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Control of *Lymantria dispar* L. for eliminating the risk of forage production loss for small ruminants

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Abstract. Range plants that constitute the basic feed source for grazing animals are harmed due to various biological and environmental factors. The quality and quantity of kermes oak (*Quercus coccifera* L.), mostly preferred by small ruminants (goats) because of the high ratio of sugar to tannin content in its leaves, can be affected seriously by infestation by gipsy moth (*Lymantria dispar* L.). In securing the quantity and protecting the quality of kermes oak vegetation, an experiment was designed to address the gipsy moth problem. During spring 2006, 2nd instar larvae were collected from the watershed of the Migdonia area of Thessaloniki prefecture and put in cases where insecticides were applied. At the same time, the entomopathogenic nematode, *Steinernema carpocapsae,* which was applied for first time in Greece as a biological control against gipsy moth, was also tested. Five treatments in four replications were applied. The results from the experiment demonstrated that *S. carpocapsae* can be used successfully as a biological control agent against gipsy moth larvae.

Keywords. Goat nutrition – Kermes oak – Gipsy moth – Range vegetation – *Steinernema carpocapsae*.

Contrôle de* Lymantria dispar *L. pour éviter le risque de chute de la production de fourrage destiné aux petits ruminants

Résumé. *Les plantes pastorales qui constituent la principale source de fourrage pour les animaux en pâturage sont menacées à cause des différents facteurs biologiques et environnementaux. La quantité et la qualité du chêne kermès (*Quercus coccifera *L.), préféré essentiellement par les petits ruminants (chèvres) à cause du rapport élevé sucre:tannins dans ses feuilles, peuvent être affectées par une sérieuse infestation par* Lymantria dispar *L. Afin de pallier ce problème, une expérience a été réalisée pour mettre en évidence l'effet de* Lymantria dispar *L. sur la biomasse de chêne kermès produite et sa qualité. Durant le printemps 2006, des chenilles de 2ème âge ont été prélevées et placées dans des cages entomologiques improvisées dans lesquelles cet essai a été réalisé. Des insecticides connus et déjà utilisés ont été appliqués ainsi que le nématode entomopathogène* Steinernema carpocapsae*, pour la première fois en Grèce, contre le* L. dispar*. Cinq (5) interventions x 4 répétitions ont été réalisées. Cet essai a montré que* Steinernema carpocapsae *peut être utilisé avec de bons résultats, contre les larves du* L. dispar*.*

Mots-clés. *Nutrition des caprins – Chêne kermès* – Lymantria dispar – *Végétation des parcours* – Steinernema carpocapsae*.*

I – Introduction

Rangelands, as physical ecosystems, provide products to mankind, as well as environmental and socio-cultural benefits. But their main product is forage, which is the basic source of feed for small ruminants. The flora in rangelands can suffer serious and extensive damage due to various causes that reduce forage production. One significant cause of damage and reduced forage production is the gipsy moth insect [*Lymantria (Porthetria) dispar* L.; Lepidoptera: Lymantriidae]; the main enemy infesting the kermes oak (*Quercus coccifera*) shrubs. Kermes oak, mostly preferred by goats because of the high ratio of sugar to tannin content of its leaves, is seriously affected by *L. dispar* infestation (Lechowicz, 1983). An epidemic of gypsy moth can result in total destruction of the

kermes oak leaves. Glyphis and Puttick (1989) reported an average of 19% loss of leaf area in kermes oak infested by gipsy moth, while Tsiouvaras (pers. comm., 2007) measured 64% loss of annual production in kermes oak, after a serious gipsy moth attack.

Epidemics occur every 5-8 years in Romania, every 6-10 in Russia, every ten years in Japan, and every 7-8 years in USA (Korchagin, 1980; Kailidis, 1986; Gninenko and Orlinskii, 2003). In Greece, the epidemics occur every 5-7 years and result in total leaf destruction of kermes oak. Universally, many researchers have studied the *L. dispar* problem by applying conventional insecticides as well as alternative, biological, means to solve the problem. Due to residual transfer of conventional insecticides to the plants and through the food chain to humans, the need for using biological control factors was felt in most of the countries where damages of gipsy moth were observed. In Greece, good results have been achieved experimentally using the biological factor *Bacillus thuringiensis*.

The objective of this study was to identify the most effective method for controlling gipsy moth to secure the safety of feeding small ruminants and, at the same time, protect the public from chemical residuals. Therefore, an experiment for controlling gipsy moth took place using conventional insecticide, an insect growth regulator and biological factors, such as the entomopathogenic nematode *Steinernema carpocapsae*. This was the first time *S. carpocapsae* had been used in Greece to protect kermes oak against gipsy moth, and the area targeted was the watershed of Migdonia in the Thessaloniki prefecture.

II – Materials and methods

During the years 2005 and 2006, efforts were made to identify *L. dispar* that infests *Q. coccifera* in the watershed of Migdonia area of Thessaloniki prefecture. The identification to species was first based on morphological characters using classification keys and then by examination of male genitalia under a stereomicroscope (Snodgrass, 1993).

During 2006, an experiment for controlling *L. dispar* took place by using the Kartell S.p.A. dispensers and using the following insecticides and control factors: "Carbaryl" (conventional insecticide), "Fenoxycarb" (insect growth regulator), "*Bacillus thuringiensis*" (biological factor) and "*Steinernema carpocapsae*" (entomopathogenic nematode). Insecticides were used according to the manufacturers guidelines. Five treatments were applied included the control, in four replications in a randomized complete block design. Larvae of the 2nd instar were collected and put on *Q. coccifera* small branches placed in entomological cages designed and constructed by the co-author C. Chryssochoides. The analysis (ANOVA) was performed using the MSTAT program and means were compared by $LSD_{05.}$

III – Results and discussion

The treatments differed significantly in their ability to control gypsy moth (Table 1). The most effective control agent was the insecticide "Carbaryl" followed by the entomopathogenic nematode *S. carpocapsae*, *B. thuringiensis* and finally "Fenoxycarb". The treatments all controlled gypsy moth more effectively than the control ($P < 0.001$, $F = 83.33$).

The importance of this research is the finding that *S. carpocapsae* can be used safely to control *L. dispar* without poisoning small ruminants feeding *Q. coccifera* and the subsequent transfer of insecticide to humans. *S. carpocapsae* was not the most effective treatment for controlling gypsy moth in this experiment, but it was almost as effective as the conventional insecticide "Carbaryl". However, *S. carpocapsae* has the added advantage of being a biological control and does not have chemical residuals that harm goats directly or humans indirectly, through consuming goat products containing chemical residues.

Table 1. Means of dead larvae of *L. dispar* by applying five treatments in four replications

Treatments	Insects	
	Dead	Dead (%)
Carbaryl	17.2 a	86.2 a
S. carpocapsae	13.8 b	68.7 b
B. thuringiensis	10.0 c	50.0 c
Fenoxycarb	8.3 d	41.5 d
Control	6.3 e	31.3 e
LSD (0.05)	1.5	7.3
CV (%)	8.6	8.6

a, b, c, d, e: means that are followed by a different letter differ significantly ($P < 0.001$).

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