Vineyard colonisation by predaceous mites (Acari: Phytoseiidae) living in surrounding vegetation

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Vineyard colonisation by predaceous mites (Acari: Phytoseiidae) living in surrounding vegetation. A three year study in the south of France

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Abstract

The aim of this work was to study the colonization by phytoseiid mites living in neighboring uncultivated areas of a vineyard in the South of France. The experimental vine plot was co-planted with *Sorbus domestica* in a framework of agroforestery investigations. This study was carried out during 3 years (1999, 2000 and 2001) in a vine plot planted in 1997. Phytoseiid mites have been collected in cultivated and uncultivated areas surrounding the experimental plot. Dispersal of these mites into the plot has been studied using aerial traps. Phytoseiid mites have been observed in the surrounding cultivated and uncultivated areas. However, densities were quite low. Phytoseiid mites dispersed into the experimental plot, but low densities of mites have been caught. Nevertheless, these densities seemed to be sufficient to provide efficient biological control against phytophagous mites. *Typhlodromus exhilaratus* was the main species trapped. This species was also the main phytoseiid mite collected in the experimental vine field and on *S. domestica* trees. Densities of mites in the vine field have increased during the three years. Phytoseiid mites seemed to have successfully colonized the experimental vine plot, but *Kampimodromus aberrans*, the species usually collected in vineyards of South of France, was not the main species observed in this case. The reasons of this colonization process is discussed here.

Introduction

The presence of predatory mites, belonging to the family of Phytoseiidae, in uncultivated areas neighboring vine plots has been widely reported (Boller *et al.* 1988; Duso 1992; Coiutti 1993; Duso *et al.* 1993; Ragusa *et al.* 1995; Duso and Fontana 1996; Tixier *et al.* 2000). Several studies have shown that diversity and abundance of phytoseiid mite species in these areas could be affected by plant composition due to the influence of plant leaf characteristics (i.e. pilosity) on mite development (Tixier *et al.* 1998, 2000; Kreiter *et al.* 2002). Great relations between phylloplan and *Kampimodromus aberrans* (Oudemans), the main phytoseiid mite species in vineyards of the Southern France and Europe, has been observed (Villaronga *et al.* 1991; Camporese and Duso 1996; Perez *et al.* 1997; Duso and Vettorazzo 1999; Kreiter *et al.* 2001).

However, little is known about mite exchanges between uncultivated and cultivated areas. Some studies have shown that phytoseiid mite disperse from uncultivated hedges, to cultivated areas, orchards and vineyards, by aerial dispersal supported by wind (Hoy *et al.*, 1984, 1985; Tixier *et al.* 1998, 2000). In a previous study conduced in South of France, it has been shown that high densities of *K. aberrans* were present in uncultivated areas bordering a vineyard and dispersed into the plot. Furthermore, this important exchange seemed to be sufficient to provide efficient biological control against phytophagous mites (Tixier *et al.* 2000, 2001). However, despite these positive results, many interrogations still exist. One concerns settlement of migrants as little gene flow has been observed between *K. aberrans* populations living in the vine plot and outside (Tixier *et al.* 2002).

Thus, the first aim of the present work is to study the colonization process in a newly planted vine plot, after declaiming of land for cultivation and to determine if results obtained previously could be generalized. The plot studied in the present work was co-planted with trees, *Sorbus domestica* L. in a framework of agroforestery investigations. Few studies deal with the influence of inter-cropping on mite communities and most of them concern herbaceous plants (Corbett *et al.* 1991; Toko *et al.* 1996; Castagnoli *et al.* 1997; Lozzia *et al.* 1998). Thus, this study also aims to determine the impact of co-plantation of vine with *S. domestica* on mite communities within the vine plot.

Material and Methods

The experimental vine field

The experimental plot studied was a productive vine plot located in Restinclières (15 km, North of Montpellier, South of France). This plot of 4494 m^2 (plantation density: 2.5 m × 1 m) has been planted in 1997 with two vine cultivars, Syrah and Grenache. This plantation has occurred on uncultivated areas, after declaiming land for cultivation. In this plot, the 6 rows of *S. domestica* have been sampled to characterize mite populations present on these trees (Fig. 1). The main pesticide treatments applied in the experimental plot during three years were fungicides essentially to protect the vine against powdery and downy mildew. However, these applications have been very scarce during these three years due to the youth of the vine plot. Two to four applications of fungicides have been applied each year. Two or three insecticide applications have also been applied in the plot each year, especially to control populations of *Scaphoideus titanus* Ball, a leafhopper vector of a serious vine mycoplasma, "the golden flavescence". All pesticides applied were selected taking into account their side effects on phytoseiid mites (Sentenac *et al.* 1999). No acaricide has been applied during these three years. This experimental plot was surrounded both by uncultivated areas, bearing essentially *Pinus* sp. L. and *Quercus* sp., and by other cultivated vine plots, also planted like the experimental plot in 1997 on declaimed land.

Surveys have been conducted in this vine field during 1999, 2000 and 2001.

Phytoseiid mites in the surrounding environment

Samplings of all the plants in the uncultivated surrounding areas have been carried out during these 3 years, 2 or 3 times per year (Fig. 1). At least 50 leaves per plant have been collected for each sample date. Each plant species presented different phytoseiid mite densities, and each of the uncultivated areas surrounding the experimental plot had a different plant composition (in abundance and dominance of plants). In order to compare the total densities of phytoseiid mites in the different uncultivated areas, an index called « Woody Richness » was used (WR; Tixier *et al.* 1998) = S (abundance-dominance of a plant species × the densities of phytoseiid mites on this plant / leaf) where: 1 = plants are rare, < 5 % of the canopy; 2 = abundant, 5-25 %; 3 = more abundant, 25-50 %; 4 = very abundant, 50-75 %; and 5 = dominant, >75 %. This index was especially useful to compare phytoseiid mite abundances in various uncultivated areas with different kind of host plants, and different canopy surfaces. It cannot be used alone to quantify phytoseiid mite abundances. In order to determine a putative gradient of colonization from remote environment, especially concerning the species *K. aberrans*, that was hardly present nearby the experimental plot, transects have been carried out once a year in 2000 and 2001 in three directions (North-East, North-West, South), the prevailing wind directions in the region. Samplings have been taken each 100 meters for 1 km

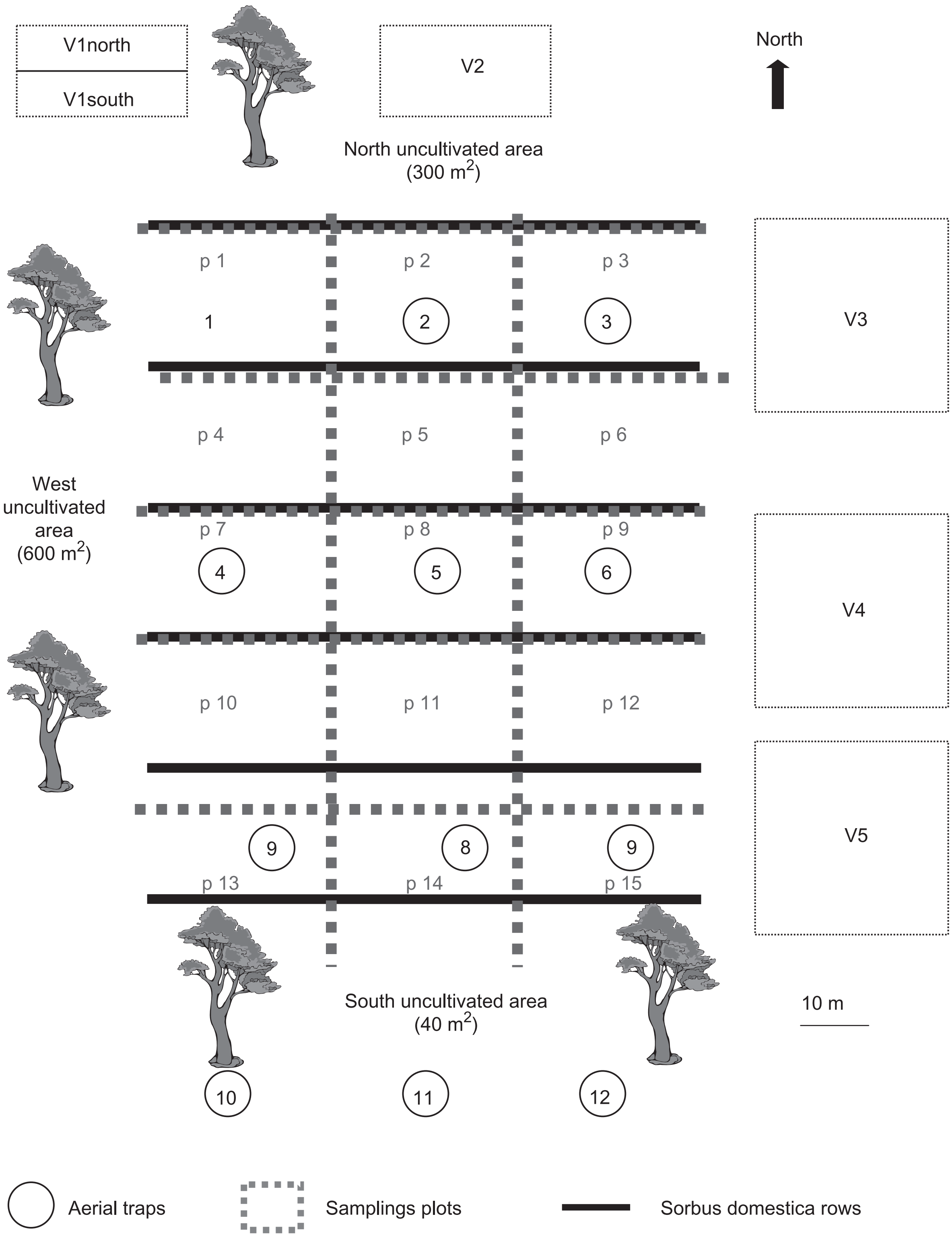

Figure 1. Presentation of the experimental vine plot (Restinclières, South of France). The sampling dates for the different areas are as follow: surrounding uncultivated areas: 1999: 25/V, 06/VII, 17/VIII; 2000: 02/V, 05/VI, 16/VIII; 2001: 15/V, 10/VII, 21/VIII; the neighbouring vine plots: 2000: 09/V, 20/VI, 01/VIII; 2001: 22/V, 17/VII, 21/VIII; the experimental vine field: 1999: 18/V, 22/VI, 22/VII, 31/VIII; 2000: 16/V, 27/VI, 25/VII, 22/VIII; 2001: 24/IV, 29/V, 26/VI, 24/VII, 04/IX.

for each direction on different plants. At each collecting site, all the plants have been sampled taking at least 50 leaves per plant.

Samples have also been carried out 3 times per year (2000 and 2001) in 6 cultivated vine plots located nearby the experimental plot (Fig. 1). In 1999, the vine plants were young and no leaf was sampled in these plots. Each neighboring vine field has been divided in several small plots. Each of these small plots of 400-600 vine-stocks, was planted with a different vine cultivar (Syrah or Grenache). At least, 30 leaves have been collected in each plot for each sampling date (Fig. 1).

Phytoseiid mite populations in the experimental vine plot

To determine how the settlement of migrants occurred, the experimental plot has been divided into 15 small plots of approximately 100 vine-stocks each. At least, 20 leaves have been collected in these plots for each sample date. Samplings have also been carried out for the same dates on the 6 rows of *S. domestica*, taking at least 30 leaves per row. Phytoseiid mites were removed from leaves using Berlese-Tullgren funnels method or the washing method (Boller, 1984). Then, phytoseiid mites were counted with a binocular microscope at 40X magnification, and mounted in Hoyer's medium on slides and identified with taxonomic keys following the generic concepts of Moraes *et al.* (2004) and Chant and McMurtry (1994).

Phytoseiid mite dispersal into the experimental vine plot

In order to estimate the dispersal of phytoseiid mites into the vine plot, traps used for aerial captures, called aerial traps, have been placed into the experimental plot, during three years. These traps comprised plastic funnels (31 cm of diameter) filled with water, and placed one meter above the vegetation on glued sticks (Tixier *et al.* 1998, 2000) (Fig. 1). The 12 traps placed in the experimental vine plot were inspected weekly. The funnels contents were filtered through 100 μm sieves and the mites were counted, mounted on slides and identified.

Statistical analysis

Non parametric ANOVA, followed by a Newman and Keuls mean comparison test (Statistica 1998) was used to compare the number of phytoseiid mites trapped in the different funnels, and the phytoseiid mite densities in the different vine plots and parts on the experimental vine field. The numbers of phytoseiid mites trapped were converted into numbers of phytoseiid mites migrating on one vine leaf. This conversion follows the relation proposed by Tixier *et al.* (2000) based on two factors: the estimation of the vegetation area that could actually be reached by phytoseiid mites and the transformation of this surface into a leaf number where migrants are able to develop. The estimation was based on the work of Carbonneau (1995) who defined the foliar surface potentially exposed to solar radiation. In our study, this surface was assumed to be similar to that exposed to the wind. The values used for the calculation of this estimation were: height and width of the vegetation: 1m and 0.5 m respectively, funnel area: 0.0707 m2, number of leaves/vine-stock: 200.

Results

Phytoseiid mites in the wild uncultivated surrounding environment

During the 3 years, the phytoseiid mite abundance (WR indexes) in the 3 uncultivated areas bordering the experimental vine field was not significantly different ($F(2,21)=0.55$, $P=0.58$) (Fig. 2). From 1999 to 2000, phytoseiid mite density increased in all these areas, but in 2001, this density was very low in all areas (Fig. 2). The density of phytoseiid mites was high early in the season (May) and then decreased during summer, except in 2001. This is a typical time variation of phytoseiid mites (Ivancich Gambarro 1987; Malison 1994), susceptibility to hot and dry conditions during summer. All the wild plants were not equally colonized by phytoseiid mites. Among the 35 plants sampled, only some: *Lonicera* sp, *Viburnum tinus* L., *Rubus* sp. and *Cornus* sp. presented great phytoseiid mite densities. For the 31 other plants sampled in the uncultivated environment, the densities observed were very low and mite occurrence not regular.

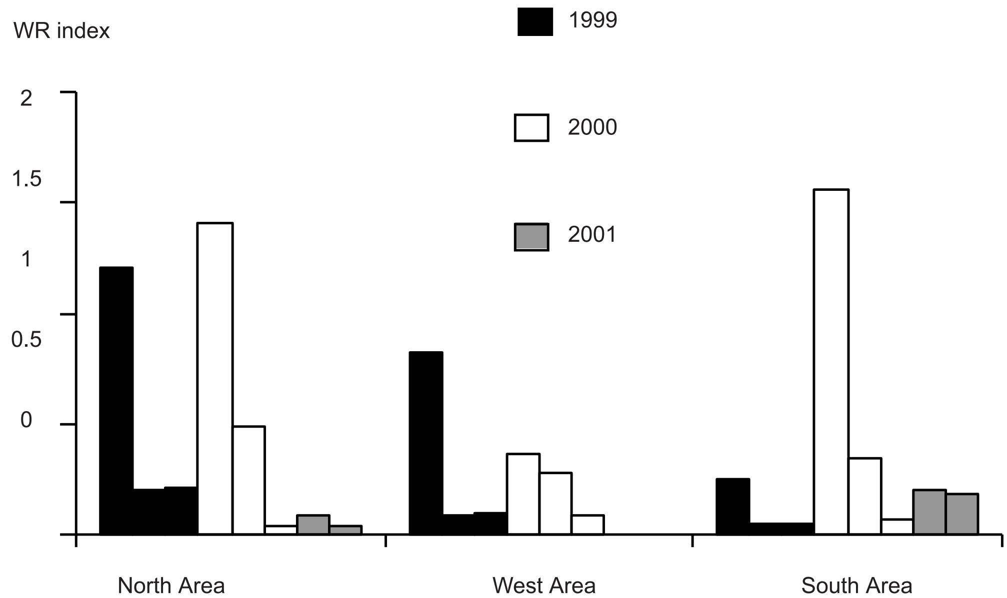

Figure 2. WR indexes (Woody richness: abundance of phytoseiid mites) obtained for the three uncultivated areas surrounding the experimental plot in 1999, 2000 and 2001.

Fourteen phytoseiid mite species have been sampled in the uncultivated areas surrounding the experimental vine field. *Typhlodromus exhilaratus* Ragusa and *Typhlodromus phialatus* Athias-Henriot were the two main species collected (Table 2). *Typhloseiella isotricha* Athias-Henriot, only found on *Inula viscosa* L., was regularly collected. At least, species like *Typhlodromus bacettii* Lombardini, *K. aberrans*, *Typhlodromus recki* (Wainstein) have been observed each year but their host plant varied (Table 2).

In 2000 and 2001, samplings carried out in the three transects directions, showed the presence of great densities of *K. aberrans* in some areas, on different plants at least 800 meters away from the plot, especially on *Celtis australis* L. and *Juniperus* sp. for the South transect and on *Quercus pubescens* Willdenow for North-East transect. However, the main species sampled for the three directions of the transects for both years was *T. exhilaratus*.

Phytoseiid mites in the cultivated environment

Phytoseiid mites have been observed in the 6 neighbouring vine plots. No significant difference has been observed between the phytoseiid mite densities in these 6 vine plots during the three years ($F(5,24)=1.10$; $P=0.34$). No significant difference has been observed between the different vine cultivars (Grenache and Syrah), either ($F(1,42)=3.02$; $P=0.89$). From 2000 to 2001, a great population increase has been observed for all the plots, except from V5. The density increased in average from 0.065 phytoseiid /leaf to 0.18 phytoseiid/leaf (Fig. 3) ($F(1,9)=0.03$; $P=0.035$).

The diversity of phytoseiid mites inhabiting the neighboring vine plots has also changed between 2000 and 2001. Four species have been collected for both years but the proportions of each species have greatly changed. In 2000, *Neoseiulus californicus* (McGregor) constituted the most important phytoseiid mite species, especially in three plots (V3, V4 and V5). In 2001, *T. exhilaratus* was the unique species collected in all the neighboring vine plots.

Phytoseiid mites dispersal into the experimental vine plot

Phytoseiid mites have been captured in all the aerial traps into the experimental vine field during the three years.

The densities of phytoseiid mites trapped were significantly different between the 3 years ($F(2,33)= 6.11$;

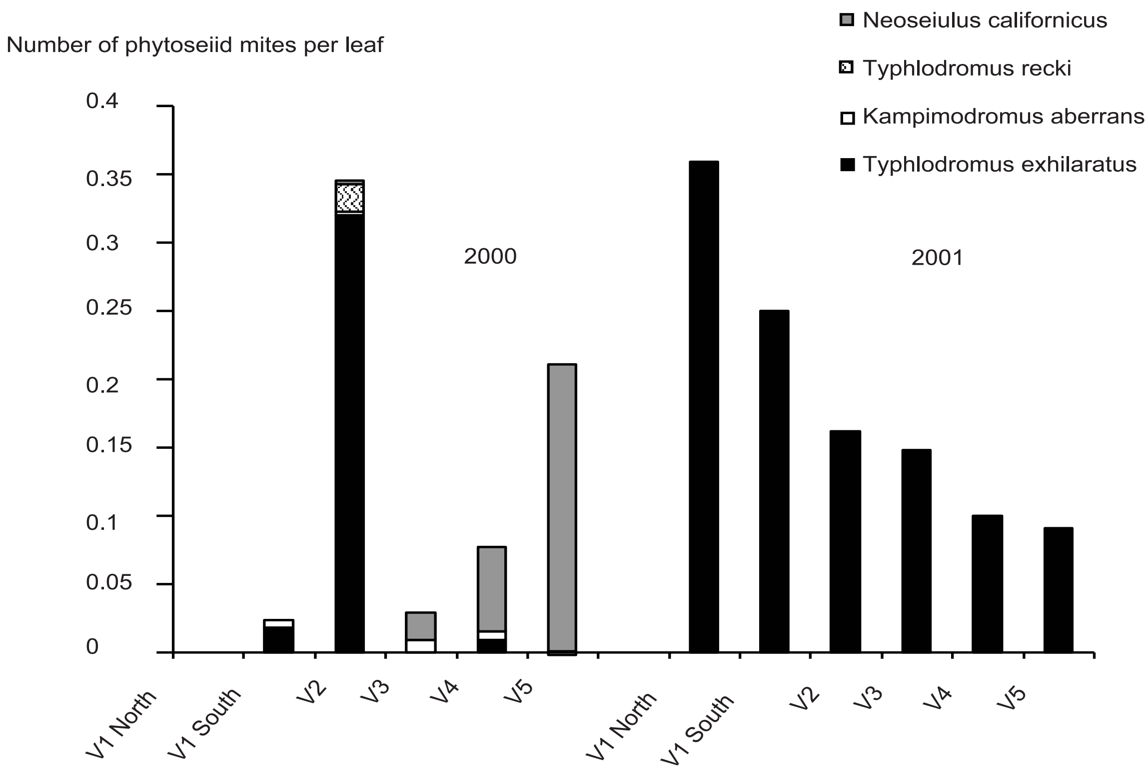

Figure 3. Phytoseiid mite densities and diversity in the neighbouring vine fields in 2000 and 2001.

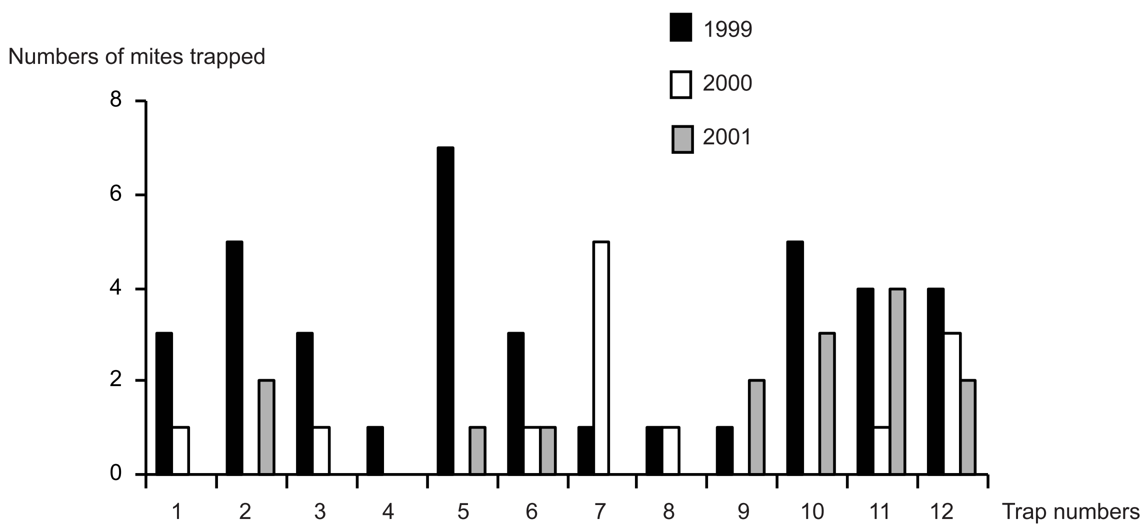

Figure 4. Phytoseiid mite number trapped in the 12 aerial traps located into the experimental vine plot in 1999, 2000 and 2001.

P=0.005) (Fig. 4). Greater phytoseiid mite numbers have been trapped in 1999 (3.01 phytoseiids/trap/year) compared to 2000 (1.08 phytoseiids/trap/year) and 2001 (1.25 phytoseiids/trap/year). The conversion of these densities in a number of mites able to colonize a vine leaf, shows that these numbers were quite important reaching in average 0.23 phytoseiids/leaf/year (minimum: 0.18, maximum: 0.33).

The mite densities captured in the 12 traps were not significantly different ($F(11,24)=0.66$; $P=0.75$). No significant difference has been observed even when traps were grouped by horizontal lines ($F(3,32)=1.46$; $P=0.24$) (Fig. 4).

Unlike in 1999 and 2000, where higher densities of mites have been trapped in July, the most important number of phytoseiid mites have been captured in May, in 2001. Seventeen species of phytoseiid mites have been trapped in the funnels during the three years (Table 1). Some species like *T. baccettii*, *Typhlodromus cryptus* (Athias-Henriot), *Typhlodromus intercalaris* (Livshitz and Kuznetsov), *T. isotricha*, *T. phialatus*, *Amblyseiella rusticana* (Athias-Henriot), *Typhloseiulus carmonae* (Chant and Yoshida-Schaul), *Typhlodromus athiasae* Porath and Swirski, *Proprioseiopsis* sp. and *Typhloseiulus eleonarae* Ragusa have been trapped only one time, especially in 1999. Two species (*T. exhilara-*

Table 1. Number and proportions of phytoseiid mites captured in aerial traps in 1999, 2000 and 2001.

	1999	*2000*	*2001*	*Total*	*%*
Kampimodromus aberrans	0	7	1	8	13.8
Typhlodromus exhilaratus	0	5	6	11	19.0
Typhlodromus recki	1	2	0	3	5.2
Typhloseiulus carmonae	0	2	0	2	3.4
Typhloseiulus athiasae	0	1	0	1	1.7
Euseius stipulatus	0	1	1	2	3.4
Proprioseiopsis sp.	0	1	0	1	1.7
Neoseiulus cucumeris	0	0	1	1	1.7
Neoseiulus aurescens	2	0	1	3	5.2
Typhlodromus corticis	0	0	1	1	1.7
Typhlodromus rhenanus	0	0	3	3	5.2
Typhlodromus barkeri	2	0	0	2	3.4
Typhlodromus cryptus	6	0	0	6	10.3
Typhlodromus intercalaris	2	0	0	2	3.4
Typhloseiella isotricha	1	0	0	1	1.7
Typhlodromus phialatus	2	0	0	2	3.4
Amblyseius rusticanus	1	0	0	1	1.7
Immatures	6	1	1	8	13.8

Table 2. Proportion of phytoseiid mite species sampled in the uncultivated areas surrounding the experimental vine plot in 1999, 2000 and 2001.

Kampimodromus aberrans	2
Neoseiulus graminis	1
Typhlodromus bacettii	1
Typhlodromus exhilaratus	44
Typhlodromus phialatus	4
Typhlodromus recki	7
Typhlodromus rhenanus	3
Typhloseiulus elonorae	1

tus and *K. aberrans*) have been mostly captured during 2000 and 2001.

Phytoseiid mites in the experimental vine plot

The phytoseiid mite densities collected in the 15 small plots were not significantly different ($F(14,174)=0.64$; $P=0.82$) (Fig. 5a). However, significant different densities were observed between plots harboring different vine cultivars ($F(1,187)=9.68$; $P=0.02$). The number of mites collected on the Syrah (0.14 phytoseiid/leaf) vine cultivar was higher than the number of mites collected on the Grenache cultivar (0.05 phytoseiid/leaf). However, this result must be interpreted with caution due to the small densities considered.

Densities of mites were high in May and then decreased during summer. In August 2001, a large population increase has been observed (Fig. 5b). *T. exhilaratus* was the main species sampled in the experimental vine field in 2000 and 2001. Some mites belonging to *K. aberrans* have been observed during the three years, but they were very few and their location in the plot changed each year.

From 1999 to 2001, phytoseiid mite density has greatly increased. The diversity of phytoseiid mites has also changed. This plot seemed to be nearly exclusively colonized in 2001 by *T. exhilaratus*.

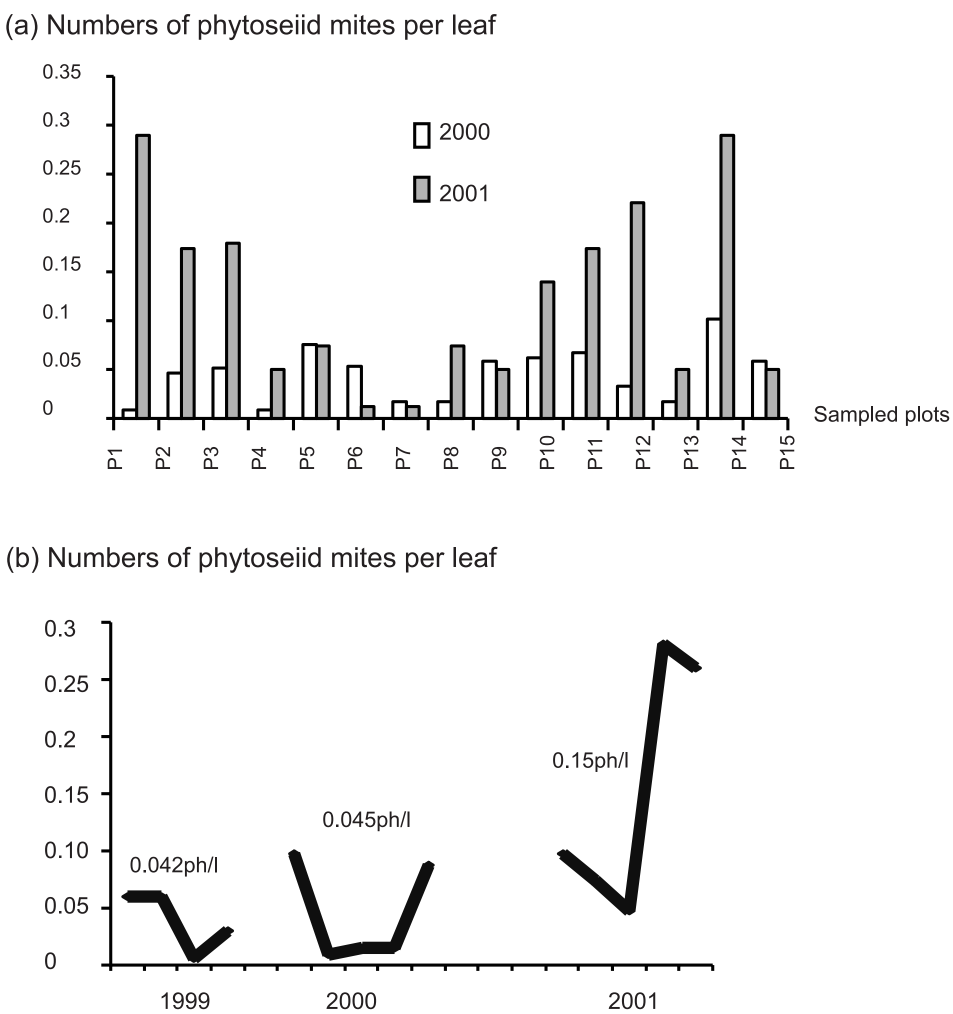

Figure 5. (a) Phytoseiid mite densities sampled in the 15 small plots into the experimental vine field in 2000 and 2001. (b) Variation of phytoseiid mite densities sampled in the experimental vine field in 1999, 2000 and 2001. Numbers above the curves correspond to the mean number of mites per leaf sampled for each year.

Mites have been observed on *S. domestica*. However, the densities and the diversity of phytoseiid mites changed each year. The density of mites was not significantly different according to the lines considered (F $(5,42)=0.36$; $P=0.87$). *T. exhilaratus* was the most important species encountered. *K. aberrans* and *T. recki* were also collected irregularly on these trees. Furthermore, *Tetranychus turkestani* Ugarov and Nikolski has been found several times on *S. domestica*.

Discussion

The results obtained in the present study were quite different from those of the previous study conducted in South of France (Tixier *et al.* 1998, 2000, 2002). Even if phytoseiid mites have been observed in the cultivated and uncultivated surrounding environment in both studies, lower mite numbers were found in the present investigation. In the previous study, the environment carried numerous trees and shrubs especially *Q. pubescens*, *C. australis*, *Rubus* sp. and *Ulmus* sp., all suitable for phytoseiid mite development and bearing high densities of mites per leaf (Tixier *et al.* 1998, 2000). In the present study, the structure and the diversity of the natural vegetation surrounding the experimental plot were completely different. The most numerous trees surrounding the experimental plot were *Pinus* sp. and *Quercus ilex* L, where small densities of phytoseiid mites have been found. Only some plants (*V. tinus* L., *Lonicera* sp., *Rubus* sp.), generally scarcely spread, except for *V. tinus*, harbored regularly high densities of phytoseiid mites. This study confirms the importance of plant diversity on the presence and the abundance of phytoseiid mites in uncultivated areas (Duso *et al.* 1993; Tixier *et al.* 2000).

The highest densities of phytoseiid mites have been observed early in the season, usually in May. This observation may be due to favorable climatic conditions (lower temperature and higher humidity) (Ivancich Gambaro 1987; Malison 1994). Furthermore, this observation could also be due to the presence of high quantity of food, particularly of pollen, during this season. The development of *T. exhilaratus* is for example, important when feeding on pollen of *Rosmarinus officinalis* L. (Ragusa 1981), well presented in the uncultivated environment of the experimental plot. This occurrence of food could also explain the presence of phytoseiid mites on a larger number of plant species in spring than later in summer.

The densities of phytoseiid mites were higher in neighboring vine crops, especially in 2001. Only, 3 species (*T. exhilaratus*, *T. recki* and *K. aberrans*) have been found each year, but *T. exhilaratus* was the dominant species.

K. aberrans has been found each year in the surrounding environment. However, its densities were very low and it has never been observed regularly on the same plant, even within the same year. This observation could show a bad adaptation of this species in the environment considered (habitat, food, competition, climatic conditions). On the opposite, the dominance of *T. exhilaratus* could be due for example to the adaptation of this mite to dry and hot climatic conditions (Liguori and Guidi 1995) (see below).

Phytoseiid mites have been trapped in the aerial funnels which, confirms that these predators can be dispersed by wind. This observation confirms previous results showing the dispersal of phytoseiid mites into crops (Hoy *et al.* 1984, 1985; Tixier *et al.* 1998, 2000). However, mite densities were lower than in the previous study. This result must be directly linked to the low abundance of mites (WR indexes) in the surrounding environment. Even if the number of phytoseiid mites trapped was relatively low, these average densities of 0.23 mite per leaf per year seemed to be sufficient to ensure rapid and efficient colonization of vineyards as no acaricide application has been required during the 3 years. However, the lack of phytophagous mites could be due to the relative remoteness of the plot from other "old" cultivated areas. The dispersal of phytoseiid mites into the plot was homogenous and no dispersal gradient from the woody margins has been observed. Several factors could explain this observation. At first, the experimental plot had a small surface and migrants could easily colonize all parts of the plot. The presence of phytoseiid mites in the 3 woody margins surrounding the present plot on one hand and no prevailing wind direction on the other hand could also contribute to bring a homogenous colonization of the plot by the mites present in the nearby environment. However, the random distribution of the trapped mites in the experimental plot could also indicate that these mites came from remote places. However, even if this hypotheses could not be excluded, we could assume, according to the biology of phytoseiid mite species considered (McMurtry and Croft 1997), that a very few proportion of mites come from remote places compare to mites coming from the surroundings.

Numerous phytoseiid species have been captured in the experimental vine field. However, many of these species have only been trapped once or during only one year. Some species, like *T. exhilaratus* and *K. aberrans*, have been regularly captured. *Typhlodromus exhilaratus* was the main species found in the surrounding cultivated and uncultivated environment. *K. aberrans*, however, was hardly found in the neighboring areas. This species has been collected in transects but in remote places (800 meters from the plot), both in the South and North West directions. As this species is reported as having a small dispersal ability (Fauvel and Cotton 1981; Perrot-Minnot 1990), dispersal over short distances can occur. As early as 1999 (first year of plantation), phytoseiid mites have been observed in the experimental vine plot. Despite the pesticide applications, the densities of these predators have increased from 1999 to 2001. This augmentation was homogenous in the whole vine field, as no difference between the 15 small plots has been observed. This observation agrees with the space homogeneity observed for the trapped mites. However, mite densities were different on the two vine cultivars. Higher densities of phytoseiid mites have been observed on Syrah, compare to Grenache. This result confirms the importance of leaf characteristics for the development of phytoseiid mites (Karban *et al.* 1995; Kreiter *et al.* 2002) as the leaves of the cultivar Grenache are glabrous and those of Syrah cultivar have a relatively high density of trichomes (Oiv-Upov-Ipgri 1997). However, the differences between densities observed on the two cultivars were tiny and no cultivar influence has been observed for the neighboring vine crops. The relation between phytoseiid mite densities and vine leaf pilosity have been emphasized several times (Duso 1992; Camporese and Duso 1996; Castagnoli *et al.* 1997; Kreiter *et al.* 2002), but not for *T. exhilaratus.* This species is found on numerous plant species. Even if pilosity could affect punctually its abundance, this factor is certainly not the most determining for the development of this species. *T. exhilaratus* was indeed the unique species found on glabrous vine cultivar in studies conduced in Italy (Castagnoli *et al.* 1997). Trees co-planted with vine also harbored phytoseiid mites, but densities were quite low. The same species were found on vine and on *S. domestica*. This observation shows the putative exchange between these two populations. High densities of tetranychid mites have been observed on these trees. However, the species mainly encountered, namely, *T. turkestani* is rarely found on vine in France (Bolland *et al.* 1998), and no impact of this occurrence has been observed on pest mite development in the vine plot. These tetranychid mites could constitute alternative food for predatory mites living in the vine plot.

T. exhilaratus was the main species collected in the experimental plot, like in surrounding vineyards and wild vegetation. This species seems to be adapted to the local conditions of the experimental plot and site. It is one of the most widespread phytoseiid mite species in central and southern Italy. It is very common on various plants and especially in vineyards, for example in Greece (Papaioannou-Souliotis *et al.* 1999). This species could feed on different phytophagous mites namely, *Panonychus ulmi* (Koch), *Eotetranychus carpini* (Oudemans) and *Colomerus vitis* (Pagenstecher), pests also found in vineyards in South of France (Castagnoli and Liguori 1986; Castagnoli *et al.* 1989). This species is a generalist predator, belonging to the group III defined by McMurtry and Croft (1997). Its development ability is great when it feeds on prey and/or pollen, especially *Q. ilex* and *Q. pubescens* pollen (Castagnoli and Liguori 1986; Liguori and Guidi 1990). In the present experimental site, *Q. ilex* is very abundant. This pollen availability could constitute one explanation for the presence and dominance of this species in this sampled area. This species can also feed on alternative prey like crawlers, especially *Phenacoccus madeirensis* Green (Ragusa and Tsolakis 1995). Furthermore, *T. exhilaratus* is very common in various habitats in hot and dry climatic conditions and shows some tolerance to low humidity. At 25°C, 55% RH (relative humidity), more than 50% of eggs hatch (Liguori and Guidi 1995). *K. aberrans* which is the most important and common species in vineyards of South of France (Kreiter *et al.* 1993, 2000) was rarely found in the experimental vine plot. Judging from the numbers of this species collected during 2000, in both the neighboring environment and in the experimental plot, it seems as if this species is beginning to colonize of the area studied. However, in 2001, this species was seldom present. *K. aberrans* seems not to be able to settle in the plot and in its environment. Several factors could explain this. At first, Tsolakis *et al.* (1997) have shown that *K. aberrans* is more abundant at the margins of cultivated plots than in more remote uncultivated places. Authors assume that this species is adapted to crop practices and especially to pesticide sprayings. This species is hardly found in old unsprayed vine plots (Tixier *et al.* 2000). In the present study, very few pesticides have been applied to the plot each year and *K. aberrans* may be not competitive in such an environment compare to *T. exhilaratus*. However, other factors like climatic conditions could also be involved. Schausberger (1998) observed a mortality rate for *K. aberrans* of 30 % at 65% RH, and a RH_{50} more important than 55%. This species seems to be less tolerant to dry climatic conditions than *T. exhilaratus*. Furthermore, Malison (1994) also showed that the development of *K. aberrans* is affected by water stressed vine plants. In the present study, climatic conditions are particularly dry and vine plants smaller, limiting humidity level at the canopy level. In the surrounding environment, wild plants are also adapted to dry conditions and do not have pilose leaves, that would limit the impact of low humidity on mite populations, especially for *K. aberrans*, that is exclusively found in high densities on pilose plants (Kreiter *et al.* 2002).

This study shows a successful colonization of a newly planted vine plot by phytoseiid mites coming from uncultivated surroundings. These observations confirm the importance of these uncultivated areas and provide an additional proof of the agronomic impact of such areas. In the present study, *K. aberrans* was not the main species colonizing the plot, as it was expected. This bad colonizing of *K. aberrans* can be linked to previous results concerning the bad colonizing of *K. aberrans* migrating into a vine plot (Tixier *et al.* 2000, 2002). The management of this species seems to be difficult. Climatic conditions, plant diversity and cultural practices could explain such observations, and experiments will be carried out next year to confirm this colonization trend and the importance of *T. exhilaratus*. In order to determine the relationships between the different populations of *T. exhilaratus*, in the experimental vine field (on vine and *S. domestica*) and its environment, molecular typing will be included in future investigations.

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