

Research Article

Four Common Insects of Durum Wheat Cultivations in Western Macedonia, Greece

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Received 21 October 2011; Accepted 10 November 2011

Academic Editor: J. S. Swanston

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The purpose of this study was to monitor population fluctuations of various species of Diptera during the growing season of durum wheat, in years 2009 and 2010. The most abundant *Hymenoptera* species was also included in the study as a control species. The species studied were *Cephus pygmaeus*, *Haplodiplosis marginata*, *Mayetiola destructor*, and *Chlorops pumilionis*. Samplings of insects were taken in eight periods to cover the late stages of durum wheat. Measurements were made every about 100 m in the field, with five wheat plants per sample, from 10 different places. Total insect individuals on each wheat plant were counted. Maximum number of individuals per plant reached 6-7 insects, except for *C. pumilionis* which showed only 3-5 individuals. Year X sampling period interaction was also found in some cases, indicating different populations' fluctuations across years. The relatively low populations found in our study may indicate low level of danger on crop production, but the unstable populations of the most multitudinous insect species *H. marginata* and *C. pygmaeus* may cover a possible danger, especially for species *H. marginata* which, in specific years, can be found in great numbers causing severe damages on wheat crops. Combination of pests may result in significant damages and a total recording procedure must be practiced.

1. Introduction

Durum wheat (*Triticum durum* = *T. turgidum* L.) is one of the most important cultivations worldwide and in some specific regions in Greece, like Thessaly and Macedonia. Wheat cultivations in Northern Greece (Macedonia) sometimes suffer pest damages from various insect species [1, 2], but in general these damages are not significant and crop production is relatively stable [3].

Order Diptera includes many important species of insects like common flies or the herbivorous species *Ceratitis capitata* (Wiedemann), which causes severe damages in many different plant species. Other insect species like Hymenoptera are reported in small populations in cereals [1]. Deligeorgidis [2] reported two thrips species in durum wheat cultivations, but their populations were considered low to cause significant damage on wheat's yield.

Haplodiplosis marginata (von Roser) (Diptera: Cecidomyiidae) is widespread in Europe and may harm many species

of cultivated and wild cereal plants [4-6]. *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae), the hessian fly or barley midge, is a very important pest of cereal crops including wheat, rye, and barley [7]. Though a native species of Asia it was introduced in Europe and later in North America. It mainly attacks the stem, although if it is really hungry it will eat any part of the plant it can find. *Chlorops pumilionis* Bjekander = *C. taeniopus* (Diptera: Chloropidae) is widespread in South, North, Central Europe, North America, Africa, and Japan. The insect is cold resistant and may harm 18 species of cultivated and wild cereal plants, such as winter and spring wheat, winter and spring barley, rye, oats, timothy grass, and couch grass [8-10]. In some cases the insect prefers wheat, in others, barley. Two types of damage are known. The first type appears with a late sowing date. Larvae injure young tissues of plants, including growing points. The stem deforms, internodes stop growing, ear does not emerge. In early sowing cultivations, reaching young ears, the larva

TABLE 1: Meteorological data in the experimental area: Mean air temperature (temp) in °C, days of rain, Mean relative (Rel.) humidity (%), for the three months of monitoring in years 2009 (09) and 2010 (10).

Month	Mean air temp	Days of rain	Rel. humidity %
April 09	11.4	3	60
May 09	16.5	3	50
June 09	19.3	3	48
April 10	11.7	5	62
May 10	16.1	5	62
June 10	19.4	5	50

Data Source: <http://www.meteo.gr/>.

comes down to tiller base and eats slender parts. Late sowing date is not a common practice for wheat cultivations in Greece.

Cephus pygmaeus L. (Hymenoptera: Cephidae) is widespread in Western Europe, Northern Africa, the Middle East, and also, introduced into Canada and the USA. Flights of adults usually coincide with the beginning of flowering of white acacia, and maximum insect numbers occur during ear formation by winter wheat and during the tillering of spring wheat. Additional feeding occurs for 5-6 days on flowers of crucifers and composites. After completion of feeding, the larva saws stem from inside at the height of a few centimeters above tillering node, plugs the stem up with a cork made of sawdust, and weaves a thin, semitranslucent and waterproof cocoon, where it overwinters [11].

The purpose of this study was to define and monitor population fluctuations of various species of Diptera during the growing season of durum wheat, in years 2009 and 2010. During monitoring, a few Hymenoptera species were recorded and finally, one, the most abundant, was included in the study as a control species for comparison reasons [2].

2. Materials and Methods

This study was conducted in the prefecture of Kozani (region of Western Macedonia, Greece), in durum wheat cultivations of the variety Bronde, in a one-hectare field during the years 2009 and 2010. Only four insect species were found (in significant populations) and defined according to taxonomy keys: *Cephus pygmaeus* L. (Hymenoptera: Cephidae), *Haplodiplosis marginata* (von Roser) (Diptera: Cecidomyiidae), *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae), and *Chlorops pumilionis* Bjekander = *C. taeniopus* (Diptera: Chloropidae).

Meteorological data are also provided for the experimental area: ELEVATION 637 m, LAT 40° 47' 12" N, and LONG 21° 25' 13" E (Table 1 and Figure 1).

Measurements were carried out during the growing season of wheat at late stages, for year 2009 sampling started from 27 of April and lasted until 15 of June and for year 2010 from 30 of April to 18 of June. Samplings of insects were taken in eight periods (every week) to cover the late stages of wheat. Measurements were made every about 100 m in the field, with five wheat plants per sample, from 10 different

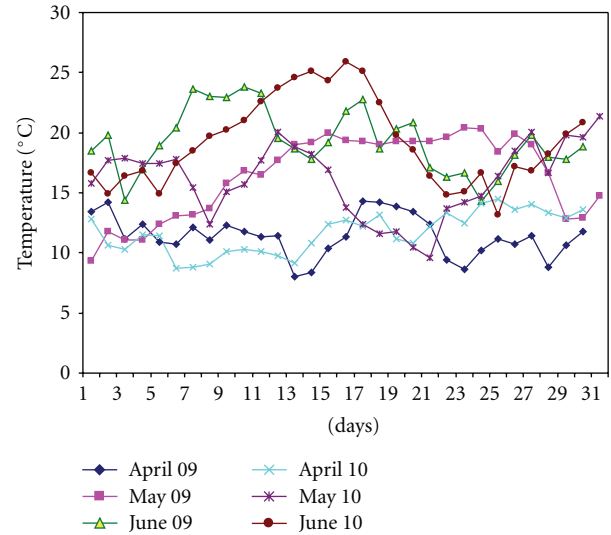


FIGURE 1: Temperature (in °C) fluctuations in daily basis for the three months of monitoring (April, May, and June) in years 2009 (09) and 2010 (10).

places (replications) in the field. Total insect individuals (per species) on each wheat plant were counted according to Deligeorgidis et al. [12, 13]. The average value of the five plants was used in calculations to make data more representative and suitable for statistical analysis (with no transformations and absence of nested analysis). ANOVA was performed in SPSS 17.0 according to Snedecor and Cochran [14], analyzing the following factors: year and sampling period (separately for each insect species).

3. Results

Meteorological data showed that during May and June temperatures showed different fluctuations between years (Figure 1) and differences in rainy days and relative humidity (Table 1). Also, May of 2010 started warmer but it was a little colder than May of 2009 and this reflects in lower insect populations in some cases (Figure 1).

According to the results presented in Table 2, for all insects studied, sampling period showed the greatest differences (significance level $P < 0.00001$). This fluctuation is also shown in Figure 2, for all insects species, for the 2 years of study. In the first sampling period insect populations were low reaching maximum between 4th and 5th period, followed by a considerable decrease in later stages (except for *C. pumilionis*, which showed relatively stable but low populations until the 6th period of sampling). *C. pygmaeus* showed some kind of interaction between year and sampling period (Table 2 and Figure 2), but this phenomenon was much more significant in the case of *H. marginata* (which showed also differences of populations between years). Year x sampling period interaction indicates different kind of populations' fluctuation across years. Insect *C. pumilionis* showed some differences in populations between the two years of monitoring.

TABLE 2: General mean of insect individuals (GM), sources of variability analyzed, degrees of freedom (*df*), and significance level, for the four species: *Cephus pygmaeus*, *Haplodiplosis marginata*, *Mayetiola destructor*, and *Chlorops pumilionis*.

Species	Source of variability	<i>df</i>	Significance level
<i>Cephus pygmaeus</i> GM = 0.903	Year	1	0.66
	Sampling period	7	0.00001
	Year X Sampling period	7	0.09
<i>Haplodiplosis marginata</i> GM = 0.985	Year	1	0.001
	Sampling period	7	0.00001
	Year X Sampling period	7	0.0001
<i>Mayetiola destructor</i> GM = 0.703	Year	1	0.414
	Sampling period	7	0.00001
	Year X Sampling period	7	0.631
<i>Chlorops pumilionis</i> GM = 0.334	Year	1	0.016
	Sampling period	7	0.00001
	Year X Sampling period	7	0.862

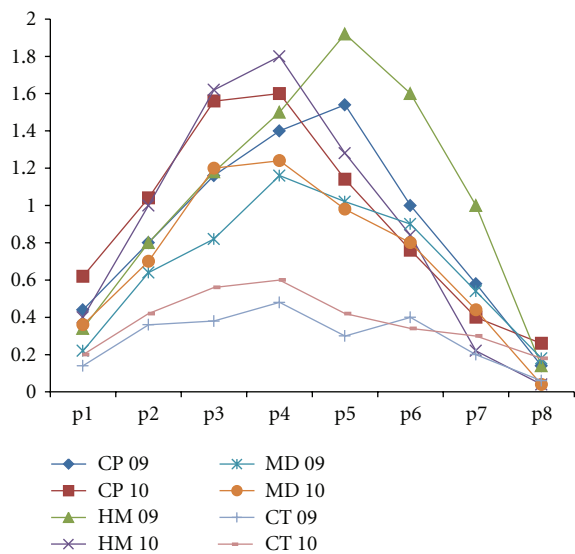


FIGURE 2: Population fluctuations (*y*-axis: mean number of individuals) across sampling periods (p1–p8), for the four species: *C. pygmaeus* (CP), *H. marginata* (HM), *M. destructor* (MD), and *C. pumilionis* = *C. taeniopus* (CT), during the 2 years (2009: 09 and 2010: 10).

Maximum number of insect individuals found on each plant was between 6–7 for the three insect species, except for *C. pumilionis* which showed a maximum between 3 and 5 individuals (Table 3). Total average values were lower, approximately from 0.7 to 1.0 adult insect individuals per plant, except for *C. pumilionis* which showed the lowest values (about 0.3 total average). There were some plants without the presence of any insects.

TABLE 3: Total average and maximum number of individuals counted on host plants, for the four species: *Cephus pygmaeus*, *Haplodiplosis marginata*, *Mayetiola destructor*, and *Chlorops pumilionis* on durum wheat plants, for each year (2009–2010).

Species and year	Total average	Maximum
2009 <i>Cephus pygmaeus</i>	0.883	6
2010 <i>Cephus pygmaeus</i>	0.923	7
2009 <i>Haplodiplosis marginata</i>	1.06	6
2010 <i>Haplodiplosis marginata</i>	0.91	7
2009 <i>Mayetiola destructor</i>	0.685	6
2010 <i>Mayetiola destructor</i>	0.72	6
2009 <i>Chlorops pumilionis</i>	0.29	3
2010 <i>Chlorops pumilionis</i>	0.378	5

4. Discussion

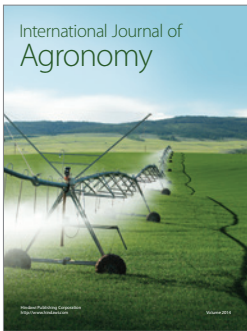
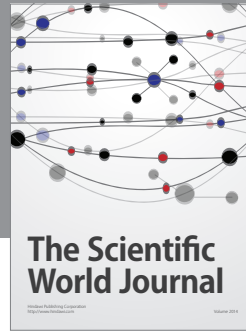
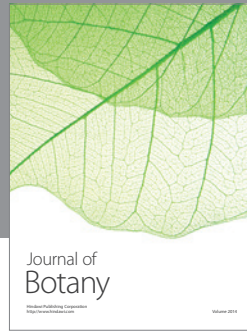
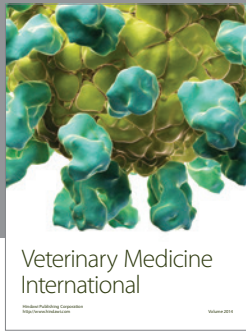
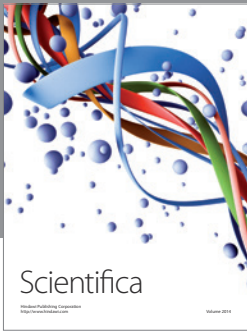
Sampling period for all insects studied showed the greatest differences as it was expected due to insect biology and cycle [12, 13]. Statistically significant interaction between year and sampling period indicates different kind of populations' size and fluctuation across years. This unstable behavior present for *H. marginata* (and in a lower level for *C. pygmaeus*) may be a result of some specific enemies, or host plant reaction [2, 13] and the climatic conditions, taking into consideration the temperature fluctuations of May in year 2010 and year x sample date interaction. Additionally, this rather unstable and unpredictable behavior, especially for the two most abundant insect species may indicate a danger for durum wheat cultivations and in the specific environment of the area (region of Western Macedonia), taking into consideration that increased attacks result into wheat's yield losses [10]. In Greece wheat sowing starts in October and lasts until December and usually early sowing is preferred because wheat plants can develop better, resulting in increased crop production. During early season it seems that young wheat plants can avoid harm by *C. pumilionis* because of very low number of individuals. Late season damages in wheat cultivations are also, not reported [1], (Department of Agriculture, personal communication). In these conditions of low pest populations, it is expected that year to year fluctuations may vary according to natural enemies' presence in the specific environment of the experimentation area [2, 15–18], although it seems that climatic conditions had more significant impact on population fluctuations. We may safely conclude that this species (*C. pumilionis*) is not an important enemy of wheat in the region of Western Macedonia.

The economic threshold has to be decided in accordance to insect population size [19] and both size and population fluctuations because of the difficulties in predictions [2]. The relatively low populations found in our study may indicate low level of danger on crop production [9, 10], but the unstable populations of the most multitudinous insect species *H. marginata* and *C. pygmaeus* may cover a possible danger, especially for *H. marginata* which in specific years can be found in great numbers, causing severe damages to wheat (and other cereal) crops [4, 6]. This damage danger implies extensive monitoring in order to apply insect control

techniques in time [6, 10, 20]. Another parameter is realized attacks per plant used by Bryson et al. [10] and Oakley et al. [20] in order to calculate damages on wheat yield. They referred 5% loses on yield when increased attacks were recorded. Finally, combination of pests may result in significant damages [2, 19] and a total recording procedure for all wheat's enemies must be practiced.

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