European larch (*Larix decidua*) and sweet chestnut (*Castanea sativa*) as host plants of spruce spider mites (*Oligonychus ununguis* Jacobi)

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Abstract: Our experiments show the lack of acceptance of *Larix decidua* and *Castanea sativa* as host plants for spruce spider mites (*Oligonychus ununguis* Jacobi) collected from spruce cultivars (*Picea glauca* ‘Conica’ and *P. abies* ‘Nidiformis’). The maximum life span of females was 7 days on both larch and sweet chestnut. During their lifetime, females deposited 1.3–1.6 eggs on larch shoots. The development of spruce spider mites on larch terminated at the nymphal stage. None of the females oviposited on sweet chestnut leaves.

Key words: spruce spider mite, sweet chestnut, larch, mortality, fecundity

INTRODUCTION

The spruce spider mite (*Oligonychus ununguis* Jacobi) is a typical polyphagous mite inhabiting many species of coniferous ornamental plants. In Poland it has been found on over 90 taxa of conifers (CZAJKOWSKA et al. 2001, PUCHALSKA 2003). Research on its occurrence on various coniferous taxa showed an interaction between the host plant taxon and the rate of its colonization by the pest. The genus most frequently and abundantly inhabited under Polish conditions by spruce spider mites was spruce (CZAJKOWSKA et al. 2001, PRZYGOUDA 2001, PUCHALSKA 2003). Further studies showed that within this genus there are some taxa particularly abundantly inhabited by *O. ununguis* (*P. pungens* ‘Glaucá’, *P. abies*, *P. abies* ‘Nidiformis’, *P. glauca* ‘Conica’), while some others are reluctantly attacked by the mite (*P. abies* ‘Virgata’). The various mite reactions to food type are well documented (PAINTER 1951, TOMCZYK et al. 1988, SMITH 1998). The morphology and anatomy as well as biochemical compounds of a plant can decide on its acceptance by phytophages (PUCHALSKA 2003).

Detailed research on spruce spider mite bionomics has revealed a considerable impact of the host plant on the development and reproductive potential of this mite
species (Boyne & Hain 1983, Gotoh 1984, Czajkowska et al. 2003). The wide range of *O. ununguis* host plants (spruces, pines, firs, thuja, false cypresses, junipers, etc.) does not mean that they are all equally attractive for the mite (Lehman 1998, Łabowski et al. 2001, Czajkowska et al. 2001). Information about the occurrence of *O. ununguis* on larches – *Larix decidua*, *L. sibirica*, and *L. kaempferi* – raises much controversy. Both in Polish (Wich 1995) and foreign (Scheller 1961, Jeppson et al. 1975, Wilson 1977) literature the listed species of larch are classified as host plants for spruce spider mites. The reports of the researchers mentioned above were questioned by Boczek and Kropczynska (1964) and by Łabowski et al. (2001), who claim that in Poland, plants of the genus *Larix* are inhabited by Oligonychus laricis Reeves.

Apart from coniferous plants, also some species of broadleaves are considered by Japanese and Chinese researchers as host plants for *O. ununguis*, namely *Quercus* spp. (Gotoh 1984, Sun et al. 1995) and *Castanea* spp. (Saito 1983, Gotoh 1984). However, this was not confirmed by results obtained later by Sun et al. (1999, 2000), who discovered sexual isolation between populations of spruce spider mites collected from coniferous and broadleaf plants (sweet chestnut, oak). The mites were paired by those authors as follows: a male coming from a coniferous plant with a female coming from a deciduous plant and the other way round. Although copulation took place, only few females oviposited. From those eggs, exclusively males hatched, proving the lack of fertilization and of reproduction by parthenogenesis. Moreover, the mites collected from sweet chestnut and oak and next transferred onto spruce shoots did not complete the development but died after reaching a nymphal stage.

Anyway in the literature there was no unequivocal statement about distinction between spruce spider mite populations inhabiting conifers and broadleaves. Therefore in this study, conducted in 2003-2004, we attempted to determine whether *O. ununguis* inhabiting 2 spruce cultivars can accept as hosts also the European larch (*Larix decidua*) and sweet chestnut (*Castanea sativa*).

**MATERIAL AND METHODS**

**Host acceptance test on European larch**

The observations were conducted under laboratory conditions (25°C, 60% relative humidity, photoperiod 16D/8N). Each test was started with 50 deutonymphs taken from mass rearing of spruce spider mites kept on 2 cultivars of spruce (*Picea glauca* ‘Conica’ and *P. abies* ‘Nidiformis’). Hatched females were paired with males for 48 h and later 50 females for each test were transferred onto shoots or leaves of each tested plant. The females were transferred by using a soft brush, as it is usually done.

The 6-cm shoots of European larch were placed in a container with water. Five fertilized females of spruce spider mite were transferred onto each of ten shoots. Each day, eggs laid were counted, and the number of dead and alive females as well as the number of the females that had deserted the shoots were recorded. Two experiments were performed: in the first experiment, spider mites were transferred from *Picea glauca* ‘Conica’, and in the second experiment, from *P. abies* ‘Nidiformis’. In each experiment the test was performed in 20 replicates of 50 females.
**Host acceptance test on sweet chestnut**

The study was carried out in MUNGER (1942) cages. A single, fertilized *O. ununguis* female was placed on the surface of a sweet chestnut leaf (3 cm diameter). The females originated from shoots of *P. glauca* ‘Conica’. Two experimental variants were compared: (1) mites introduced onto the leaf underside; and (2) mites introduced onto the leaf upperside. All cages were kept in a growth chamber at 25°C, 60% relative humidity and photoperiod 16D/8N. Observations of the females were carried out every day. The experiment was repeated twice, with 10 leaves per variant, each time using 50 females.

The results were analysed by using ANOVA and the Mann-Whitney test for mean separation (Statgraphic® Plus for Windows 4.1. 1994–1999). In the analyses, significance was assumed at $P = 0.05$. 

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**Fig. 1.** History of some *Oligonychus ununguis* females transferred onto European larch shoots from (A) *Picea glauca* ‘Conica’ and (B) *P. abies* ‘Nidiformis’. Records from the second day of observation.
Table 1. Mortality during embryogenesis and female fecundity of *Oligonychus ununguis* on *Larix decidua* after transfer from *Picea glauca* ‘Conica’ (1) and *P. abies* ‘Nidiformis’ (2)

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Mean number of eggs per female (±SE)</th>
<th>Mortality during embryogenesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.6 (±0.32) a</td>
<td>97%</td>
</tr>
<tr>
<td>2</td>
<td>1.3 (±0.11) a</td>
<td>55%</td>
</tr>
</tbody>
</table>

Means followed by the same letters are not significantly different (Mann-Whitney test, *P* = 0.6985).

RESULTS

*Host acceptance test on European larch*

Data obtained from both experiments show the lack of acceptance for *Larix decidua* as a host plant for spruce spider mites. The females that previously fed on *Picea glauca* ‘Conica’ (experiment 1), drastically decreased in numbers. Within 48
hours, 54% of specimens deserted the shoots, and 28% were found dead (Fig. 1A). The females that remained on larch needles for more than 2 days (18% of the population) lived on average for 3.5 days (SE =1.7). The maximum life span of females living on European larch was 7 days. In their lifetime, the females produced few eggs (mean 1.6 eggs/female). At the same time, a high mortality rate was observed during the embryogenesis (97%) (Table 1). All the larvae died within a day after hatching. Similar results were obtained after transferring *Oligonychus ununguis* females onto shoots of European larch from shoots of *P. abies* ‘Nidiformis’ (experiment 2). On the second day of the experiment, 4% of females were found alive on larch shoots, 64% were dead, and the rest had deserted the shoots (32%) (Fig. 1B). Like in the previous experiment, the last living female was found on day 7. In their lifetime, females deposited on average 1.3 eggs/female. The mortality rate during embryogenesis was 55% (Table 1). Only 1 larva proceeded to 1st nymphal stage, but no further development followed and the spider mite died soon after. All the other larvae lived for no longer than 1–2 days.

*Host acceptance test on sweet chestnut*

This test gave negative results irrespective of the side of the leaf (Fig. 2). In both cases 50% of females were found dead on the third day after the transfer of mites. The average life span of females was similar on the leaf underside and upper-side: 3.5 (SE =0.23) and 3.2 (SE =0.27) days, respectively. Females lived for up to 5 days, and none of them oviposited on *C. sativa* leaves.

**DISCUSSION**

Many reports indicate that larch (*SCHELLER 1961, WILSON 1977*) and some broadleaves, such as oak (*GOTOH 1984, SUN et al. 1995, SUN et al. 1996*) or sweet chestnut (*SHINKAJI 1975, SAITO 1983, WANIBUCHI & SAITO 1983, GOTOH 1984*) are similarly attractive as host plants for *Oligonychus ununguis* as spruce is (*SCHELLER 1961, JEPSSON et al. 1975, WILSON 1977*). However, RICHMOND and SHEILAR (1996) suggested that spider mites feeding on broadleaf trees and coniferous trees constitute different biotypes or perhaps even different species.

The negative results obtained in the host acceptance test on *Larix decidua* and *Castanea sativa* by using female spruce spider mites, seem to corroborate this hypothesis. In our experiment the mite was not capable of completing the developmental cycle after transfer onto European larch shoots from spruce shoots. Feeding on European larch needles, the pest died in the larval stage. Only in one case did it develop into a protonymph, but then it died. It can be therefore assumed that this mite, described till now as *O. ununguis* from spruce, is despite the morphological similarity probably a different species – the larch spider mite (*Oligonychus laricis*).

Similar tests, carried out by previous authors on sweet chestnut, excluded the possibility of the pest developing on trees of this species. Female spruce spider mites lived for up to 5 days on sweet chestnut leaves, without depositing eggs during that time. Our results correspond with those reported by SUN et al. (1999, 2000) who showed that there is sexual isolation between the spruce spider mite population collected from coniferous plants and the population from broadleaf trees (sweet chest-
nut or oak). Thus, the results of our study together with the report by SUN et al. (1999, 2000) allow to presume that the spider mite feeding on broadleaf trees is probably a species distinct from the one occurring on coniferous plants.

Further investigations should aim at providing undisputable evidence for species distinction between the spruce spider mites from spruce and the spider mites inhabiting European larch or sweet chestnut. Therefore, genetic material of the spider mites collected from coniferous plants and deciduous plants should be subjected to comparative analysis.

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