Vitis **47** (1), 51–54 (2008)

Natural predatory enemies of the erineum strain of *Colomerus vitis* (Pagenstecher) (Acari, Eriophyidae) found on wild grapevine populations from southern Spain (Andalusia)

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Summary

The Eurasian wild grapevine, *Vitis vinifera* L. subspecies *sylvestris* (Gmelin,) Hegi constitutes a dioecious relative of cultivated grape varieties. It constitutes an important phytogenetic resource, threatened by human activities. The most frequent phytophagous species on this European wild vine is the erineum strain of *Colomerus vitis* (Pagenstecher) (Acari, Eryophyidae). The aim of the present paper is to identify the natural enemies of the cited mite in wild grapevine populations situated in southern Spain. Results indicated that such kind of predatory biocenosis is integrated by Phytoseiidae (*Euseius stipulatus, Kampimodromus* sp., *Neoseiulella litoralis, Phytoseiulus persimilis, Typhloseiella isotricha, Typhlodromus phialatus, Typhlodromus rhenanoides*), Tydeidae (*Orthotydeus caudatus,Tydeus caudatus*), and dipteran, Cecidomyiidae (*Arthrocnodax vitis*).

K e y w o r d s : *Colomerus vitis*, erineum strain, natural enemies, *Vitis vinifera* L. subspecies *sylvestris*, southern Spain.

Introduction

The Eurasian wild grapevine, *Vitis vinifera* L. subspecies *sylvestris* (Gmelin) Hegi, constitutes a dioecious relative of the cultivated grape varieties, *Vitis vinifera* L. subspecies *sativa* (D.C.) Hegi, which are hermaphrodite. Only a very small percentage of hermaphrodite plants can be found in the wild (Anzani *et al.* 1993). Such kinds of vines were selected and domesticated by man over thousands of years (Mc Govern 2003). Over 70 % of the Iberian Peninsula cultivars display chlorotypes that are only compatible with their having derived from wild grapevine populations situated in Western Europe (Arroyo-García *et al.* 2006).

In Europe, due to the impact of several human activities, as reported from Issler (1938) to Arnold *et al.* (1998), wild grapevines are included in the red list (Iucn 1997). Their populations are, currently, disseminated around Central an Southern regions, where they occupy different kinds of habitats. Flood plains, river bank forests, colluvial positions on the slopes of mountains and sandy soils with a shallow phreatic stratum are the main ones. In Spain, the majority of the relictic populations are usually located in some parts of river-bank forests using other botanical species, shrubs and trees as a support (Ocete *et al.* 1997; Arnold 1999).

Each population is integrated by individuals with heavy ampelographical differences, due to its high genetic diversity (Grassi *et al.* 2004) and, also, exhibit different degrees of tolerance to pests and diseases (Ocete *et al.* 2004; Gallardo 2005). The Grape Erineum mite, *Colomerus vitis* (Pagenstecher) (Acari, Eriophyidae), and the powdery mildew, *Uncinula necator* Burr., a pathogen imported into Europe during the XIX century, are the widest sanitary problems affecting wild grapevine populations all over this continent (Ocete *et al.* 2000). It is necessary to underline that, at present, the incidences of both parasites are not so strong as to provoke the death of the affected vines.

The first recorded information on symptoms caused by the Grape Erineum mite was registered by Malpighi (1680) in Italy. In Spain there is no reference in the comprehensive work of De Herrera (1513), where the main pests affecting vineyards at that time were mentioned. The first written citations appeared during the XIX th century, as shown by Urien de Vega and Diego-Madrazo (1891). Nowadays, this mite appears in the majority of vineyards situated in Europe, America, Africa and Australia (Galet 1982).

Only two of the three strains of this mite caused symptoms on Spanish wild vines, the *erineum* and the *leaf curl* strains (Ocete *et al.* 2000), but all of them chose buds for hibernation. The presence of felty galls (erinea) on the lower leaf surface and blisterlike swellings on the upper one, caused by the first cited strain, are much more frequent than downward curling or rolling leaves, caused by the other cited strain. No damage caused by the *bud* strain was discovered, until now, in spite of having caused economical problems in several grape-producing regions (Keifer *et al.* 1982). The highest infestations caused in Andalusia were detected in Sherry vineyards situated in the province of Cádiz (Castillo *et al.* 1990), especially with dry weather and average temperatures situated between 26 and 32 ºC (Reyes 2004).

However, the erineum strain affects also cultivated varieties (Ravaz 1888, Kido 1981, Flaherty and Wilson 1999), among them, the international Cabernet Sauvignon cultivar shows a high susceptibility among them and also its hybrid, the rootstock 333 EM. Sometimes, chemical treatments are necessary to control this pest (Smith and Stafford 1948) mainly in commercial grape nurseries

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situated in the North and East of Spain. The identification of the natural predatory enemies of the erineum strain of several wild grapevine locations constitutes the aim of this paper, in order to contribute to the knowledge of the ecological relationships of *C. vitis* within its natural habitat, free from selective pressure caused by pesticides on cultivated vineyards, and also to investigate the biocenosis of arthropods around wild grapevine in the Iberian peninsula. The populations sampled were situated in different geographical areas of Southern Spain.

Material and Methods

Locations of wild populations were carried out in river-bank forests and sandy soils (Doñana National Park) in Andalusia, during flowering time (May-June).

Twenty five leaves with erinea were chosen at random from a maximum of ten individuals belonging to each location, in summer time, between 1999 and 2005, taking into account that several vines could not be sampled because their shoots were situated at a height of more than 20 m. Moreover, 25 winter buds from each area were also examined.

In the laboratory, leaves were put in a chamber at 4 ºC for 20 min to slow down the activity of the predatory mites. Immediately after, erinea were studied under the binocular to pick up natural enemies of this mite in action. In the case of the mites, the Berlese-Tullgren funnel was also used to obtain a gradient of temperature and humidity to extract the mites from the erinea. Buds were opened and examined directly under the binocular.

Predatory specimens of *C. vitis* were separated and introduced into tubes with ethanol (70 %) with 2 drops of glycerine. Larvae of dipterans were compared with items from the catalogue of Skuhravá (1986). Mites were cleared in lactic acid and mounted on Heinze-PVA medium. Observations were made using an interference contrast microscope. Generic nomenclature for the Phytoseiidae follows the criteria proposed by Chant and McMurtry (1994) for the Typhlodrominae and Moraes *et al.* (1986) for the Amblyseiinae.

Results and Discusion

Eleven wild grapevine populations integrated by ten vines, at least, were studied. They were spread over six of the eight provinces of the region.

The main characteristics of each location and the list of predatory natural enemies of this mite are shown in the Table.

Around only the 12 % of the erinea contained some type of natural enemies, mainly mites, Phytoseiidae (7 species), Tydeidae (2 species), and dipteran, Cecidomyiidae (1 species). In the case of predatory mites, the highest number of erinea with predatory mites was found on leaves situated between 1,5-2,5 m from the ground. The maximum number of mobile forms of predatory mites per erineum was three.

The distribution of Phytoseiidae species varies with the location of the wild grapevine populations. The most frequent, in the Subbético mountain-range is *T. rhenanoides,* species identified in 4 samples from the area, in the Cádiz and Málaga provinces; it is a mite cited by LARA and Ocete (1993) on wild grapevines in Andalusia. *T. phialatus* appears in two sites from the Sierra Morena mountain-range, situated in the Sevilla and Córdoba provinces. On the other hand, along the Rhine´s flood plains, the most frequent predators were *Euseius finlandicus* (Oudemans) while *Neuseiulella tiliarum* (Oudemans) was in the population situated in Sainte Croix en Plaine (Alsace), respectively. *Typhlodromus tiliae* (Oudemans) y *Phytoseius sp.,* were found in Ketsch (Baden-Württemberg) Natural Reserve (Ocete *et al.* 2000). *T. phialatus* can also be found in Southern vineyards such as the Sherry wine-producing area, in the province of Cádiz (Castillo *et al*. 1990); Ribera del Guadiana (Arias and Nieto 1991) and other Spanish Denominations of Origin (García-Marí *et al*. 1987; Villaronga *et al*. 1991). The latter species together with *T. pyri* and *K. aberrans* are the best represented in the majority of the Spanish vine-producing districts (Pérez Moreno 1997) and on vegetation free from chemical treatments around some French vineyards (Tixier *et al.*, 2000). In this last reference, also *T. isotricha* was referred to.

The mite *K. aberrans* constitutes the main species in vineyards situated in southern France, where it exhibits resistance to copper fungicides (Auger *et al.* 2005) and is also frequent in orchards, together with *T. rhenanoides,* and a large list of another Phytoseiidae.

The predator *P. persimilis* is common in the Iberian Peninsula on several spontaneous plants and cultivars (García-Marí *et al.* 1987). It constitutes a trading species used in biological control of Tetranychiideae (Toledo and Albujer 1985), such as the *two spotted spider mite*, *Tetranychus urticae* (Koch) as it occurs in Andalusian greenhouses (García-Marí 1994). This predator was also cited on American grapevine species (Karban *et al.*, 1995).

In reference to *T. athenas*, it is described as a predator of mites affecting hazelnut cultivars from the Mediterranean basin, as in Sicilia, where, also *T. rhenanoides* and *K. aberrans* are included, according to Moreas *et al.* (2004).

The most representative Phytoseid in Mediterranean cultivars is, probably, *E. stipulatus*, but it is only present in a small number of erinea from the population of Sevilla province. This species together with *T. phialatus*, *T. rhenanoides*, *T. phialatus* and *K. aberrans* frequently controll *Panonychus ulmi* (Koch) (Acari, Tetranychidae) on pear and apple trees orchards situated in Northeastern Spain (Sarasúa, *et al.* 2000).

Only a few adults of *N. litoralis* were found in the population of Sevilla. It is a species, also detected in Israel, common around coastal areas (Moreas *et al*. 2004).

Other very frequent species in the Mediterranean area is *P. ubiquitus*, especially feeding on eriophid fig mites. *T. caudatus* is a viviparous mite usually frequent in Hungarian vineyards (Gyoerffyne 1990), which we also found feeding on *Calipitrimerus vitis* (Nalepa) affecting wild vines in the province of Cádiz. Within winter buds, only Oribatei were found in the sample taken in Doñana National Park. It

T a b l e

Location and list of predatory natural enemies

Province	Name of the location	Coordinates	Natural enemies found
Sevilla	La Minilla dam	006º 09' 25" W, 37º 39' 34" N 006º 10' 09" W, 37º 40' 07" N	*Typhlodromus phialatus* Athias-Henriot (Acari, Phytoseiidae) *Neoseiulella litoralis* (Swirski y Amitai) (Acari, Phytoseiidae) *Euseius stipulatus* (Athias-Henriot) (Acari, Phytoseiidae) *Phytoseiulus persimilis* Athias-Henriot (Acari, Phytoseiidae)
Huelva	Doñana National Park	006º 23' 17" W, 36º 52' 29" N – 006º 23' 21" W, 36º 52' 43" N	Some individuals of *beetle mites* (Acari, Oribatei)
Jaén	Borosa river	003º 52' 18" W – 37º 29' 25" N	*Typhlodromus athenas* Swirskii y Ragusa (Acari, Phytoseiidae)
Córdoba	Valdefuentes creek	005º 07' 03" W, 38º 03' 39" N 005º 07' 45" W, 38º 03' 13" N	*Typhlodromus phialatus* Athias-Henriot *(Acari, Phytoseiidae)*
Cádiz	Los Hurones dam	005º 33' 35" W, 36º 43' 10" N 005º 33' 30" W, 36º 42' 56" N	*Kampimodromus sp.* (Acari, Phytoseiidae) *Typhloseiella isotricha* (Athias-Henriot) (Acari, Phytoseiidae) *Orthotydeus caudatus* (Dugés) (Acari, Tydeidae)
	Millán creek	005º 28' 24" W, 36º 39' 09" N 005º 28' 33" W, 36º 38' 10" N	*Orthotydeus caudatus* (Dugés) (Acari, Tydeidae) *Pronematus ubiquitus* (Mc Gregor) (Acari, Tydieidae)
	El Bosque river	005º 29' 47" W, 36º 46' 11" N 005º 28' 43" W, 36º 46' 19" N	*Typhlodromus rhenanoides* Athias-Henriot (Acari, Phytoseiidae) *Arthrocnodax vitis* Rübsaamen (Diptera, Cecidomyiidae)
	Tavizna river	005º 29' 46" W, 36º 43' 28" N 005º 29' 46" W, 36º 43' 27" N	*Typhlodromus rhenanoides* Athias-Henriot (Acari, Phytoseiidae) *Arthrocnodax vitis* Rübsaamen (Diptera, Cecidomyiidae)
	Los Parralejos creek	006º 59' 09" W, 36º 17' 01" N 006º 58' 55" W, 36º 17' 02" N	*Tydeus caudatus* (Dugés) (Acari, Tydeidae)
	El Chorreadero creek	005º 29' 55" W, 36º 49' 23" N 005º 29' 35" W, 36º 49' 17" N	*Typhlodromus rhenanoides* Athias-Henriot (Acari, Phytoseiidae) *Arthrocnodax vitis* Rübsaamen (Diptera, Cecidomyiidae)
Málaga	Turón river	004º 57' 58" W, 36º47'03" N 004º 55' 33" W, 36º47'54" N	*Typhlodromus rhenanoides* Athias-Henriot (Acari, Phytoseiidae) *Arthrocnodax vitis* Rübsaamen (Diptera, Cecidomyiidae)

is a curious fact, because their common habitat is in soil.

The gall-midge *A. vitis* was described by Rübsaamen (1895) as a predator of *C. vitis* in German vineyards. This dipteran is frequent in four populations situated along the Subbético mountain range, in the provinces of Cádiz and Málaga, where between one and three larvae per erineum are registered, as it was refered previously by Ocete and Skuhravá (1995). This dipteran was always observed accompanied by *T. rhenanoides*. There is not any citation on *A. vitis*, up to the present, in Spanish vineyards. In spite of this, there are current references in some Italian vineyards (Sasso and Viggiani 2002).

Finally, it is necessary to emphasize that the biodiversity of natural enemies of *C. vitis* is higher than the exhibited one in the Sherry Denomination of Origin, with a surface of 10,500 ha, where the only representative species are *T. phialatus*, and much more secondarily *T. pyri*. Their abundance is higher in those 4,500 ha under mating-disruption system, using sex pheromone dispensers, against the grape moth, *Lobesia botrana* (Denis & Schiffermüller) (Lepidoptera, Tortricidae), with a minor incidence of conventional chemical treatments (Atria-Viña, 2000-2004).

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Received January 23, 2007