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Tyrophagus neiswanderi (Acari: Acaridae) as a Pest of Greenhouse Spinach in Antalya, Turkey

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ABSTRACT

Tyrophagus neiswanderi (Johnston & Bruce 1965) generally lives in stored products as saprophyte and on dead bodies of arthropods living in the soil, organic fertilizers, mushroom houses, greenhouses, algae and plant scraps. In this study, however, it was observed in roots and shoots of spinach (*Spinacia oleracea* L.) plants originated from greenhouse commercial crop in 2016-2017, in cultivated areas around Antalya, Turkey. This is the first record of *T. neiswanderi* occurring in spinach plants under greenhouse conditions in Antalya, Turkey.

Keywords: Astigmata; Mite; Antalya; Turkey

1. Introduction

Tyrophagus spp. (Acari: Acaridae) are fungivorous mites live in stored food products and decaying organic materials. Some *Tyrophagus* Oudemans (1924), species can cause economic damage both in ornamental plants and vegetables grown in greenhouses (Fan & Zhang 2007). *T. putrescentiae* (Schrank), *T. perniciosus* Zakhvatkin, *T. similis* Volgin, *T. neiswanderi, T. longior* (Gervais) and *T. palmarum* (Oudemans) are the most common species cause which damages in houses, stored foods and some plants (Griffiths 1979). *T. neiswanderi* is mainly considered a pest of ornamental and horticultural crops (Sánchez-Ramos et al 2007). Eight species of the *Tyrophagus* have been recorded from Turkey (Özer et al 1989; Çobanoğlu 1996; 2009; Kılıç & Toros 2000; Kılıç et al 2012; Kumral & Çobanoğlu 2015). They are; *T. longior* (Gervais 1844); *T. lini* (Oudemans 1924); *T. neiswanderi* (Johnston & Bruce 1965); *T. perniciosus* (Zakhvatkin 1941); *T. putrescentiae* (Schrank 1781); *T. robertsonae* (Lynch 1989) and *T. similis* (Volgin 1949).

Tyrophagus similis Volgin that belong to genus *Tyrophagus*, has been detected in dry apricots and stored products in Turkey (Kılıç & Toros 2000; Çobanoğlu 2009). It has been reported that *Tyrophagus putrescentiae* (Schrank) is detected in *Morchelle* spp. (Ascomycetes), roses and bulbous plants (Çobanoğlu & Bayram 1998; 1999; Bayram & Çobanoğlu 2006). *Tyrophagus perniciosus* Zahvatkin species was detected in the conifer collected in the surveys carried out in different regions of Turkey between 1999 and 2003 (Bayram & Çobanoğlu 2007). In addition, *T. putrescentiae*

and *T. perniciosus* species were detected on fresh onion cultivated in diffrent districts of İzmir, Turkey in between 2006-2008 (Kılıç et al 2012). To our best knowledge, there is no record that *Tyrophagus s*pecies have damage to spinach in Turkey. *T. neiswanderi* the first detected on spinach in Antalya province in the Mediterranean region. There is also report that *T. neisvanderi* is found in some plants (cucumber) grown in the greenhouse (Johnston & Bruce 1965; Fischer 1993; Kadono & Endo 1996).

2. Material and Methods

The research was carried out on the spinach grown greenhouse condition in Antalya Province during 2016-2017. The survey was conducted every two weeks throughout the vegetation periods (September to March). The pest observations were carried out on at least 20 plants in an area of 250 m^2. Plant material was collected from fresh leaves near the root was examined by stereo microscope, and the pests were prepared for identification. All measurements are given in micrometers (µm). The mites were extracted by using Berlese funnel set-up and the mites were cleared in a mixture of lactophenol: Nesbitt 1:1 and mounted in the Hoyer's medium, on microscobic slides. The mites were identified according to Hughes (1976), Griffiths (1985) and Fan & Zhang (2007). All measurements are given in micrometers (µm). The mean of the measurements is given first followed by the range in parentheses. Figures taken by digital image system or drawn by using microscope directly. The voucher specimens of species were deposited in the mite collection of the Department of Plant Protection (Ankara University, Ankara, Turkey). The mean of the measurements is given first followed by the range in parentheses. Species identification was made by Dr. Sultan Çobanoğlu (Ankara University, Ankara, Turkey).

3. Results

Genus (*Tyrophagus* Oudemans, 1924): *Tyrophagus* species is mostly fungivorous and is commonly found in stored food products and decaying organic matter. The species of this genus are well known and common species. *Tyrophagus* (Astigmata, Acaridae) includes about 35 species and is worldwide in distribution (Fan & Zhang 2007).

Female

T. neiswanderi is relativelly large, milky-white colour (Figure 1). Female dorsum (3 females measured) Length: 494-577 µm (Figure 2).

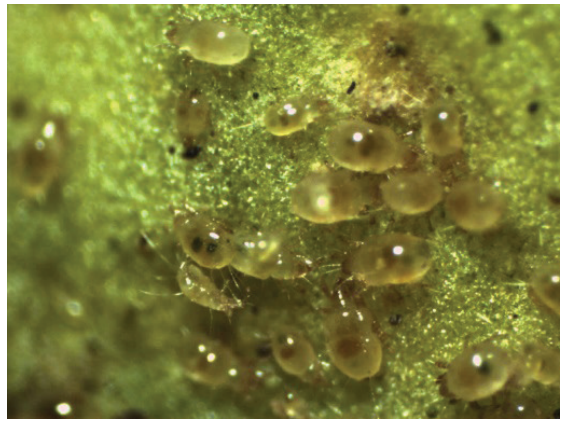


Figure 1- Feeding on spinach leaf

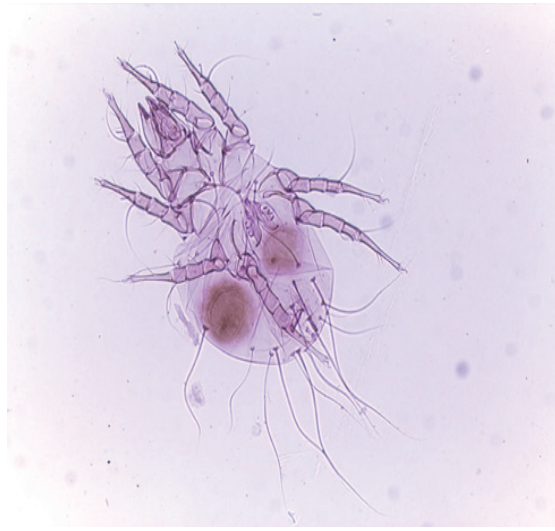


Figure 2- Dorsum

The most important characteristics of this genus are the following: external vertical setae (ve) is placed on anterior of dorsal propodosomal shield

with the half length of internal vertical (vi) (Figure 3a)*;* they rise on the same level. Internal scapular setae (Sci) (Figure 7) are longer than the external scapular setae (Sce) (Figure 7a). Supracoxal setae present. On genu I ($Ϭ_1$) less than three times longer than ($Ϭ_2$) (Figure 3).

Dorsal propodosomal shield with prominent eyespots, Supra coxal setae (Figure 5) widened at base with a few moderate pectination. Hysterosomal setae d1 short, as long as or slightly longer than c1 and antrerior lateral setae (d_2).

Leg I, solenidion Tarsus I (Figure 4) and II (ω) cylindrical, with a round tip. Spermatheca (Figure 6) triangular, funnel-shaped base longer and expanded like funnel shaped. All legs with well developed pretarsus and stalked like claw.

Male

Male (3 males measured) length 384-501 µm (Figures 8). Male is very close to female. Idiosoma is 416 (384-501) µm in lenght and 251 (186-310) µm in width. The shape of idiosoma and dorsal setae and solenidion on tarsus I and II and the genu I (Ϭ1 and Ϭ2) similar as in female. On the ventral surface of the male, one pair of small anal suckers exists on each side of the anus (Figure 9). The two suckers on Tarsus IV (Figure 10) are divided in three part from the base to apex of the segment. The lateral sclerites of supporting aedeagus (Figure 11) are turned outwards, the aedeagus short and bent, tapering from base to tip with straight end.

Distribution:

Tyrophagus neiswanderi (Johnston & Bruce 1965) (Figures 1-11): Material examined: Turkey, Antalya, Tarım district, (36°53'12.80"N, 30°44'44.92), elevation: 47 m, 15♀♀, 10♂♂, 30.09.2016, Kırışık and Topuz.

This is a cosmopolit species. Argentina, Australia, Brazil, China, Germany, England, Endonasia, The Netherlands, Italy, Japan, Mexico, Netherlands, New Zealand, Poland, South Africa, Switzerland, Spain, U.K., U.S.A., Turkey (Fan & Zhang 2007; Cılbırcıoğlu 2017).

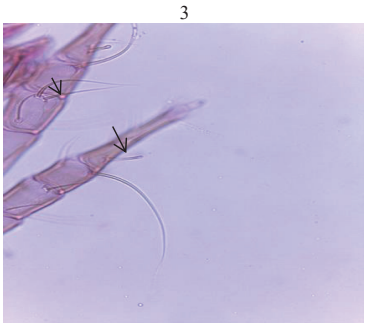
Distribution in Turkey: Kastamonu (Cılbırcıoğlu 2017).

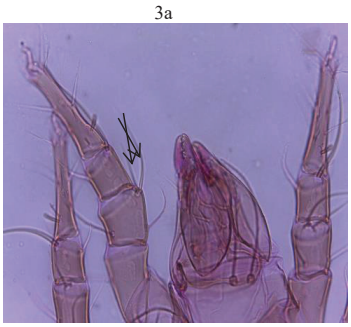
4. Discussion

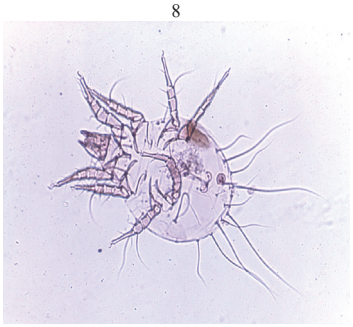
T. neiswanderi was determined in 2016, in commercial spinach greenhouses located in Tarım district of Antalya, Turkey. Field observations started from spinach planting to until the harvesting period. The soil was especially rich in manure and the mites continued devoloping by infecting the spinach plants until to the the next planting season. It has been determined that the pest caused damage to plants during the vegetation period (September to March) in 2016 and 2017.

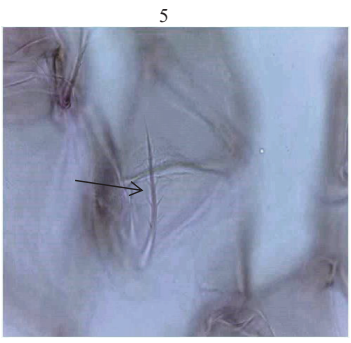
T. similis, T. pernicious and *T. dimidiatus* (Hermann) species have been found to cause damage to spinach (Lange & Bacon 1958; Saito 2016; Kasuga 2005; Nakao 1989; Nakao & Kurosa 1988). However, there is no report that *T. neiswanderi* was harmful to spinach. *T. neiswanderi* is mostly harmful to the cucumber plants. It feeds on the outer part of young cucumber plants, causing morphological disorder and reducing the market value of the product. It also gives damage to plants, causing yellowish spots on the leaves after that they drop such as numerous small holes shown up to 4 mm in diameter (Johnston & Bruce 1965; Nakao & Kurosa 1988; Fischer 1993; Kim et al 2014). *T. neiswanderi* was also detected in orchids grown in New Zealand (Martin & Workman 1985) and cutflowers grown in Japan (Ehara & Gotoh 2000). In surveys caried out in Antalya, it has been observed that high number of *T. neiswanderi* adults was seen on the young leaves and they damaged roots and young shoots of the spinaches and led to further morphological disorders (Figure 12).

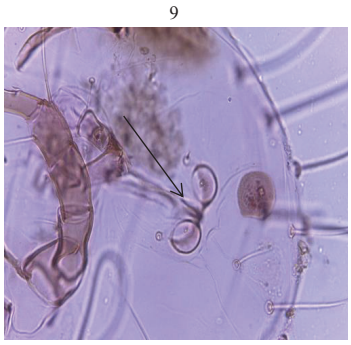
Since the *T. neiswanderi* usually feeds in soil with organic fertilizers, plant detritus and small organisms, it requires strick control measures for soil. Even though chemicals may not be direct solution to control this pest. Indeed, *T. similis* could not be controlled with chemicals applied to soil and spinaches (Kasuga & Amano 2002; 2003). However, a previous study pointed out that *T. similis*

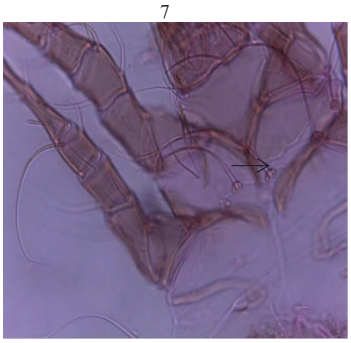


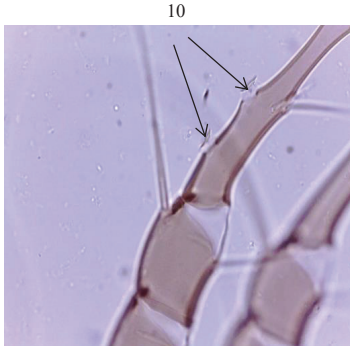


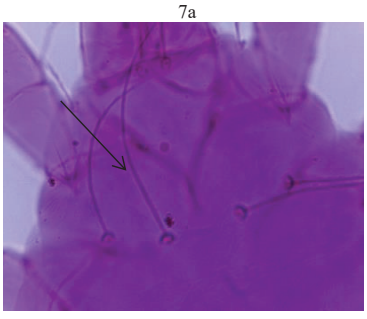


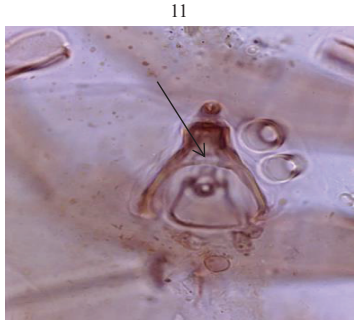












Figures 3-7- *Tyrophagus neiswanderi* female: 3. On genu I (σ_1 and σ_2), 3a. Vertical internal seta(vi) 4. Tarsus I. Solenidion, 5. Supracoxal seate x 100, 6. Spermatheca, 7. Scapular setae sci, 7a. Scapular setae sce

Figures 8-11- Tyrophagus neiswanderi male: 8. Dorsum, 9. Anal sucker, 10. Tarsus IV, sucker, 11. Aedeagus

Figure 12- Damage to spinach

could be controlled by increasing soil temperature at least at 35 °C for 5 hours. Additionally, it was also suggested that reducing organic manure usage and removing plant wastes from plantation area would be useful to decrease pest damage (Kasuga & Amano 2000; Kasuga & Honda 2006).

T. neiswanderi is mostly associated with greenhouse plants. In our case it makes serious damage on the greenhous spinach. It is necessary to investigate control measures and management methods against *T. neiswanderi*.

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