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## Biological Control of Egyptian Mealybug, *Icerya aegyptiaca* (Douglas) Infesting Agave Cactus, *Agave americana* by Releasing Parasitoid *Anagyrus pseudococci*

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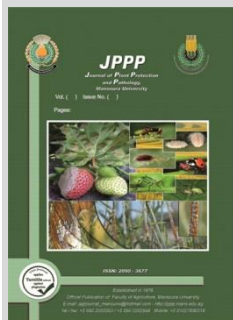
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### ABSTRACT

Current study aimed to evaluate the management of Egyptian Mealybug, *Icerya aegyptiaca* (Douglas) (Hemiptera: Coccoidea) infesting Agave Cactus, *Agave americana* L. (Fam.: Agavaceae) through releasing different levels of parasitoid *Anagyrus pseudococci* (Girault) (Hymenoptera: Encyrtidae). Experiments were conducted on Agave Cactus during 2022 at two different areas (governorates), Al-Zohrya park (Cairo Governorate) and Antoniadis park (Alexandria Governorate). Three levels of the parasitoid *A. pseudococci* were released at both of the two successive zones; 25 egg /plant, 50egg /plant and 75egg /plant. Results obtained show that in Al-Zohrya park in the 1<sup>st</sup> level of the parasitoid releasing (25egg /plant) the percentage of reduction (%) in the mean number of the successive insect *I. aegyptiaca* increased gradually whereas it was 23, 34, 44, 54 and 61% on first-March, mid-March, first-April, mid-April, first-May and mid-May respectively. Also, in the 2<sup>nd</sup> level of the parasitoid releasing (50eggs/plant) the percentage of reduction % in the mean number of *I. aegyptiaca* were increased gradually to reach to; 26, 38, 47, 57 and 69% respectively in the same times. Lastly, in the 3<sup>rd</sup> level of the parasitoid releasing (75 eggs/plant) the percentage of reduction % in the mean number of *I. aegyptiaca* increased gradually to reach to; 29, 40, 52, 61 and 70 % respectively in the same times. Results were in the same trend in Antoniadis park.

**Keywords:** Egyptian Mealybug, *Icerya aegyptiaca*, infesting Agave Cactus, *Agave Americana*, parasitoid *Anagyrus pseudococci*



### INTRODUCTION

Agave Cactus, *Agave americana* L. (Fam.: Agavaceae) is one of the most important cactus plants, it has many beneficial health effects beside its normal uses in decoration, Maria *et al.* (2015) who also indicated to that *A. americana* has shown beneficial health effects and these effects components concentration in its leaves and rhizomes. Also, Jian *et al.* (2004) referred to the importance uses of *A. americana* in food industry- beside its beautiful shapes and different flowers color- whereas three important steroidal saponins were isolated from the waste residue of fiber separation from *A. americana* leaves. Matthew *et al.* (1999) indicated to that *A. americana* has thick and long leaves which used for different medicinal and also the essential ornamental purposes, also sap of the plant contains many important components such as; glycosides, calcium oxalate crystals and number of important components.

The Egyptian Mealybug, *Icerya aegyptiaca* (Douglas) (Hemiptera: Coccoidea) consider one of the most serious pests infesting ornamental plants and many other crops, Zhou *et al.* (2022) who also indicated to that *I. aegyptiaca* is an important and serious pest that has a protective shell and insecticides always failed to reach to it because of difficulties penetration this protective shell. Also, Habib and Taghavi (2007) indicated to that *I. aegyptiaca* causes serious and cosmetic damages when its abundant white wax cover leaf surfaces and its population densities are high. Hall 2009 indicated to that *I. aegyptiaca* is a serious

pest which infesting many crops and ornamental plants and trees which causes a dangers effects on it. Also, Watson *et al.* 1995 referred to that *I. aegyptiaca* is a dangers and serious pest to many plants and crops especially huge trees such as *ficus spp.* and causes serious injuries to them. Also, Islam and Copland (1997) studied host preference of *Anagyrus pseudococci* (Girault) and found that the most host preference for this parasitoid were Citrus mealybug, *Planococcus citri* (Risso) and The Eegyptian mealybug, *Icerya aegyptiaca* (Douglas).

Current study aimed to evaluate the management of The Egyptian Mealybug, *I. aegyptiaca* infesting Agave Cactus, *A. americana* through releasing different levels of parasitoid *A. pseudococci*.

### MATERIALS AND METHODS

Experiments were conducted on Agave Cactus, *Agave americana* L. at two different zones (governorates); Al-Zohrya park (Cairo Governorate) and Antoniadis park (Alexandria Governorate). Experiments were carried out on twelve cactus trees at both of the two successive zones (parks) located in isolated area in both of them.

#### Release of parasitoid *Anagyrus pseudococci*:

Releasing parasitoid *A. pseudococci* was conducted on *A. americana* grown at both of the two successive areas during successive season 2022. Both of the two successive parks contain twelve plants (trees) of *A. americana* divided into four groups (repects) each one contains three plants. Three repect of them for different (three) parasitoid release

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levels and the last one (three plants) used as control. Normal releasing and recommended agricultural processes were conducted, also non pesticides control against mealybugs were used during study. Three levels of *A. pseudococci* were carried out; 1<sup>st</sup> level contains 25 egg/plant (one card), 2<sup>nd</sup> level contains of 50 egg/plant (two cards) and the 3<sup>rd</sup> one contains of 75 egg/plant (three cards) were released (one time) on mid of February month season 2022 on cactus plants at both of the two successive zones. Samples were taken randomly every 15 days at both the two successive zones and counting started from the 1<sup>st</sup> of March season 2022 in cactus plants.

**Statistical analysis:**

Results obtained were statistically analyzed and the percent of the reduction % of *I. aegyptiaca* after *A. pseudococci* releasing was calculated according to Hendrson and Tilton equation (1955). Results obtained were subjected to analyze of variance (ANOVA) and the means of population were compared by F test at 0.05 level, using SAS program (SAS Institute, 1988).

**RESULTS AND DISCUSSION**

Experiments were carried out to evaluation the management of The Egyptian Mealybug, *Icerya aegyptiaca* (Douglas) (Hemiptera: Coccoidea) infesting Agave Cactus, *Agave americana* L. (Fam.: Agavaceae) through releasing different levels of parasitoid *Anagyrus pseudococci* (Girault) (Hymenoptera: Encyrtidae). Experiments were carried out during season 2022 at two different zones (governorates), Al-Zohrya park (Cairo Governorate) and Antoniadis park (Alexandria Governorate). Three levels of the parasitoid *A. pseudococci* were release at both of the two successive zones; 25 egg/plant, 50egg/plant and 75egg/plant.

**Cairo Governorate:**

Results obtained and tabulated in Table (1) and Figures (1, 2 and 3) indicated to the mean number of *I. aegyptiaca* infested *A. americana* at Al-Zohrya Garden (Cairo Governorate) at both of the three levels of parasitoid release (25 egg/plant, 50 egg/plant and 75 egg/plant) compared to control. Whereas in the 1<sup>st</sup> level of the parasitoid releasing (25 egg/plant) mean population numbers of *I. aegyptiaca* individuals on agave cactus plants decreased gradually from 25 individual/plant on the 1<sup>st</sup> March to 22, 16, 11, 6 and 3 individual/plant on dates mid-March, 1<sup>st</sup> April, mid-April, 1<sup>st</sup> May and mid-May respectively compared to control which mean population numbers of *I. aegyptiaca* individuals changed from 30 individual/plant on the 1<sup>st</sup> March to 34, 37, 45, 53 and 67 individual/plant at the same dates respectively. Results obtained show also that the reduction percentage % of *I. aegyptiaca* population in the 1<sup>st</sup> level of parasitoid release increased ascending as follow; 23.0, 34.0, 44.0, 54.0 and 61.0% at the same times respectively.

In the 2<sup>nd</sup> level of the parasitoid releasing trees (50 egg/plant) mean population number of *I. aegyptiaca* individuals decreased gradually from 31 individual/ plant on the 1<sup>st</sup> March to 26, 19, 12, 6 and 2 individual/plant on dates mid-March, 1<sup>st</sup> April, mid-April, 1<sup>st</sup> May and mid-May respectively compared to control which mean population number of *I. aegyptiaca* changed from 38 individual/plant on the 1<sup>st</sup> March to 43, 50, 59, 68 and 73 individual/plant at the same times respectively. Results obtained show also that the

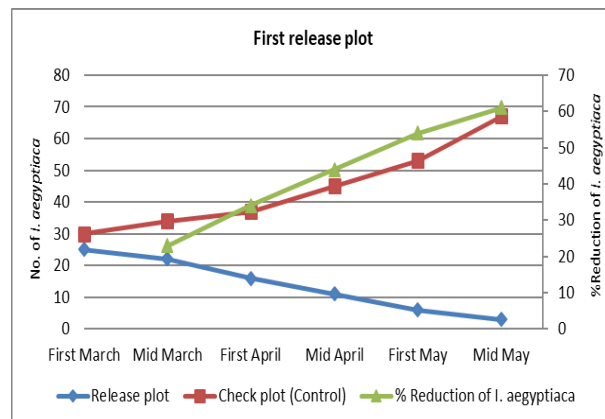
reduction percentage % of *I. aegyptiaca* population in the 2<sup>nd</sup> level of parasitoid releasing increased ascending as follow; 26.0, 38.0, 47.0, 57.0 and 69.0% at the same dates respectively.

Whereas in the 3<sup>rd</sup> level of the parasitoid release (75 egg/plant) mean population number of *I. aegyptiaca* individuals decreased gradually from 35 individual/plant on the 1<sup>st</sup> March to 28, 20, 11, 5 and 2 individual/plant on dates mid-March, 1<sup>st</sup> April, mid-April, 1<sup>st</sup> May and mid-May respectively compared to control which mean population number of *I. aegyptiaca* changed from 40 individual/plant on the 1<sup>st</sup> March to 45, 53, 60, 69 and 90 individual/plant at the same times respectively. Results obtained show also that the reduction percentage % of *I. aegyptiaca* in the 3<sup>rd</sup> level of parasitoid releasing increased ascending as follow; 29.0, 40.0, 52.0, 61.0 and 70.0% at the same times respectively.

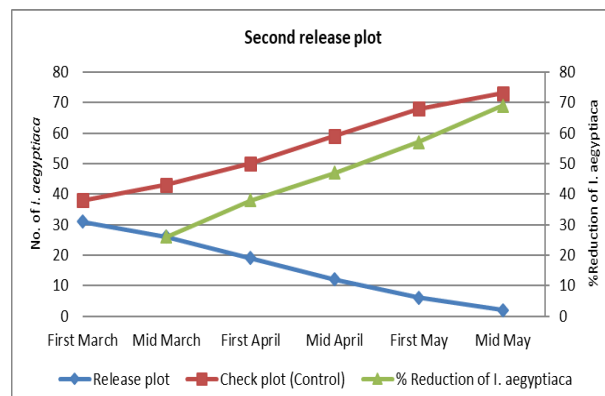
**Table 1. Population fluctuations of *I. aegyptiaca* at Cairo Governorate**

Date	1 <sup>ST</sup> level of release			2 <sup>nd</sup> level of release			3 <sup>rd</sup> level of release		
	R	C	%	R	C	%	R	C	%
First March	25	30	-	31	38	-	35	40	-
Mid-March	22	34	23	26	43	26	28	45	29
First April	16	37	34	19	50	38	20	53	40
Mid-April	11	45	44	12	59	47	11	60	52
First May	6	53	54	6	68	57	5	69	61
Mid May	3	67	61	2	73	69	2	90	70
F (0.05)	273.88			322.15			385.62		
L.S.D	1.078			1.035			1.073		

**R: Release plot C: Chick plot (Control) %: % Reduction percentage**



**Fig. 1. Population fluctuations of *I. aegyptiaca* in the 1<sup>st</sup> level of parasitoid releasing (25egg/plant) at Cairo Governorate**



**Fig. 2. Population fluctuations of *I. aegyptiaca* in the 2<sup>nd</sup> level of parasitoid releasing (50egg/plant) at Cairo Governorate**

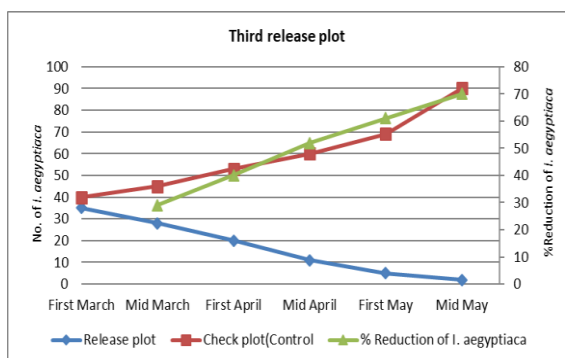


Fig. 3. Population fluctuations of *I. aegyptiaca* in the 3<sup>rd</sup> level of parasitoid releasing (75egg/plant) at Cairo Governorate

**Alexandria Governorate:**

Results obtained and tabulated in Table (2) and Figures (4, 5 and 6) indicated to the mean number of *I. aegyptiaca* infested *A. americana* at Antoniadis park (Alexandria Governorate) in both of the three levels of parasitoid release (25 egg/plant, 50 egg/plant and 75 egg/plant) compared to control. Whereas in the 1<sup>st</sup> level of the parasitoid releasing (25 egg/plant) mean population number of *I. aegyptiaca* individuals decreased gradually from 30 individual/ plant on the 1<sup>st</sup> March to 25, 18, 11, 6 and 3 individual/plant on dates mid-March, 1<sup>st</sup> April, mid-April, 1<sup>st</sup> May and mid-May respectively compared to control which mean population number of *I. aegyptiaca* changed from 35 individual/plant on the 1<sup>st</sup> March to 39, 43, 49, 60 and 79 individual/plant at the same times respectively. Results obtained show also that the reduction percentage % of *I. aegyptiaca* population in the 1<sup>st</sup> level of parasitoid releasing increased ascending as follow; 26.0, 35.0, 47.0, 56.0 and 63.0% at the same times respectively.

**Table 2. Population fluctuations of *I. aegyptiaca* at Alexandria Governorate**

Date	1 <sup>st</sup> level of release			2 <sup>nd</sup> level of release			3 <sup>rd</sup> level of release		
	R	C	%	R	C	%	R	C	%
First March	30	35	-	34	39	-	37	42	-
Mid-March	25	39	26	27	43	28	29	47	30
First April	18	43	35	20	53	40	21	59	43
Mid-April	11	49	47	12	62	49	11	70	56
First May	6	60	56	6	73	58	5	85	63
Mid May	3	79	63	2	80	70	1	93	82
F (0.05)	315.21			397.44			425.63		
L.S.D	1.037			1.081			1.066		

R: Release plot C: Chick plot (Control) %: % Reduction percentage

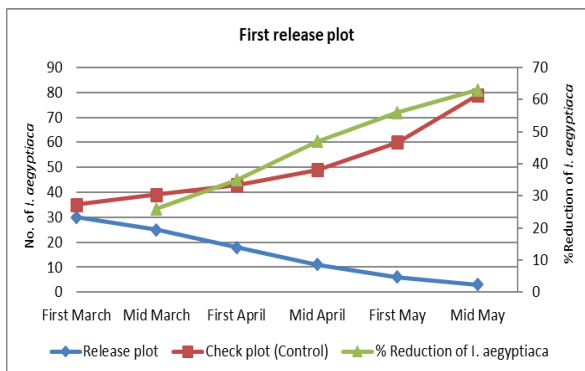


Fig. 4. Population fluctuations of *I. aegyptiaca* in the 1<sup>st</sup> level of parasitoid releasing (25egg/plant) at Alexandria Governorate.

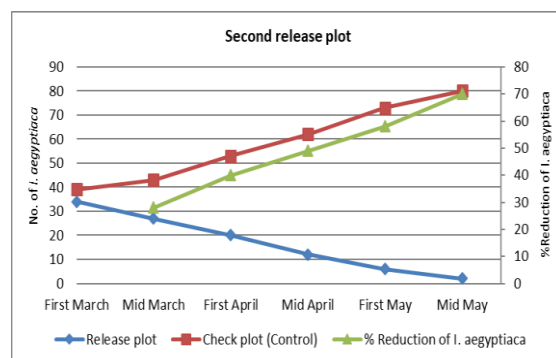


Fig. 5. Population fluctuations of *I. aegyptiaca* in the 2<sup>nd</sup> level of parasitoid releasing (50egg/plant) at Alexandria Governorate

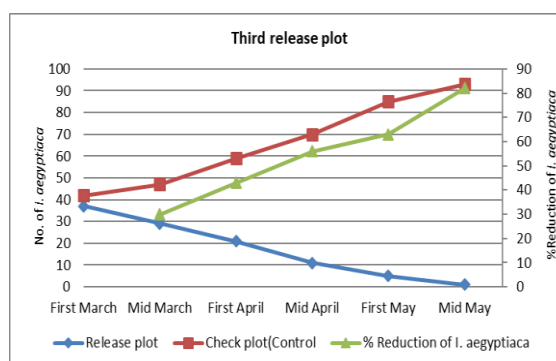


Fig. 6. Population fluctuations of *I. aegyptiaca* in the 3<sup>rd</sup> level of parasitoid releasing (75egg/plant) at Alexandria Governorate

In the 2<sup>nd</sup> level of the parasitoid release (50 egg/plant) mean population number of *I. aegyptiaca* individuals decreased gradually from 34 individual / plant on the 1<sup>st</sup> March to 27, 20, 12, 6 and 2 individual/plant on dates mid-March, 1<sup>st</sup> April, mid-April, 1<sup>st</sup> May and mid-May respectively compared to control which mean population number of *I. aegyptiaca* changed from 39 individual/plant on the 1<sup>st</sup> March to 43, 49, 60 and 79 individual/plant at the same times respectively. Results obtained show also that the reduction percentage % of *I. aegyptiaca* population in 2<sup>nd</sup> level of parasitoid releasing increased ascending as follow; 28.0, 40.0, 49.0, 58.0 and 70.0% at the same times respectively.

Whereas in the 3<sup>rd</sup> level of the parasitoid release (75 egg/plant) mean population numbers of *I. aegyptiaca* individuals decreased gradually from 37 individual /plant on the 1<sup>st</sup> March to 29, 21, 11, 5 and 1 individual/plant on dates mid-March, 1<sup>st</sup> April, mid-April, 1<sup>st</sup> May and mid-May respectively compared to control which mean population number of *I. aegyptiaca* changed from 42 individual/plant on the 1<sup>st</sup> March to 47, 59, 70, 85 and 93 individual/plant at the same times respectively. Results obtained show also that the reduction percentage % of *I. aegyptiaca* population in the 3<sup>rd</sup> level of parasitoid releasing increased ascending as follow; 30.0, 43.0, 56.0, 63.0 and 82.0% at the same times respectively.

Statistical analysis showed that were highly significant differences between the three parasitoid releasing levels (25, 50 and 75 egg/plant) in reduction mean population number of *I. aegyptiaca* at both the two successive zones compared to control. Whereas F(0.05) and L.S.D values for the three parasitoid releasing levels (25, 50 and 75 egg/plant) at Cairo Governorate were; (273.88, 1.078), (322.15, 1.035) and (385.62, 1.073) respectively,

while these values at Alexandria Governorate were (315.21, 1.037), (397.44, 1.081) and (425.63, 1.066) respectively.

Results obtained were agreement with those obtained by Samia *et al.* (2019) who indicated to the effects of the insect infestation by *I. aegyptiaca* on the internal components of some cactus and referred to the serious effect of this pest on cactus components. Mazzeo *et al.* (2007) in Italy indicated to the serious effects of *I. aegyptiaca* mealybug on many cactus plants. Also, Blumberg *et al.* (1995) studied responses by encapsulation of four mealybug species to parasitization by *Anagyrus pseudococci* and indicated to that *I. aegyptiaca* was more suitable than other mealybug species for *A. pseudococci* development. Islam and Copland (1997) indicated to that *Anagyrus pseudococci* (Girault) is a potential biological control agent of the Citrus mealybug, *Planococcus citri* (Risso). And also Mustu *et al.* (2008) indicated to that *Anagyrus pseudococci* (Girault) parasitoid attacks several mealybug species and causes many damages to them.

## CONCLUSION AND RECOMMENDATION

### The current works appeared the following:-

Releasing parasitoid *Anagyrus pseudococci*, on Egyptian mealybug, *Icerya aegyptiaca* (Douglas) Infesting Agave Cactus, *Agave americana*. Results showed that in Al-Zohrya park in 1<sup>st</sup> level of parasitoid releasing 25egg/plant; reduction% in mean number of successive insect *I. aegyptiaca* increased gradually whereas it was 23, 34, 44, 54 and 61% on first-March, mid-March, first-April, mid-April, first-May and mid-May respectively. Also, in 2<sup>nd</sup> level of parasitoid releasing 50eggs/plant; reduction% in mean number of *I. aegyptiaca* were increased gradually to reach to; 26, 38, 47, 57 and 69% respectively in same times. In 3<sup>rd</sup> level of parasitoid releasing 75 eggs/plant; reduction% in mean number of *I. aegyptiaca* increased gradually to reach to; 29, 40, 52, 61 and 70 % respectively in same times. Results showed that, the same trend in Antoniadis park. Throughout the previous data, we can recommend to use the high numbers of parasitoid-eggs *A. pseudococci*, in biological control against *I. aegyptiaca* Infesting Agave Cactus, *A. americana*.

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## المكافحة الحيوية لحشرة البق الدقيقي المصري *Icerya aegyptiaca* (Douglas) التي تصيب صبار آجاف *Agave americana* بواسطة إطلاق الطفيل *Anagyrus pseudococci* (Girault)

جميلة عبد الرحمن محمد هيكل وعبدلة فوزى عبد السلام سعد

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - الجيزة - مصر

### المخلص

أجريت التجارب بغرض دراسة تقييم المكافحة الحيوية لحشرة البق الدقيقي المصري *Icerya aegyptiaca* (Douglas) التي تصيب صبار آجاف *Agave americana* عن طريق إطلاق طفيل *Anagyrus pseudococci* (ثلاثة مستويات من الإطلاق 25 بيضة/نبات، 50 بيضة/نبات و 75 بيضة/نبات). أجريت التجارب خلال عام 2022 في منطقتين (محافظة المنيا ومحافظة القاهرة) وحديقة أنطونيناس (محافظة الإسكندرية). وقد أوضحت النتائج المتحصل عليها في محافظة القاهرة عند إطلاق المستوى الأول من الطفيل محل الدراسة (25 بيضة/نبات) كانت النسب المئوية لتناقص الحشرة موضع الدراسة (البق الدقيقي المصري) *I. aegyptiaca* إلى 23، 34، 44، 54 و 61% أول مارس و منتصف مارس و أول أبريل و منتصف أبريل و أول مايو ومنتصف مايو على الترتيب. وعند إطلاق المستوى الثاني من الطفيل (50 بيضة/نبات) كانت نسب تناقص الحشرة 26، 38، 47، 57 و 69% في نفس التوقيتات السابقة على الترتيب. وعند إطلاق المستوى الثالث من الطفيل (75 بيضة/نبات) وصلت نسب تناقص الحشرة إلى 29، 40، 52، 61 و 70% في نفس التوقيتات السابقة على الترتيب. وكانت النتائج في نفس الاتجاه وعلى نفس المنوال في الثلاثة مستويات من إطلاق الطفيل محل الدراسة في محافظة الإسكندرية.