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APHIDS ON ALMOND AND PEACH: PRELIMINARY RESULTS ABOUT BIOLOGY IN DIFFERENT AREAS OF TUNISIA

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Mdellel L., Ben Halima Kamel M. – Aphids on almond and peach: Preliminary results about biology in different areas of Tunisia.

Four aphid species are known to colonize peach and almond in Tunisia: *Hyalopterus pruni* species complex, *Myzus persicae* Sulzer, *Brachycaudus amygdalinus* Shouteden and *Pterochloroides persicae* Cholodkovsky. Eggs identification, date of lay and effect of orientation on egg laying were described. Brief information about biology, preferential host, distribution and growth rates are given for each species.

KEY WORDS: Aphids, biology, eggs, preferential host.

INTRODUCTION

Peach, *Prunus persica,* and almond, *Prunus amygdalus,* are considered very important fruit trees in Tunisia because of their high price, tolerance to stress conditions and still bearing good yield, and because of the small number of pests that affect them. More than 22714.5 hectares of peach and 22139.9 hectares of almond are grown in Tunisia (DGPA, 2010). Sfax (Southern Tunisia) is one of the most important regions which produces almond in Tunisia (DGPA, 2010). Almond and peach trees are attacked by many insect pests, like *Ceratitis capitata* Wieddeman (GUERFALI *et al.*, 2007), *Ruguloscolytus amygdali* Guerin and many aphids (EL TRIGUI & EL SHERIF, 1989; JERRAYA, 1996, 2003; BEN HALIMA KAMEL & BEN HAMOUDA, 2004). Aphids are considered a serious pest which causes serious economic damages because of direct removal of plant nutrient or the transmission of viruses causing plant diseases (HUANG e*t al.,* 1981; LECLANT, 1981; LECLANT & LECOQ, 1996; MAMOUNI, 2006). Furthermore, BEN HALIMA KAMEL & BEN HAMOUDA (2004) recorded four harmful aphid species in Tunisia which attack leaves (*Myzus persicae* Sulzer, *Hyalopterus pruni* Geoffroy*, Brachycaudus amygdalinus* Schouteden) and one which attacks branch cortex *Pterochloroides persicae* Cholodokovsky. Indeed, these species were the most harmful for peach and almond (BEN HALIMA-KAMEL & BEN HAMOUDA, 2005; JERRAYA, 2003). Biology and dynamic description of these species were mentioned shortly previously. This makes control of aphids difficult.

This study aims to survey aphids species on almond and peach, to describe their biology in different climates (arid and semi arid) and to follow their population dynamic. This is the first step in the biological control program against almond and peach aphid in Tunisia.

METHODS AND MATERIALS

STUDY AREAS AND DETERMINATION OF APHID SPECIES

This study was carried out in several sites of Tunisia where orchards of almonds and peach are widely planted: Mornag (Fig. I, a semi-arid climate), Jemmel (Fig. I, b - arid climate) and Chott Mariem (Fig. I, c - arid climate). The aphid species were collected by cutting infested fragments and branches. Sampling was carried out weekly from July 2006 to July 2008 during the infestation season on almonds and peach trees. Terminology used in the identification was the one used by BLACKMAN & EASTOP (1984, 1994, 2000) and LOZIER *et al.* (2008).

BIOLOGY AND LIFE CYCLE

Biological surveys were carried out under natural field conditions on peach and almond trees. Eggs survey started

Fig. I
Tunisia map representing areas of study (a) Momang. (b) Chott Mariem, (c) Jammel.

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on September 2006 and samples were collected by cutting fragments weekly. All samples were examined under Leica MS5 dissecting microscope where the number, shape and colour of eggs were recorded and kept within muslin to identify larvae species after emergence. The date of laying eggs was determined using the covering muslin on fragments of peach and almond. Every three weeks from October 2006 to December 2006, six more trees had their fragments covered with muslin. On February 2007, the larvae emergence was controlled weekly under the muslin.

From each orientation (North, South, East and West) of almond and peach trees, two samples were collected from five host trees. This permitted to survey the orientation effect on egg laying. In total, 45 trees were submitted to sampling. Fragments were examined under Leica MS5 dissecting Microscope and eggs were enumerated.

Table 1 – Aphids species recorded at different areas

Species of aphids	Area	Fruit trees
Brachycaudus amygdalinu Shouteden. (Macrosiphini, Aphidinae)	Chott Mariem and Jemmel	Almond, Peach
Hyalopterus pruni species complex (Aphidini, Aphidinae)	Chott Mariem and Jemmel	Almond, Peach
Myzus persicae Sulzer (Macrosiphini, Aphidinae).	Chott Mariem, Jemmel and Mornag	Almond, Peach
Pterochloroides persicae Cholodovsky (Lachnini, Lachinae)	Jemmel	Almond, Peach

Succession of infestation on fruits stone

Samples of peach and almond infested by Aphidinae in different areas were collected from the spring of 2007 to July 2007. All fragments were measured, examined and present aphids were recorded. For *P. persicae,* the survey was carried out from July 2007 to July 2008. On the studied *Prunus* species, infested parts were evaluated and aphids were recorded. The density of aphids was calculated per linear meter and the succession of aphid from one host to another was noted. In addition, the Mean Relative Growth Rates (M.R.G.R) in natural conditions was calculated for the determination of the preferential host according to Fisher (1920), Radford (1967) and Leather & Dixon's (1984) formula:

M.R.G.R= R = (Ln W1 -Ln W2)/ (T2-T1) where W1 and W2 are the number of aphids at the time of sampling and (T2-T1) is the time duration between two successful samples.

Data analysis

The relationship between orientation and aphid eggs density was submitted to statistical analysis with SPSS (version13.0.) using Duncan's Multiple Range Test DMRT at 5% level.

RESULTS AND DISCUSSION

Aphid species

Aphid's survey on almond and peach in different areas of study (Chott Mariem, Jemmel and Mornag) showed the presence of four aphid's species: *Hyalopterus pruni* species complex, *Myzus persicae* Sulzer, *Brachycaudus amygdalinus* Shouteden and *Pterochloroides persicae* Cholodovsky (Table 1). Jerraya (2003) and Ben Halima Kamel & Ben Hamouda (2004, 2005), have also identified these species. Moreover, occasional species of aphids were identified in the coastal area of Tunisia like *Aphis gossypii* Glover, *Macrosiphum rosae* L. and *Brachycaudus prunicola* Kaltenbach (Ben Halima Kamel & Ben Hamouda (2004, 2005). In the same context, studies on aphids associated with almond and peach in different countries proved the presence of these species in Egypt and Syria (Darwich *et al.* (1989), Talhouk (1972, 1977). Furthermore, many other species were identified in United states of America: *Aphis spiraecola* Patch, *Brachycaudus helichrysi* Kaltenbach, *Brachycaudus persicae* Passerini, *Brachycaudus schwartzi* Borner, *Hysteroneura setariae* Thomas, *Macrosiphum euphorbiae* Thomas, *Myzus cerasi* Fabricius, *Myzus varians* Davidson and *P. persicae* and *Hyalopterus persikonus* M. (Stoetzel & Miller, 2008; Lozier *et al.*, 2008).

Biology

Biological following of different species of aphids on stone fruit trees led us to describe their biology. Concerning *H. pruni* species complex, the research of eggs on different fragments permitted to identify an ovoid green egg around dormant buds of almond and peach in November and December. Similarly, Jerraya (1996) gave the same description of *H. pruni* species complex. In addition, our results about the date of lay were similar to Jerraya's (1996, 2003). *H. pruni* species complex laid significantly more eggs on almond than on peach (Table 2). A few number of eggs were observed on peach in Chott Mariem in January. The highest density of egg was observed on almond in January in Jammel (1.52 egg/m). As regards orientation study, Table 3 demonstrates a significant difference between numbers of eggs laid in the north part compared to the other orientation. Moreover, in two different localities (Mornag and Jammel), means of eggs in the north part were significantly different to south, west and east part. The choice of the north orientation can be related to two different factors: position of trunk relative to the sun or wind direction. As for wind, Pasek (1988) shows that its direction can influence the insect dispersal and the choice of sites to lay eggs. In fact, during autumn, in Tunisia, wind has a frequent north direction with high speed (NIM, 2007) and this can cause aphids to choose the trunk in the north side of trees. Regarding to the sun, north side of trees is less exposed to heat and radiation, thus it would protect aphids and eggs. Our results demonstrate the preference of *H. pruni* species complex to lay eggs on almond rather than on peach and especially on the north side of the trunks. Furthermore, aphids were observed on herbaceous plants (*Phragmites spp*). This shows the holocyclicity of *Hyalopterus species* which exhibits a dioecious holocyclic life cycle in different zones of study, colonizing peach and almond as a primary host and *Phragmites spp.* as secondary hosts.

Concerning *M. persicae*, ovoid and white eggs were found around dormant buds of peach in December 2006 in

Table 2 – Linear density per meter of *Hyalopterus pruni species complex* eggs on different hosts and biotopes.

Area	Chott Mariem				Jemmel				
Date	Almond		Peach		Date	Almond		Peach	
Parameter	Length (m)	Density (Egg/m)	Length (m)	Density (Egg/m)	Parameter	Length (m)	Density (Egg/m)	Length (m)	Density (Egg/m)
11.12.06	4.3	0	4.5	0	08.12.06	2.5	0	3.2	0
18.12.06	3.5	0.85	2.8	0	20.12.06	4.3	0.23	3.4	0
27.12.06	2.7	0.74	3.2	0	28.12.06	2.8	0.71	2.9	0.68
10.01.07	3.1	0.32	2.7	0.37	04.01.07	3.2	0.62	1.7	1.17
18.01.07	1.8	1.11	2.3	0.86	11.01.07	1.9	1.52	3.8	0.37
27.01.07	2.3	0.86	2.9	0	16.01.07	2.6	0	1.9	0.28
13.02.07	1.9	0.52	2.6	0	07.02.07	1.7	0	2.5	0
27.02.07	2.1	0	3.1	0	21.02.07	2.5	0	2.8	0
13.03.07	2.6	0	2.4	0	28.02.07	3.8	0	3.1	0
18.03.07	1.7	0	1.8	0	16.03.07	1.9	0	2.6	0

Table 3 – Orientation effect on laying eggs for *Hyalopterus species* at different sites (X=M±SD).

Orientation	Jemmel	Mornag
North	14^{a} ±1.11	9^{a}±1.11
South	2^{b}±0.38	0^{b}±0
West	5^{b}±0.38	2^{b}±0.69
East	2^{b}±0.66	2^{b}±069

Values followed by the same letter within a column are not significantly different at the P<0.05 level (Duncan test).

Mornag. We confirmed that these were *M. persicae's* eggs after the emergence of larvae in February. However our results were not consistent with HULLE *et al.* (1999) which showed that eggs of *M. persicae* were shiny black. But according to STRATHDEE *et al.*, (1995) the colour of fertilized eggs can change. The author proved that colour of fertilized eggs of *Ropalosiphum padi* L. change to shiny black. In opposition to *H. pruni* complex species, eggs of *M. persicae* were observed on different fragments of peach without any orientation preference. Our results demonstrated that *M. persicae* is a holocyclic aphid. Similarly, JERRAYA (1996, 2003) and HULLE *et al.* (1999) mentioned the holocyclicity of *M. persicae*. Moreover, BEN HALIMA KAMEL & MABROUK, (1997) and BEN HALIMA-KAMEL & BEN HAMOUDA (1998) showed that *M. persicae* in Tunisia can exhibit an anholocyclic life cycle on different herbaceous plants like *Convolvulus arvensis* (*Convolvulacae*). In the same context, MINKS & HARREWIJN (1987) proved that *M. persicae* exhibits a heteroecious holocyclic life cycle in cold winter areas using *Prunus* (Rosaceae) as a primary host and various herbaceous plants as secondary hosts, and it can exhibit an anholocyclic life cycle on secondary hosts in temperate regions. As for *Brachycaudus amygdalinus* biology, we didn't observe eggs during our studies. Thus, further observations are needed to deepen in the knowledge about the life cycle of this species in Tunisia. This aphid is holocyclic dioecic and it was observed on different spontaneous plants such as *Polygonum persicaria* (Polygonaceae) (HULLE *et al.,* 1999). Concerning *P. persicae*, our results showed that this pest reproduces by parthenogenesis throughout the year on peach and almond. This confirmed the anholocyclicity of these aphids in Tunisia, as reported by TRIGUI & CHERIF (1987) and BEN HALIMA KAMEL & BEN HAMOUDA (2004, 2005). These authors observed *Pterochloroides persicae* on *P. persica, P. amygdalinus, P. armenica* and *P. domestica* with parthenogenetic generation in Tunisia. Similar surveys conducted in Turkey (ASLAN, 2005; ESIN & GAZI, 2007) and in Egypt (DARWICH *et al.*, 1989) confirmed the anholocyclicity *of P. persicae* on *Prunus*. Moreover, KAIRO & POSWAL (1995) reported that the host range and status of *P. persicae* varies in different country areas depending on the particularities of plant species grown. Furthermore, the authors proved the holocyclicity of aphids and described their egg colour, which was shiny and jet. In the same context, in Syria and Lebanon, KAIRO & POSWAL, (1995) indicated the apparition date of oviparous in October and oviposition started from October to January; hatching begins from mid January to March, and fundatrix females reach the adult stage in mid April. Fundatrix generation is completed in early May. *P. persicae* can achieve holocyclic and anholocyclic life cycles depending on environmental conditions. Anholocyclic population was observed in Syria and Lebanon in the warmer coastal area, and the holocyclic in cold interior parts (TALHOUK, 1977). Also, observations reported by BLACKMAN & EASTOP (1994, 2000, 2006) and RAKHSHANI *et al.* (2005) demonstrate that, in colder areas like Romania, Italy and Greece, *P. persicae* exhibit a holocyclic life cycle.

SUCCESSION OF INFESTATION ON FRUIT STONE TREE

Results in Table 4 demonstrate that the M.R.G.R of *H. pruni* species complex is more significant on almond than on peach. Indeed, population grows on almond at the beginning of March and continues until June. A population peak is observed in March and decreases on May. Still, some specimens were observed on peach on May until June. Then, survey of *H. pruni* species complex on herbaceous plant showed that the aphid moves to *Phragmites communis* in May. These results proved that *H. pruni* species complex prefers almond when it start its population in March by parthenogenesis, and as soon as it reaches the highest density (Table 5) it changes the host to peach and *Phragmites spp* in May. In this context, JERRAYA (1996) explained the dynamics of aphids by the search of a new host after reaching a high population on almond trees. This author indicated that the persistence of leaves on almond was responsible for a longer duration of *H. pruni* species complex infestation. Indeed, LOZIER *et al.* (2008) men-

tioned the preference of *H. pruni* species complex for almond in 16 localities in the world. However, our results contradict the interpretation of LECLANT (1981) who indicated that the importance of damages caused by *H. pruni* species complex was more severe on peach rather than on almond. Added to that, the decrease of aphid population on May and June can be related to temperature variation.

Concerning *M. persicae*, Table 4 and Fig. II showed that aphid appeared early in spring on peach. Results showed a significant difference between population on almond and peach (Table 5). However, *M. persicae* started colonizing peach in March and continued to May. The presence of *M. persicae* on almond from April to June with low density can be explained by the research of sap on other different host. Then, our results proved that peach was the preferential host of *M. persicae*. Similarly, JERRAYA (2003) and LECLANT (1981) mentioned peach as a preferential host for *M. persicae*. As for *B. amygdalinus*, Table 4 and Fig. II showed that activity of this pest was similar on almond and peach, as shown by the lack of a significant difference on the densities of aphids on almond and peach. Similarly, Hullé *et al.,* (1999) and Laamari's (2008) results proved the presence of this pest on almond and peach but they did not indicate its preferential host.

As for *P. persicae*, Table (4) and Fig. III proved that aphids were observed first on almond in January and then they moved to peach on February and March. M.R.G.R results showed that aphids don't have a preference for peach or almond. The succession and the growth of this aphid were related to climatic conditions and tree phenology. However, in Tunisia, EL TRIGUI & EL SHERIF, (1989) mentioned that *P. persicae*'s cycle period was related to temperature and the host plants sap. Furthermore, WALTERS & DEWAR (1986), HARRINGTON *et al.,* (1990), WERKER *et al.,* (1998) in COCU *et al.*, (2005) proved that duration and severity of extreme low temperature during winter influenced *P. persicae* survival. Moreover, our results proved that *P. persicae* grows similarly on almond and peach and its dynamic can be related to many factors that should be studied.

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Table 4 – Aphids M.R.G.R on peach and almond.

Species	*H. pruni species complex*		*B. amygdqlinus*		*M. persicae*		*P. persicae*		
Date 1	Almond	Peach	Almond	Peach	Almond	Peach	Date 2	Almond	Peach
12.03.07	770	0	0	0	0	0	10.03.08	0	0
18.03.07	460	0	0	0	0	0	14.03.08	9	9
2.04.07	480	0	0	20	16	36	20.03.08	12	9
10.04.07	300	0	3	16	19	24	24.03.08	6	20
19.04.07	230	0	0	14	14	17	28.03.08	2	10
26.04.07	210	0	0	10	13	0	02.04.04	0	12
1.05.07	200	41	14	13	0	0	6.04.08	0	6
9.05.07	160	7	5	7	0	8	10.04.08	0	0
16.05.07	120	86	0	6	7	2	14.04.08	0	0
22.05.07	110	40	0	9	6	0	18.04.08	0	0
30.05.07	100	60	0	5	0	0	22.04.08	0	0
6.06.07	80	20	0	6	3	0	6.05.08	0	0
13.06.07	0	0	0	2	0	0	13.05.08	0	0
21.06.07	0	0	0	0	0	0	21.05.08		0
AVERAGE10^{-3}	268	42	11	17	73	98	AVERAGE10^{-3}	7	12

Table 5 – Level of infestation on almond and peach of Aphidinae in Chott Mariem (X=M±SD)

Trees	Fragments number	Length (m)	*B. amygdalinus*	*H. pruni species complex*	*M. persicae*
Almond	280	28.06	82±11.49	35927±3531.2	34±6.66
Peach	280	20.38	266±45.06	748±118.59	2442±273.32

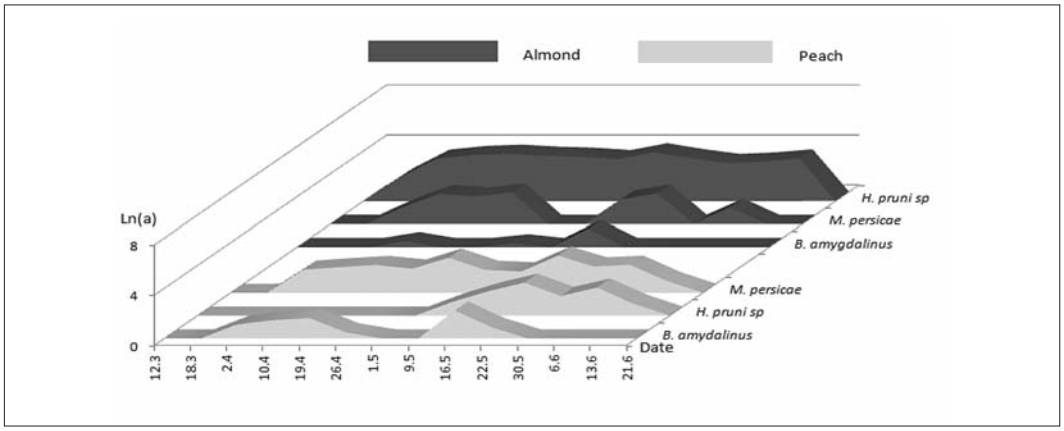

Fig. II
Aphids species density on peach and almond in Chot Mariem zone.
Ln: log neperien; a: number of aphid per linear meter (July 2006 to July 2007).

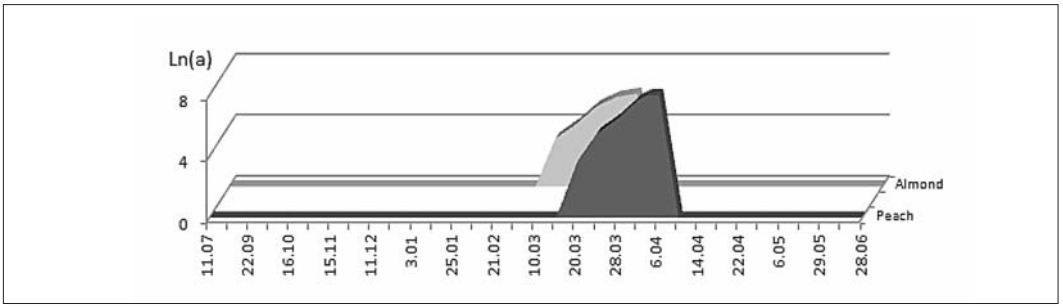

Fig. III
P. persicae succession on peach and almond in Chott mariem zone.
Ln: log neperien; a: number of aphid per liear meter.

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