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Some Observation on Leafhoppers in Peach Orchards in Northern Tunisia

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ABSTRACT

Serious damage caused by cicadellid insects have been observed for a few years in peach orchards in Tunisia. In this study the abundance of cicadellid in peach ecosystem is explored. Population density of cicadas has been measured in orchard, on peach trees, edge trees and weeds. Two trapping techniques were used: sweep net trapping and sticky yellow traps. The quantification of cicadas population on weed species show that Graminacea are most plants containing cicadas, specially *Echinichloa colona* (about 5 cicadas m^{-2}). Cicadas captured on sticky yellow traps on edge shows that *Acacia ebernua* is the most visited species by cicadas. Captured cicadas species in sticky yellow traps deposited in peach canopy show that peach trees are visited essentially by two cicadellidae species: *Asymmestrasca decedens* and *Zygina flammigera*. Dynamics of these two leafhopper species was studied during 2 years. The adults activity begin from February to October with a maximum in June and July. This study constitutes a preliminary observation on peach leafhopper biology in Tunisia and this is a background for future pest management programs.

Key words: *Asymmestrasca decedens, Zygina flammigera,* leafhopper, peach, biology, North-East Tunisia, Cicadellidae

INTRODUCTION

Cicadas (Auchenorrhyncha) are very common insect in most terrestrial ecosystems particularly agricultural areas. Many species are regarded as pests of cultivated plants and can also be vectors of different plant diseases. Nevertheless, only few surveys have been carried out in Tunisian agricultural areas on cicadas. There have not been any comprehensive studies on cicada biology up to now in Tunisian peach orchards (Najar *et al*., 1998; Boukhris-Bouhachem *et al*., 2007; Chaieb *et al*., 2011).

Peach trees exhibiting stunted shoots with small curled leaves were detected in summer 2007 and 2008 in several orchards in northern Tunisia (Mornag). Leafhopper provokes serious damage on young trees, in nurseries and on grafted plants. Damage was hardly noticed in adult bearing trees. According to studies done in affected orchards, a large number of adult and juvenile leafhoppers were observed on peach shoots and on weeds (Chaieb *et al*., 2011).

Among the diversified Cicadellidae family, the Typhlocybinae which represents a very specialized group of minute insects, quite regular in shape and sizeable range, often brightly

colored and related with typical damage to plants (Grassi and Dal Ri, 2006). Many cicadellids are phloem feeders but Typhlocibins group feed on intracellular liquid of parenchyma cells because of their mouthpart small size. This limited use of the plant is associated with typical injuries, often mistaken with Thysanopteran or mite-feeding punctures, appearing as small areas of depigmented cell clusters. These areas can turn brown with necrosis and induce wider plant deformations (Nickel and Holzinger, 2006).

Recently damages similar to what previously described were observed on Tunisian peach and almond trees. The leaves show discolored spots that became increasingly necrotic. These symptoms can be confused with mite attacks. The feeding activity induces alterations on plant tissues, especially on young, tender tissues on the top of branches, inducing curled and twisted leaves. When the infestation is particularly high, many new small leaves are produced. This feeding activity causes alterations on plant tissues. Damaged leaves may turn yellow starting from the margins and definitively dry and die (Chaieb *et al*., 2011).

Leafhoppers biodiversity on peach trees in Tunisian North East were studied. And *Zygina flammigera* were shown to be major species feeding on these cultivated trees. *A. decedens* was previously reported on grapevine but not as stone fruit pest, while *Z. flammigera* is new for the Tunisian fauna (Chaieb *et al*., 2011).

The aim of this research was to study quantitatively the cicadellid populations in Northern Tunisian peach orchards ecosystem including cultivated plant, weed and edge.

MATERIALS AND METHODS

Study of cicadellid populations on weeds: For the quantification of leafhoppers we choose peach orchards with a dominance of weed specie. We used sweep net technique to collect leafhopper. Each sample was collected on linear distance of 30 m of a meter wide. This will allow us to reduce the number of leafhoppers captured per unit area and estimate the abundance of species or populations of leafhoppers on each plant host. At least three replications of 30 m^{-2} was done for each weed specie. Five principal species of Graminacea were investigated: *Cynodon dactylon, Echinochloa laevita, Setaria verticillata, Hordeum murinum, Erigeron canadensis*, 2 dicotyledonous associations: Chenopodiacea (*Chenopodium album* and *Chenopodium murale*) and Amaranthacea (*Amaranthus retroflexus, Amaranthus hybridus and Amaranthus angustifolius*).

Study of cicadellid populations on edge: The principal species of edge trees in Mornag was *Acacia ebernua, Cupressus sempervirens* and *Tamarix aphylla*. To estimate the population of leafhopper hibernating on each specie, we used yellow sticky traps during January 2009. Traps of 25×25 cm were placed in the canopy of each edge specie at 1.5 m height in the same farm. Traps were observed after one month and leafhopper cathed were counted. Three replications, for each species, were done.

Study of cicadellid populations on peach trees: Mornag, a severely impacted area with cicadellid damages, was chosen for field studies. Two techniques were used to investigate the leafhopper populations: sweep net and yellow sticky traps. One trap of 25×25 cm were placed in culture peach and at 1.5 m height. Leafhoppers were counted weekly and traps renewed monthly.

To verify leafhopper specie, tiny insects were collected in the net using a mouth aspirator and were killed with ethyl acetate vapours and eventually dried at room temperature until identification. Yellow traps were observed weekly and renewed monthly from February to October and insects were unglued using a paint brush and white spirit, then stored in alcohol until

identification. Morphological identification of the Typhlocybinae genus rely on the use of few features, mainly color patterns, but can only be ensured by observation of the male genitalia characteristic shape (James *et al.*, 2008; Demichelis *et al.*, 2010). Hence, the apical part of the male abdomen is cut and put for 12 to 24 h in 10% KOH solution, then rinsed with water and observed in glycerine under stereomicroscope at magnification x40 to x60. Identification is based on key of Faune de France (Della-Giustina, 1989).

Data analysis: Analyse of variance of data from study of leafhopper on weed and edge were done using ANOVA procedure, comparison of means is done by Duncan test using SPSS 11 software. Differences were considered as significant when $p<0.05$.

RESULTS

Study of cicadellid populations on weeds: The capture of leafhoppers per sweep net technique in weeds showed variability in the population depending on the species weed. *Echinechloa* and *Setaria* are most important reservoirs of leafhoppers. Captures of about 150 cicadelles/30 m^{-2} are observed in the case of *Echinichloa*. It is also interesting to note that the monocots are more receptive to leafhoppers than dicots (Fig. 1).

Study of cicadellid populations on hedge: Traps placed at canopy species used as a hedge show that some are covered by more than other leafhoppers, *Acacia ebernua* for exemple example seems to be a refuge for a large population of leafhoppers. *Cupressus sempervirens* and *Tamarix aphylla* do not seem to be a preference host plant for cicadellid (Fig. 2).

Study of cicadellid populations on peach trees: Monitoring of catches of the two main species of leafhoppers of fishing allows us to observe two periods of growth: The first period coincides with the beginning of peach vegetation activity, during this period we see the proliferation in number and limited in time. The population of both species seems similar. A second period comes around the beginning of May, during this period the spread of leafhoppers is more important in terms of number and spread over time. During this period there has been a proliferation of larger number of *Asymmetrasca* compared to that of *Zygina* (Fig. 3). In 2009, 1116 leafhopper were trapped, 82.2% *Asymmetrasca* and 15.9% *Zygina*, in 2010, 1218 leafhopper trapped: 78.8% *Asymmetrasca* and 19.8% *Zygina*. Other cicadellid species were trapped too but they have a very limited number (<2%), they are not be considered as peach pest and will not be studied here.

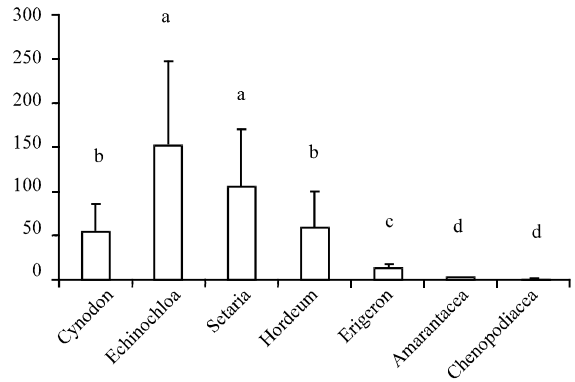

Fig. 1: Mean number of leafhopper adults captured in 30 m^2 of each specie of weed

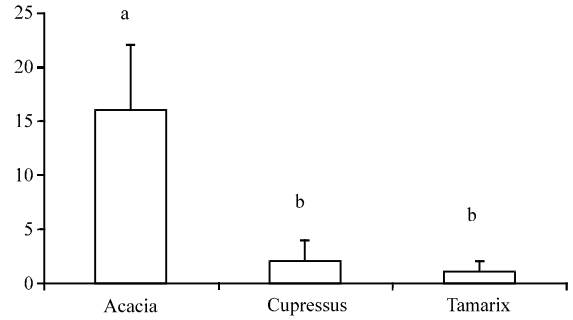

Fig. 2: Mean number of leafhopper adults trapped in yellow sticky trap on different edge species. Means with same letters are not significantly different at $p<0.05$ (Duncan test)

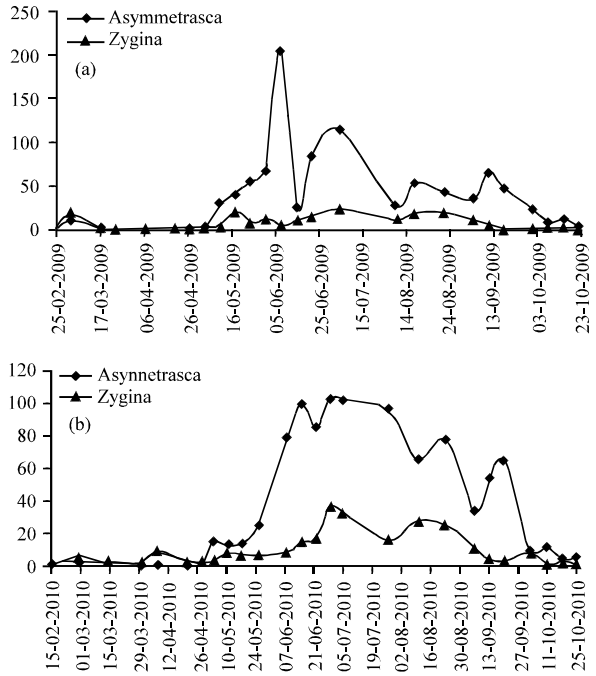

Fig. 3(a,b): Evolution of the number of captured *A. decedens* and *Z. flammigera* during (a) 2009 and (b) 2010

DISCUSSION

Leafhoppers constitute an important pest for peach and other stone fruit species in Mediterranean region. Important damage has been detected in different *Prunus* spp. orchards during 1999 in Spain. Damage is attributed to the feeding activity of leafhoppers (Homoptera: Cicadellidae) and is very important in growing plants. The dynamics of these insects was followed between 1997 and 1999 in five different orchards by means of three methods. The most important species was *Asymmetrasca* decedens. It was abundantly collected in summer when several peaks were observed. Only a single maximum of nymphs was detected. No difference was found between orientations but a preference to grafted plants was observed (Torres *et al.*, 2000).

On peach tree leafhopper feeds on the sprouts causing serious damage to nurseries and trees in formation. *Asymmetrasca* decedens has been identified as the specie responsible for this

damage. This leafhopper specie has been found in other crops such as cotton, citrus, beet, in association with: *Empoasca decipiens et Empoasca pteridis*. The leafhopper begins to enter the crop in February-March, multiplying itself extraordinarily during the month of June and decrease its activity in the following months. The optimum dates of treatment are noted to be the first fortnight of June (nymphs), or the end of May (adults before the laying of eggs) (Torres *et al*., 2000).

In Italy *A. decedens* Paoli and *Z. flammigera* are the commonest leafhoppers infesting peach trees in Campania (southern Italy). *A. decedens* can cause severe damage (leaf curling) mainly on young plants and leaves. The percentage of infested shoots reached peaks of 54% (1989) and 80% (1990). Adults migrate into peach orchards in April-May, from then populations develop the maximum density in late July and after decrease. The eggs are deposited, in general singly, in a wound produced in the main leaf vein. The apical leaves of the youngest shoots and the medio-distal part of the leaf are the preferred site for oviposition. The average number of young stages per shoot can reach more than 2.5 individuals. *Z. flammigera* is very common, but net a pest as *A. decedens*. This species is plasmophagous and cause silvering symptoms on the infested leaves. (Viggiani *et al*., 1992). Recently in Italy a study on 8776 cicadellid captured in peach show that 97% are *A. decedens* and 3% are *Z. flammigera* (Viggiani and Tesone, 2008). In Tunisia the percentage of *Z. flammigera* seems to be more important than in Italy (19.8% in 2010 and 15.9% in 2009) (Chaieb *et al*., 2011).

A. decedens is a polyphagous species which can feed important crops such as beans, beet, cotton, citrus, grapevine, lucerne and potatoes. In recent years, this species has been observed causing damage to peach trees in southern Europe: Italy (Viggiani *et al*., 1992) and Spain (Alvarado *et al*., 1994). Leafhopper population can be increased with many factors: climatic conditions, the presence of alternative food plants, cultural practices (fertilizers and irrigation), presence of natural enemies. Adults of *A. decedens* usually overwinter in the shelter of evergreen plants (citrus, for example) and reappear in spring. Although adult leafhoppers can already be detected in February in peach orchards in southern Spain (Alvarado *et al*., 1994), it is in May that their number increases. Eggs are laid on the underside of leaves in June. They hatch about 2 weeks later and the nymphs feed on leaf tissues for about 5 more weeks, passing through five instars before reaching the adult stage. Nymphs are very active and move about the foliage if disturbed but, unlike the adults, they cannot jump. This generation is the one causing damage to peach in both Spain (Alvarado *et al*., 1994) and Italy (Viggiani *et al*., 1992). Eggs of a second generation are laid in August and a third one can even occur depending on environmental conditions. It was precisely in August that growers detected the damage in almond trees. Whether this corresponded to the second generation or not deserves further investigation (Jacas *et al*., 1997).

Leafhopper causes important damage on almond trees in Spain, insect exhibit stunted shoots with small curled leaves have been detected in Spanish almond orchards. Damage attributed to the feeding activity of leafhoppers (Homoptera: Cicadellidae) could be detected during the summer. The dynamics of these insects was followed in 1997 in three different orchards by means of yellow sticky traps to monitor adult activity and by collecting young shoots to monitor immatures. *A. decedens* was the predominant species. Leafhoppers were detected in may but did not peak until mid July, when damage was conspicuous. Abundant catches were observed during the whole summer. Contrarily, nymphs exhibited one single maximum at the end of July. Any control measure against this pest should be directed against this nymphal peak. In Spain a study on almond cicadellid show that 85.2% are *A. decedens*, 11.6% *Frutioidia bisignata* and only 2.5% of *Z. flammigera* (Torres *et al*., 1998). In Tunisia a study done on 2251 leafhoppers captured on

almond show that 79.3% was *A. decedens* and 19.3% *Z. flammigera*. The percentage of Z. flammigera seem to be most important than in Spain (Chaieb *et al*., 2011). It seem that in Tunisia except *A. decedens* and *Z. flammigera* no other important species was detected.

In 2003, *Asymmetrasca decedens* was recorded for the first time on red raspberry in Trentino, alpine region in the north-east of Italy. The damage of this new pest was spectacular, especially on autumnal fruiting variety Polka. Preliminary results of these surveys suggest that, on cultivated raspberry, the pest may complete 2-3 generations in a season, from the end of May to the end of October. The second generation is the most damaging on autumnal fruiting varieties. During the season, part of *A. decedens* population may develop on various spontaneous hosts too, from which adults may continuously migrate towards the raspberry crops. The combined use of yellow sticky traps and visual leaves inspections represent a valuable method to monitor the population development of the pest on the crop and to time treatments correctly (Grassi and Dal Ri, 2006). The period of adults activity in Tunisia seems to be more important than in Italy and Spain. *A. decedens* and *Z. flammigera* were trapped earlier since late February, in Europe this happen in May, this can be attributed to more favourable climatic conditions in Tunisia. More investigations are necessary in Tunisian peach orchards to propose such leafhoppers live cycle.

CONCLUSION

Leafhopper constitutes serious threats to peach production and may have economic importance as cited before in some Mediterranean countries. Preliminary observations on the biology of cicadellids show that leafhopper, their cycle is closely related to weed and edge. The survey of principal leafhopper on peach tree shows that these last have a principal activity in summer between March and October. Further bio-ecological studies should be conducted with deeper phonological analysis; investigation of the interaction with beneficial fauna is necessary to implement an adequate management program.

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