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The emerging problem in cereal crops in North-Eastern Tunisia: The cereal leaf beetles *Oulema* Spp. (Coleoptera; Chrysomelidae; Criocerinae) dynamic populations and infestation rate

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Abstract

Cereals are attacked by several pests which reduce their yield and cause important losses. The Cereal Leaf Beetles (CLB) are emerging pests on cereals responsible of considerable damages. *Oulema* spp. (Coleoptera; Chrysomelidae; Criocerinae) populations and their infestation rates were evaluated on barley culture. Obtained results showed that cereal leaf beetles colonized the two barley plots (P1 and P2) in the same way during the survey period unless P1 was attacked earlier than P2 due to the quick development of plants as a consequence of the suitable climate conditions and the soil structure. The highest infestation rates reached values of about 72% and 70% for P1 and P2 respectively. Then, they tended to decrease approaching hot season. Cereal leaf beetles prefer a humid space with fresh vegetation without chemical applications.

Keywords: Cereal leaf beetles, barley, infestation

Introduction

The genus *Oulema* Gozis (1886) (Coleoptera; Chrysomelidae; Criocerinae) contains four harmful species for cereals. *Oulema melanopus* Linnaeus (1758) is considered as a pest with real economic damages, although it is a very abandoned species by researchers [1]. It is the most dreadful *Oulema* species in the Mediterranean region and North Africa [2] and the most worldwide dispersed [3]. It has been recorded in Asia, Europe and North Africa, such as in Tunisia, Morocco and Algeria [3, 4].

This pest attacks all Poaceae species. However, it prefers oat, barley and wheat. It measures 6 to 8 mm in length with red legs and the thorax is unlike the head. The elytra are metallic blue. Larvae are 4 to 5 mm in length with a body covered by its mucilaginous droppings. These larvae cause the most damage than adults by forming long streaks between veins on the leaves top. Losses increase with the larvae development [5].

Adults overwinter in fields and they start mating during Mai [2, 5, 6]. The egg-laying activity starts in June. Females can lay between 50 to 275 eggs on the superior side of leaves. Eggs have a yellowish orange colour and oval form. Larvae are feeding for 2 to 3 weeks, and then they pupate in the soil. About 3 weeks, adults emerge and start feeding during 2 to 3 weeks before hibernation. This species has one generation per year [2, 5]. The Cereal leaf beetles (CLB) has many natural enemies. Larvae can be attacked by several ladybug species or parasitoids. *Tetrastichus julis* Walker (1839) (Hymenoptera; Eulophidae) is a parasitoid that reduces and successfully maintains cereal leaf beetles' populations under the economic threshold [5]. Lacewings are effective for capturing leaf beetles' larvae [1]. On the other side, larvae of *O. melanopus* can be easily controlled in the chemical way by pyrethroid application [7]. Furthermore, enhancing plant development by fertilisation is necessary to reduce damages [5].

The aim of this study is to monitor *Oulema* spp. dynamic populations and to evaluate the infestation rate on barely crops in Northern Tunisia in order to determine critical periods of the pest occurrence to establish an integrated pest management.

Materials and Methods

Experimental sites

The study was carried out in a barley field of about 40 hectares located in the region of Mograne in the governorate of Zaghouan in Tunisia and belongs to the Higher School of

Agronomy of Mograne (36°25'45.90''N 10°05'36.55''N). Two plots (P1 and P2) of barley were chosen randomly to serve for this study. Each plot has an area of about 1 hectare (Figure 1).

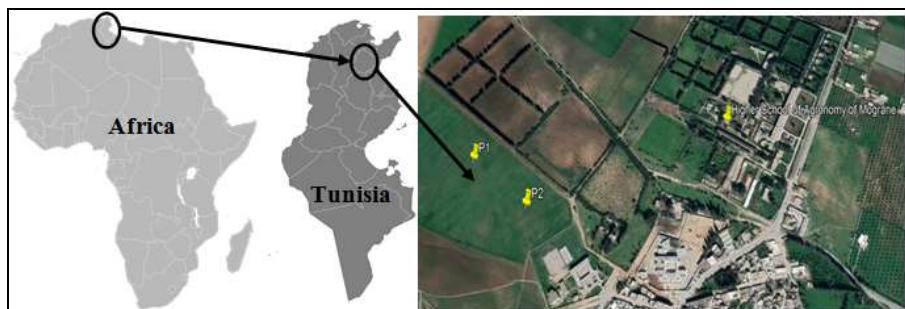


Fig 1: Geographical localization of the experimental site (Legend; P1: Plot 1, P2: Plot 2).

Study period

This study was carried out during 2017 from February 02nd to Mai 15th.

Sampling method

Each plot was divided into five lines of about 100 m of length and distant one another of about 20 m. From each plot, 50 plants were collected weekly along the five lines, placed into plastic bags and transferred to the laboratory of Entomology in the Higher School of Agronomy of Mograne to collect the insects. A sweeping net along five lines was made in the purpose of catching adults. The second sampling method consists of crossing each line using a net sweeping to collect insects.

Identification of the specimen

The genus identification was carried out based on morphological criteria mentioned in the identification key of White [8].

Statistical analysis

Data was analysed by SPSS 20 (Statistical Package for the Social Sciences).

Results

Specimens that have been reported in investigated cereal crops belong to the genus *Oulema* Gozis (1886) (Coleoptera; Chrysomelidae; Criocerinae) (Figure 2).



Fig 2: *Oulema* spp. Adult observed under binocular.

In both plots, populations of Coleoptera and of *Oulema* spp. specifically were compared for the purpose of evaluating which was the most colonised plot. Several families of Coleoptera have been identified in both barley plots and the most important pests belong to the family of Chrysomelidae, which are the CLB *Oulema* spp. The results (Figure 3, 4) demonstrated that there were no significant differences between of Coleoptera populations in both plots and the same for *Oulema* spp. These results proved that the two plots were leaded under the same conditions.

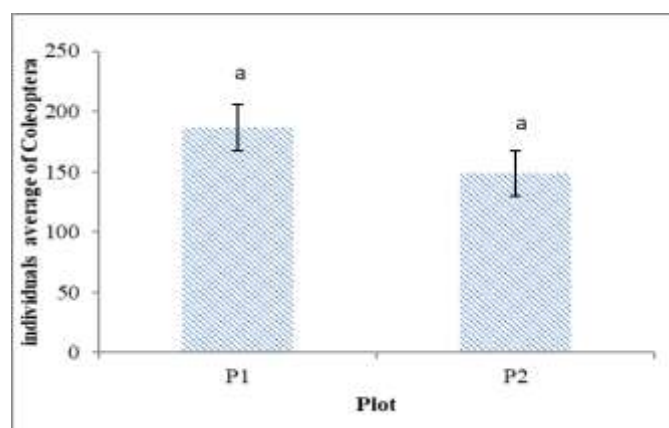


Fig 3: Coleoptera populations in both barley plots (Legend; P1: Plot 1, P2: Plot 2) (Means followed by the same letter are not significantly different according to Duncan's test at $\alpha=0.05$).

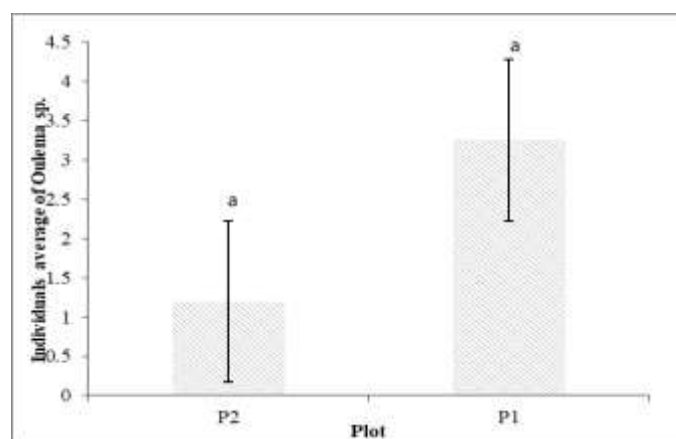


Fig 4: *Oulema* spp. populations in both barley plots (Legend; P1: Plot 1, P2: Plot 2) (Means followed by the same letter are not significantly different according to Duncan's test at $\alpha=0.05$).

According to the obtained results in P1 (Figure 5), adults were present during February with low values with a maximum of 4 adults recorded on February 22nd 2017. Larvae began to appear during March with 5 individuals. Adults subsequently reappeared after the larval decline to establish a new generation, with a peak of 20 individuals on April 12th 2017.

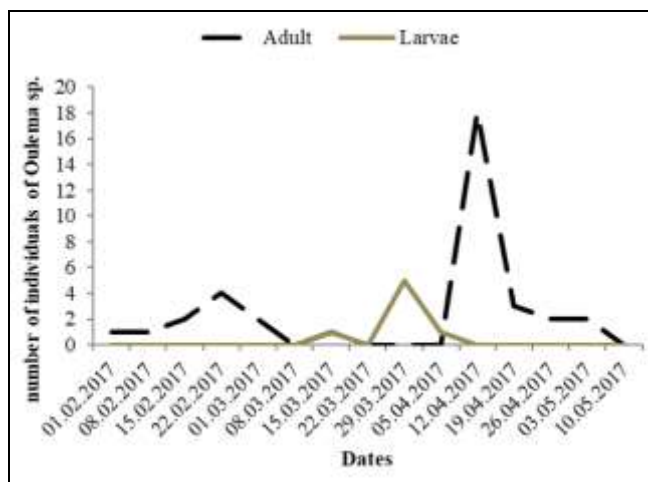


Fig 5: *Oulema* spp. Dynamic population (larvae and adults) on barley in P1.

Concerning P2 (Figure 6), adults were present since February and March, with a maximum of 5 individuals on March 22nd 2017. Regarding larvae, they were observed on March 22nd and 29th and April 05th 2017 with respectively 2, 5 and 1 individuals.

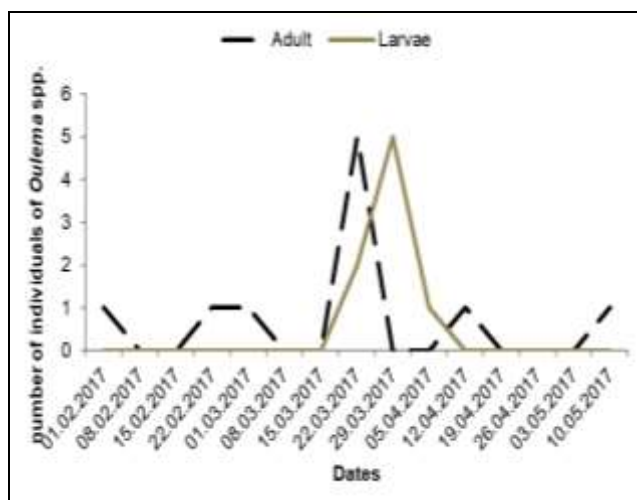


Fig 6: *Oulema* spp. dynamic populations (larvae and adults) on barley in P2.

Damages caused by the CLB were observed on cereal leaves (Figure 7) and quantified. The infestation rate (Figure 8), it was higher generally in P2 except on February 1st 2017 and April 12th 2017 when infestation rates were more important in P1 reaching respectively values of about 72% and 28%, while they were only 12% and 22% in P2. Maximum infestation rates values in P1 and P2 were respectively, about 72% recorded on March 01st and 46% on March 22nd 2017. Percentages of attacked plants declined by the end of the study period.



Fig 7: Damages of CLB on barley leaves.

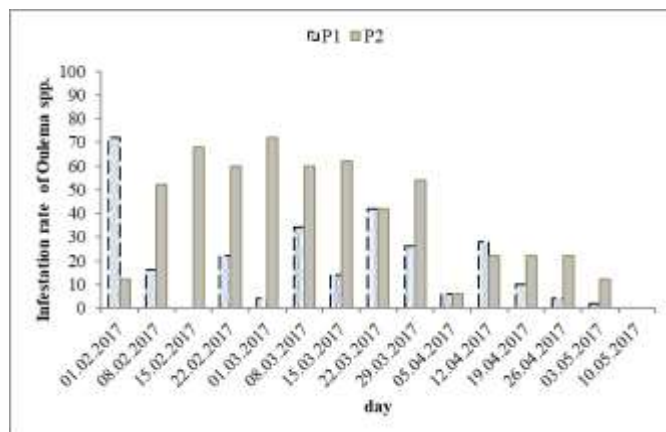


Fig 8: infestation rate of *Oulema* spp. in the two plots of barley P1 and P2 in the region of Mograne.

Discussion

Obtained results do not match with what has been cited by other works. Cereal leaf beetles are active from mid-March until July, while the egg-laying will take place by the end of March and early April [9, 10]. This precocity is probably explained by the availability of suitable climate conditions at the experimental site. Noting the difference in results carried out in Nanterre in France according to Anderson and Paschke [9] and in Michigan in the USA with Wellso *et al.* [10], this claimed that the phenology and adaptation of beetles to plants differ from one region to another.

Based on the studies of Thrap *et al.* [11], beetles are sensitive to chemical treatments that can interrupt or break their cycle. According to Dimitrijevic *et al.* [12], the combination of nitrogen and potassium in foliar fertilisation accelerates the plant development and its maturity before that larvae reach its maximum of activity. These affirmations confirm our results knowing that both plots have been treated by herbicide applications and foliar fertilizations rich in nitrogen and potassium on February 22nd 2017. Furthermore, a fertilization based on potassium reduces the quality of the host plant which will be unpleasant to be consumed by beetles, hence plant damages decrease [12]. Periods of highest damages alternate with the period when adults and larvae appear. However, larvae are considered as the most harmful instars that can produce high damages up to 70% on wheat and between 38% and 75% on barley. Barley and oat are known to be more resistant to damage than wheat [13, 14, 15].

Conclusion

This study has revealed that the first outbreaks of *Oulema* spp. in the region of Mograne were recorded during February and its decline in May approaching the end of the cycle of the culture. Studying the evolution of CLB dynamic populations and their infestation rates led to conclude that the cereal leaf beetles are dangerous pests causing important economic damages that can amount to more than 70%. However, these insects are still sensitive to chemical fertilizations and the state of vegetation.

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