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Prospection and Identification of natural's enemies of *Pterochloroides persicae* Cholodovsky (Hemiptera, Aphididae) in Tunisia

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Abstract

A study carried out from 2010 to 2014 documented the prospection and the identification of natural enemies associated with colonies of *Pterochloroides persicae* in cultivated *Prunus sp* at different sites in Tunisia. The predator's records were principally the coccinellid *Coccinella algerica* Kovar, two syrphids, *Episyrphus balteatus* and *Metasyrphus corollae* and one lacewing *Chrysoperla carnea*. *C. algerica* was observed from February to June and the highest number of adults and larva was registered on April in the three studied sites. Nevertheless, syrphid flies and lacewing were observed from April to June with numeric importance respectively in Chott Mariem and Jammel.

Keywords: *Pterochloroides persicae*, *Prunus sp*, natural enemies, Tunisia

1. Introduction

Pterochloroides persicae Cholodkovsky (Hemiptera, Aphididae) is a polyphagous aphid species that feeds on several hosts belonging to three families (Rosaceae, Rutaceae, Salicaceae) [1]. It's a pest of Asian origin and precisely from China [2,3]. Afterward, *P. persicae* was widespread in the world: in Asia, Europe, Africa and America [2, 4, 1, 5, 3, 6, 7, 8, 9]. In several countries of these continents, *P. persicae* has assumed pest status on several plants causing severe damages [1, 10, 11, 12, 13, 14]. The detrimental influence of large population on their hosts and their ability to plant vector viruses give them an economic importance that far outweighs their diversity [15]. At now, aphids have developed resistance to many commonly used pesticides [16]. Thus, pesticide resistance problems require alternative control strategies such as biological control [17]. Indeed, *P. persicae* is attacked by a number of natural's enemies including species of predators, parasitoids and entomopathogenic fungi. Talhouk (1977) [2] demonstrated the presence of *Aphidoletes aphidimyza* Rondani, some coccinellids and syrphids. Most of these are generalists that have probably either moved from the surrounding habitat to exploit this new prey source or were already present in orchard systems exploiting other aphid species. Also, Kairo and Poswal (1995) [1] proved that a few parasitoids from the family Braconidae have been recorded attacking the brown peach aphid with particular importance are those in the genera *Pauesia*. Most interesting of these are the parasitoids *Pa. antennata* and an *Aphidius* sp. The literature on biological control agents attacking *P. persicae* includes also some pathogens causing significant mortality such as *Capnodium* sp in Central Asia [18]. More detailed research has however only been conducted on one pathogen found in Latvia, *Entomophthora thaxteriana*, which has now been renamed *Conidiobolus obscures* [18]. This species was tested against several aphids and found to give substantial mortalities. In Tunisia, the potential negative impact of *P. persicae* on stone fruits trees in Tunisia requires rapid identification of those that may be key biocontrol agent. The aim of this study is to determine the range of natural's enemies present near *P. persicae* population on fruits trees orchards in different regions in Tunisia.

2. Materials and Methods

2.1. Study Areas

Several collections were carried out from 2010 to 2014 from different areas of Tunisia where conventional orchards of almond, plum, apricot and peach are widely planted: in the north: Ariana (Sidi Thabet: (36° 54' 31" N, 10°02' 33") an upper arid and on the coast of Tunisia, we chose two regions: the first was in Chott Mariem: site of High Agronomic Institute of Chott Mariem (35° 52' 31" N, 10° 34' 16" E) and the second in Jammel (35°38'24" N, 10°45' 36" E).

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Moreover, *Pterochloroides* colonies were investigated on host's trees in many other sites such as Sidi Alouane (Mahdia), Werdanine (Monastir) and Sahloul (Sousse).

2.2. Determination of natural enemies

Hoverflies and ladybirds instars were placed individually in plastic boxes with perforated top for aeration. They were transported to the laboratory and stored at room at 20°C, a photoperiod 16/8 (L/D) and relative humidity 60±10%. Predator's instars were fed daily *P. persicae* until they reach adult hood. Hoverflies adults were identified using key of Le Monnier and Livory (2003) [19]. Similarly, adults of coccinellids were identified with reference to Chandler (1969) [20], keys. Nevertheless, the lacewing adults were identified according to Rotheray (1991) [21], keys. Also, the number of each predator (larvae or adults) was registered from February to June 2011 and compared.

2.3. Data analysis

Data were analyzed using Duncan's multiple range tests to detect the differences between the mean numbers of predators recorded in the three sites (SPSS 2005). The same method was used to detect the differences between mean numbers of predators per month in the three studied sites.

3. Results and Discussion

The occurrence of natural enemies of *P. persicae* in *Prunus* orchards at prospected areas in Tunisia permitted us to identify predator's species principally lady beetles (Coleoptera, Coccinellidae), flower flies (Diptera, Syrphidae) and lacewing (Neuroptera, Chrysopidae). As for lady beetles, 289 coccinellids adults and 128 larvae were collected. *Coccinella algerica* Kovar was the single species identified near colonies of *P. persicae* during February, March, April, May and in June (Fig. 1 A, B, C). The highest number of *C. algerica* adult was registered in April in the three studied sites (Figs. 2- 3). A significant difference was observed in the three sites (Sidi Thabet, Chott Mariem, Jammel) between means number of *C. algerica* adults registered in April and those registered in February, March, May and June ($F=5.07$, $df=4$, $P_{\text{value}}=0.009$; $F=6.32$, $df=4$, $P_{\text{value}}=0.003$; $F=9.007$, $df=4$, $P_{\text{value}}=0.001$). During observation period, a significant difference was noted between means number of *C. algerica* adults per week in Chott Mariem in comparison with those in Jammel and in Sidi Thabet ($F=18.06$, $df=2$, $P<0.05$) (Table 1). Similarly, the high number of *C. algerica* larva was registered in Chott Mariem (Table 1) and a significant difference was observed between mean number of larva per week in Chott Mariem in comparison with those registered in Sidi Thabet and Jammel ($F=13.74$, $df=2$, $P_{\text{value}}=0.001$). No significant difference was noted for the number of larvae during period of study in the three studied biotops. As for syrphids, from the 51 larvae that have been recorded from April to June (Fig. 1 D) only two species were identified: *Episyrphus balteatus* De Geer 1776 (Diptera, Syrphidae) (Fig. 1 E) and *Metasyrphus carollae* Fabricius 1794 (Diptera, Syrphidae) (Fig. 1 F). The high number of syrphid larvae was recorded in Chott Mariem in comparison with those in Sidi Thabet and Jammel (Table 1). Nevertheless, no significant difference was noted between the means number of syrphid larva per week in the three biotops. Nevertheless, no significant difference was observed between mean numbers per week of larva of hoverflies in the three biotops. Concerning the lacewing, *Chrysoperla carnea* Stephens 1836 (Neuroptera, Chrysopidae) was the single species identified near aphid's population at the end of April, May and June. Only the eggs and the larva of *C. carnea* were

observed (Fig. 1 G-H). The important number of larva of *C. carnea* was registered in Jammel (Table 1). No significant difference was observed between means number of larva per week of *C. carnea* in three studied sites.

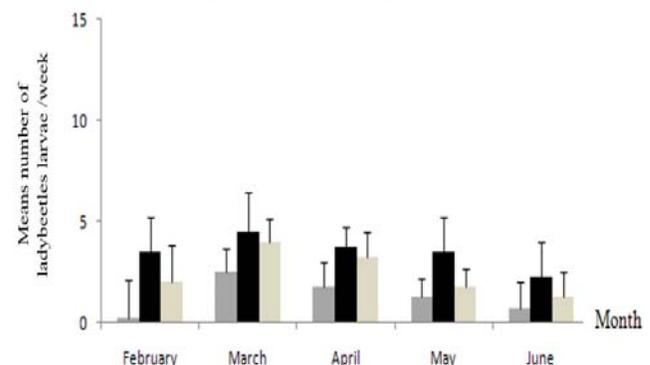
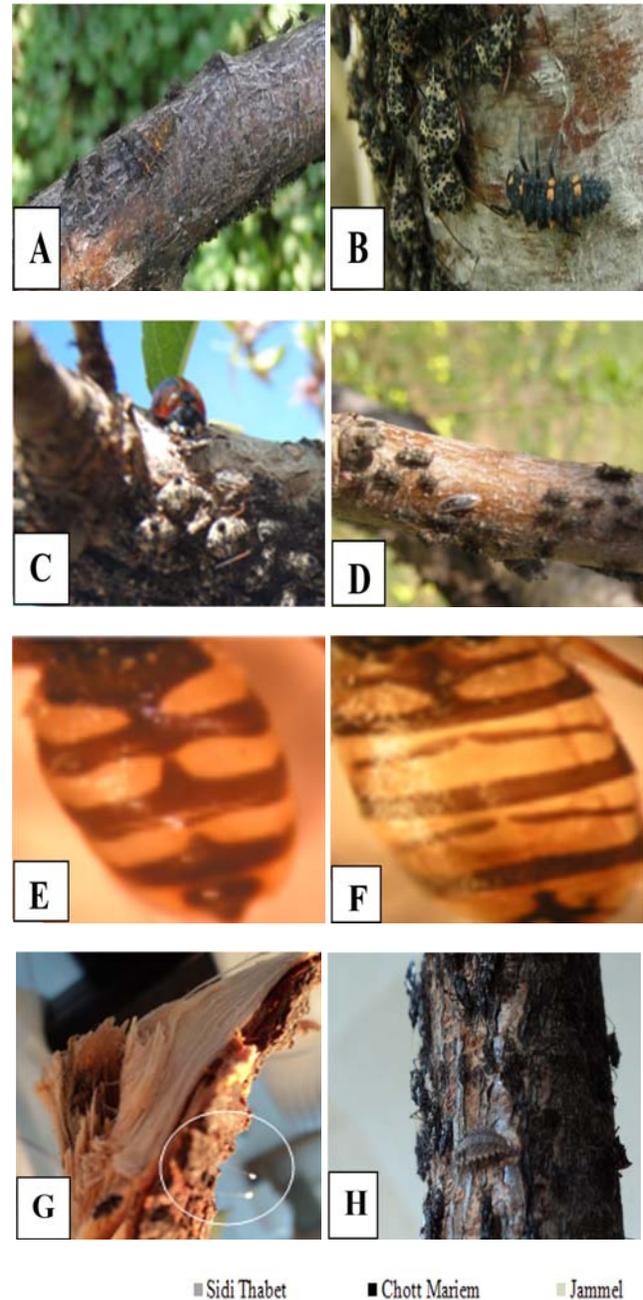


Fig 2: Weekly means number of ladybeetles larvae collected in three different biotope in Tunisia

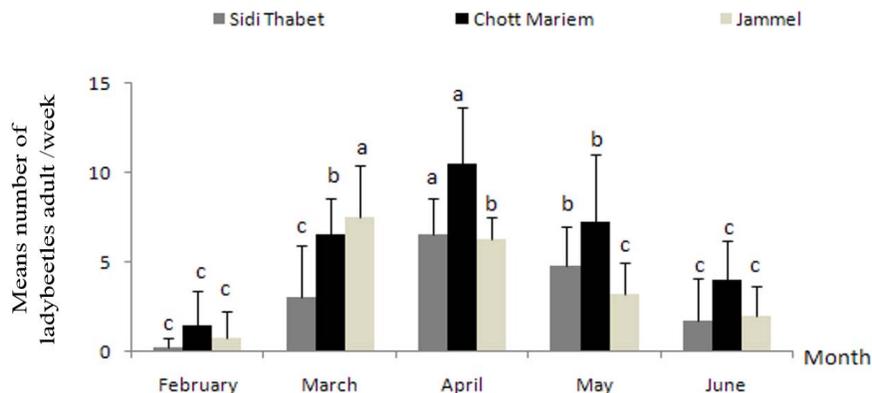


Fig 3: Weekly means number of ladybeetles adults collected in three different biotope in Tunisia. Different letters with mean values in a row indicate significant differences between the treatments by Duncan test at P=0.05.

Table 1: Auxiliary distribution on *Prunus* host at prospected areas

	Natural enemies	Sidi Thabet	Chott Mariem	Jammel
1. Syrphid fly	Larvae			
	Total	10	24	17
	Means±SD/Week	0.55±0.92	1.11±1.47	0.94±0.99
2. Ladybeetles	Adult			
	Total	73	127	89
	Means±SD/Week	4.05 ^b ±2.77	7.05 ^a ±3.99	4.94 ^b ±2.64
	Larvae			
3. Green lacewing	Total	21	77	40
	Means±SD/Week	1.16 ^b ±1.38	4.27 ^a ±2.27	2.22 ^b ±1.66
	Larvae			
3. Green lacewing	Total	6	11	15
	Means±SD/Week	0.33±0.84	0.61±0.97	0.83±1.09

Different letters with mean values in a row indicate significant differences between the treatments by Duncan test at P=0.05.

In this study, the prospection and the identification of natural enemies of *P. persicae* on *Prunus* trees in Tunisia proved that three families of aphidophagous predators attacking the brown peach aphid: Coccinellidae (*C. algerica*), Chrysopidae (*C. carnea*) and Syrphidae (*E. balteatus* and *M. carollae*) have been recorded. In the literature on biological control agents attacking *P. persicae* includes the predatory midge *Aphidoletes aphidomyza* Rondani [2], some entomopathogens like *Capnodium* sp in Central Asia and *Entomophthora thaxteriana*, which has now been renamed *Conidiobolus obscurus* in Latvia, some coccinellid like *Cheilomenes propinqua* Mulsan, *Coccinella septempunctata* Linnaeus and *Coccinella undecimpunctata* Linnaeus [22] and some syrphid species: *Ischiodon aegyptius* (Wideman), *Melanostoma scalare* (Fabricius), *Metasyrphus carollae* (Fabricius), *Paragus azueus* Hull and *Paragus longiventris* Loew [22]. Also, Kairo and Poswal (1995) [1] proved the presence of a few parasitoids from the family Braconidae. The parasitoids in the genera *Pauesia* and *Aphidius* are particularly highly important. In fact, they almost exclusively attack Lachninae [23]. The most interesting of these are the parasitoids *Pauesia antennata* [1, 22, 11]. Other reports of parasitoids attacking the brown peach aphid include *Lysiphlebus fabarum* (Marshall) [24] and *Diaeretiella rapae* (McIntosh), but these are not considered as very efficient. As for predator's efficiency, the records of *C. algerica* larva and adult near *P. persicae* population from February to June and the highest mean relative growth rate of this aphid during this period revealed that this predator is generalists and is unlikely to have a significant impact. Indeed, Mdellel and Ben Halima (2012) [25]. Demonstrated, in

laboratory condition, that *C. algerica* don't have a significant impact on controlling this pest in comparison with *Acyrtosiphon pisum* (Hemiptera, Aphididae). Nevertheless, it proved to be effective on controlling *Aphis gossypii* under green house [26]. Concerning the syrphid fly, no study has yet provided information about the efficiency of these syrphid flies against *P. persicae*. However, Van Lenteren (2012) [27] showed some hover flies like *E. balteatus*, known as effective predator on various aphids in the field and it's one of the most important commercial flies released against different aphid's species especially in greenhouses. Also, Sadeghi and Gilbert (2000) [28] proved that the larvae of this species has been known as predator of more than 100 species of aphids worldwide and its predation has been investigated on some species like *Aphis gossypii* [29], *Myzus persicae* Sulzer [30], *Acyrtosiphon pisum* [31]. Similarly, Hindayana, (2001) [32]. proved that several studies showed the high performance of *E. balteatus* especially against different species of cereal aphids, *M. persicae* on tobacco, *Brevicoryne brassicae* on *Brassica* plants. Concerning *M. carollae*, no study demonstrated the efficiency of this predator against *P. persicae* in Tunisia elsewhere in the world but it has been proved to be efficient against several aphids' species like the pea aphid *Acyrtosiphon pisum* [33]. As for the lacewing *C. carnea*, no study has provided information about the efficiency of this predator against *P. persicae*. Nevertheless, Sarwar (2014) [34] proved that it is considered among the most effective generalist predator of aphids. Messina and Sorenson (2001) [35]. reported that it can reduce the aphid population on some plants and their effectiveness was 84%. Also, Sarwar (2014)

^[34] mentioned that the releases of larvae of *C. carnea* in the field had better survival compared to the releases in egg form. In the same context, Tauber *et al.* (2000) ^[36] proved that releases of the second-instar larvae of *C. carnea* have proven to be very successful for the control of the green peach aphid in peppers, tomato and eggplant. Eggs are less reliable for releases and some early releases did not hatch, probably because of poor weather conditions. Furthermore, the eggs may not hatch if weather is extremely cold or hot at faster rates. To summarize, in prospected areas, several auxiliaries were associated with this pest but they are generalist and not efficient. Therefore, it's necessary to introduce from Iran or Pakistan the specific parasitoid *P. antennata*, an interesting enemy for the control of *P. persicae*. This parasitoid is a potential candidate for biological control achieved through the use of natural enemy in Tunisia to control the brown peach aphid.

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