

## **Ecological studies and evaluate of using the predator, *Coccinella undecimpunctata* L. as a biological control agent against cumin aphids in Middle Egypt.**

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### **SUMMARY**

The most pests associated with cumin plant were *Myzus persicae*, *Aphis gossypii* and *Thrips tabace*. Seasonal population fluctuation of *M. persicae* were carried out in Beni Suef Governorate during the growing seasons, 2019/2020 and 2020/2021. The peak of *M. persicae* population density was during spring in the two seasons of investigation. Natural enemies of *M. persicae* were the predators, *Coccinella undecimpunctata*, *Chrysoperla carnea* and *Paederus alfieri* and the parasitoid, *Aphidius colemani*. The combined effect of max., min. and relative humidity on seasonal population of *M. persicae* was highly significant in the two seasons.

**KEY WORDS:** Cumin, *Myzus persicae*, natural enemies, ecological factors, *Coccinella undecimpunctata*

### **INTRODUCTION**

The dried seed of the herb (*Cuminum cyminum* L. ; Family: Apiaceae) is known as cumin which is considered as one of the most important seed spice in Egypt. It is a native of the Levant and Upper Egypt and now it is grown mainly in hot countries. Cumin seeds are also having several medicinal properties used as

stimulant, antioxidant, anti-diabetic, antiseptic, antihypertensive herb, cholesterol level reducer, carminative, stomachic, astringent and constructive in diarrhea and dyspepsia. Cumin aldehyde is good de-toxicant which help in the regular removal of toxins from the body (**Meena et al., 2021**).

The green peach aphid, *Myzus persicae* (Sulzer) (Hom.: Aphididae) is a pest on cumin plant that distributed in all warm and temperate regions of the world (**Abdel-Rahman et al., 2015**). Direct feeding harms a few of these crops, but the majority of these crops are harmed by its role as a viral vector. It is consider the major pest problem of cumin (**Meena et al., 2018 and 2021**)

Coccinellids are the major predator in many countries in the world (**Ward et al., 2020**).

There is no doubt that, insect pest problems are changing in Egypt as a result of a range of circumstances e.g., climate changes or resistance of pesticides. So, the strategies of integrated pest control are being spread among the farmers by the Ministry of Agriculture since the 1990s. So, the objective of this investigation that undertaken in Beni Suef Governorate was aimed to determine the following:

- (1) Survey of cumin insect pests,
- (2) Seasonal population fluctuation of, *M. persicae* on cumin,
- (2) Survey of natural enemies of *M. persicae* on cumin,
- (3) The effect of mean max., min. temperatures and relative humidity on the population density of *M. persicae* on cumin and
- (4) Evaluate of using the predator, *C. undecimpunctata* as a biological control agent in Beni Suef Governorate.

## **MATERIALS AND METHODS**

- **Experimental design**

Field experimental studies were conducted in the Sids region, Beni-Suef Governorate, Egypt.

One feddan was selected and cultivated with cumin for two sequence seasons 2019/2020 and 2020/2021. This area was divided to two plots (20×40m<sup>2</sup>) for treated and control. 10 m wide walkway along the field was used to separate between these two plots to avoid the effect of drifting treatment.

Cumin normally planted during first week of Oct. After three weeks of plantation date, weekly samples were collected from 27<sup>th</sup> October to 20<sup>th</sup> April. Regular conventional farming practices were carried out in accordance with Egyptian Ministry of Agriculture standards, and no chemicals were used during the study period, and weeds were manually eliminated.

### **I. Survey of cumin insect pests:**

Survey of different cumin insect pests were carried out weekly from 7 to 10 am along the two growing seasons, 2019/2020 and 2020/2021.

### **II. Seasonal population fluctuation of, *M. persicae* on cumin:**

Weekly regular samples consisted of 40 plants that were randomly collected from the untreated cumin field and continued until the end of the season. Each sample was kept in paper bags and transferred to the laboratory. Counts of *M. persicae* were recorded at each inspection date. Mean numbers of *M. persicae* per plant were calculated.

### **III. Survey of *M. persicae* natural enemies:**

Along the two seasons of study, field samples of 10 cumin plants that heavily infected by aphids were randomly collected weekly and packed in paper bags then, taken to the laboratory.

These specimens were carefully examined and a needle was used to remove all other insects except *M. persicae* with its natural enemies were desired to be surveyed. Those samples were enclosed in plastic jars of 15 cm. diameter and 20 cm. height covered with muslin held in position by a rubber band and kept under preferential conditions for securing any emerging parasitoids.

All emerged parasitoids were collected, sorted into species and preserved in vials containing ethanol 70% and glycerin 5%, the slide mounting of represented specimens, was conducted as well.

The different insect species were identified in Biological Control Res., Dept., Plant Prot. Res. Inst, ARC Ministry of Agric., Giza, Egypt.

### **III. Combined effect of three weather factors on population density of *M. persicae* on cumin:**

- **Meteorological Data:**

The weekly weather data (maximum, minimum temperatures and the mean relative humidity) of Beni-Suef Governorate from 27<sup>th</sup> October to 20<sup>th</sup> April during the seasons 2019/2020 and 2020/2021 were obtained from the Meteorological Station of Sids Research Centre, Beni-Suef Governorate.

- **Statistical analysis:**

Correlation and partial regression coefficient values were calculated between the seasonal population density of *M. persicae* (the dependent variable Y) and the weather factors (independent variable X) by using SPSS Computer Program V.20.

These data were analyzed and presented as means  $\pm$  SE (Standard Error). Analysis of variance, (F- test) and the explained variance percentage (E.V. %) were estimated.

$$E.V.\% = r^2 \times 100$$

r = correlation value

### **IV. Estimate of using the predator, *Coccinella undecimpunctata* L. to control *M. persicae*:**

- **Rearing of the predator, *C. undecimpunctata*:**

During the winter of 2019 and 2020, adults of *C. undecimpunctata* were collected from the clover fields of Beni Suef Governorate. They were placed in plastic jars of 2L, covered with a piece of white muslin using rubber bands. The jars were supplied by wheat seedlings afflicted with a sufficient amount of aphids,

*Rhopalosiphum padi*. The deposited eggs were collected, transported to Petri dishes, and preserved until hatching on pieces of black plastic. To avoid cannibalism, newly hatched larvae were moved into individual plastic cups and fed daily by an appropriate number of aphids until pupation. Pupae were kept under observation until adults' emergence. Coccinellids were reared in the laboratory under controlled conditions ( $25 \pm 1^\circ\text{C}$ , 40-50 R.H%. and photoperiod 16:8 L: D).

- **Treatments**

The treatments were evaluated in the cumin field against the aphid *M. persicae* by releasing 3<sup>rd</sup> larval instar of the predator, *C. undecimpunctata* at the rate of 5 larvae/m<sup>2</sup>. Four releases were applied biweekly in 1<sup>st</sup>, 15<sup>th</sup> of March, 1<sup>st</sup> and 15<sup>th</sup> of April.

- **Data collection**

Forty random cumin plants were weekly collected from treated region then put in paper bags and transferred to the laboratory. The numbers of *M. persicae* were counted and recorded at each inspection date. Mean numbers of this pest per plant were calculated.

Percentage of reduction is detected by using the Percentage Decrease Calculator online (<https://www.calculatorsoup.com/calculators/algebra/percentage-decrease-calculator.php>).

## RESULTS AND DISCUSSION

### **I. Survey of cumin insect pests:**

The most pests associated with cumin plant in Beni Suef Governorate were the cotton aphid; *Aphis gossypii* Glover, the green peach aphid, *Myzus persicae* Sulzer (Homoptera: Aphididae) and the onion thrips; *Thrips tabae* L. (Thysanoptera: Thripidae). The green peach aphid was the most dominant insect pest on cumin plants in the field.

This result was similar to **Abd El-Raheem, and Abd EL-Wareth (2015)** who found *Aphis craccivora* Koch, *M. persicae* and *T. tabae* on cumin in Assiut,

Egypt. While, **Dadhich et al. (2023)** found *A. gossypii* on cumin in Mandor-Jodhpur, India.

## **II. Survey of natural enemies *M. persicae* on cumin:**

Survey natural enemies of *M. persicae* on cumin resulted in three predators and one parasitoid. *Coccinella undecimpunctata* L. (Col.: Coccinellidae) (adult and larvae) was the most dominant aphid predator, followed by *Paederus alfieri* Koch (Col.: Staphylinidae) and *Chrysoperla carnea* (Steph.) (Neur.: Chrysopidae). The parasitoid was *Aphidius colemani* Viereck, (Hym.: Braconidae)

These results were similar to **Awadalla, et al., (2018)** found eleven spots ladybird, *C. undecimpunctata*, was the most associated aphid predator, followed by other predators, *Cydonia vicina* isis Cr., *C. vicina nilotica* Mul., *Scymnus* sp. and *Rhyzobius litura* Fab. (Coccinellidae), *P. alfieri* (Staphylinidae), *C. carnea* (Steph.) (Chrysopidae), *Metasyrphus corolla* (Fab.) (Syrphidae) *Orius* sp. (Hemiptera) in Kafr Elsheikh Governorate, Egypt.

## **III. Seasonal population of *M. persicae* on cumin:**

Data illustrated in Fig, 3 (A) showed the seasonal population of *M. persicae* which was the major insect pest on cumin crop. The population density was low during winter then increased gradually during February and March to reach highest level. One activity peak of 105 and 116 individuals/ plant recorded in 6<sup>th</sup> April and 30<sup>th</sup> March in the two seasons respectively. After the population density reached the highest level, it declined to the end of the planting season.

The mean seasonal number of green peach aphid was higher in the second season (24.2 aphids/plant) than of the first season (20.6 aphids/plant).

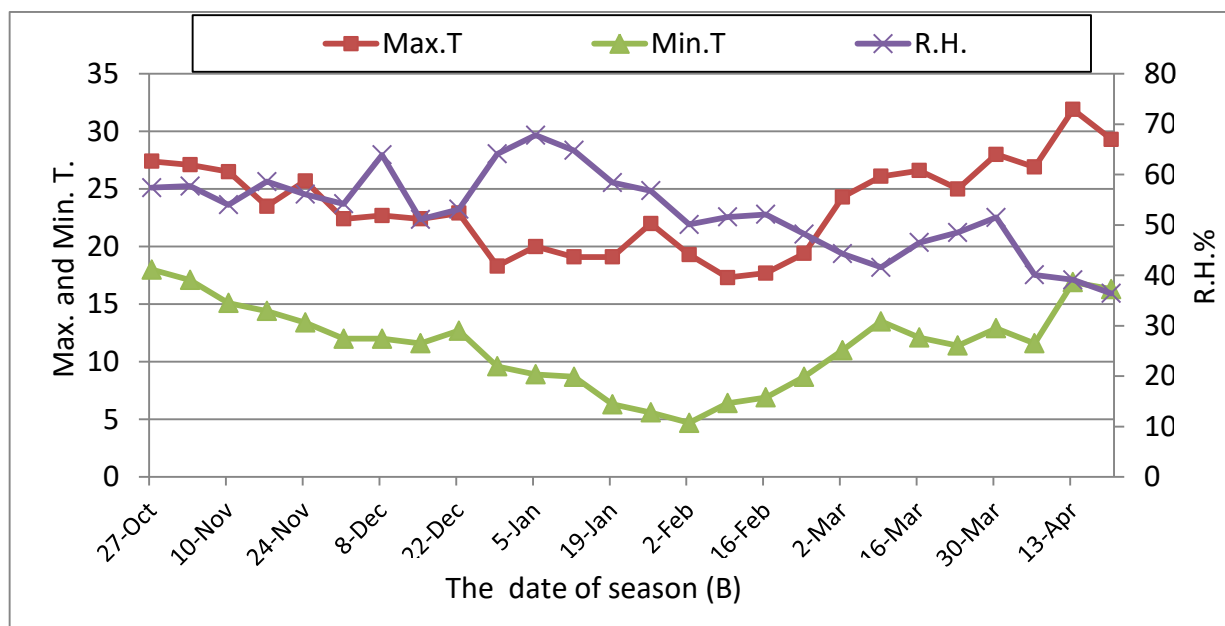
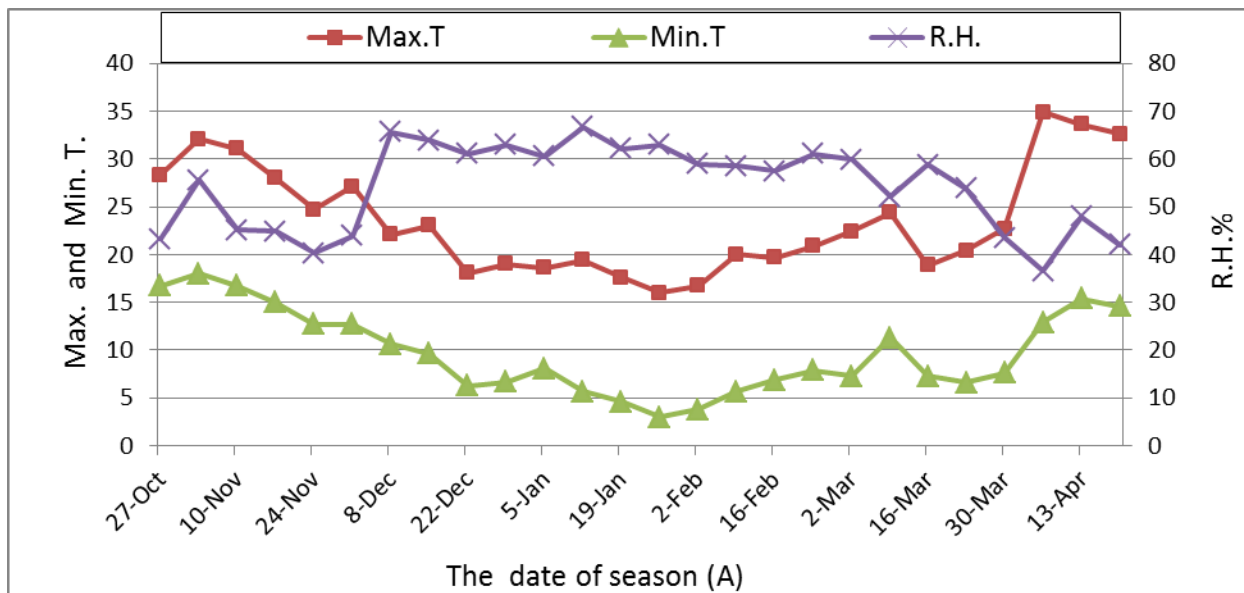
These results agree with **Abdel Rahman et al., (2015)** who study population of the green peach aphid, *M. persicae* infesting cumin plants in Assiut, Upper Egypt. Maximum population density of the green peach aphid occurred in the half of February. The number of *M. persicae* was significantly higher in the second season (42.1 aphids /plant), than that of the first season (24.9 aphids/ plant).

#### **IV- Combined effect of three weather factors on population density of *M. persicae* on cumin:**

Data illustrated in **(Fig. 1)** showed the weekly means of the three weather factors (max., min. temperatures and relative humidity) during two successive seasons of study 2019/2020 and 2020/2021 from October, 27<sup>th</sup> to April, 20<sup>th</sup> in Beni-Suef Governorate. While **Fig. (2)** showed the normal P-P plot of regression standardized residual of the weekly counts of *M. persicae*/ plant of cumin in the field as affected by corresponding means of the weather factors during the two seasons of study.

The combined effect of the three weather factors was highly significant on the population densities of *M. persicae* in the two seasons of investigation. The percentages of explained variance were 70.3% and 71.8% (where,  $r=0.49$  and  $0.52$ ) while F-tests were 7.15 and 7.82 for the two seasons respectively (Table,1).

These results were similar to **Abd El-Raheem and Abd EL-Wareth, (2015)** who found that temperature and relative humidity significantly affected on the population densities of *Myzus persicae* (Sulzer) (Hemiptera: Aphididae) in Assiut Governorate.



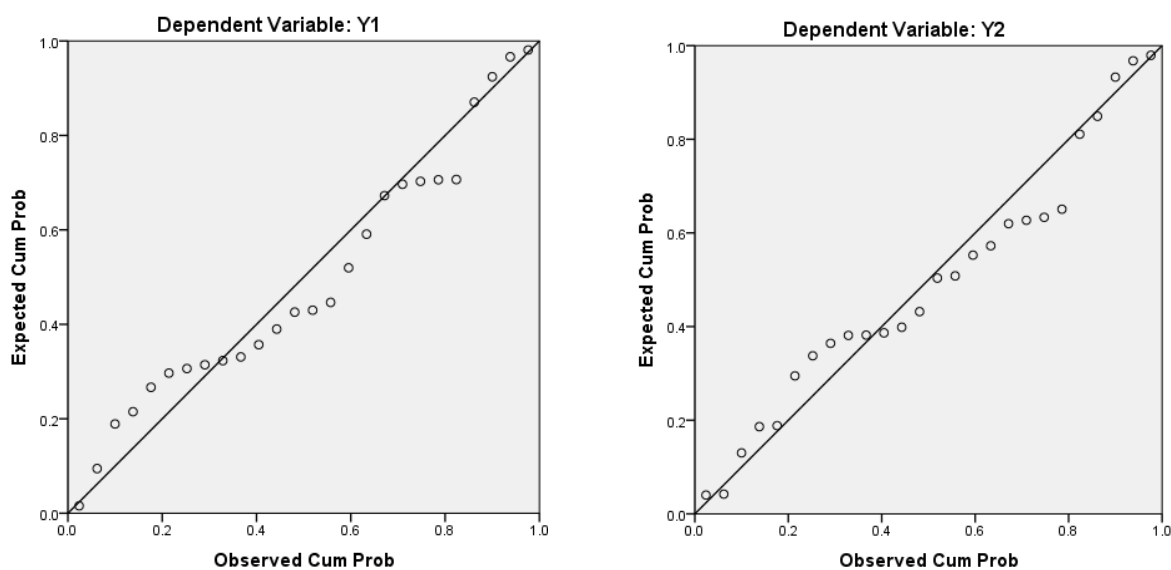
**Fig. (1):** Weakly means of maximum (Max. T.), minimum (Min. T.) temperatures (°C), relative humidity (R.H.%) during two successive seasons of study 2019/2020 (A) and 2020/2021 (B) from October, 27<sup>th</sup> to April, 20<sup>th</sup>) in Beni-Suef Governorate, Egypt.



**Table (1): Correlation coefficient and partial regression of the weekly mean counts of *Myzus persicae*/ plant of cumin as affected by corresponding means of Max., Min. temperatures and relative humidity (R.H.%) during two successive seasons 2019/2020 and 2020/2021 from 27<sup>th</sup> October to 20<sup>th</sup> April in the field of Sids, Beni-Suef Governorate, Egypt.**

| Season                 | X factor                  | Analysis of partial regression |       |        |       | Analysis of variance |        |
|------------------------|---------------------------|--------------------------------|-------|--------|-------|----------------------|--------|
|                        |                           | r                              | B     | SE     | t     | F                    | E.V. % |
| 1 <sup>st</sup> season | Max. T. (X <sub>1</sub> ) | 0.49                           | 6.65  | ± 2.26 | 2.95  | 7.15*                | 70.3   |
|                        | Min. T. (X <sub>2</sub> ) |                                | -8.67 | ± 2.59 | -3.35 |                      |        |
|                        | R.H.% (X <sub>3</sub> )   |                                | -1.34 | ± 0.79 | -1.7  |                      |        |
| 2 <sup>nd</sup> season | Max. T. (X <sub>1</sub> ) | 0.52                           | 10.49 | ± 3.22 | 3.26  | 7.82*                | 71.8   |
|                        | Min. T. (X <sub>2</sub> ) |                                | -6.64 | ± 2.98 | -2.23 |                      |        |
|                        | R.H.% (X <sub>3</sub> )   |                                | -0.2  | ± 0.86 | -0.23 |                      |        |

\*Highly significant at probability level 0.01 (correlation (r), coefficient value (B), standard error (SE), t-values (t), F- test (F) and percentage of explained variance E.V. %)



**Fig. (2): Normal P-P plot of regression standardized residual of the weekly counts of *Myzus persicae*/ plant of cumin as affected by corresponding means of max., min. temperatures and relative humidity during two successive seasons 2019/2020 (Y1) and 2020/2021 (Y2) from 27<sup>th</sup> October to 20<sup>th</sup> April in Beni-Suef Governorate, Egypt.**

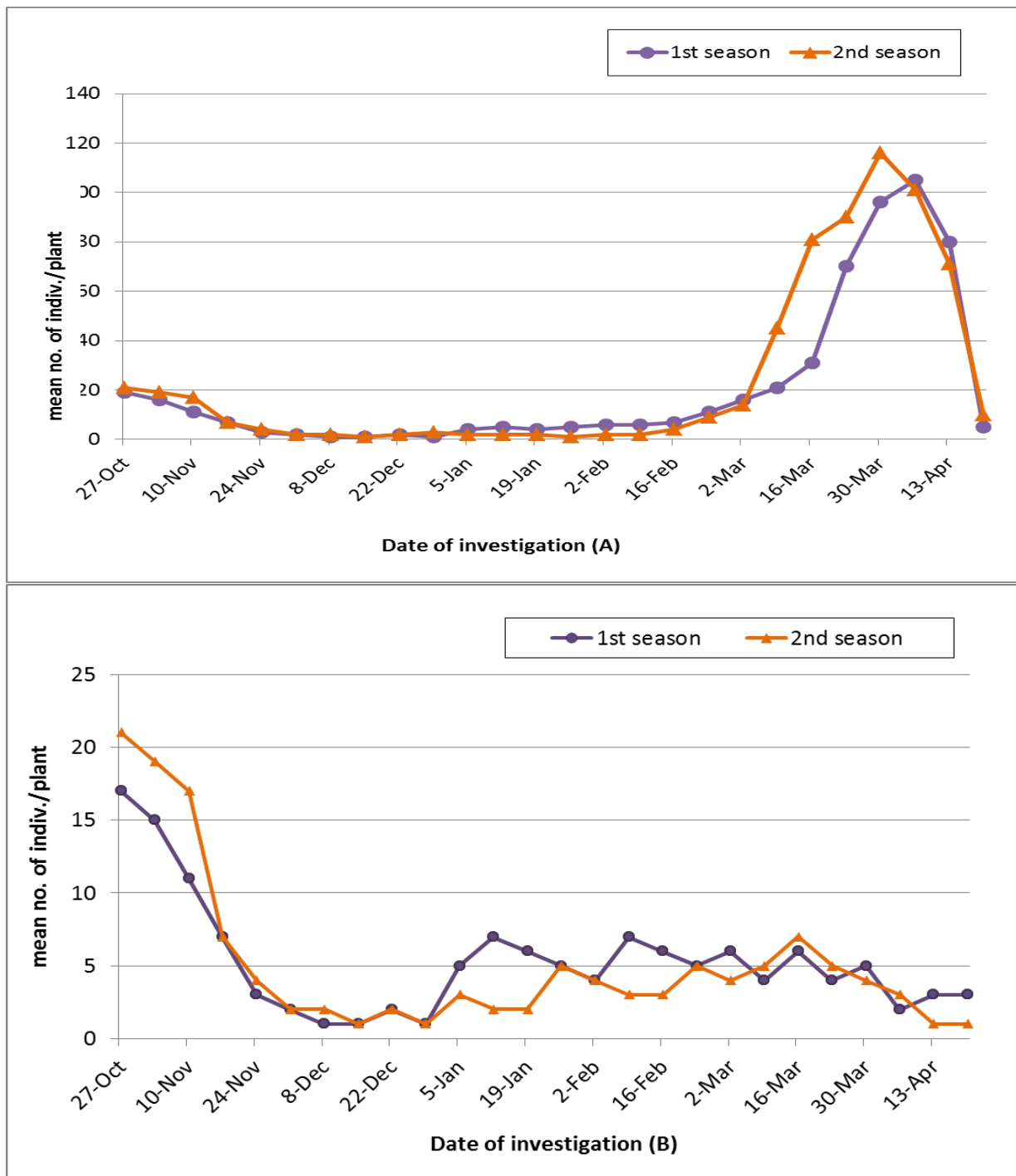
## **V. Estimate of using the predator, *Coccinella undecimpunctata* L. to control**

### ***M. persicae*:**

As shown in **Fig. 3 (A&B)**, releasing the predator, *C. undecimpunctata* during the two seasons of investigation succeeded in reducing the seasonal mean of *M. persicae* population density from 20.6 to 5.3 and from 24.2 to 5.1 individuals/ plant of cumin with 74.3% and 78.9% reduction in the two seasons respectively.

The review on this point is rare but **Abd El-Gawad and El-Zoghbey (2009)** used the *C. undecimpunctata* as abio-control agent against *M. persicae* and *A. gossypii* (Sulzer) on cucumber at Qalubia Governorate, Egypt. Releasing of this predator was repeated 4 times (3 larvae/ m<sup>2</sup>) at 15-day intervals. Reduction in population of *M. persicae* was 42.97 and 41.03% in the two seasons of study respectively.

In conclusion, the obtained results revealed that *A. gossypii*, *M. persicae* and *T. tabace* were most pests associated with cumin plant in Beni Suef Governorate. Survey natural enemies of *M. persicae* on cumin resulted in three predators, *C. undecimpunctata* (adult and larvae) *P. alfierii*, *C. carnea* and the parasitoid, *A. colemani*. The combined effect of max, min. temp. and relative humidity was highly significant on the population density of *M. persicae* in the two seasons of investigation. Releasing of *C. undecimpunctata* reduced the population density of *M. persicae* on cumin under field conditions with 74.3% and 78.9% reduction in the two seasons respectively.



**Fig. (3): Weekly mean numbers of *Myzus persicae*/ plant of cumin from the control (A) and treated (B) areas (by releasing *Coccinella undecimpunctata*) during the two seasons 2019/2020 and 2020/2021 from 27<sup>th</sup> October to 20<sup>th</sup> April in the field of Sids, Beni-Suef Governorate, Egypt.**

### References

**Abd El-Gawad, H. A., and El-Zoghbey, A. A. (2009).** Use the *Coccinella undecimpunctata* L. for controlling *Aphis gossypii* Glover and *Myzus persicae* (Sulzer) on cucumber in Egypt. Egypt. Acad. J. biolog. Sci., 2(1): 81-85.

**Abd El-Raheem, A. A. and H. M. Abd EL-Wareth (2015).** Seasonal abundance and population fluctuation of certain medicinal plant pests and their associated natural enemies in Assiut Governorate, Egypt. J. Plant Prot. and Path., Mansoura Univ., 6 (11):1543 – 1554.

[https://journals.ekb.eg/article\\_75425\\_5899c2d797661d5649cefc327d65ffde.pdf](https://journals.ekb.eg/article_75425_5899c2d797661d5649cefc327d65ffde.pdf)

**Abdel-Rahman, M. A. A; Azza M. A. Awad, S. A. Abdel-Salam, M. A. K. Nasser and Nour El-Houda R. Abdel-Hamed (2015).** Population age structure of the green beach aphid, *Myzus Persicae* [Sulzer][Homoptera: Aphididae] in Cumin fields in Assiut Upper Egypt. Ass. Univ. Bull. Environ. Res., 18 (1): 1-10

**Awadalla, S. S., Ghanim, A. A., Abd Allah, F. E. and Abdel-Aziz A. A. (2018).** The Main Insect Pests Attacking Wheat Plants and their Associated Predators in Sakha District, Kafr Elsheikh Governorate. J. Plant Prot. and Path., Mansoura Univ., Vol.9 (2): 97 – 101.

**Ward S., van Helden M., Heddle T., Ridland P. M., Pirtle E. and Paul A Umina P. A. (2020).** Biology, ecology and management of *Diuraphis noxia* (Hemiptera: Aphididae) in Australia. Austral Entomology (2020) 59, 238–252.

**Dadhich, S., Pandey, S., and Kumawat, M. M. (2023).** Bio-efficacy of some insecticides against aphid, *Aphis gossypii* Glover and their effects on natural enemies in cumin. Annals of Plant Protection Sciences, 31(1), 49-54.

**Meena, N. K., Lal, G., Kant, K., Meena, R. S. and Meena, S. R. (2018).** Pest scenario of cumin (*Cuminum cyminum* L.) and population dynamics in semi-arid region of Rajasthan. International J. Seed Spices 8, 80–83.

**Meena, N. K., Meena, R. S., Singh, R., Meena, M., Verma, A. K., Choudhary, S., Ravi, Y and Saxena, S. N. (2021).** Field Efficacy of Different IPM Modules for Management of Aphid on Cumin (*Cuminum Cyminum* L.) Under Semi-Arid Conditions.

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