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A survey of the predators of the citrus black fly *Aleurocanthus woglumi* (Hemiptera: Aleyrodidae) on *Citrus aurantifolia* in Lahj Governorate, Republic of Yemen

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Abstract:

During this study, the types of predators present in the environment of the citrus black fly *Aleurocanthus woglumi* Ashby (Hemiptera: Aleyrodidae) were identified in two different locations in Al-Houta district - Lahj Governorate, were conducted during the period extending from April 2010 to March 2011, in order to benefit from them in the integrated pest management program. Nineteen species of predators have been grouped. Twelve species are insect predators, 7 of which belong to the family Coccinellidae, 2 species, each to the families Chrysopidae and Formicidae, and one species to the family Coniopterygidae. Seven species of non-insect predators (Spiders) of the order Araneae and mites of the order Acarina. The results also showed that the insect predators of the family Chrysopidae of the type *Mallada boninensis* Okamoto and the family Coniopterygidae and non-insect (Spiders) 3 species of them of the order Araneae, and a new record in Yemen.

Introduction

Asia is the original home of the citrus black fly *Aleurocanthus woglumi* Ashby (Hemiptera: Aleyrodidae), which was first classified in the Caribbean in 1913 in Jamaica and 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 Thomas, 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 spreads

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). The citrus black fly is considered the deadliest insect pest in citrus throughout the Republic of Yemen and infects other hosts in addition to citrus trees such as mango, banana, guava, papaya, pomegranate and dams trees (Ba-Angood, 2008). Al-warf plants and 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, 27 host plants were recorded, including citrus species (Murad and Ba-Angood, 2008), and they were found in more than 300 host plants (Nguyen and Hamon, 1993).

The damage occurs by feeding the nymphs and the adult insects on the lower surface of the leaves with their sucking piercing mouthparts, and they secrete honeydew materials that are a suitable environment for the growth of the black mold fungus on the leaves, which causes them to blacken and attract dust, which affects the process of photosynthesis and the feeding process of trees, so the fruits appear black, atrophic and small size, and the combined action of sucking the sap with the presence of the black mold fungus leads to a severe decrease in tree production (Rajak and Diwakar, 1987; French *et al.*, 1997; Ministry of Agriculture, 2000 and Ba-Angood, 2008). A group of predators attacks the citrus black fly, and a large burrow contributes to limiting its spread. A number of predators have been found in the Yemeni environment on the insect. As indicated by many studies, it was mentioned by Ba-Angood (1977) that the predator *Serangium* sp. was found in the eggs of the insect. Also, Ba-Angood (1990), through a preliminary inventory of some vital enemies of insect pests in Yemen, recorded a number of predators on the citrus black fly, including the larvae *Chrysoperla carnea*, *Cheilomenes vicina propinqua*, *Coccinella septempunctata*, predatory ladybirds, *Chilocorus* sp. and *Delphastorus* sp. The following predators were also found (Ba-Angood, 2002) in a survey study of the most important natural enemies in the Republic of Yemen: *Serangium citctum* (coleoptera: coccinellidae), *Eryngiopos harteni* (Acarina: Stigmataeidae) and *Chilomenes vicina propinqua* (Coleoptera: Coccinellidae) on the citrus black fly. Al-Kaf (1988) mentioned that there are some predators, including *Chrysoperla carnea* and beetles belonging to the family Coccinellidae found on the insect. Muharram (2003) and Al-

Ghashem (1994) indicated the presence of the following predators: *Eryngiopos harteni* (Acarina: Stigmataeidae) and *Tetraprachys* sp. (Coleoptera: Coccinellidae) on the insect. Raimundo *et al.* (2000) found the predator *Serangium buettikeri* on in the insect. Ba-Angood and Murad (2008) recorded 6 types of insect predators belonging to 3 families, including the family Coccinellidae, Formicidae, Raphidiidae on the insect, and three types of unclassified spiders belonging to the order Araneae.

Satpute *et al.* (1989) studied the natural enemies of an insect and found that predators *Catana parcesetosum* (*Serangium parcesetosum*) and *Anisochrysa boninensis* (*Mallada boninensis*), fed on the insect. Elizondo and Quezada (1990) explained that the predators *Chrysopa* spp. and *Delphastus* sp. are considered one of the most important vital enemies of the insect in Costa Rica. And Khan *et al.* (1991) found in Pakistan five types of predators on the insect. Aruna *et al.* (2017) observed predators Coccinellidae and Chrysopidae and spiders as natural enemies of *A. woglumi*. It is worth noting that predators were used in the control of the insect and gave effective results, as Cherry and Dowell (1979) indicated that the predator *Delphastes pusillus* (LeConte) and spiders were the most common, as it reached 90% of the predators that were captured, and the predator *D. pusillus* reduced the infection from 52 - 66 % In the Florida region, this depends on the predator stage, especially in the fourth larval stage, as the fourth stage of larvae preys 52% of the nymphs of the citrus black fly. And Legaspi *et al.* (2001) noted the success of the predator *Serangium parcesetosum* on the eggs of the insect, as it was able to reduce the number of eggs hatched from 157-47 eggs for the female, in a laboratory experiment at

the Texas Agricultural Station at Texas A & M University. Lavhe and Nimbalkar (2000) reported that the predator *M. boninensis* (Okamoto) was used to control the insect's nymphs.

To evaluate the use of the previous predator against the citrus black fly Kolhe *et al.* (2003) in Maharashtra state, India, found that the release of two pairs of adults from this predator reduced the infestation by a range of between 34 - 40%. Inspecting the natural enemies of pests in the agricultural environment, identifying them and using them in the control process aims to reduce the use of pesticides (Al-Ghashem, 1994). Since the global trend today is to rationalize the use of pesticides and implement the Integrated Pest Management (IPM) program, this study aimed to identify the predators of the pest in the city of Al-Houta in order to benefit from them in the integrated management programs and reduce the use of pesticides.

Materials and methods

Regular visits were made, one visits every week, to the two study sites (Al-Haj Yahya farm, Al-Fallujah farm) in Al-Houta in Lahj Governorate during the period from the beginning of April 2010 until the end of March 2011. The predators were observed and collected during the survey process and the detection of insect instars and yellow sticky traps (which are rectangular wooden panels with dimensions of 12 x 20 cm painted yellow, wrapped with transparent rectangular plastic pieces to place the adhesive and fixed with clips, then the trap is attached inside the field to the tree branches with a tie nylon clip attached to the top of the trap to identify predators.

The predators present on the insect instars that were seen preying on the insect were collected and their presence was assessed before collecting the leaves by a magnifying 20x lens, and the assessment of the predators on

the traps was also done after collecting from the field and brought to the laboratory, and the larva of the predator was carried in nylon bags to the laboratory I fed on the insect and left until it turned into a complete insect. Then the predators were taken and kept in plastic test tubes, each 1.5 cm in diameter and 5 cm long, containing 70% ethyl alcohol.

The obtained samples of predators were classified based on a study (Ba-Angood and Murad, 2008), and some of them were identified in Yemen, and samples of them were sent abroad and were classified by Prof. Dr. Shaaban Abd-Rabou (Plant Protection Research Institute , Agricultural Research Center, Egypt).

Results and discussion

The results of the current study showed the presence of 19 species of predators in the vicinity of the citrus black fly in the city of Al-Houta, belonging to five families belonging to five orders. The results (Table 1) indicated that 12 types of insect predators and 7 types of non-insect predators were recorded.

The results also showed that the Coleoptera order recorded the most number of predators (7 species) belonging to the Coccinellidae family found on eggs, nymphs and adults, followed by the Araneae order, where 6 species were recorded on the whole unclassified insect, and the Neuroptera order, 3 of which were recorded Species on eggs and nymphs belonging to the two families Chrysopidae, and only one species is not classified, Coniopterygidae, while the order Hymenoptera, two species were recorded, including whole insects, while the order Acarina, only one species was recorded on nymphs and pupae, not classified.

It is clear from the results that the highest rate of predators on one leaf was for the species *D. pusillus*, *Scymnus*

spp, *C. vicina propinqua* of the Coccinellidae family, whose numbers ranged from 8 adults, 10 larvae/leaf, 5 adults, 6 larvae/ leaf, and 4 adults/leaf, respectively. As for the rest of the predatory species, their numbers ranged from 1-2 adults and 1-2 larvae/leaf.

The results (Table 1) indicate that 10 species of whole insects were recorded as predatory insects found on the yellow sticky trap, 7 of them belong to Coleoptera of the family Coccinellidae, and the rest belong to the ranks Neuroptera 2 and Hymenoptera only one of them. It is noted from the results obtained (Table 1) that the predator *D. pusillus* of the Coccinellidae family had more rates and quality on the trap than the other predators: 23 adults / trap, followed by the predators *Scymnus* spp, *C. vicina propinqua* whose numbers ranged from 12 adults / trap, 6 adults /trap, respectively. As for the rest of the predatory species, the rate of their presence on one trap ranged from 1-3 whole insects/trap. The results also showed that the insect predators of the family Chrysopidae of the type *M. boninensis* and the family of Coniopterygidae and non-insect (Spiders) of the order Araneae, 3 of which are not classified, are a new record in Yemen.

These obtained results are consistent with what was indicated by Ba-Angood (2002 and 1990) and Ba-Angood and Murad (2008) in the recording of the predator *Cheilomenes vicina propinqua* on the insect. It also agrees with the results reached by Ba-Angood (1990), Al-Kaf (1988) and Ba-

Angood and Murad (2008) in the recording of the predator *Chrysoperla carnea* on the insect. It corresponds to the findings of Alivm *et al.* (2016) that the predators of Coccinellidae and Chrysopidae were distinguished as predators of this insect and the first was the dominant one. It is consistent with the findings of (CABI, 2021) in the recording of the predator *Scymnus smithinus* on the insect. It is also similar to the results obtained by Dowell *et al.* (1981) and Ba-Angood and Murad (2008), where they found some spiders feeding on the whole insects of the citrus black fly. Our results are consistent with what was found by Satpute *et al.* (1989), which showed that there are unknown mites that feed on the citrus black fly. It agrees with what was indicated by Dowell and Cherry (1981) that yellow traps captured a large number of whole insects of predators of the family Coccinellidae, up to 7 species.

Many predators of the citrus black fly have been monitored and due to the importance of biological control and the effectiveness of predators in reducing the pest community, so its use in biological control can play an effective role within the framework of integrated pest management. - Some studies indicated the presence of predators on the insect, including Neuroptera and *D. pusillus* beetle, and they were important in reducing the pest population. These predators were recorded in this study, so we believe that it is necessary to raise and use them in Yemen.

Table (1): Types of predators collected from the farms of Al- Haj Yohya and Al-Fallujah in the city of Al-Houta on the citrus black fly *Aleurocanthus woglumi* from April 2010-March 2011.

M	Order	Family	Type of predator	Predator locations on		The rate of predator presence/			Collection area	
				Life stages (Citrus blackfly host)	The trap	Leaf	Trap	Al-Haj Yohya farm	Al-Fallujah farm	
1	Coleoptera	Coccinellidae	<i>Scymnus</i> sp.1	Adults / Eggs /Nymphs	+	5 adults and 6 larvae	12 adults	+	+	
2			<i>Scymnus</i> sp.2	Adults / Eggs	+	2 adults	4 adults	+	+	
3			<i>Scymnus interruptus</i>	Adults / Eggs	+	1 adult	3 adults	-	+	
4			<i>Scymnus smithinus</i>	Adults/ Eggs /Nymphs	+	8 adults and 10 larvae	23 adults	+	+	
5			<i>Delphasthes pusillus</i>	Adults / Eggs	+	4 adults	6 adults	+	+	
6			<i>Cheilomenes vicina propinqua</i>	Eggs	+	1 adult	3 adults	-	+	
7	Hymenoptera	Formicidae	<i>Serangium</i> sp	Adults	+	1 adult	3 adults	+	+	
8			<i>Cataglyphis sinaitica</i>	Adults	-	1 adult	-	-	+	
9	Neuroptera	Chrysopidae	<i>Monomorium Yemen</i>	Eggs /Nymphs	+	1 larva	2 adults	+	+	
10			<i>Chrysoperla carnea</i>	Eggs /Nymphs	+	1 larva	2 adults	+	+	
11			<i>Mallada boninensis</i>	Eggs /Nymphs	-	2 larvae	-	-	+	
12	Araneae	-	Unclassified	Adults	-	1 adult	-	+	+	
13			Six unclassified species	Nymphs / Pupae	-	2 adults	-	+	+	

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