Journal of Entomology

ISSN 1812-5670

Academic Journals Inc.

www.academicjournals.com

Journal of Entomology 8 (5): 484-490, 2011
ISSN 1812-5670 / DOI: 10.3923/je.2011.484.490

Two Thrips Species in Durum Wheat Cultivations in the Region of Western Macedonia, Greece

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ABSTRACT

The purpose of this study was to monitor population fluctuations of two thrips species (*Limothrips cerealium* and *Limothrips denticornis*), during the growing season of durum wheat, in years 2009 and 2010. 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 thrips individuals (per species) on each wheat plant were counted. The species *Lema melanopa* was also included in measurements (to make comparisons between thrips species more independent). According to the results for all three insects studied, sampling period showed the greatest differences. *L. denticornis* and *L. melanopa*, showed a significant interaction between year and sampling periods, indicating different population fluctuations in the two years. *L. cerealium* showed a stable population fluctuation across years. *L. denticornis*, showed also differences in population across years. This unstable behavior may be a result of some specific enemies or competition phenomena between the two thrips species, since maximum values of the two species were recorded in different sampling periods. Maximum number of thrips individuals found on each plant was 7 for *L. denticornis* and 9 for *L. cerealium* but maximum average values were close to 2 for *L. denticornis* (in 6th sampling period) and 2.8-3.3 for *L. cerealium* (between 4th and 5th sampling period). The relatively low populations of thrips species found in this study did not resulted in significant and apparent damages in durum wheat cultivation but the economic threshold for *L. denticornis* and *L. cerealium* has to be decided in combination to other insect pest species.

Key words: Durum wheat, limothrips, population fluctuations, competition, recording period

INTRODUCTION

Thysanoptera are considered as a very important order, since this class includes many insect species of economic importance. Thrips species (Thysanoptera: Thripidae) are considered of great economic importance because they harm plants in many ways, such as damages on leaves, fruits, pollen etc. (Palmer *et al*., 1989; Murphy *et al*., 2004; Deligeorgidis *et al*., 2006a). Generally, thrips species are polyphagous and thus, they may harm a large number of plant species (Deligeorgidis, 1997; Marullo, 2009). Moreover, thrips are virus vectors, infecting many cultivations with Tomato Spotted Wilt Virus (TSWV), causing great damages in trees, crop plants and vegetables (Ananthakrishnan and Annadurai, 2007). Deligeorgidis *et al*. (2006a) reported

evaluation techniques of damage size on cucumbers (*Cucumis sativus* L.) after thrips attack. In durum wheat (*Triticum durum* L.) cultivations there were reported only a few thrips species of minor importance for yield (Prescott *et al*., 1986; Minaei and Aalichi, 2001; Larsson, 2005; Alavi *et al*., 2007).

Limothrips cerealium (Haliday), the grain thrips, is a common species of small grains like wheat (*Triticum* spp.). The female grain thrips is 1-2 mm in length and dark brown to black in color. The male is slightly smaller and paler than the female and lacks of wings. *Limothrips denticornis* (Haliday), the barley thrips, is usually found on barley (*Hordeum* spp.), rye (*Secale* spp.), oat (*Avena* spp.) or wheat plants. The body is 1.2 to 1.5 mm long and dark brown. This is a widespread species in North America and Europe (Moritz *et al*., 2001). Damages usually are light and described as silvery leaves and more rarely, dried wheat ears. In wheat, triticale and rye cultivations, the mean number of thrips per leaf sheath was around 8 in all three crops (Larsson, 2005). The effect on the leaf sheath alone contributed to a significant proportion of the yield loss. The yield loss caused by *L. denticornis* was about the same in all three crops, with a variation between 21 and 26 kg per thrips per leaf sheath and hectare. The economic injury level was found to be about 14 thrips per straw. The economic threshold for *L. denticornis* has to be decided when the females are flying into the crop and it was found to be 0.5 females per straw at earing. Economic damage by *L. denticornis* alone was estimated to be 20% of the total number of experiments for all three crops but total economic damage for *L. denticornis* together to other thrips species and aphids was estimated at 40% (Larsson, 2005).

Many other thrips species are reported in wheat and barley plants: *Haplothrips tritici* Kurd., *Sitothrips arabicus* Priesner, *Rhipidothrips gratiosus* Uzel (Alavi *et al*., 2007), *Haplothrips aculeatus* (Fabricius) (Minaei and Aalichi, 2001) etc. Other insects like aphids or stink bugs and wheat beetles are also reported (Prescott *et al*., 1986). Coleoptera, are reported in wheat cultivations but are mostly known to harm stored wheat kernels (Fleming, 1988; White and Lambkin, 1988). Sometimes, they are found on wheat plants in great numbers (Reay-Jones, 2010).

The purpose of this study was to monitor population fluctuations of two (common in northern Greece) thrips species in comparison to a Chrysomelidae species, during the growing season of wheat, across years. This is very important for determining possible damages that usually depend on the size of thrips populations.

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. Two thrips (Thysanoptera: Thripidae) species were defined: *Limothrips denticornis* (Haliday) and *Limothrips cerealium* (Haliday). 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 places (replications) in the field. Total thrips individuals (per species) on each wheat plant were counted according to Deligeorgidis *et al*. (2005a, 2006b, 2007). 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 according to Snedecor and Cochran (1980), analyzing the following factors: year and sampling period (separately for each

insect species used). In order to perform more appropriate and representative comparisons, an additional species found in the same field was used: *Lema melanopa* L. (Coleoptera: Chrysomelidae) from a completely different taxonomic order, which was sampled and analyzed statistically in the same way as the two thrips species (this unrelated species was chosen to compare the behavior of seasonal population fluctuations).

RESULTS

According to the results presented in Table 1, for all three insects studied, sampling period showed the greatest differences (significance level $p<0.00001$). This fluctuation is shown in Fig. 1, for all three insects species, for the 2 years of study. In the first sampling period the average number of thrips individuals is 0.5 or lower and from the 4th to 6th period these numbers increase significantly. At late stages (8th sampling period), insect populations are decreasing.

L. denticornis and *L. melanopa*, showed a significant interaction between year and sampling periods, indicating different population fluctuations in the two years (Table 1). On the other hand,

Table 1: General mean of insect individuals (GM), sources of variability analyzed, degrees of freedom (df) and significance level, for the three species: *Lema melanopa, Limothrips denticornis* and *Limothrips cerealium*

Species	Source of variability	df	Significance level
Lema melanopa	Year	1	0.168
GM = 0.822	Sampling period	7	0.00001
	Year X sampling period	7	0.002
Limothrips denticornis	Year	1	0.038
GM = 1.177	Sampling period	7	0.00001
	Year X sampling period	7	0.0001
Limothrips cerealium	Year	1	0.845
GM = 1.624	Sampling period	7	0.00001
	Year X sampling period	7	0.493

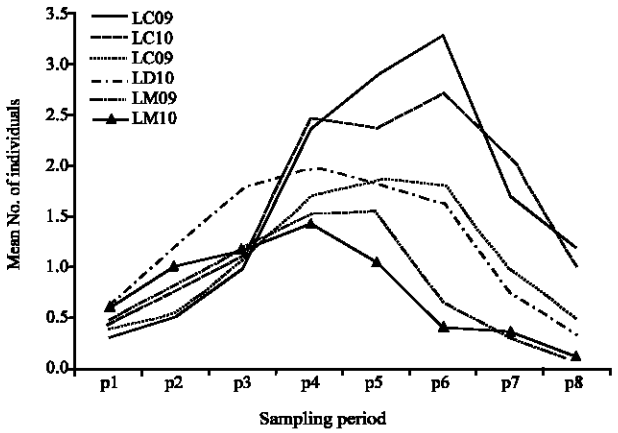

Fig. 1: Population fluctuations across (p1-p8), for the three species: *Lema melanopa* (LM), *Limothrips denticornis* (LD) and *Limothrips cerealium* (LC), during the 2 years (2009: 09 and 2010: 10)

Table 2: Total average, maximum and minimum number of individuals counted, for the three species: *Lema melanopa*, *Limothrips denticornis* and *Limothrips cerealium* on durum wheat plants, for each year (2009-2010)

Species	Year	Total average	Maximum	Minimum
Lema melanopa	2009	0.821	7	0
Lema melanopa	2010	0.763	7	0
Limothrips denticornis	2009	1.098	5	0
Limothrips denticornis	2010	1.258	6	0
Limothrips cerealium	2009	1.643	9	0
Limothrips cerealium	2010	1.605	7	0

L. cerealium showed a stable population fluctuation across years. *L. denticornis*, showed some differences in population size across years (Table 1, Fig. 1).

In present study, maximum number of thrips indidividuals found on each plant was 5-6 for *L. denticornis* and 7-9 for *L. cerealium* (Table 2) but maximum average values were close to 2 for *L. denticornis* (in 6th sampling period) and 2.8-3.3 for *L. cerealium* (between 4th and 5th sampling period), as shown in Fig. 1. Total average values were lower (Table 2). Maximum values of the two species were recorded in different periods and from the 4th sampling period and after, *L. cerealium* was recorded in greater numbers. For *L. melanopa* maximum was found at 7 individuals, maximum average value was 1.5 and total average value was around 0.8 (Table 2, Fig. 1).

DISCUSSION

Sampling period for all three insects studied, showed the greatest differences. This was expected since insect populations vary within the year (Deligeorgidis *et al*., 2005a, 2007) and is something usual for thrips species (Webb *et al*., 1970). This fluctuation was present in both years of study. *L. denticornis* and *L. melanopa*, showed a significant interaction between year and sampling periods, indicating different population fluctuations in the two years. This phenomenon was also reported for other insect species (Deligeorgidis *et al*., 2005a, 2007, 2008). *L. cerealium* showed a stable population fluctuation across years. *L. denticornis*, showed additional differences in population size across years. This unstable behavior may be a result of some specific enemies, or host plant reaction (Deligeorgidis, 1997; Deligeorgidis *et al*., 2005b), or competition phenomena between the two thrips species similar to those described for *Frankliniella occidentalis* (Pergande) and *Thrips tabaci* Lindeman (Deligeorgidis *et al*., 2006b). According to present findings, population fluctuations of *L. cerealium* are more predictable across years, while population fluctuations of *L. denticornis* are rather unstable and unpredictable, in durum wheat cultivations and in the specific environment of the area (region of Western Macedonia). For polyphagous species like *F. occidentalis*, significant population fluctuations might be the final result for many reasons: high or low temperature and humidity and different host plants where thrips migrate seeking for flowers (Chyzik and Ucko, 2002).

Larsson (2005) reported a relatively large number of thrips individuals in wheat, triticale and rye cultivations. He found that the mean number of thrips per leaf sheath was around 8 in all three crops and also reported that maximum number was 27 thrips individuals per leaf sheath. In our study, maximum number of thrips individuals found on each plant was different for the two thrips species (5-6 for *L. denticornis* and 7-9 for *L. cerealium*). Maximum average values were found in 6th sampling period for *L. denticornis* and between 4th and 5th sampling period for *L. cerealium*. This differences may indicate a kind of competition (Andjus *et al*., 2001; Deligeorgidis *et al*., 2006b), since maximum values of the two species were recorded in different periods and from the 4th

sampling period and after, *L. cerealium* was recorded in greater numbers. It should be noted that the two thrips species of the genus *Limothrips* (*L. cerealium* and *L. denticornis*) exhibit similar behavior and biology but they have different origin representing Europe and America respectively (Herrick, 1924; Franssen and Mantel, 1965; Chisholm and Doncaster, 1982). This competition phenomenon has been also reported for Coleoptera (Coccinellidae), between species with different origin (Europe and Asia) but similar biology (Kajita *et al*., 2000). For other thrips species like *Frankliniella occidentalis* (Pergande) and *Thrips tabaci* Lindeman, maximum individual numbers were recorded between 4th and 5th sampling period, at late May recordings (Deligeorgidis *et al*., 2005a).

Larsson (2005) reported that population density in the leaf sheath was correlated with the damage observed on the leaf sheath as percentage of damaged surface. The effect on the leaf sheath alone contributed to a significant proportion of the yield loss. Thrips in the ear and aphids also contributed to the damage. The yield loss caused by *L. denticornis* was about the same in all three crops (wheat, rye and triticale), with a variation between 21 and 26 kg per thrips per leaf sheath and hectare. The economic injury level was found to be about 14 thrips per straw, which is greater than our recordings. For onion cultivations, variety selection may result in thrips repulsion and yield improvement up to 19% (Malik *et al*., 2004). *L. melanopa* was found in smaller numbers, as it was expected for Coleoptera insects (Fleming, 1988; White and Lambkin, 1988).

CONCLUSION

The economic threshold for *L. denticornis* and *L. cerealium* has to be decided in combination to other insect species (Alavi *et al*., 2007). Larsson (2005) reported that economic damage by *L. denticornis* alone was 20% for all three crops studied (wheat, rye and triticale) but total economic damage for *L. denticornis* together to other thrips species and aphids was estimated at 40%. The relatively low populations of thrips species found in present study did not resulted in significant and apparent damages in durum wheat cultivation. According to our findings, population fluctuations of *L. cerealium* are more predictable across years, while population fluctuations of *L. denticornis* are rather unstable and unpredictable, in durum wheat cultivations and in the specific environment of the area.

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