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EFFECT OF SOME CHEMICAL CONSTITUENTS OF CERTAIN CITRUS TREE HOSTS ON THE POPULATION DENSITY OF *Aonidiella aurantii* (Maskell) AND *Chrysomphalus aonidum* (L.) AND THEIR POPULATION FLUCTUATIONS

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ABSTRACT: This investigation was carried out to study the effect of some chemical constituents (total phenols, total carbohydrates, total proteins and pH values) of three citrus tree host leaves (sweet orange, navel orange and mandarin) on the population density of *Aonidiella aurantii* **(**Maskell) and *Chrysomphalus aonidum* (L.) in relation with prevailing temperature and relative humidity in different citrus orchards at Minia Alkamh district, Sharkia Governorate, Egypt during two successive years extended from December 2012 to November 2014. The results showed that sweet orange appeared to be the most susceptible citrus tree hosts to infestation by the scale insects followed by navel orange and mandarin at the least. The population density of *A. aurantii* had three peaks on the three citrus tree hosts in the two years. Also, *C. aonidum* recorded three peaks on the navel orange in the two years, while on sweet orange indicated four peaks occurred during the first year and three peaks of densities were obtained during the second one. On mandarin trees, three and four peaks were observed in the aforementioned years, respectively. The highest population was exhibited by *A.aurantii* in the first peak by 636 insects/300 leaves on sweet orange on February in the second year while, it was recorded by *C. aonidum* in the third peak by 59 insects/300 leaves on October in the same year. There was a positive relationship between both of total carbohydrates and total proteins and the population density of *A. aurantii* and *C. aonidum* on sweet orange, navel orange and mandarin, while no relation was found between each of total phenols and pH values and the infestation level by the two scale insects.

Key words: Citrus tree hosts, *Aonidiella aurantii*, *Chrysomphalus aonidum,* population density, chemical constituents.

INTRODUCTION

Citrus is one of the most important fruit crops in the world and ranked first among fruit crops in Egypt. Citrus plantations are among the most important horticultural crops in Egypt especially grown for export of their fruits (Tawfeek, 2012). The cultivated area with citrus in Egypt has enormously increased through the last decades reaching about 530415 fad. The fruiting area reached 440706 fad., producing about 4402180 tons with a mean of 10.42 tons/ fad., (Statistics of the Ministry of Agriculture, 2014). Citrus fruits contain a variety of vitamins, minerals, fiber, and phytochemicals such as carotenoids, flavonoids, and limonoids, which appear to have biological activities and health benefits. There is considerable evidence that citrus fruit have antioxidant and antimutagenic properties and positive associations with bone, cardiovascular and immune system health (Turner and Burri, 2013).

Citrus trees are at risk of sustaining damage by scale insects infestation. Scales derive their name from the shell-like, protective covering they form over themselves (Wawrzynski and Ascerno, 2009). Scale insects damage citrus trees by extracting vital fluids from the tree, resulting in poor fruit quality and tree health. Habib *et al.* (1971), Darwish (1976), Abd-Elfattah *et al.* (1978), Amin and Salem (1978), El-Rahman *et al.* (1979), El-Nabawi *et al.*

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(1986), El-Nabawi and Ammar (1987), Farag *et al.* (1990) and Tawfeek (2007) reported that infestation of citrus by red scale insect *Aonidiella aurantii* (Maskell) depends largely on the size of infestation in November. Population fluctuations of *Aonidiella aurantii* and *Chrysomphalus aonidum* (L.) were studied by many authors (Hafez *et al.*, 1970; Salman, 1970; Abul-Nasr *et al.,* 1975; Abul-Nasr *et al.,*1977; El-Deeb *et al.,* 1992; Selim, 1993; Morsi, 1999). The aim of this work was study the effect of some chemical constituents of certain citrus tree hosts on the population densities of *A. aurantii* and *C. aonidum* as well as their population fluctuations.

MATERIALS AND METHODS

Population Fluctuations of Some Scale Insects Infesting Certain Citrus Tree Hosts

These experiments were carried out at Minia Alkamh district, Sharkia Governorate during the two successive years during the period between December 2012 to November 2014 in citrus orchards about 20 faddans area (more than 12 years old) to study the population fluctuations of two scale insects *Aonidiella aurantii* (Maskell) and *Chrysomphalus aonidum* (L.) on certain citrus tree hosts. This farm was cultivated with citrus tree hosts (sweet orange, navel orange and mandarin) which received normal agricultural practices and no chemical control was applied. One faddan was selected for each citrus tree hosts. Three citrus trees were selected in each tree host which nearly similar in size and vegetation. The plant sample technique (25 leaves) was used for collecting the main two scale insects *A. aurantii* and *C. aonidum* which infesting sweet orange, navel orange and mandarin trees from the main directions (north, south, east and west) and inner during the period from December 2012 to November 2014. Weekly samples were put in paper bags and transferred to the laboratory in the same day for examination and counting the number of the two scale insects *A. aurantii* and *C. aonidum* by the aid of stereoscopic microscope and the peaks were recorded. The daily means of minimum, maximum temperature and relative humidity were obtained from the Meteorological Department of the Agricultural Research Station at Sharkia Governorate. The records of these factors were recalculated to get the daily averages within a month. The obtained data were statistically analysed according to Costat Software Microcomputer Program (Anonymous, 1990).

Chemical Analysis of Certain Citrus Tree Host Leaves

Samples of citrus tree host leaves were collected from the investigated citrus trees to determine some chemical constituents. Total phenols were determined according to the method described by Song *et al*. (2010). Total nitrogen was estimated according to Bremner and Mulvaney (1982). Total protein constituents were calculated by multiplying crude nitrogen percentage by the conversion factor 6.25. Total carbohydrates in leaves were determined by colorimetrically using the anthrone reagent and the color intensity was measured at 240 mu following the method described by Dubois *et al*. (1956). pH value was estimated in plant sap using pH meter (Feldman, 1956).

RESULTS AND DISCUSSION

Population Density of Some Scale Insects *Aonidiella aurantii* (Maskell) and *Chysomphalus aonidum* (L.) Infesting Certain Citrus Tree hosts

Results in Table 1 show the annual total number of *A. aurantii and C. aonidum* infesting some citrus tree hosts (sweet orange, navel orange and mandarin) at Minia Alkamh district, Sharkia Governorate, Egypt during the two successive years from December 2012 to November 2014. The annual total numbers of both scale insects *A. aurantii* and *C. aonidum* recorded higher level of densities in the second year of investigation than in the first one. Population densities of *A. aurantii* were higher than *C. aonidum* on the three citrus tree hosts during the two years of study. *A. aurantii* had the highest annual total number (2550 and 3070 insects) and *C. aonidum* recorded 244 and 291 insects on sweet orange in the two years of study, respectively. Generally, it is clear that the highest population density of the aforementioned scale insects in the two years was recorded on sweet orange by a total number of 6155 insects followed descendingly by 1388 insects on navel

Table 1. Annual total number of *A. aurantii* and *C. aonidum* infesting certain citrus trees at Minia Alkamh district, Sharkia Governorate during two years from December 2012 to November 2014

Citrus tree host	Annual total number of scale insects						
	2012/2013			2013/2014			General total
	A. aurantii	*C. aonidum*	Total number	*A. aurantii*	*C. aonidum*	Total number	
Sweet orange	2550	244	2794	3070	291	3361	6155
Navel orange	514	101	615	646	127	773	1388
Mandarin	325	38	363	416	76	492	855
F	314.36**	13.01		1845.81**	19.57*		

Tabulated F values 0.05 = 19.01 and 0.01= 99.14

orange and 855 insects on mandarin. Statistical analysis of data showed that there were highly significant differences between the population density of *A. aurantii* on different citrus tree hosts in the two years of study. While in case of *C. aonidum* there were insignificant differences in the first year and significant differences in the second one. These results agree with those obtained by Tawfeek (2012) who found that the highest mean numbers of *Parlatoria ziziphi* on the upper surface of leaves was recorded on sweet orange (398.9 individuals/ leaf), navel orange (270.0 individuals/leaf) and mandarin (159.2 individuals/ leaf).

Effect of Some Chemical Constituents of Certain Citrus Tree Host Leaves on the Population Density of Scale Insects, *A. aurantii* and *C. aonidum*

Results presented in Table 2 show the relationship between some chemical constituents of citrus tree hosts (sweet orange, navel orange and mandarin) and the population density of *A. aurantii and C. aonidum* at Minia Alkamh district, Sharkia Governorate during the period between December 2013 and November 2014. The results cleared that there were highly significant differences between the total phenols, total carbohydrates, total proteins and pH values in the three citrus hosts. Also, there were highly significant differences between the population density of *A. aurantii* while, in case of *C. aonidum* there were significant differences on different citrus hosts. From these results it is clear that there is a positive relationship between chemical constituents (total carbohydrates and total proteins) and the population density of *A. aurantii* and *C. aonidum* on sweet orange, navel orange and mandarin. The highest infestation by the two scale insects were recorded on sweet orange (3361 insects) with a mean total carbohydrates (11.77%) and total proteins (10.56%) followed by navel orange (773 insects) and mandarin (492 insects) with a mean of total carbohydrates (8.81% and 7.94%) and total proteins (6.09% and 4.10%), respectively. The obtained results are in agreement with the findings of Abo-Alnour *et al*. (2016) who found that there were positive relationships between chemical constituents (total carbohydrates and total proteins) and the population density of aphid, leafhopper and whitefly insects infesting some citrus tree hosts

In respect of total phenols and pH values, results in Table 2 appear that no clear relation was found between each of total phenols or pH values and the infestation by *A. aurantii* or *C. aonidum*. These results disagree with those of Abo-Alnour *et al*. (2016) who mentioned that there were reverse correlation between total phenol and pH values and the population density of aphid, leafhopper and whitefly insects infesting some citrus tree hosts.

Table 2. Effect of some chemical constituents of certain citrus tree host leaves on scale insects, *A. aurantii* and *C. aonidum* at Minia Alkamh district, Sharkia Governorate during the second year 2013/2014

Citrus tree host	Chemical constituent				Total number of scale insects		General total number of scale insects
	Mean of total phenols (mg GA/gdw)	Mean of total carbohydrates (mg/dl)	Mean of total proteins (mg/dl)	pH value	*A. aurantii*	*C. aonidum*	
Sweet orange	2.00	11.77	10.56	6.18	3070	291	3361
Navel orange	0.21	8.81	6.09	6.07	646	127	773
Mandarin	5.00	7.94	4.10	6.25	416	76	492
F	2458.70**	7532.78**	7086.97**	159.76**	1845.81**	19.57*	

Tabulated F values 0.05 = 19.01 and 0.01 = 99.14

Population Fluctuations of Certain Scale Insects

California red scale insect, *A. aurantii*

The monthly total numbers of *A. aurantii* during the two investigated years are recorded in Tables 3 and 4.

Three peaks of population density were obtained during the two years of study with a big population in the second year on the three citrus tree hosts. In the first year, three peaks occurred on February, June and September on sweet orange and navel orange with a monthly total number of 603, 99 and 244 insects and 88, 53 and 76 insects/300 leaves at 14.4, 26.0 and 24.5°C with 82.8%, 65.4% and 65.8% RH, respectively (Table 3). Also, three peaks on mandarin occurred on February, June and October in the first year with monthly total number of 55, 18 and 58 insects/300 leaves at 14.4, 26.0 and 24.1°C with 82.8%, 65.4% and 66.3% RH, respectively. In the second year of study, the three peaks occurred on February, June and October on sweet orange and navel orange with a monthly total number of 636, 135, 285 insects/300 leaves and 110, 71, 67 insects at 15.7, 27.9 and 23.9°C with 61.3%, 34.5% and 53.9% RH, respectively (Table 4). In case of mandarin the three peaks occurred January, May and October with monthly total number of 66, 29 and 56 insects/300 leaves at 15.1, 25.4 and 23.9°C with 59.9%, 39.9% and 53.9% RH, respectively. These results are in agreement with those obtained by some authors such as Habib *et al.* (1971) who recorded that *A. aurantii* had 3-4 generations. Kamel (2010) studied the population density of the citrus red scale, *A. orientalis* infesting navel orange leaves in 7 Governorates of Lower Egypt and found that the insect had 3-4 annual population peaks. Moustafa (2012) added that the populations of red scale insect had two peaks, the first peak occurred on April and the second one on October.

Citrus black scale insect, *C. aonidum*

Results given in Tables 3 and 4 show the population fluctuations of *C. aonidum* on the aforementioned three tested citrus tree hosts, (sweet orange, navel orange and mandarin). During the first year (2012/2013) four peaks were noticed on sweet orange with monthly total number of 26, 15, 47 and 41 insects/300 leaves on January, March, June and September at means of 13.1, 17.4, 26.0 and 24.5°C and with 84.2%, 77.8%, 65.4% and 65.8% RH, respectively (Table 3). On the other hand, three peaks of population density with relatively low numbers were noticed for *C. aonidum* on navel orange on February, July and September with a monthly total numbers of 16, 12 and 22 insects/300 leavs at 14.4, 26.5 and 24.5°C and with 82.8%, 66.0% and 65.8% RH, respectively, while on mandarin on January, July and September with a small monthly total number of 3, 10 and 8 insecs/300 leaves at 13.1, 26.5 and 24.5°C with 84.2%, 66.0% and 65.8% RH, successively. In the second year (2013/2014) three peaks occurred on January, June and October with monthly total

Table 3. Annual abundance of certain scale insects *A. aurantii* and *C. aonidum* on navel orange, sweet orange and mandarin at Minia Alkamh district, Sharkia Governorate during the first year from December 2012 to November 2013

Date (month)	Monthly total number of scale insects/300 leaves									General total	Mean	
	Sweet orange			Navel orange			Mandarin				Temp. (°C)	RH (%)
	A. aurantii	*C. aonidum*	Total number	*A. aurantii*	*C. aonidum*	Total number	*A. aurantii*	*C. aonidum*	Total number			
Dec. 2012	167	10	177	33	2	35	27	1	28	240	14.8	63.6
Jan. 2013	379	26	405	59	4	63	49	3	52	520	13.1	84.2
Feb.	603	13	616	88	16	104	55	0	55	775	14.4	82.8
Mar.	309	15	324	50	5	55	11	1	12	391	17.4	77.8
Apr.	163	4	167	16	2	18	3	1	4	189	19.3	69.1
May	9	7	16	13	3	16	6	3	9	41	25.0	62.4
June	99	47	146	53	10	63	18	4	22	231	26.0	65.4
Jul.	80	22	102	21	12	33	15	10	25	160	26.5	66.0
Aug.	147	29	176	21	9	30	30	2	32	238	26.6	66.6
Sep.	244	41	285	76	22	98	32	8	40	423	24.5	65.8
Oct.	200	22	222	45	14	59	58	4	62	343	24.1	66.3
Nov.	150	8	158	39	2	41	21	1	22	221	19.7	67.15
Total number	2550	244	2794	514	101	615	325	38	363			
General mean	212.50	20.33		42.83	8.42		27.08	3.17				

Table 4. Annual abundance of certain scale insects *A. aurantii* and *C. aonidum* on navel orange, sweet orange and mandarin at Minia Alkamh district, Sharkia Governorate during the second year from December 2013 to November 2014

Date (month)	Monthly total number of scale insects/300 leaves									General total	Mean	
	Sweet orange			Navel orange			Mandarin				Temp. (°C)	RH (%)
	A. aurantii	*C. aonidum*	Total number	*A. aurantii*	*C. aonidum*	Total number	*A. aurantii*	*C. aonidum*	Total number			
Dec. 2013	158	14	172	30	4	34	33	6	39	245	19.6	64.9
Jan. 2014	422	33	455	77	12	89	66	11	77	621	15.1	59.9
Feb.	636	25	661	110	9	119	62	2	64	844	15.7	61.3
Mar.	351	20	371	75	11	86	44	8	52	509	18.8	48.7
Apr.	255	12	267	31	6	37	15	0	15	319	22.2	46.4
May	112	15	127	37	9	46	29	1	30	203	25.4	39.9
June	135	24	159	71	12	83	13	7	20	262	27.9	34.5
July	123	23	146	31	12	43	18	6	24	213	28.8	53.6
Aug.	196	28	224	30	13	43	27	8	35	302	29.6	54.5
Sep.	274	31	305	64	15	79	42	8	50	434	28.5	50.8
Oct.	285	59	344	67	21	88	56	17	73	505	23.9	53.9
Nov.	123	7	130	23	3	26	11	2	13	169	19.7	58.7
Total number	3070	291	3361	646	127	773	416	76	492			
General mean	255.83	24.25		53.83	10.58		34.67	6.33				

number of 33, 24 and 59 insects/300 leaves on sweet orange at 15.1, 27.9 and 23.9°C with 59.9%, 34.5% and 53.9% RH, respectively (Table 4). In respect to navel orange, three peaks were noticed on January, March and October with monthly total number of 12, 11 and 21 insects/300 leaves at 15.1, 18.8 and 23.9°C with 59.9%, 48.7% and 53.9% RH, consecutively. On the other hand, four peaks with a low density occurred on mandarin on January, March, June and October with monthly total numbers of 11, 8, 7 and 17 insects/300 leaves at 15.1, 18.8, 27.9 and 23.9°C with 59.9%, 48.7%, 34.5% and 53.9% RH, respectively. The results are partially in harmony with the findings of Moustafa (2012) who mentioned that, the black scale insect *C. aonidum* population reached maximum numbers during May (1826 and 1747/ 30 leaves and 15 twigs) in first and second years, respectively.

Effect of Some Weather Factors on the Population Density of *A. aurantii* and *C. aonidum* Infesting Certain Citrus Tree Hosts During the Two Years of 2012/2013 and 2013/ 2014

Results presented in Table 5 show the simple correlation (r), simple partial regression coefficient (b) and coefficient of determination (CD%) for the relationship between the monthly mean temperature, monthly mean relative humidity and the population density of certain scale insects attacking citrus tree hosts during the two successive years 2012 /2013 and 2013/ 2014.

A. aurantii

Statistical analysis of the obtained data showed that the correlation coefficient between the activity of *A. aurantii* population and mean temperature was negative and significant (r_1= -0.701* and -0.643*) on sweet orange, while it was insignificant (r_1 = -0.399 and -0.426) on navel orange and mandarin (r_1= -0.305 and -0.540), respectively during the two investigated years (Table 5). Concerning the correlation between *A. aurantii* population and relative humidity, there were positive and highly significant correlations on sweet orange (r_2 = 0.875**) and significant on navel orange (r_2 = 0.591*), while on mandarin it was positive and insignificant (r_2 = 0.451), in the first year of study. In the second one, these values were positive and insignificant (r_2 = 0.389, 0.026 and 0.442) on sweet orange, navel orange and mandarin, consecutively.

There were negative and insignificant partial regressions between the population densities of *A. aurantii* and mean temperature (b_1= -0.146 and -0.610 on sweet orange), (b_1= 0.056 and -0.579 on navel orange) and (b_1= 0.040 and -0.426 on mandarin) during 2012/2013 and 2013/2014, respectively (Table 5). Partial regressions between the population densities of *A. aurantii* and the mean relative humidity were in general positive and insignificant (b_2 = 0.770 and 0.061 on sweet orange), (b_2 = 0.631 and -0.285 on navel orange) and (b_2 = 0.480 and 0.213 on mandarin) during 2012/2013 and 2013/2014, respectively.

Means of both temperature and relative humidity affected *A. aurantii* population by 77.60% and 41.60% on sweet orange, 35.10% and 24.00% on navel orange and 20.40% and 32.40% on mandarin during 2012/2013 and 2013/2014, respectively (Table 5).

C. aonidum

There were positive and insignificant correlations between the mean number of *C. aonidum* and mean temperature in both years, whereas r_1= 0.450 and 0.140 on sweet orange and r_1= 0.355 and 0.395 on navel orange, while it was positive and significant on mandarin r_1= 0.607* in the first year and insignificant in the second one (r_1= 0.098). Relative humidity showed negative and positive insignificant effects on the population of *C. aonidum*, with r_2 values of -0.082 and 0.070 on sweet orange and 0.023 and -0.203 on navel orange and -0.350 and 0.146 on mandarin in the two years of study, respectively (Table 5).

There were positive and insignificant partial regression coefficients between the population density of *C. aonidum* and mean temperature (b_1= 0.813 and 0.294 on sweet orange, 0.764 and 0.402 on navel orange and 0.736 and 0.248 on mandarin, for the two investigated years, successively. Concerning relative humidity, there were positive insignificant partial regression coefficients between mean relative humidity and the population density of *C. aonidum* on sweet orange, navel orange and mandarin (b_2= 0.503 and 0.204, 0.573 and 0.013 and 0.180 and 0.279) in the two investigated years, respectively (Table 5).

Table 5. Simple correlation coefficient (r), partial regression coefficient (b) and coefficient of determination (CD%) between some weather factors and the population density of certain scale insects on sweet orange, navel orange and mandarin at Minia Alkamh district, Sharkia Governorate during the two years from December 2012 to November 2014

Insect pest	Citrus tree hosts	Simple correlation coefficient				Partial regression coefficient				Total CD (%)	
		r_1		r_2		b_1		b_2			
		2012-2013	2013-2014	2012-2013	2013-2014	2012-2013	2013-2014	2012-2013	2013-2014	2012-2013	2013-2014
A. aurantii	Sweet orange	-0.701*	-0.643*	0.875**	0.389	-0.146	-0.610	0.770	0.061	77.60	41.60
	Navel orange	-0.399	-0.426	0.591*	0.026	0.056	-0.579	0.631	-0.285	35.10	24.00
	Mandarin	-0.305	-0.540	0.451	0.442	0.040	-0.426	0.480	0.213	20.40	32.40
C. aonidum	Sweet orange	0.450	0.140	-0.082	0.070	0.813	0.294	0.503	0.204	32.50	4.90
	Navel orange	0.355	0.395	0.023	-0.203	0.764	0.402	0.573	0.013	28.10	15.60
	Mandarin	0.607*	0.098	-0.350	0.146	0.736	0.248	0.180	0.279	38.40	6.50

r_1= simple correlation coefficients for mean temperature and r_2 for mean relative humidity.

b_1= Partial regression for mean temperature and b_2 for mean relative humidity.

* Indicates significantly degree at 0.05% level of probability and ** Indicates highly significantly at 0.01% level of probability.

Both temperature and relative humidity affected *C. aonidum* population by 32.50%, 28.10% and 38.40% in the first year and 4.90, 15.60% and 6.50% in the second one on sweet orange, navel orange and mandarin, successively (Table 5).

REFERENCES

Abd-Elfattah, M., A. El-Minshawy and E. Darwish (1978). The seasonal abundance of two scale insects, *Lepidosaphes beckii* (New.) and *Aonidiella aurantii* (Maskell.) infesting citrus trees in Egypt. Proc. 4th Conf. Pest Control, NRC, Cairo, 1: 78-84.

Abo-Alnour, F.A.I., O.I.M. Hegab, A.M. Hegab and A.A. Abd-Elsamad (2016). Ecological studies on some homopterous insects infesting certain citrus and guava trees. Zagazig J. Agric. Res., 43 (5): 1705-1722.

Abul-Nasr, S., S. Swailem and N.M. Ahmed (1975). Seasonal fluctuations of the citrus red scale insect, *Aonidiella aurantii* (Maskell) in certain regions of Lower Egypt (Hemiptera: Homop.: Diaspididae). Agric. Res. Rev., 33 (1): 149-159.

Abul-Nasr, S., S. Swailem and N.M. Ahmed (1977). Population studies on the Egyptian citrus scale insect, *Chrysomphalus ficus* Ashmead in different regions (Hemiptera: Homop. : Diaspididae). Agric. Res. Rev., 35 (1): 127-137.

Amin, A.H. and Y.S. Salem (1978). Population studies on scale insect tree hosts *Parlatoria ziziphus*, a new pest of citrus trees in Egypt (Homoptera, Coccoidea, Diaspididae). Proceedings of the 4th Conference of Pest Control, 30 September to 3 October, Cairo, Egypt, 49-56.

Anonymous (1990). Costat Software Microcomputer Program; Version 4-20, Cohort Software, Berkley CA, USA.

Bremner, J.M. and C.S. Mulvaney (1982). Total Nitrogen. In (Page, A.L.; R.H. Miller and D.R. Keeney Eds.). Methods of Soil Analysis, Part 2 Ame. Soc. Agron. Masison., WIWSA.

Darwish, E.T.E. (1976). Biological and control studies on the scale insects attacking citrus trees in Monoufia province. M.Sc. Thesis, Fac. Agric., Menoufia Univ., Egypt.

Dubois, M., K.A. Giles, J.K. Hamilton, P.A. Rebevs and F. Smith (1956). Colorimetric method for determination of sugars and related compounds. Analy. Chem., 28: 350 - 356.

El-Deeb, M.A., A. Shahein, M.M. El-Zohairy and A.S. Hassan (1992). Seasonal fluctuations of the citrus red scale insect, *Aonidiella aurantii* (Maskell) on three citrus tree hosts in Sharkia region. Zagazig. J. Agric. Res., 19 (4): 1879-1895.

El-Nabawi, A. and I.M. Ammar (1987). Population studies on the red scale, *Aonidiella aurantii* (Mask.) on different citrus hosts in Shebin El-Kom. Bull. Soc. Entomol. Egypt, 67: 13-21.

El-Nabawi, A., M.M.A. El-Rahim and M.A. Ammar (1986). Factors affecting the population density of three scale insects on grapefruit trees. Minufiyai. Res., 11: 1025-1043.

El-Rahman, A., S.M. Metwally and F.M. El-Agamy (1979). Population density and sex ratio of certain scale insects on different citrus hosts at Kafr-El-Sheikh region. J. Agric. Res. Tanta Univ., Egypt, 52: 101-110.

Farag, A., M.M.A. El-Rahim, E.T.E. Darwish and A.M. Zaki (1990). On the abundance of certain insect and mite pests on different citrus varieties. Proc. Int. Conf. Econ. Entomol., 1: 313-324.

Feldman, I. (1956). Use and abuse of pH measurements. Analyt. Chem., 28 (12): 1859.

Habib, A., H.S. Salama and A.H. Amin (1971). Population studies on scale insects infesting citrus trees in Egypt. Z. Fur Angew. Entomol., 69: 318-330.

Hafez, M., M.F.S. Tawfik and A. Raouf (1970). Fluctuations of the population densities of the black scale, *Chrysomphalus ficus* Ashm. At. Tech. Bull., 2: 3-16.

Kamel, A.S. (2010). Insects attack citrus trees in Al- Qalyubiyah Governorate, Egypt. Egypt. Acad. J. Biolog. Sci., 3 (2): 107-117.

Morsi, G.A. (1999). Studies on the natural enemies of scale insects infesting some fruit trees. Ph. D. Thesis, Benha Branch, Zagazig Univ., 235.

Moustafa, M. (2012). Scale insects (Coccoidae: Hemiptera) infested citrus trees and their natural enemies, with a key of these pests in Egypt. Egypt. Acad. J. Biolog. Sci., 5 (1): 1-23.

Salman, A.F. (1970). Studies on the morphology, biology and control of certain coccids in Egypt. M. Sc. Thesis, Fac. Agric., Ain-Shams Univ., Egypt.

Selim, A.A. (1993). Ecological studies on armored scale insects infesting citrus trees (Homoptera: Diaspididae). M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., Egypt.

Song, F., R. Gan, Y. Zhang, Q. Xiao, L. Kuang and H. Li (2010). Total phenolic constituents and antioxidant capacities of selected Chinese medicinal plants. J. Mol. Sci., 11: 2362-2372.

Statistics of the Ministry of Agriculture (2014). Statistics of fruit production.

Tawfeek, M.E. (2007). Bioecological studies on some armoured scale insects and their parasitoids. Ph.D. Thesis, Fac. Agric. Alex. Univ., Egypt.

Tawfeek, M.E. (2012). Distributions of armoured scale insects infesting citrus trees in different localities in Egypt. J. Entomol., 9 (6): 429-434.

Turner, T. and B.J. Burri (2013). Potential nutritional benefits of current citrus consumption. J. Agric., (3): 170-187.

Wawrzynski, R.P. and M.E. Ascerno (2009). Scale insects of trees and shrubs; http//www.extension.umn.edu/distribution/horticulture/dg1019.html.

تأثير بعض المكونات الكيميائية لبعض عوائل الموالح على كثافة مجموع الحشرة القشرية الحمراء والحشرة القشرية السوداء وتقلباتهما الموسمية

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تم إجراء هذا البحث لدراسة تأثير بعض المكونات الكيميائية (مركبات الفينول الكلية، الكربوهيدرات الكلية، البروتينات الكلية ودرجة الحموضة) لبعض عوائل الموالح (البرتقال السكري، البرتقال أبو سرة واليوسفي) على كثافة المجموع وكذلك تقلبات تعداد الحشرة القشرية الحمراء والحشرة القشرية السوداء في بساتين الموالح في منطقة منيا القمح بمحافظة الشرقية- مصر وعلاقتها بدرجات الحرارة والرطوبة النسبية خلال عامين متتاليين من ديسمبر ٢٠١٢ إلى نوفمبر ٢٠١٤، أوضحت النتائج أن البرتقال السكري هو أكثر أنواع الموالح قابلية للإصابة بالحشرات القشرية يليه البرتقال أبو سرة وأخيراً اليوسفي حيث سجلت الكثافة العددية للحشرة القشرية الحمراء ثلاث ذروات على العوائل الثلاثة من الموالح تحت الدراسة في كلا العامين، وأيضاً سجلت الحشرة القشرية السوداء ثلاث ذروات من النشاط على البرتقال أبو سرة في كلا العامين، بينما على البرتقال السكري سجلت أربع ذروات للنشاط في العام الأول على حين أنه فى العام الثانى ٢٠١٤/٢٠١٣ سجلت ثلاث ذروات، كما سجلت على اليوسفى ثلاث ذروات من النشاط في العام الأول بينما سجلت أربع ذروات للنشاط في العام الثاني، أعلى تعداد تم تسجيله للحشرة القشرية الحمراء في الذروة الأولى كان ٦٣٦ حشرة/٣٠٠ ورقة على البرتقال السكري في شهر فبراير في العام الثاني وللحشرة القشرية السوداء فى الذروة الثالثة بتعداد ٥٩ حشرة/٣٠٠ ورقة في شهر أكتوبر في نفس العام، كانت هناك علاقة موجبة بين الكربوهيدرات الكلية والبروتينات الكلية والكثافة العددية للحشرة القشرية الحمراء وكذلك السوداء على البرتقال السكرى والبرتقال أبو سرة واليوسفي، بينما لا توجد هناك علاقة واضحة بين كل من الفينولات الكلية ودرجة الحموضة والإصابة بكلا النوعين من الحشرات القشرية.

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