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Biological studies of the citrus blackfly *Aleurocanthus woglumi* (Hemiptera: Aleyrodidae) infesting *Citrus aurantifolia* in Lahej Governorate, Republic of Yemen

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Abstract:

This study was conducted to investigate the life cycle of the citrus blackfly *Aleurocanthus woglumi* Ashby (*Hemiptera*: *Aleyrodidae*) on *Citrus aurantifolia* seedlings during the period from December 2010 and continued until March 2011 in a private orchard in Al-Houta city, Lahej Governorate. The results of the study showed that the average duration of the incomplete stages from laying the egg until the exit of the adult insect (generation period) under field conditions at an average temperature of 25.83°C and a relative humidity of 66.75% was 70.6 days, and the average incubation period for eggs was 14.6 days, and the average duration of the nymph and pupa phase was 56 days. The average duration of the nymph and pupa phases (The four ages of the nymph) was 8.2 days, 8.2 days, 7.6 days and 32 days for the first, second, third and fourth ages (The pupa), respectively. The results showed the mortality rate in the incomplete stages from laying the egg until the exit of the adult insect, as it was 44.06% in the egg phase, in the nymph and pupa phase it amounted to 85.27%, and in the phase of the egg until the emergence of the adult insect (Generation duration) it reached 91.76%. The results also showed the mortality rate in the nymph and pupa stages (The ages of the four nymphs) as it was 35.13, 12.66, 7.5% for the first, second and third ages, respectively, and in the fourth age of the nymph (The pupa), the mortality rate reached 71.89%.

Introduction

The citrus blackfly *Aleurocanthus woglumi* Ashby (Hemiptera*:* Aleyrodidae) is one of the important insect pests that infect citrus in the whole of the Republic of Yemen. Honey is a suitable environment for the growth of black mold fungus on the leaves, which causes them to blacken and attract dust, which affects the photosynthesis and nutrition process of trees, so the fruits appear black, atrophic and small in size, and the combined action of sucking the sap with the presence of the black mold fungus leads to a severe decrease in production of the tree (Rajak and Diwakar, 1987; French *et al*., 1997; Ministry of Agriculture, 2000 and Ba-Angood, 2008).

Approximately 5-10 nymphs/cm 2 of the leaf are sufficient

to reduce the nitrogen level to less than 22% necessary for the growth of fruits and caused losses ranging from 20-80% of the citrus crop. Research conducted in Mexico showed that the production of fruits decreased to more than 90% when the infection exceeded 5-7 nymphs/cm2 of the leaf (De Lemos *et al.*, 2017). Asia is the original home of the insect, as it was first classified in the Caribbean countries in 1913 in Jamaica, and it is currently found in many Caribbean countries and Central America. It was first seen in Trinidad in 1997 and then spread on the island (Ministry of Agriculture, 2000).

It was recorded in South Africa in January 1959 (Bedford and Tomas, 1965), in America (Nguyen and Sailer, 1987), and the United States of America (Dowell and Steinberg, 1990) and in Nagpur in India (Satpute *et al*., 1989). In the Arab world, it is found in Egypt, Saudi Arabia, the United Arab Emirates, the Sultanate of Oman, Iraq, Syria and Yemen (Ba-Angood, 2008).

It is spread in Yemen in all citrus growing areas (Ba-Angood *et al.*, 1997). It was recorded in Yemen for the first time in 1970 (Ba-Angood, 1977). It affects other families in addition to citrus trees such as mangoes, bananas, guavas, papayas, pomegranates and dams trees (Ba-Angood, 2008), Indian cork (Al-Kaf, 1988), coffee (Ba-Angood *et al.*, 1997), okra and some types of flowers (Ministry of Agriculture, 2000) and in Lahj Governorate, it was recorded on 27 plant families that included citrus species (Murad and Ba-Angood, 2008), and it was found on more than 300 plant families (Nguyen and Hamon, 1993).

Many studies dealt with the life cycle of the insect, as it was mentioned (Ba-Angood, 2008) in a study of the life of the insect. The female lays her eggs in the form of small circles on the lower surface of the leaves, and each female lays 2-3 circles, and in each circle there are 28-34 eggs during a period of 3-4 days after it exit from the last life of the nymph (The pupa) and at a temperature of 32°C, it completes her life cycle in about 40 day. He also pointed to a cluster in another study of the life of the insect, in which he mentioned that the egg takes 8-12 days to hatch, the first age takes 8-20 days, the second between 8-30 days, the third takes 6-20 days, and the last nymph (Pupa) age 16 - 40 days and the life cycle from the egg to the adult insect takes 46-122 days (Ba-Angood, 2008).

Al-Kaf (1988) indicated in a study of the insect's life on citrus species that the period from laying eggs until their hatching ranged between 10.5-11.5 days, while the phases of the nymph and pupa ranged between 54.7-55.8 days, and the period from laying eggs until the exit of the adult insect ranged Between 65.2-67.3 days at temperatures of 29°C.

Hassan (1989) found in a study on the life of the insect on seedlings of Baladi Lim and Valencia orange that the average period from the egg to the adult insect takes 72 days and 78 days, respectively. The period from laying eggs until hatching into nymphs is 19.0 days, 16.20 days, and the average period for the nymph and pupa phases is 52.9 days, 62.35 days for Baladi lime and Valencia orange, respectively, under an average temperature of 24.46°C and a humidity of 79%.

Dowell and Steinberg (1990) found that the female's ovaries are ready 36-24 hours after turning into a full insect at a temperature of 24°C - 27°C. In Venezuela, Boscan *et al.* (1981)

mentioned that the egg takes 12-26 days to hatch and the larva takes three ages ranging from 19-6, 7-6, 19-9 days, respectively, while the pupa stage takes 32-21 days and takes One generation has a period ranging between 103-54 days during the months from February to May. In Florida, Nguyen and Hamon (1993) concluded that the eggs hatch within a period ranging between 7-10 days, the first age takes 7-16 days, and the second between 7-30 days, and the third takes 6-20 days, while the pupa phase ranges between 16-50 days, and the life cycle from the egg to the whole insect ranges between 133-45 days, depending on the temperature.

French *et al.* (1997) added that one generation takes about 60 days at a temperature of 90°F, 75 days at a temperature of 80°F and 120 days at a temperature of 70°F. The Ministry of Agriculture and Irrigation in Trinidad and Tobago noted that the period of the egg to the first nymph takes 7-10 days, the period of the first lifespan from the nymph to the second 7-15 days, the period of the second life of the nymph to the third 7-30 days, the period of the third life from the nymph to the maiden 6-20 days, while the period of pupa was 15 - 60 days, and the period from the egg to the adult insect was 43-150 days.

The short period occurs when temperatures rise (Ministry of Agriculture, 2000) and in India (Patel and Patel, 2001) found that when they studied the life cycle of potted plants on lime, the average incubation period was 15.27 days, the average nymph phase period was 24.32 days, and the average pupa period The one that turns into a male is 73.38 days, while the period of the pupa that turns into a female is 71.39 days at an average temperature of 25.9°C and a relative humidity of 52.5%.

Pena *et al.* (2009) in the study on the life of the insect, concluded that the average incubation period for the egg is 15 days, and the fourth age of the nymph (Pupa) takes an average longer than the three ages of the nymph, and the average period from the egg to the adult insect takes 70 days under an average temperature of 27.4°C and a humidity of 79.4%. The number of annual generations of the insect varies from one region to another, and some researchers have indicated this. In Venezuela, Boscan *et al.* (1981) stated that the insect has four generations per year.

In Florida, Nguyen and Hamon (1993) found that the insect has six generations per year. Weeks *et al.* (2012) indicated that the insect has three to six generations per year, overlapping in the year according to the local climate. The natural death rate varies in the different insect stages of the citrus fly, and Boscan *et al*. (1981) they found that the natural death rate for eggs was 58.26%, and for the three ages of the larva, the death rate was 59.07, 53.85, 76.71%, respectively, while the death rate reached in the pupal stage to 74.44%. Hassan (1989) concluded that the natural death rate of insects on lemongrass in eggs was 35%, and the death rate for nymphs and pupae was 67%, while the death rate for the stage from the egg until the exit of the full insect was 78%. Patel and Patel (2001) stated that the average hatchability rate for eggs is 75.61%. As for the number of insects that reach the full stage, its average reaches 16.9 / 100 eggs (Boscan *et al.,* 1981).

The number of annual generations of the insect varies from

one region to another, and some researchers have indicated this. In Venezuela, Boscan *et al.* (1981) stated that the insect has four generations per year. In Florida, Nguyen and Hamon (1993) found that the insect has six generations per year. And Weeks *et al.* (2012) indicated that the insect has three to six generations per year, overlapping in the year according to the local climate. The natural mortality rate varies in the different insect stages of the citrus blackfly, and Boscan *et al.* (1981) found that the natural mortality rate for eggs was 58.26%, and for the three ages of the larva, the mortality rate was 59.07, 53.85, 76.71%, respectively, while the mortality rate reached in the pupa stage to 74.44%. Hassan (1989) concluded that the natural mortality rate of insects on lemongrass in eggs was 35%, and the mortality rate for nymphs and pupa was 67%, while the mortality rate for the stage from the egg until the exit of the full insect was 78%.

Patel and Patel (2001) stated that the average hatchability rate for eggs is 75.61%. As for the number of insects that reach the full stage, it averages up to 16.9 / 100 eggs (Boscan *et al.*, 1981). and due to the importance of the insect, farmers resort to using many pesticides to combat this pest, some of which are harmful to vital enemies such as novacron 40% E.C. methidathion 40% E.C. The number of spraying times to combat this pest has increased to more than 4 times per year (By cluster) 2008.

Since the global trend today tends to rationalize the use of pesticides and implement the integrated pest management (IPM) program, which requires information about the insect, including its life, the current study targeted some biological studies on the citrus blackfly, in order to benefit from them in the future program of integrated pest management.

Materials and methods

This field experiment was carried out in a private orchard in Al-Houta city in Lahej Governorate on lemongrass seedlings during the period from 13/12/2010 and continued until 2/3/2011 at an average temperature of 25.83°C and a relative humidity of 66.75%. Two seedlings of lemons placed in polyethylene bags were brought from the plantation management nursery to the private orchard. Four fresh and infested-free leaves were randomly selected from each seedling and numbered from 4-1, then the incomplete phases development period (Generation duration) was followed for a number of the egg rings that were laid within nine days, and the infection was natural, meaning that the females were not selected and placed in cages.

The readings were taken for the number of egg rings, the number of eggs in each ring, the number of the three stages of the nymph, the number of pupa and the number of adults with the naked eye. Females laid eggs on 7 leaves, while one leaf was not laid on it. The number of eggs on one leaf for nine days ranged from 28-145 eggs / leaf. Insect stages were identified, as the shape of the eggs is oval and their color at the beginning of laying is white, then turns to yellow, then to brown, then to black at the beginning of its hatching until the age of the first nymph, whose shape is elongated oval and its color is black. Then it turns into the second age of the nymph, which is slightly larger than it and its shape is oval-convex, and its color is pale black and there are

yellow spots and many thorns on the upper part of its body.

Distinguishing between the three phases of the nymph (First, second, third) through continuous observation of them and it is characterized by the fact that it sheds from one phase to another in the same place (Fixed), then the third nymph's life turns into the fourth nymph's life, which is called the pupa because it is static and from it the complete insect emerges and forms it Oval, shiny black in color, with many thorns, then gradually a white waxy layer appears around its edges. This waxy layer increases in density with the near exit of the full insect. With the exit of a honeycomb substance from the upper area (the area of exit of the insect It also shows the movement of the insect inside the virgin before the exit, and when the insect leaves a hole in the shape of the letter T on its back, and the whole insect at the beginning of its exit from the virgin, the color of its head, chest and stomach was red-orange, then gradually turns to brown, then to blackish blue, then to black, and its body and wings are covered with a thin layer of wax, and a distinction was made between the female and the male, the female is larger than the male, as the female has a transverse body in the middle, while the male has a thin body, and the examination was carried out daily from the beginning of laying eggs until the exit of the full insect.

The incubation period of eggs was calculated on the basis of the time between laying and hatching the eggs, and the duration of the first age of the nymph was calculated on the basis of the time period between the exit of the first age of the nymph from the egg until her transformation into the second age of the nymph, and the duration of the second life of the nymph was calculated on the basis of the time period between the exit of the second age of the nymph from the first age of the nymph until her transformation into the third age of the nymph, and the duration of the third age of the nymph was calculated on the basis of the time period between the exit of the third age of the nymph from the second age of the nymph until her transformation into the fourth age of the nymph (Pupa), and it was calculated Duration of the three ages of the nymph on the basis of the time period between the exit of the first age of the nymph from the egg until immobility. The duration of the fourth age of the nymph (Pupa) was calculated on the basis of the period between the onset of the zygote until the exit of the adult insect. The mortality rate was calculated in the different incomplete stages of the egg to the adult insect (Generation duration). Then the incubation periods, the three ages of the nymph and the puparium were recorded and the arithmetic mean, and standard error were calculated for them (Al-Ani and Tabara, 1980).

Results and discussion

The results of the study (Table 1) showed the duration of the incomplete stages from the egg to the exit of the adult insect (Generation duration) on the lemon seedlings, as the incubation period for the eggs ranged from laying until hatching to nymphs between 14-15 days with an average of 14.6 ± 0.13 During the months of December 2010 and January 2011, at an average temperature of 25.65°C and a relative humidity of 67.5%. The duration of the nymph and pupa phases ranged between 51-61 days, with an average of 56 ± 0.91 at an average temperature of 25.83°C and a relative

humidity of 66.75% during the months from December 2010 to March 2011. As for the period of development of the incomplete stages (generation period) from laying the egg until the exit of the adult insect, it ranged between 65-76 days with an average of 70.6 ± 1.01 during the months from December 2010 until March 2011 at an average temperature of 25.83°C and relative humidity of 66.75%.

Table (1): The duration of the different incomplete instars from egg to adult (Generation duration) of the citrus black fly *Aleurocanthus woglumi* on lemongrass seedlings *Citrus aurantifolia* in a private orchard in Lahij Governorate.

	Range of 1 phase duration in days		
	Egg	**The nymph and pupa**	**From egg to adult (Generation duration)**
Range	14 -15	51 -61	65 -76
Average	14.6	56	70.6
Standard error ±	0.13	0.91	1.01

The results of the study are consistent with previous results carried out by (Hassan, 1989), where it was found in a study about the life of the insect on the seedlings of the municipal lemon from November to February that the period from the egg to the adult insect takes 44-92 days with an average of 72 days, the period from laying eggs until hatching To nymphs 10-24 days with an average of 19.0 days, and the period for the nymph and pupa phases is 20-78 days with an average of 52.9 days, under average temperatures of 24.46°C and relative humidity of 79%. These results are similar to what was obtained (Murad, 2007), which found in a study on the life of the insect on lemon trees from December to March that the incubation period for eggs is 14-17 days, with an average of 15.9 days, and the duration of nymphs and pupae is 53-57 days, with an average of 55.7 days, and the duration from the egg. To the adult insect (Generation period) 67-74 days, with an average of 71.6 days, under average temperatures of 26.25°C and relative humidity of 76%. These results are also consistent with what was found by Dowell *et al.* (1981), where he found that the egg period takes 9-97 days, and the life cycle from egg to adult insect takes 567-52 days at temperatures of 32°C and 16°C, respectively.

The results recorded in (Table 2) showed the period for the development of each stage of the nymph and the pupa (the four ages of the nymph). The three ages of the nymph ranged between 8-9 days with an average of 8.2 ± 0.12, 7-9 days with an average of 8.2 ± 0.19, and 7-8 days with an average of 7.6 ± 0.13 for the first, second and third ages, respectively, at an average temperature of 25.65°C and a relative humidity of 67.5% during the months of December 2010 and January 2011. The duration of the fourth lifespan of the nymph (the pupa) ranged between 29-35 days, with an average of 32 ± 0.56, at an average temperature of 25.87°C and a relative humidity of 67% during the months from January to March 2011.

Table (2): Longevity of nymph and pupa of citrus black fly *Aleurocanthus woglumi* on lemongrass seedlings *Citrus aurantifolia* in a private orchard in Lahej Governorate

	Range of 1 phase duration in days				
	The first age of the nymph	**The second age of the nymph**	**The third age of the nymph**	**The fourth age of the nymph (Pupa)**	**The nymph and pupa**
Range	**8 - 9**	**7 - 9**	**7 -8**	**29 -35**	**51 -61**
Average	**8.2**	**8.2**	**7.6**	**32**	**56**
Standard error ±	**0.12**	**0.19**	**0.13**	**0.56**	**0.91**

These results are consistent with the findings of Dowell *et al.* (1981), where he showed that the period of the first nymph phase ranges between 7 - 37 days, the second 5 - 55 days, the third 6 - 70 days, and the fourth 25-272 days, all at temperatures of 32°C. 16°C respectively for each of the phases, and this corresponds to what was found (Ba-Angood, 2008) in a study of the life of the insect, where it was mentioned that the first lifespan takes 8-20 days, the second 8-30 days, and the third 6-20 days, while the last life of the nymph) It takes 16-40 days, and it is noted from the results (Table 1, 2) that the period from laying the egg until the exit of the full insect has been long due to the low temperatures during the study period, as the insect's life is affected by the temperature, and these results are consistent with the results of Dowell *et al.* (1981) and Boscan *et al.* (1981).

The results showed (Table 3 and Figure 1) that the mortality rate in the egg phase was 44.1% at an average temperature of 25.65°C and a relative humidity of 67.5% during the months of December 2010 and January 2011. The mortality rate in the nymph and pupa phases reached 85.27% at an average temperature of 25.83°C and a relative humidity of 66.75% during the months from December 2010 to March 2011. As for the mortality rate of the incomplete stages from the egg until the exit of the adult insect (generation period) it reached 91.76% during the months from December 2010 until March 2011 at an average temperature of 25.83°C and a relative humidity of 66.75%.

Table (3): Mortality rate in the different incomplete stages of the egg to the adult (Generation duration) of the citrus black fly *Aleurocanthus woglumi* on lemongrass seedlings *Citrus aurantifolia* in a private orchard in Lahij Governorate.

Phase	Number of episodes	Number that was followed from the mentioned phase	Number that completed its development	Number of mortalities	Mortality rate (%)
Egg	**21**	**631**	**353**	**278**	**44.1**
The nymph and pupa	**21**	**353**	**52**	**301**	**85.3**
From egg to adult (Generation duration)	**21**	**631**	**52**	**579**	**91.8**

These results are consistent with the findings of (Murad, 2007), where it was found that the mortality rate of the stage from the egg until the exit of the adult insect (Generation duration) was 88.1%, and the nymphs and pupae had the mortality rate of 79.1%, while the mortality rate in the egg stage was 42.8%. The results of the study are close to the results of a previous study conducted by (Hassan, 1989), in which he explained that the mortality rate in the various insect stages of the citrus blackfly was 35% in eggs, and the mortality rate or nymphs and pupae was 67%, and the mortality rate for the stage from the egg until the exit of the full insect was It was 78%.

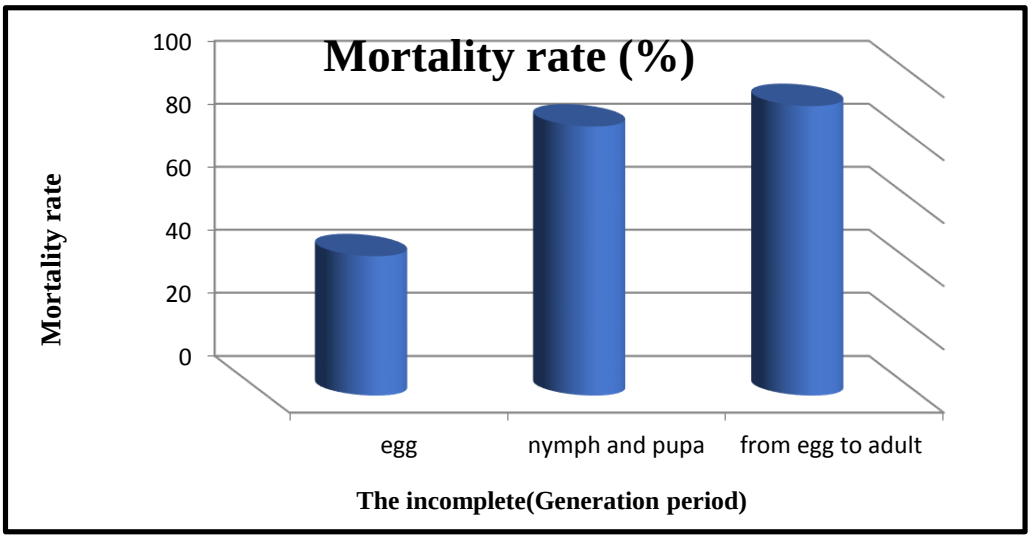
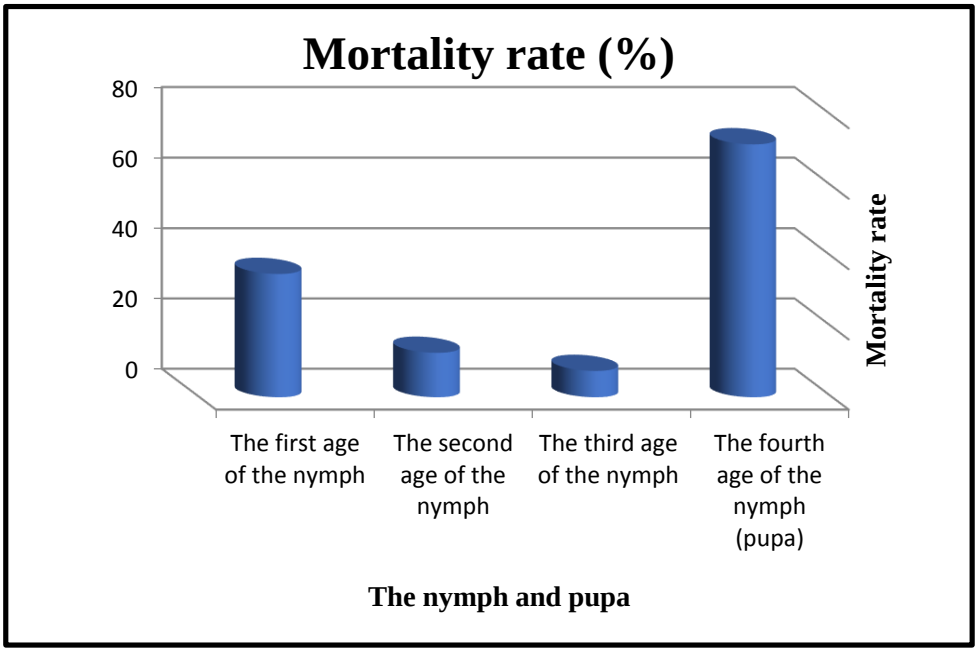


Figure (1): shows the mortality rate in the incomplete stages (Generation period) of the citrus black fly.

The results showed (Table 4 and Figure 2) that the mortality rate in the nymph and pupa stages was 35.13% in the first age of the nymph, and it was 12.66% in the second age of the nymph, and in the third age of the nymph it amounted to 7.5, and it reached 71.89 % in the fourth age of the nymph (the pupa) at an average temperature of 25.83°C and a relative humidity of 66.75% during the months from December 2010 to March 2011.These results are consistent with what was found by (Boscan *et al*., 1981) that the mortality rate in the fourth age of the nymph (Pupa) was 74.44%, and close to what he also mentioned that the mortality rate in the first age of the nymph was 59.07%. It was seen from the results (Tables 3, 4) that the death rate in the egg phases and the first age of the nymph increased due to their lack of tolerance to the surrounding environmental conditions such as the strong winds on 20/12/2010 and the continuous winds during the first week of January 2011 due to their small size and softness. The death rate in the fourth age of the nymph (virgin) due to continuous heavy rain and winds from mid-January to the end of February 2011, as well as the presence of natural enemies in the winter is relatively more.

Table (4): Mortality rate in the nymph and pupa of citrus black fly *Aleurocanthus woglumi* on lemongrass seedlings *Citrus aurantifolia* in a private orchard in Lahij Governorate.

Phase	Number of episodes	Number that was followed from the mentioned phase	Number that completed its development	Number of mortalities	Mortality rate (%)
The first age of the nymph	21	353	229	124	35.13
The second age of the nymph	21	229	200	29	12.66
The third age of the nymph	21	200	185	15	7.5
The fourth age of the nymph (pupa)	21	185	52	133	71.89
The nymph and pupa	21	353	52	301	85.27



Figure(2): Shows the mortality rate in the nymph and pupa phase of the citrus black fly.

References

Al-Ani, T. A. and Tabara, **T. A. (**1980): Applied foundations in planning agricultural experiments. Ministry of Higher Education and Scientific Research, Institute of Technical Institutes, Republic of Iraq, pp. 77 - 64.

Al-Kaf, N. S. (1988): Life cycle of the citrus black fly on some citrus species in Democratic Yemen. Yemeni Agricultural Journal, 1 (2): 113 - 106.

Ba-Angood, S. A. (2008): Insect and mite pests of horticultural crops and their integrated management in the Republic of Yemen. Aden University House for Printing and Publishing, pp 286.

Ba-Angood, S. A.; Ghaleb, A. M. and Salam, **A. M. A. (1997):** A list of the important insect and mite pests, their geographical distribution, and their most important plant families in Yemen. Postgraduate Studies and Scientific Research Affairs, Republic of Yemen, Aden University for Printing and Publishing, pp 25.

Ba-Angood, S.A. (1977): Field trials for the control of *Aleurocanthus woglumi* in the Yemen. PANS , 23 (2): 149-152.

Bedford, E.S.G. and Thomas, **E.D. (1965):** Biological control of the citrus blackfly ,*Aleurocanthus woglumi* Ashby (Homoptera :Aleyrodidae)in South Africa. Journal Ent. Soc. S. Africa , 28(1): 117-132.

Boscan-de-Martinez, N.; De-Martinez-N-Boscan and Martinez-N-Boscan-de. **(1981):** Biology of the citrus blackfly *Aleurocanthus woglumi* Ashby (Homoptera:Aleyrodidae) in the field. Agronomia Tropical 1981,Publ.1983 Recd.1985, 31 (1 - 6): 211 - 218.

De Lemos, K. L.; de Lemos, R. N. S. ; Medeiros, F. R. ; da Siliva, E. A. ; Mesquita, R. and Araujo, **J. R. G. (2017):** Insecticidal activity of *Azadirachta indica*

A. Juss. Extracts on *Aleurocanthus woglumi* Ashby (Hemiptra: Aleyrodidae) Journal of Medicinal Plants Research, 11(13): 260- 263.

Dowell, R.V .; Cherry , R . H . ; Fitzpatrick , G.E . ; Reinert, J . A . and Knapp, **J.L. (1981):** Biology, plant-insect relations, and control of the citrus blackfly, *Aleurocanthus woglumi* Ashby (Homoptera: Aleyrodidae). Tech Bull .Univ.Fla , No. 818 : pp 49.

Dowell, R.V. and Steinberg, **B.** (**1990):** Influence of host plant on fecundity of *Aleurocanthus woglumi* Ashby (Homoptera: Aleyrodidae). Pan-pacific Entomologist , 66(1): 62-65.

French, J.V.; Moreno, D. S. ; Summy, K. R. ; Sparks Jr, A. N. and Lummus, P. F. (**1997**): Citrus blackfly. Texas A & M-Kingsville , pp 4.

Hassan, I. O. (1989): Life cycle of the citrus black fly, *Aleurocanthus woglumi* Ashby, on Valencia and Lime in the People's Democratic Republic of Yemen. Student project, Nasser College of Agricultural Sciences, University of Aden, pp 13.

Ministry of Agriculture (2000): The citrus blackfly. A farmer's guide to Identification and control. The extension Unit Regional Administration South. Land and Marine Resources. Kings Wharf, San Fernando. Republic of Trinidad and Tobago , pp 4.

Murad, H. A. **(2007):** Biology and ecology of the citrus blackfly, *Aleurocanthus woglumi* Ashby (Aleyrodidae: Homoptera) in Al-Houta city and its suburbs, Lahej Governorate, Republic of Yemen. MSc Insects. Plant Protection. Nasser College of Agricultural Sciences-University of Aden. pp 113.

Murad, H. A. and Ba-Angood, S. A. (2008): Effect of environmental factors on the presence of the citrus blackfly *Aleurocanthus woglumi* Ashby (Aleyrodidae: Homoptera) in different locations in Al-Houta city and its suburbs, Lahej Governorate, Republic of Yemen. The Fifth Scientific Conference of the Yemeni Life Sciences Society, Scientific Program and Abstracts, Mukalla, November 22-23, pp 32.

Nguyen, R.U and Sailer, R. I. (1987): Facultative hyperparasitism and sex determination of *Encarsia smithi* (Silvestri) (Hymenoptera: Aphelinidae). Ann. Entomol. Soc. Am , 80 (6): 713 – 719.

Nguyen, R.U. and Hamon, A.B. (1993): Citrus blackfly, *Aleurocanthus woglumi* Ashby (Aleyrodidae: Homoptera). Fla. Dept-Agric &Consumer Serv, Division of Plant Ind . Entomo . circular , No. 360 : pp 3.

Patel, P.S. and Patel, G.M. (2001): Biology of the Citrus blackfly, *Aleurocanthus woglumi* Ashby (Aleyrodidae: Homoptera) on Kagzi lime. Pest-Management and Economic, Zoology , 9 (2): 147 – 150.

Pena, M. R.; de Silva, N. M.; Vendramim, J. D.; Lourencao, A. L. and Haddad, **M. de L. (2009):** Biology of the Citrus blackfly, *Aleurocanthus woglumi* Ashby (Aleyrodidae: Homoptera), in host plants. Neotropical Entomology (Impresso), 38 (2): 245- 261.

Rajak, R.L and Diwakar, M.C. (1987): Kolshi problem in orange orchards of vidarbha region (Maharashtra). Plant-Protection- Bulletin Faridabad, 39 (4): 1- 2.

Satpute, P. P.; Taley, Y. M. ; Nimbalkar, S. A. and Kadu, N . R. (1989): Natural enemies of citrus blackfly, *Aleurocanthus woglumi* Ashby in Nagpur region. Bulletin of Entomology New Delhi , 27 (2): 128 –131.

Weeks, J. ; Martin, A.K. W. ; Hodges, A. C. and Leppla, **N. C. (2012):** Citrus blackfly. Citrus Pests. www.idtools. org .