agamy *et al*., 1996 and El-Dessouki, 2019). Sugar beet (*Beta vulgaris* L.) is a member of the family Chenopodiaceae is one of the most important sugar crops in the world. Sugar beet-grown areas in Egypt have been increased to 640.000 Fadden in 2020. Sugar crops (Sugar cane and sugar beet) receive great attention in Egypt because of their strategic and industrial values. Therefore, it is mandatory to increase the local sugar production to cope with the increasing population requirements.

The present work was outlined to evaluate the occurrence and population dynamics of the sugar beet leaves looperworm *S. donovani* and their associated predatory insects and weather factors under field conditions in Kafr El-Sheikh Governorate.

## Materials and methods

### 1. Laboratory experiment to the identification of the insect:

During season 2019/2020, the sugar beet leaves looperworm *S. donovani* larvae were collected in plastic gars from sugar beet fields at Kafr El-Sheikh Governorate and transferred to the laboratory at Plant Protection Department, Faculty of Agriculture, Al-Azhar University, Nasr City, Cairo. The larvae were maintained in the growth chambers under the condition of 26 ± 1 °C, and with a photoperiod regimen of (12 L: 12 D) and fed on sugar beet leaves until pupation. The pupae were individually put in the Petri dishes (d = 9 cm) for the emergence of adults. Emerged adults were transferred into plastic tubs to the laboratory for identification at the Department Classification, Plant Protection Research Institute, Agricultural Research Center.

### 2. Field experiments:

Were carried out at the farm of Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt, during seasons; 2019/ 2020 and 2020/ 2021. The experimental area was two feddans, divided into plots each of 2100m2 and cultivated with sugar beet var. Karam in mid-September of both seasons. All recommended agricultural practices were followed during the growing season without insecticide applications.

### 3. Population fluctuations of *Scopula donovani* and its associated predators:

To study the seasonal fluctuation of population density of *S. donovani*, weekly samples consisting of 20 plants were taken randomly from four replicates, replicate size was 84 $m^2$ equivalent to 1/50 of feddan. These plants were visually examined in the field to count the larvae of the pests. Five insect predators were counted per plant; the number of eggs and larvae of

the green lacewing, and *Chrysoperla carnea* Steph. (Neuroptera: Chrysopidae) larvae and adults of *Scymnus* spp. (Coleoptera: Coccinellidae) and the eleven spotted lady- beetle, *Coccinella undecimpunctata* L. (Coleoptera: Coccinellidae), adults of the rove beetle, *Paederus alfierii* Koch. (Coleoptera: Staphylinidae), and larvae of syrphus fly, *Syrphus corolla* Fabricius ( Diptera: Syrphidae), the weather factors: temperature, relative humidity, and rainfall were obtained from Meteorological Station of Sakha, Egypt.

**4. Statistical analysis**

**SAS (SAS Institute, 2003)** was used to determine the partial correlation and regression coefficient between the prevailing weather factors and the population of *Scopula donovani*. Significant differences between population means of insects, predatory insects on sugar beet plants were determined according to Duncan (1955).

**Results and discussion**

**1. The looper worm *Scopula donovani* as a new insect pest on sugar beet:**

The present study represents the first record of the looper worm, *S. donovani* attractive sugar beet plants (*Beta vulgaris* L.var. Kram) in Kafr El-Sheikh governorate, Egypt. Sugar beet plants consider new host plant of *S. donovani* in Egypt during seasons 2019 /2020 and 2020 /2021 in Kafr El-Sheikh governorate The looper worm was noticed for the first time on sugar beet plants at the farm of the Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt, during the sugar beet growing season of 2019. In the subsequent season, the infestations increased heavily.

Photographs showing the infestation of *S. donovani* on leave parts of sugar beet plants are shown in Figure 1. Larvae, pupa, and adults of *S. donovani* were observed on sugar beet leaves (Figure 1: A–D). The infestation started with a few individuals of *S. donovani* on the small leaves of the sugar beet plant, followed by their spread to the plant. The larvae feed on the plant leaves of the sugar beet plants are shown in Figure (1). where they eat the lower epidermis and the inner tissue, causing serious damage (Figure 1: A) and feed on the plant (Figure1:B). Pupae (Figure1: C).

Adults of this insect (Figure 1:D). These findings are similar to previously recorded symptoms Tao Ma *et al*. (2019) reported that the 1st and 2nd instar larvae of *Scopula subpunctaria* mainly damage the hypodermis and mesophyll, the 3rd instar larvae feed on the margin of leaves causing the shape of "C" and the 4th or 5th instar larvae could eat all the leaves.

Data presented in Figure (2) recorded the weekly mean temperature, relative humidity, and rain during seasons, 2019/2020 and 2020/2021.

These results are similar to previously Mesbah (1991) found that larvae of *Scopula* spp. were firstly recorded on sugar beet as a leaf feeder, a total season of eggs and larvae of *Scopula* spp. from April to May in 1988- 1989 season was 8 and 60 individuals in disouk region and 60 individuals during 1990 season in Sakha region at Kafr El-Sheikh, Egypt. El-Dessouki ( 2019) served *Chrysodeixis gamma*, *Chrysodeixis chalcites*. and *Scopula coenosaria luridata* (Zeller),were from sugar beet plants. The presence of *S. donovani*, was recorded from the European continent for the first time, and the known distribution area of this taxon is extended to include Spain (Granada ) (Gaston *et al*., 2013).

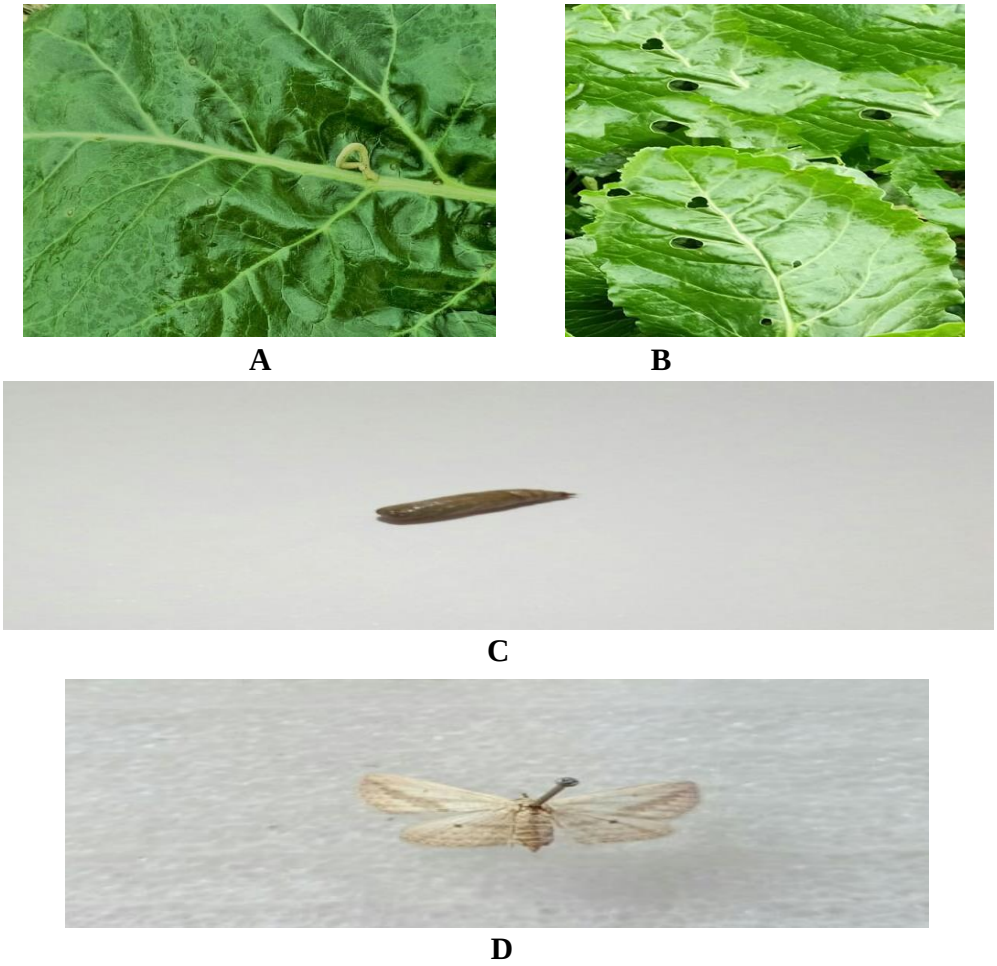

**Figure ( 1): Infestation of *Scopula donovani* larvae on leave parts of sugar beet plants. A- B: Larvae on leaves, C: Pupae and D: Adult moth.**

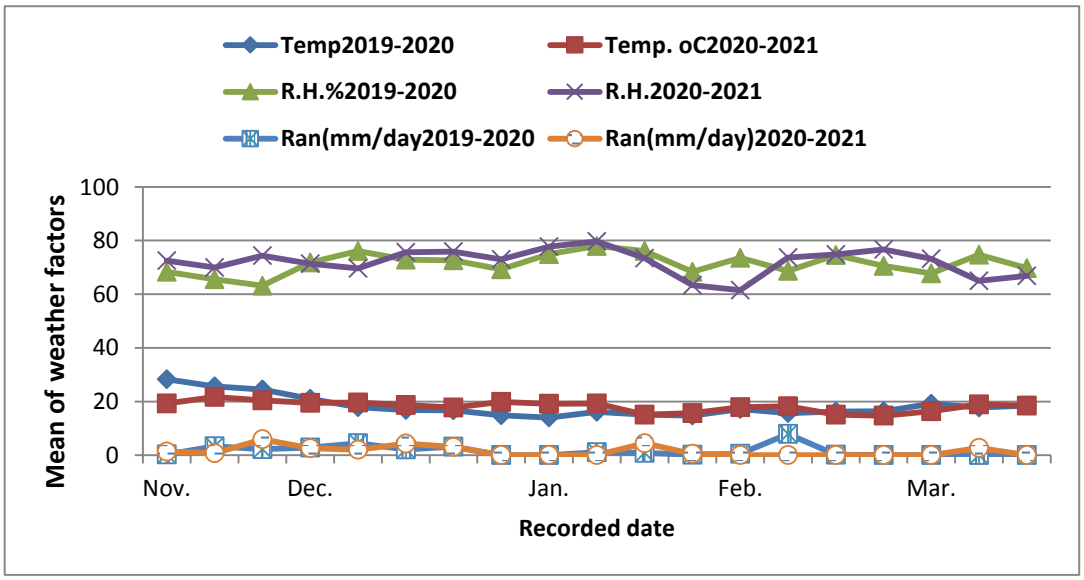


**Figure (2): Mean of temperature (ºC), R.H. (%) and ran fall (mm/day) in Kafr El-Sheikh Governorate throughout the two successive seasons.**

**2. Population fluctuations of *Scopula donovani* in sugar beet fields:**

Data represented in Figure (3) showed the population density of *Scopula donovani*, larvae started to appear at the 3rd week of Nov. 2019 (2 larvae/20 plants) and then disappeared after three weeks. The highest number was recorded in the 3rd week of Mar. 2020 (7 larvae/20 plants). In the second season, 2020- 2021 the first occurrence of larvae on sugar beet plants was recorded in the 3rd week of Nov. 2020 (3 larvae/20 plants) (Figure 2). The highest number was recorded at 2nd week of Jan. 2021 (9 larvae/20 plants.

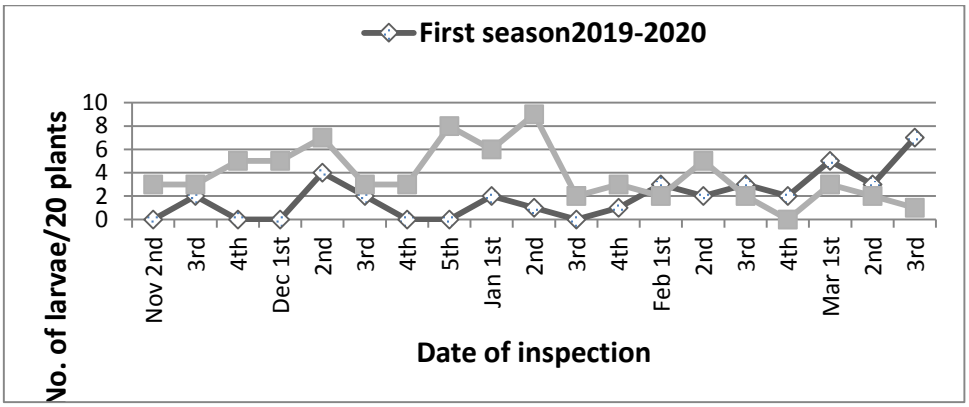


**Figure (3): Population fluctuation of *Scopula donovani* during (2019-2020) and (2020-2021) seasons.**

Data presented in Table (1) showed the monthly average number of *S. donovani*, larvae during two seasons. the first season it can be noticed that, the highest monthly average number of *S.donovani* were recorded in March 2019 with an average number of 5.0 larvae. While the second season the highest monthly average number of *S. donovani* was recorded in Dec 2020 with an average number of 5.2 larvae. In Korea, Leech (1897) first recorded 11 species of *Scopula*. Rahouma (2018) found that the tomato flower worm, *Scopula coenosaria luridata* (Zeller) is a harmful pest to tomatoes causes the falling of flowers and newly setting tomato fruits, in all regions of Egypt. Mohisen (2012) reported that *Autographa gamma* are common pests attacking sugar beet plants, from period Oct-May in total 20 and 60 larvae in the first and second season, respectively.

**Table (1): Monthly average numbers of the sugar beet leave loopermoth *Scopula donovani*, during 2019-2020 and 2020-2021 seasons.**

| Month | 2019-2020 | 2020-2021 |
|---|---|---|
| **Nov.** | 0.6 | 3.6 |
| **Dec.** | 1.2 | 5.2 |
| **Jan** | 1.0 | 5.0 |
| **Feb** | 2.5 | 2.2 |
| **Mar.** | 5.0 | 2.0 |
| **Total** | 10.30 | 18.00 |
| **Mean ±S. E** | 2.0±**0.8** | 3.60±0.67 |

**3. Population fluctuations of insect predators associated with *Scopula donovani*:**

**3.1. Ladybirds, *Scymnus* spp.:**

Data in Figure (4) showed that during 2019/2020 larvae and adults of *Scymnus* spp. the first appearance was recorded on 26 of Nov. (5 insects/20 plants) and existed till the end of the season (2 individuals /20 plants). The highest number (10 individuals /20 plants) was reached at 10 of Mar. 2020. In the 2021 season, the highest number (14 individuals /20 plants) was recorded on 6 of Jan. 2021 (Fig 5). These results are in agreement with these of Mesbah (1991) and El-Khouly (2006) reported that the population of coccinellids started to increase in March and April and reached their higher peaks in April and May.

**3.2. The eleven spotted lady-beetle *Coccinella undecimpunctata* :**

During 2019-2020 adult of *C. undecimpunctata* first appearance was recorded on 28 of Jan. (1 insect/20 plants). The highest number (10 individuals /20 plants) was reached at 25 of Feb. 2020 (Figure 4). In the 2021 season, the highest number (3 individuals /20 plants) was recorded on 27 of Jan. 2021 (Figure 5). Guirguis (1985) in Egypt found that the Coccinellid predators, *C.undecimpunctata* and *Cyd onia vicina nilotica* var. appeared in sugar beet fields from April till June.

**3.3. The green lacewing *Chrysoperla carnea* :**

The chrysopid individuals in the first season started to appear on 19 of Nov. (6 individuals /20 plants) and remained until the end of the season (17 of Mar. 2020.) where the peak of eggs and the larval population was reached (19 individuals /20 plants) (Fig 4). In the second season, 2020- 2021 the first occurrence of eggs and larvae on sugar beet plants was recorded on 18 of Nov. 2020 (7 individuals /20 plants). The highest number was recorded on 23 of Dec. 2020 (13 individuals /20 plants) (Figure 5). Mesbah (1991) reported that *C. carnea* exhibited 1-3 peaks of abundance in sugar beet fields. Talha (2001) at Dakahliya, recorded that the highest population of *C. Carnea*, *P. alfierii*, *Scymnus syriacus*, and *C. undecimpunctata* from the September plantation. Shalaby (2012) mentioned that the highest peak of *C. carnea* was (46 egg and larvae/40 plants) on November 25th. Three following peaks were recorded on January 15th (20), February 25th (35), and April 15th (13 eggs and larvae).

**3.4. The rove beetle *Paederus alfierii* :**

Data in Figure (4) also shows the first season of adult *P. alfierii* existence on sugar beet plants, the first one started on 19 of Nov. Two following peaks were recorded on 11 of February (6) and 3 of Mar. (8 adults/20 plants). The highest peak was recorded on 10 of Mar. 2020 (12 adults/20 plants). In 2020- 2021 the first occurrence of adult *P. alfierii* on sugar beet plants was recorded on 18 of Nov. 2020 (2 adults/20plants). The highest number at 16 of Dec. 2020 (3 adults/20 plants) (Fig 5). Guirguis (1985) in Egypt found that *Paederus alfierii* appeared in sugar beet fields from April till June. Shalaby (2001) stated that *Paederus alfierii* was encountered only from the October plantation at Kafr El Sheikh.

**3.5. Syrphus fly *Syrphus corolla* :**

In the first season, the larvae of *S. corolla* firstly occurred from a high peak at 21 Jan. 4 larvae/20 plants (Figure 4). In the second season, 2020-2021 the larvae of *S. corolla* started to bear on 20 of Jan.2021 (5 larvae/20 plants) (Figure 5). The highest peak was recorded on 27 of Jan. 2021 (13 larvae/20 plants). Bazazo and Besheit

(2020) demonstrated that *S. corolla* were important predatory insects in sugar beet fields during two seasons of studies.

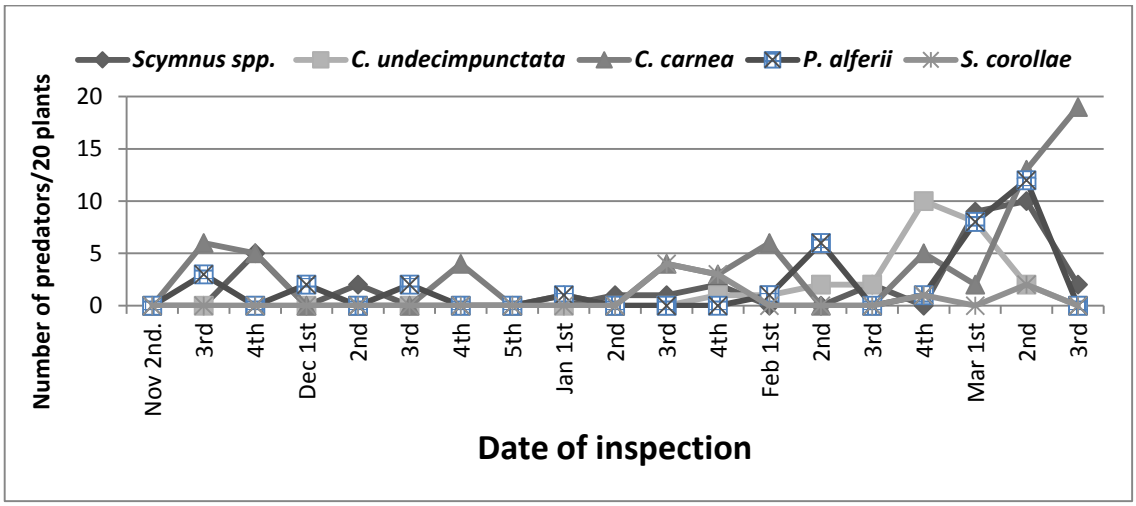


**Figure (4): Population Fluctuation of predatory insects on 20 sugar beet plants during the first season (2019-2020).**

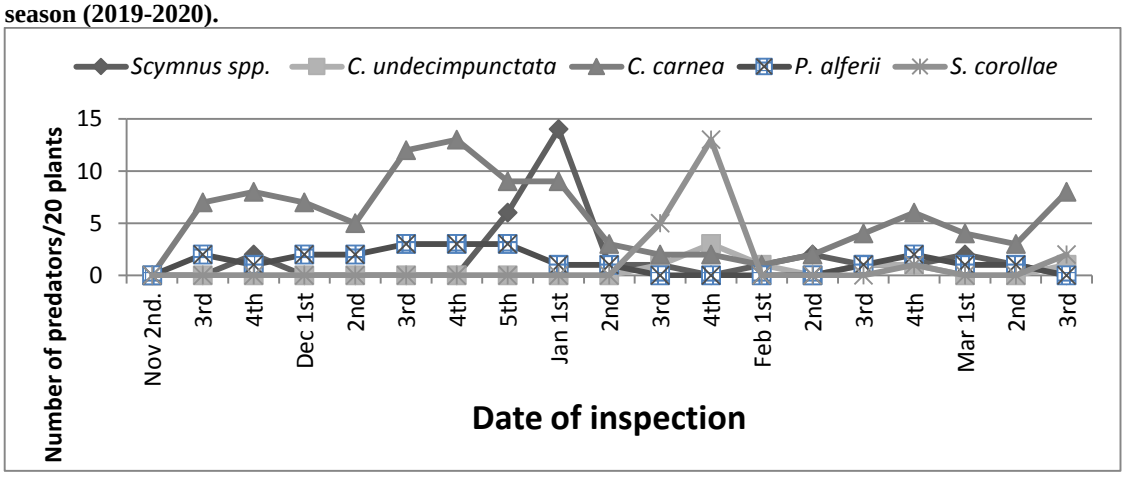


**Figure (5): Population fluctuation of predatory insects on 20 sugar beet plants during the second season (2020-2021).**

## 4. The relationship between the insect pests and predators:

The results of simple-correlation coefficient between larvae of *S. donovani* and predators' insects during 2019-2020 season in a Table (2) indicated that significantly effect with predators *C. undecimpunctat*a, *P. alferii*, and *Scymnus* spp. and (r) values were 0.51, 0.539, and 0.512 respectively, whereas the relation was insignificant between *S. corolla* and *C. carnea* and insect population, (r) values were -0.18 and 0.13. The correlation between insect population and total insect predators was a significant effect. While in the second season in Table (2) revealed that correlation analysis values were insignificant positive with (r) values were 0.05 and 0.15 between the insect population and *S. corolla* and *Scymnus* spp., whereas, the relationship was insignificant. Negative with (r) values were -0.027and -0.23 between the insect population and *C. undecimpunctat*a, *P. alferii* insects. Correlation between the insect population and *C. carnea* insects was positive significant with (r) value -1.18. Correlation between the insect

population and total of insect predators was insignificant effect.

**Table (2): Simple correlation analysis on the effect of insect predators in the population fluctuations of *Scopula donovani* during 2019- 2020 and 2020- 2021 seasons, September plantations.**

| Seasons | Factors | r | P |
|---|---|---|---|
| 2019-2020 | ***Syrphus corolla*** | -0.181 | 0.471 |
| | ***C. undecimpunctata*** | 0.51 | 0.039 |
| | ***P. alferii*** | 0.530 | 0.035 |
| | ***C. carnea*** | 0.136 | 0.588 |
| | ***Scymnus* spp.** | 0.512 | 0.044 |
| | **Total of predators** | 0.536 | 0.051 |
| 2020-2021 | ***Syrphus corolla*** | 0.057 | 0.920 |
| | ***C. undecimpunctata*** | -0.027 | 0.843 |
| | ***P. alferii*** | -0.239 | 0.199 |
| | ***C. carnea*** | -1.186 | 0.063 |
| | ***Scymnus* spp.** | 0.158 | 0.780 |
| | **Total of predators** | 0.076 | 0.633 |

## 5. Effect of climatic factors on the population density of *Scopula donovani* insects:

The data of the simple correlation in the 2019- 2020 season, Table (3) showed that the relationship was an insignificant relationship between the insect population and daily mean of temperature, daily mean of rain and R.H. % with (r) values were -0.058, 0.11 and 0.53 respectively. On the other hand, the regression coefficient analysis cleared that the relationship was insignificant negative with a daily mean of temperature and insignificant positive with R.H% and daily mean of rainfall (b) values were 0.029, 0.058, and 0.043 insects respectively. The combined effect was 30.8%. in the 2020-2021 season, Table (3) cleared that the relationship was a significant relationship between the insect population and daily mean of temperature and (r) value were 0.618, whereas the relation was insignificant between the daily mean of R.H.% and rainfall with (r) values were 0.438 and -0.239 respectively. On the other hand, the regression coefficient revealed that the relationship was significantly positive with the daily mean of temperature and the insect population, whereas the relationship was insignificant between the daily mean of R.H% and rainfall with (b) values were 0.719, 0.180, and -0.235 insects respectively. The combined effect of the climatic factors, predators, and the insect population was 46.3%.

**Table (3): Statistical parameters of sugar beet leaves loopermoth *Scopula donovani* population in relation to certain weather factors, predatory insects on sugar beet plants during 2020 and 2021 seasons, September plantations.**

| Seasons | Factors | r | B | E.V% |
|---|---|---|---|---|
| 2019-2020 | **Temp. °C** | -0.050 | -0.029 | 30.8% |
| | **R.H. %** | 0.111 | 0.058 | |
| | **Rain fall** | 0.053 | 0.043 | |
| | **Predators** | 0.536** | 0.105** | |
| 2020-2021 | **Temp. °C** | 0.618** | 0.719** | 46.3% |
| | **R.H.%** | 0.438 | 0.180 | |
| | **Rain fall** | -0.239 | -0.235 | |
| | **Predators** | 0.076 | 0.023 | |

**(r) = correlation coefficient (b) = regressions coefficient**

**** High significantly EV=explained variance R.H.= relative humidity**

**Acknowledgment**

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