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# Host plants, distribution, natural enemies and seasonal abundance of the hemispherical soft scale *Saissetia coffeae* (Hemiptera: Coccidae) including new records with special references of this pest in Egypt

**El-Amir S M, Shaaban Abd-Rabou, Rania S Ammar**
Agricultural Research Center, Plant Protection Research Institute, Dokki, Giza, Egypt

**Abstract**
Recently the hemispherical soft scale *Saissetia coffeae* (Walker) (Hemiptera: Coccidae) **is** considered one of the most important pests in Egypt. It is polyphagous and is a well known pest of coffee, ornamental shrubs and greenhouse plants. The honeydew produced by heavy populations allows the development of sooty mould fungi on the host plant. The aim of the present work is to survey host plant species, their distribution, natural enemies and seasonal abundance of *S. coffeae* during 2020-2022 in Egypt. It attacks 20 host plants, three of them recorded here for the first time in Egypt. These are *Ficus nitida*, *Psidium guajava* and *Pinus halepensis* and are distributed in nine governorates. These are, Alexandria, Assiut, Aswan, Gharbiya, Giza, Mersa Matruh, North Sinai, Qena and South Sinai. The results, also, indicated that this species parasitized by 13 species of aphelinids, encyrtids and pteromalid of parasitiod species. Two of them recorded here for the first time in Egypt. These are *Diversinervus elegans* Silvestri and *Metaphycus zebratus* (Mercet) as well as seventeen species of predators were recorded and collected from concerned specimen under investigation here found in Egypt. Six of them are new records. These are *Chilocorus bipustulatus* L., *Clitostethus arcuatus* Rossi, *Cydonia vicina isis* Cr., *Pharoscymnus various* Kirsch., *Rhyzobius lophanthae* (Blaisdell) and *Rhyzobius littura* Fab. Special references of this pest species are provided.

**Keywords:** the hemispherical soft scale, *Saissetia coffeae*, host plants, distribution, natural enemies, new records, seasonal abundance and Egypt

## Introduction

The hemispherical scale, *Saissetia coffeae* (Walker) (Hemiptera: Coccidae) is one of the most important pests in different parts of the world including Egypt (Abd-Rabou, 2005) [8]. This scale is distributed in the tropics and in some sub-tropical areas (Hill, 1983) [26]. *S. coffeae* infests different parts of the plant and fruits. A major concern with *S. coffeae* is their excretion of abundant honeydew, which contaminates fruit, leaves, and surfaces beneath plants. Honeydew encourages the growth of black sooty mold and attracts ants, which in turn protect scales from natural enemies. When numerous, some scale species weaken plants and cause them to grow slowly. Branches or other plant parts may die if they remain heavily infested with scales. If plant parts die quickly, dead brownish leaves may remain on branches, giving them a scorched appearance. Several years of severe infestations may kill young plants. Soft scales reduce plant vigor, but seldom kill trees or shrubs (Gill, 1997) [21].

*S. coffeae* is a parthenogenetic species and males are unknown. In the field, the adult females of *S. coffeae* can easily be distinguished from the similar *S. oleae* by the absence of the H-shaped ridge on the dorsum. It is the most serious soft scale insects infesting guava trees in Alexandria (El-Minshawy *et al.*, 1971 and 1974) [16, 17]. Moursi *et al.* (1991) and Abd El-Razak (2000) [34, 1] recorded *S. coffeae* (Walker) on *Codiaum interruptum; S. hrmispherica* Targ. On *Anthurium* sp. and *Adiantum* sp.

## Materials and methods

We reviewed the literature reporting infestations of crops and ornamentals in Egypt and performed a complementary survey across Egypt during 2020-2022. This sampling was done in 27 governorates. The governorates vary greatly in size and climatic conditions. The focus of the sampling was on wild and cultivated plant species in agricultural production areas. Moreover, sampling was performed monthly to avoid biases related to differences in seasonal dynamics of *S. coffeae* populations. Infested plants infested were examined in the field using a pocket magnification lens. Infested leaves, flowers or fruiting structures were collected and placed separately in paper bags for further examination in the laboratory. Identification of taxa was then made by examining *S. coffeae* stages that were slide-mounted in Canada balsam, following the methods described in Abd-Rabou (1997) [3].

Dynamics of *S. coffeae* on *Psidium guajava* trees was carried out in Giza governorate, during 2021- 2022. The selected orchard did not receive any chemical control for two years before starting these studies and within studying period. All trees received the same horticultural practices.

Ten trees were selected at each grove infested with this scale insects. Selected trees were similar in size, shape, height and vegetation. Samples were picked up at two-week intervals throughout the study. Samples random size was 30 leaves presenting from all directions. The samples were packed in polyethylene bags with minute holes and transferred to the laboratory for examination, using stereoscopic microscope binocular. All alive insects found on each leaf surface was assorted and recorded as: eggs, nymphs and adults. Obtained data was pooled for each inspection, direction and leaf surface.

Simple correlation and regression values were calculated to obtain information about the relationships between the three tested weather factors and the population of *S. coffeae*.

## Results and discussion

### 1. Host plants infested the hemispherical soft scale *Saissetia coffeae*

Table (1) should that the *hemispherical soft scale S. coffeae* infested 20 host plants, three of them recorded here for the first time in Egypt. These are *Ficus nitida, Psidium guajava and Pinus halepensis. Also, Table (1)* presented the scientists studies the host plants of *S. coffeae in Egypt.*

**Table 1:** Host plants infested *Saissetia coffeae.*

| Species | Family | References |
|---|---|---|
| 1. *Justicia bracteata* | Acanthaceae | Hall,1922 and Abd-Rabou and Evans, 2021[22, 12] |
| 2. *Thunbergia sp.* | Acanthaceae | Hall,1922 and Abd-Rabou and Evans, 2021[22, 12] |
| 3. *Mangifera indica* | Anacardiaceae | Hall,1922 and Abd-Rabou and Evans, 2021[22, 12] |
| 4. *Beaumontia grandiflora* | Apocynaceae | Hall,1925 and Abd-Rabou and Evans, 2021[24, 12] |
| 5. *Asparagus officinalis* | Asparagaceae | Hall,1924 and Abd-Rabou and Evans, 2021[2,3, 12] |
| 6. *Cycas revoluta* | Cycadaceae | Ezzat and Hussein, 1969 and Abd-Rabou and Evans, 2021[20, 12] |
| 7. *Croton sp.* | Euphorbiaceae | Ezzat and Hussein, 1969 and Abd-Rabou and Evans, 2021[20, 12] |
| 8. *Bauhinia sp.* | Fabaceae | Hall,1922 and Abd-Rabou and Evans, 2021[22, 12] |
| 9. *Ferns sp.* | *Ferns* | Hall,1922 and Abd-Rabou and Evans, 2021[22, 12] |
| 10. *Hibiscus sp.* | Malvaceae | Hall,1924 and Abd-Rabou and Evans, 2021[2,3, 12] |
| 11. *Ficus sp.* | Moraceae | Ezzat and Hussein, 1969 and Abd-Rabou and Evans, 2021[20, 12] |
| 12. *Ficus nitida* | Moraceae | Present work |
| 13. *Psidium guajava* | Myrtaceae | Present work |
| 12. *Pittosporum sp.* | Pittosporaceae | Hall,1922 and Abd-Rabou and Evans, 2021[22, 12] |
| 13. *Pittosporum tobira* | Pittosporaceae | Hall,1922 and Abd-Rabou and Evans, 2021[22, 12] |
| 14. *Symphyotrichum novi-belgii* | Asteraceae | Hall,1924 and Abd-Rabou and Evans, 2021[2,3, 12] |
| 15. *Solanum sp.* | Solanaceae | Hall,1922 and Abd-Rabou and Evans, 2021[22, 12] |
| 16. *Lippia sp.* | Verbenaceae | Ezzat and Hussein, 1969 and Abd-Rabou and Evans, 2021[20, 12] |
| 17. *Olea europaea* | Oleaceae | Hall, 1925 and Abd-Rabou and Evans, 2021[24, 12] |
| 18. *Aster* sp. | Asteraceae | Abd-Rabou and Evans, 2021 [12] |
| 19. *Pinus halepensis* | Pinaceae | Present work |
| 20. *Citrus sp.* | Rutaceae | Hall, 1924 [2,3] |

### 2. Distribution of the hemispherical soft scale *Saissetia coffeae*

During the present work this species was recorded distributed in nine governorates. These are, Alexandria, Assiut, Aswan, Gharbiya, Giza, Mersa Matruh, North Sinai, Qena and South Sinai. Mohammed and Nada (1991) [32] stated that soft scale insects distributed all over Egypt including *S. coffeae*.

### 3. Parasitoids of the hemispherical soft scale *Saissetia coffeae*

Three species of aphelinids, eight species encyrtids and on pteromalid species were recorded and collected from concerned specimen under investigation here found in Egypt (Table, 2). Two species recorded here for the first time in Egypt. These are *Diversinervus elegans* Silvestri and *Metaphycus zebratus* (Mercet). Many authors recorded the parasitoids of *S. coffeae e.g.*, El-Minshawy and Saad (1976); Abd-Rabou, 2001 a, b, c, 2005, 2017; Moursi, 2010 and Abd-Rabou and Ahmed (2011) [15, 2, 4, 5, 8, 9, 33, 10].

**Table 2:** Parasitoids of the hemispherical soft scale *Saissetia coffeae*

| Species | Family | References |
|---|---|---|
| 1. *Coccophagus cowperi* Girault | Aphelinidae | Abd-Rabou, 2005 [8] |
| 2. *Coccophagus lycimnia* (Walker) | Aphelinidae | Abd-Rabou, 2001b and Moursi, 2010 [4, 33] |
| 3. *Coccophagus scutellaris* (Dalman) | Aphelinidae | Abd-Rabou, 2001a [2] |
| 4. *Diversinervus elegans* Silvestri | Encyrtidae | Present study |
| 5. *Encyrtus infelix* (Embleton) | Encyrtidae | Moursi, 2010 [33] |
| 6. *Marietta leopardina* Motschulsky | Aphelinidae | Moursi, 2010 [33] |
| 7. *Metaphycus flavus* (Howard) | Encyrtidae | Abd-Rabou and Ahmed, 2011 [10] |
| 8. *Metaphycus helvolus* (Compere) | Encyrtidae | Abd-Rabou, 2001b and Moursi, 2010 [4, 33] |
| 9. *Metaphycus lounsburyi* (Howard) | Encyrtidae | Abd-Rabou, 2001b [4] |
| 10. *Metaphycus zebratus* (Mercet) | Encyrtidae | Present study |
| 12. *Microterys nietneri* (Motschulsky) | Encyrtidae | Abd-Rabou, 2001c, 2012 and Moursi, 2010 [5, 7, 33] |
| 13. *Scutellista cyanea* Motschulsky | Petromalidae | El-Minshawy and Saad,1976; Abd-Rabou, 2001a, 2017 and Moursi, 2010 [24, 2, 9, 33] |

### 4. Predators of the hemispherical soft scale *Saissetia coffeae*

Seventeen species of predators were recorded and collected from concerned specimen under investigation here found in Egypt. Six of them are new record. These are *Chilocorus bipustulatus* L., *Clitostethus arcuatus* Rossi, *Cydonia vicina isis* Cr., *Pharoscymnus various* Kirsch., *Rhyzobius lophanthae* (Blaisdell) and *Rhyzobius littura* Fab. Many researcher studied the predators of *S. coffeae (Table 3).*

**Table 3:** Predators of the hemispherical soft scale *Saissetia coffeae*

| Species | Family | References |
|---|---|---|
| 1. *Chilocorus bipustulatus* L. | Coccinellidae | Present work |
| 2. *Clitostethus arcuatus* Rossi | | Present work |
| 3.*Coccinella septempunctata* L. | | Abd-Rabou and Badary, 2006 [11] |

| | | |
|---|---|---|
| 4.*Coccinella undecimpunctata* L. | | Abd-Rabou and Badary, 2006 [11] |
| 5. *Cydonia vicina isis* Cr. | | Present work |
| 6. *Cydonia vicina nilotica* Muls. | | Abd-Rabou and Badary, 2006 [11] |
| 7. *Exochomus flavipes* Thunb. | | Abd-Rabou and Badary, 2006 [11] |
| 8. *Pharoscymnus various* Kirsch. | | Present work |
| 9. *Rhyzobius lophanthae* (Blaisdell) | | Present work |
| 10. *Rhyzobius littura* Fab. | | Present work |
| 11. *Scymnus syriacus* Marseul | | Abd-Rabou and Ahmed, 2011 and Abd-Rabou and Badary [10, 11] |
| 12. *Paederus alfierii* Koch | Steaphilinidae | Abd-Rabou and Badary, 2006 [11] |
| 13. *Eublemma scitula* (Rambur) | Erebidae | Moursi, 2010 [33] |
| 14. *Metasyrphus corollae* Fab. | Syrphidae | Abd-Rabou and Badary, 2006 [11] |
| 15. *Chrysoperlla carnae* Steph. | Chrysopidae | Abd-Rabou and Badary, 2006 [11] |
| 16. *Orius albidipennis* (Reuter) | Anthocoridae | Abd-Rabou and Badary, 2006 [11] |
| 17. *Orius laevigatus* (Fieber) | Anthocoridae | Abd-Rabou and Badary, 2006 [11] |

**5. Seasonal abundance *of* the *hemispherical soft scale Saissetia coffeae***

The results of *S. coffeae* population dynamics on *Psidium guajava* trees over 2021-2022 years and its relation with minimum and maximum temperatures as well as minimum and maximum relative humidity are presented in Figs (1 - 8). The mean number of individuals were *1435.4, 830.3* and *382.6* individuals for eggs, nymphs and adults of *S. coffeae*, respectively, during the first year**.** while in the second year, the mean number of individuals were 1683.2, 972.7 and 460.6 individuals for eggs, nymphs and adults of *S. coffeae*, respectively. Eggs density reached its maximum on October 1st, 2021 and 2022, showing 4130 and 4910 eggs/sample, respectively. Lowest eggs density occurred during the period on January 1st, 2021 and December 15th 2022, showing 228 and 201 eggs/sample, respectively.

Nymphs density reached its maximum on October 1st, 2021 and 2022, showing 2750 and 2250 eggs/sample, respectively. Lowest nymphs density occurred during the period on January 1st, 2021 and December 15th 2022, showing 110 and 165 eggs/sample, respectively. Adults density reached its highest on October 1st, 2021 and 2022, showing 1014 and 1345 eggs/sample, respectively. Lowest nymphs density occurred during the period on January 1st, 2021 and 2022, showing 80 and 92 eggs/sample, respectively.

Data in Tables (4 and 5), showed that the relationship between temperatures and relative humidity and population density of S. *coffeae* during the two years under consideration.

During the present work the results indicated that the populations of *S. coffeae* has two peaks one in May and October.These results are in agreement with El-Agamy *et al*. (1994) [14], who recorded three generations of *S. coffeae* trees in Kafr El-Sheikh Governorate in May, August and October and in contradicting with the findings of El-Minshawy and Saad (1976) [15]. They stated that S. *coffeae* had three generations, during April-May, June-July and August-September. The third generation overwinters as second nymphal instar from November till February.

**Table 4:** Population dynamics of *the hemispherical soft scale Saissetia coffeae* on guava trees in Giza Governorate, during 2021 season.

| Inspection date | Average no. of Individuals | | | Temp. | | R.H.% | |
|---|---|---|---|---|---|---|---|
| | Eggs | Nymphs | Adults | Max. Temp. | Min. Temp. | Max. R.H.% | Min. R.H.% |
| 1/1/2021 | $222^{o}$ | $111^{u}$ | $80^{w}$ | 21.9 | 9.7 | 61.8 | 40.7 |
| 15/1. | $305^{no}$ | $144^{t}$ | $86^{v}$ | 21.3 | 9.5 | 59.8 | 36.7 |
| 1/2. | $325^{no}$ | $185^{s}$ | $99^{u}$ | 19.7 | 9.9 | 57.9 | 32.9 |
| 15/2. | $425^{mno}$ | $229^{r}$ | $126^{t}$ | 17.4 | 7.5 | 52.0 | 30.5 |
| 1/3. | $530^{lmn}$ | $320^{q}$ | $150^{r}$ | 23.2 | 10.4 | 50.1 | 24.7 |
| 15/3. | $640^{klm}$ | $362^{p}$ | $164^{q}$ | 18.0 | 8.7 | 46.8 | 16.5 |
| 1/4. | $720^{jkl}$ | $444^{o}$ | $185^{p}$ | 22.0 | 9.1 | 50.1 | 25.5 |
| 15/4. | $833^{jk}$ | $530^{n}$ | $201^{o}$ | 21.2 | 8.0 | 52.8 | 27.7 |
| 1/5. | $925^{j}$ | $623^{m}$ | $275^{m}$ | 29.5 | 15.0 | 52.2 | 20.8 |
| 15/5. | $1230^{i}$ | $762^{l}$ | $328^{l}$ | 31.4 | 17.1 | 53.4 | 20.1 |
| 1/6. | $1545^{h}$ | $855^{j}$ | $366^{J}$ | 32.4 | 18.8 | 52.8 | 21.6 |
| 15/6. | $1630^{gh}$ | $960^{i}$ | $429^{h}$ | 34.8 | 19.6 | 52.9 | 26.3 |
| 1/7. | $1743^{gh}$ | $1120^{h}$ | $483^{g}$ | 32.9 | 20.5 | 56.4 | 30.9 |
| 15/7. | $1862^{fg}$ | $1255^{f}$ | $530^{f}$ | 33.7 | 21.8 | 58.5 | 35.3 |
| 1/8. | $1933^{eg}$ | $1425^{e}$ | $701^{e}$ | 33.5 | 20.6 | 60.2 | 38.1 |
| 15/8. | $2265^{d}$ | $1225^{g}$ | $775^{d}$ | 33.8 | 20.9 | 60.3 | 38.8 |
| 1/9. | $2640^{c}$ | $1665^{c}$ | $927^{c}$ | 32.9 | 20.8 | 53.9 | 27.2 |
| 15/9. | $3830^{b}$ | $1930^{b}$ | $970^{b}$ | 32.5 | 20.1 | 56.7 | 32.1 |
| 1/10. | $4130^{a}$ | $2250^{a}$ | $1014^{a}$ | 34.7 | 21.0 | 56.3 | 32.5 |
| 15/10. | $3250^{c}$ | $1466^{d}$ | $345^{k}$ | 28.9 | 17.8 | 57.4 | 32.8 |
| 1/11. | $2166^{de}$ | $950^{i}$ | 382i | 29.1 | 17.9 | 58.2 | 33.5 |
| 15/11. | $775^{jk}$ | $832^{k}$ | $245^{m}$ | 28.4 | 16.6 | 59.1 | 36.1 |
| 1/12. | $325^{no}$ | $175^{i}$ | $180^{p}$ | 21.9 | 9.8 | 59.3 | 37.2 |
| 15/12. | $201^{o}$ | $110^{u}$ | $141^{s}$ | 21.3 | 9.5 | 57.8 | 33.2 |
| r (with tem) | 0.578 | 0.630 | 0.543 | | | | |
| r (with R.H.) | 0.131 | 0.620 | 0.152 | | | | |
| $L.S.D._{0.05}$ | 241.33 | 13.97 | 5.51 | | | | |

**Table 5:** Population dynamics of *the hemispherical soft scale Saissetia coffeae* on guava trees in Giza Governorate, during 2022 season.

| Inspection date | Average no. of Individuals | | | Temp. | | R.H.% | |
|---|---|---|---|---|---|---|---|
| | Eggs | Nymphs | Adults | Max. Temp. | Min. Temp. | Max. R.H.% | Min. R.H.% |
| 1/1/2022 | 228$^{t}$ | 165$^{u}$ | 92$^{w}$ | 26.8 | 15.6 | 65.4 | 37.8 |
| 15/1. | 314$^{s}$ | 175$^{u}$ | 121$^{v}$ | 26.1 | 14.9 | 63.1 | 35.4 |
| 1/2. | 365$^{r}$ | 190$^{t}$ | 145$^{t}$ | 24.6 | 15.7 | 61.3 | 29.7 |
| 15/2. | 485$^{q}$ | 208$^{s}$ | 150$^{s}$ | 22.4 | 13.2 | 55.7 | 21.8 |
| 1/3. | 613$^{p}$ | 275$^{r}$ | 138$^{u}$ | 27.9 | 15.9 | 53.8 | 30.4 |
| 15/3. | 690$^{o}$ | 350$^{q}$ | 165$^{s}$ | 22.9 | 14.4 | 50.5 | 32.7 |
| 1/4. | 795$^{n}$ | 386$^{o}$ | 199$^{p}$ | 27.1 | 14.7 | 53.7 | 25.9 |
| 15/4. | 896$^{m}$ | 495$^{n}$ | 232$^{o}$ | 26.0 | 13.4 | 56.4 | 24.9 |
| 1/5. | 1002$^{l}$ | 603$^{m}$ | 240$^{n}$ | 34.4 | 20.7 | 53.8 | 26.8 |
| 15/5. | 1435$^{k}$ | 702$^{l}$ | 256$^{m}$ | 36.6 | 22.3 | 53.9 | 31.7 |
| 1/6. | 1650$^{j}$ | 895$^{k}$ | 285$^{i}$ | 37.5 | 24.5 | 54.4 | 35.9 |
| 15/6. | 1700$^{i}$ | 965$^{j}$ | 345$^{k}$ | 39.6 | 25.6 | 56.3 | 40.5 |
| 1/7. | 1825$^{h}$ | 1335$^{h}$ | 522i | 37.8 | 26.2 | 59.9 | 42.9 |
| 15/7. | 1950$^{g}$ | 1440$^{g}$ | 590$^{h}$ | 38.5 | 27.8 | 61.9 | 43.8 |
| 1/8. | 2228$^{f}$ | 1711$^{e}$ | 711$^{f}$ | 38.3 | 27.1 | 63.0 | 32.0 |
| 15/8. | 3030$^{e}$ | 1750$^{d}$ | 890$^{d}$ | 38.9 | 26.8 | 63.7 | 37.2 |
| 1/9. | 3426$^{d}$ | 1900$^{c}$ | 1101$^{c}$ | 37.6 | 26.2 | 57.0 | 37.8 |
| 15/9. | 4050$^{c}$ | 2185$^{b}$ | 1265$^{b}$ | 37.7 | 25.8 | 59.8 | 37.9 |
| 1/10. | 4910$^{a}$ | 2750$^{a}$ | 1354$^{a}$ | 39.8 | 25.9 | 59.5 | 38.4 |
| 15/10. | 4155$^{b}$ | 1711$^{e}$ | 811$^{e}$ | 34.2 | 23.0 | 60.9 | 41.1 |
| 1/11. | 2240$^{f}$ | 1525$^{f}$ | 601$^{q}$ | 34.8 | 23.9 | 61.7 | 42.5 |
| 15/11. | 1730$^{i}$ | 988$^{i}$ | 366$^{j}$ | 33.9 | 22.7 | 62.5 | 38.0 |
| 1/12. | 445$^{q}$ | 365$^{p}$ | 285$^{l}$ | 26.7 | 15.8 | 62.6 | 45.8 |
| 15/12. | 235$^{t}$ | 275$^{r}$ | 190$^{q}$ | 26.2 | 15.3 | 61.7 | 41.6 |
| r(with Tem) | 0.570 | 0.621 | 0.593 | | | | |
| r(with RH) | 0.0461 | 0.0453 | 0.0602 | | | | |
| L.S.D. $_{0.05}$ | 41.24 | 41.88 | 4.52 | | | | |

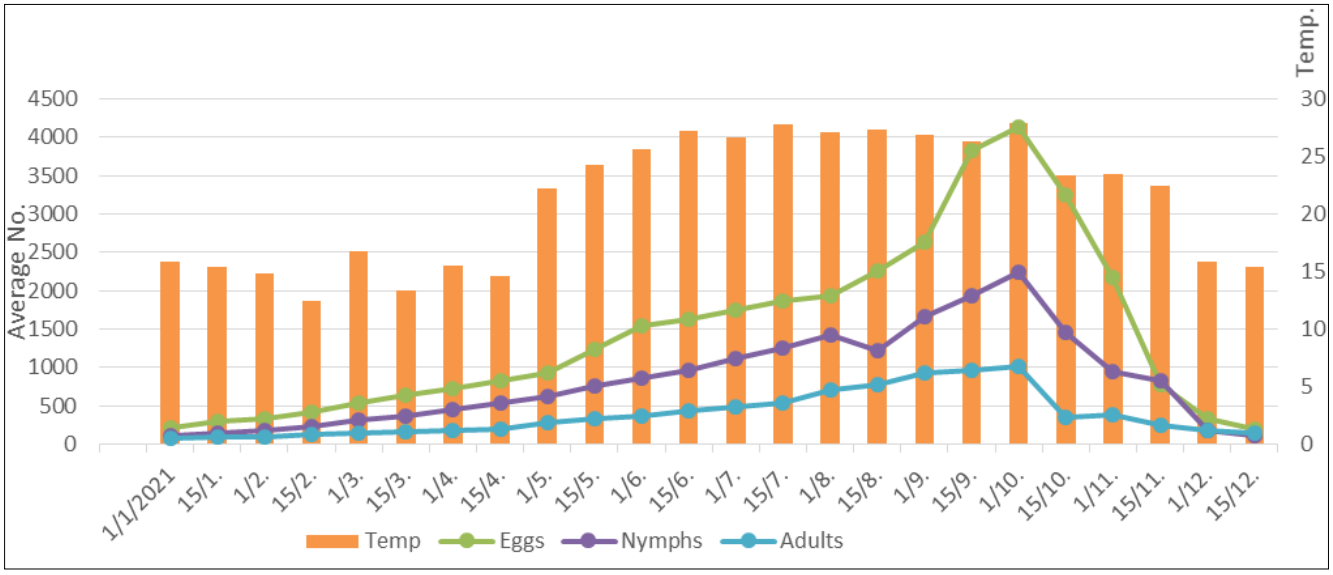


**Fig 1:** Population dynamics of the hemispherical soft scale *Saissetia coffeae* on guava trees in Giza Governorate, during 2021 season with relation to temperature.

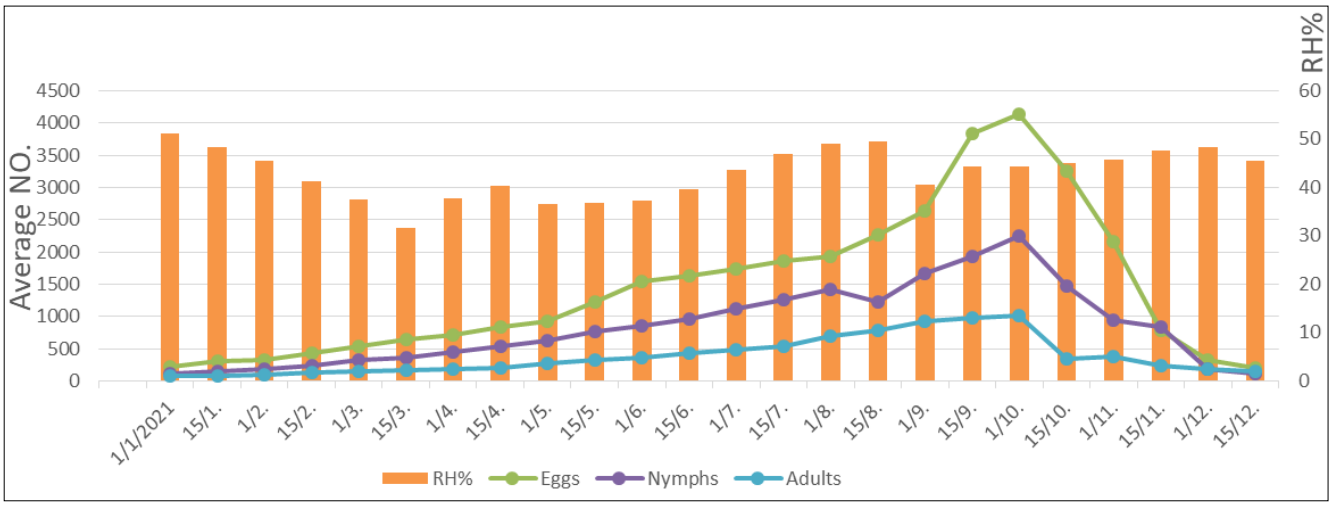


**Fig 2:** Population dynamics of *the hemispherical soft scale Saissetia coffeae* on guava trees in Giza Governorate, during 2021 season with relation to relative humidity.

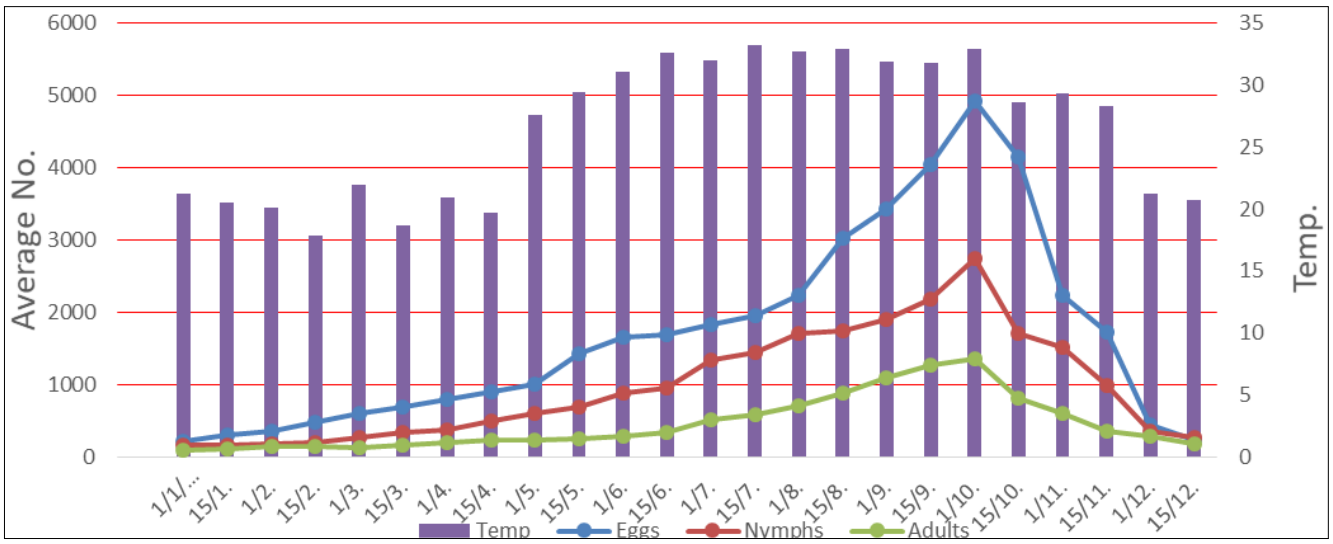


**Fig 3:** Population dynamics of *the hemispherical soft scale Saissetia coffeae* on guava trees in Giza Governorate, during 2022 season with relation to temperature.

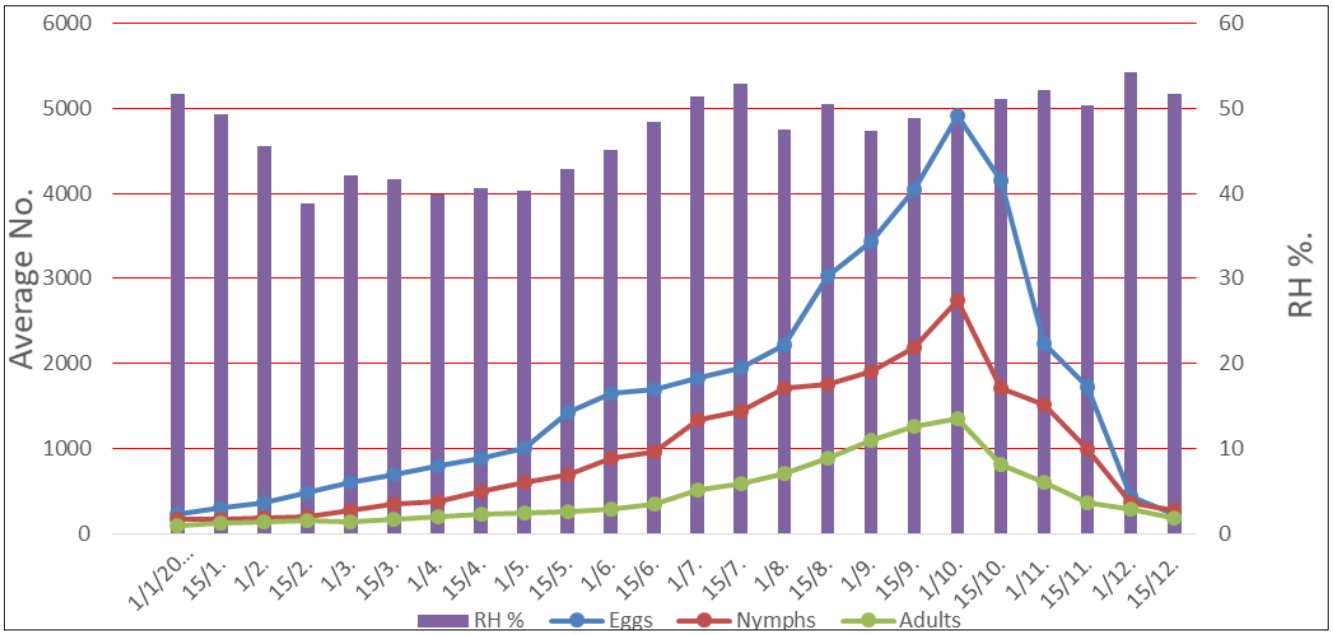


**Fig 4:** Population dynamics of the hemispherical soft scale *Saissetia coffeae* on guava trees in Giza Governorate, during 2021 season with relation to relative humidit

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