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Orijinal araştırma (Original article)

Distribution and biology of the Mediterranean Pine Shoot Beetle *Tomicus destruens* (Wollaston, 1865) in the Western Mediterranean region of Turkey[1]

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Summary

The number of drying trees in *Pinus brutia* Tenore, 1811 forests in Western Mediterranean Region of Turkey has increased in recent years due to *Tomicus destruens* (Wollaston, 1865) (Coleoptera: Curculionidae, Scolytinae) damage. However, there have been a limited number of studies on the distribution, biology and damage of the beetle. The purpose of this study was to determine its biology, distribution and damage and it was carried out in *Pinus brutia* and *Pinus nigra* forests of the Western Mediterranean Region between 2006 and 2008. Observations to determine the biology and flight period of the beetle were carried out by using trap logs and pheromone traps at different elevations. In addition, survey studies were conducted throughout the region to determine *Tomicus destruens* distribution. *P. brutia* and *P. nigra* were determined as host plants of the beetle in Antalya, Isparta, Burdur, Afyonkarahisar and Muğla forests. Clear differences were observed concerning the biology of *T. destruens* at different elevations. It had only one generation per year but the flight period varied between november at lower elevations and february at higher elevations. Evidence of the increased importance of this pest can be seen in damage to the trunks and shoots of trees, especially in *P. brutia* plantation areas.

Key words: *Tomicus destruens*, *Pinus brutia*, *Pinus nigra*, biology, Western Mediterranean Region, Turkey

Anahtar sözcükler: *Tomicus destruens*, *Pinus brutia*, *Pinus nigra,* biyoloji, Batı Akdeniz Bölgesi, Türkiye

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Introduction

The pine shoot beetles *Tomicus* spp., with a total of 6 species worldwide, are among the most important pests in pine forests in Europe, Asia, North America and North Africa. Among these species, *Tomicus piniperda* (Linneaus, 1758), *Tomicus minor* (Hartig, 1834) and *Tomicus destruens* (Wollaston, 1865) are known from European forests. Additionally, *Tomicus piniperda* is reported from Asia and North America*, Tomicus destruens* in Mediterranean countries, and *Tomicus minor* in Asian forests. *Tomicus brevipilosus* (Eggers, 1929), *Tomicus pilifer* (Spessivtsev, 1919) and *Tomicus puellus* (Reitter, 1894) are also pests of Asian forests (Vasconcelos et al., 2003; Vasconcelos et al., 2006; Faccoli et al., 2005a).

In 1865, *T. destruens* was described as a different species by Wollaston (Wollaston, 1865). After the studies of Schedl, who rejected this species status (Schedl, 1932; Schedl, 1946), *T. piniperda* and *T. destruens* species were considered to be synonyms for many years (Faccoli, 2006). However, as a result of the studies of Lekander (1971) on the morphologic characters of larvae, and the morphologic and genetic studies of Gallego & Galián (2001); Kohlmayr et al., (2002) and Kerdelhue et al. (2002), *T. piniperda* and *T. destruens* were again described as different species. In spite of the importance of *T. destruens* in Mediterranean countries its biology was unclear until recently. Some articles reported that it produces two generation per year (Nanni & Tiberi, 1997; Ciesla, 2004); but many authors state in later articles that *T. destruens* is univoltine species (Gallego & Galián, 2001; Faccoli et al., 2005b; Chakali, 2005; Peverieri & Faggi, 2005; Vasconcelos et al., 2006; Peverieri et al., 2008).

Three hair rows were found on the antennal club of *T. destruens* between the second and third suture. *T. piniperda* had only one row. Three different hair types were detected on the elytra – two hair types were found on *T. piniperda*, whereas the third hair type was only detected on the elytra of *T. destruens* (Kohlmayr et al., 2002). Pfeffer (1995) described differences between *T. piniperda* and *T. destruens* based on the colour of the antennal club of mature adult beetles: *T. piniperda* has brown and *T. destruens* has red-yellow antennal clubs. The biology of both species, particularly in the flight period, significant differences were found. *T. destruens* has its reproductive flight during autumn, whereas *T. piniperda* reproduces at the end of winter or early spring (Peverieri et al., 2008). Similarly, flight period of *T. piniperda* has given as March and April in Turkey (Selmi, 1998).

In the many studies carried out on *Tomicus* species in pine forests of Turkey, *T. minor* and *T. piniperda* are generally cited. For *T. destruens*, which was long considered to be synonymous with *T. piniperda* due to their morphologic resemblance, there are records of the samples collected from Marmaris (Lekander, 1971), Hatay-Teknepınar (Horn et al., 2006) and the

Western Mediterranean Region (Sarıkaya & Avcı, 2007). In Turkey, there have been no comprehensive studies in recent years on the biology, distribution and host plants of *T. destruens,* which causes significant damage, especially in *P. brutia* forests in the Mediterranean and Aegean Regions. Due to its resemblance to *T. piniperda* in terms of damage and morphologic characters, some data on *T. piniperda* had been wrongly attributed to *T. destruens*.

The numbers of drying trees in *P. brutia* and *P. nigra* forests in Turkey have increased in recent years because of *T. destruens* damage (Sarıkaya & Avcı, 2007). The threat of the pest to *P. brutia* and *P. nigra* forests requires an effective control strategy. For this reason, the biology and distribution of the beetle needed to be clearly defined. Therefore, this study was conducted to investigate the biology and distribution of *T. destruens.*

Material and Methods

The biology and distribution of *Tomicus destruens* (Wollaston, 1865) were studied in *Pinus brutia* and *Pinus nigra* forests of the Western Mediterranean Region from 2006 to 2008. Four different experimental sites (Aşağıgökdere, Taşdibi, Yaka and Çobanpınarı forests) were selected on the basis of elevation differences to determine the biology and flight period of the beetle (Table 1, Figure 1). The experimental area Çobanpınarı and Aşağıgökdere was natural and old a red pine forest. Taşdibi area was red pine natural regeneration. There was a large amount of logs and woods in the forest waiting. Yaka area was middle-aged and mixed of red pine and Crimean pine. At the same time, to clarify the expansion and biological stages of *T. destruens,* surveys were conducted throughout the region.

Table 1. Locations and characteristics of experimental sites

Research area	Geographical position	Altitude (m)	Aspect	Forest characteristics
Burdur-Bucak-Taşdibi	37º 15′ N 30º 49' E	265	S	Natural and young *Pinus brutia* forest
Burdur-Ağlasun-Çobanpınarı	37º 34′ N 30º 45' E	360	E	Natural *Pinus brutia* forest
Isparta-Eğirdir-Aşağıgökdere	37º 35′ N 30º 49' E	440	SW	Natural *Pinus brutia* forest
Afyonkarahisar-Yaka	37º 51″ N 30º 03' E	1000	SE	Natural *Pinus brutia* and *Pinus nigra* mixed forest

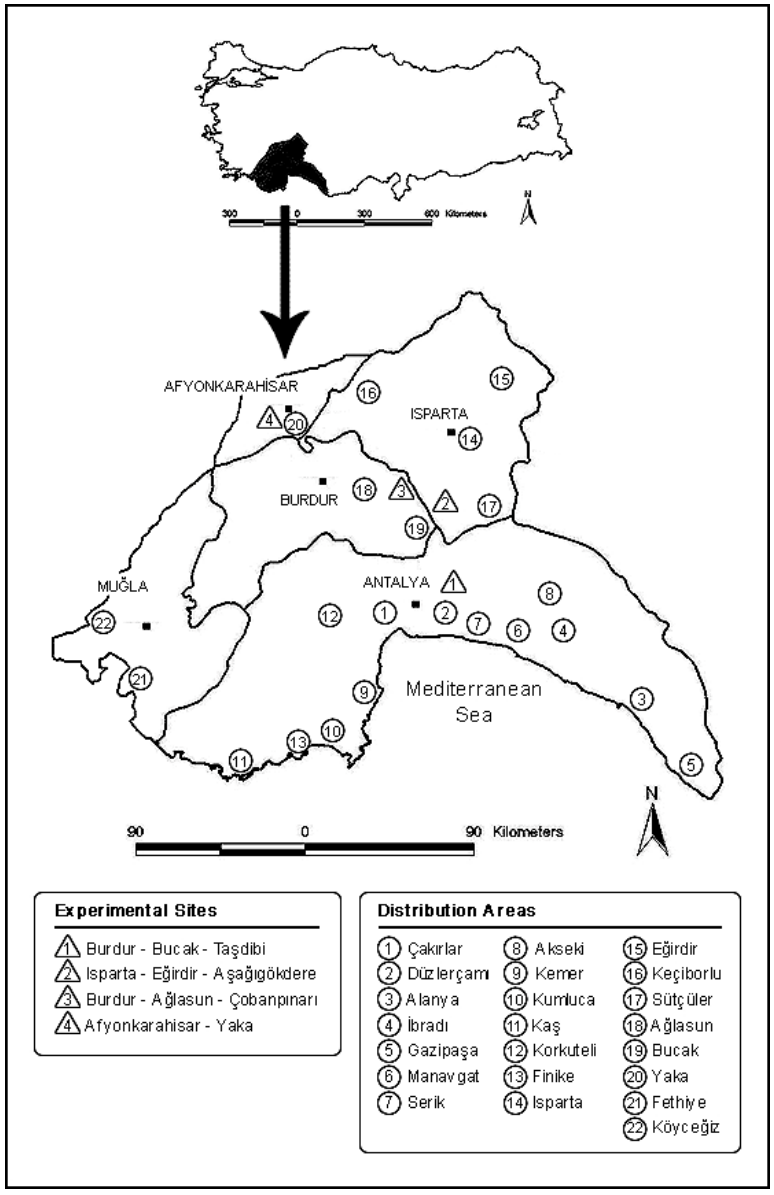

Figure 1. Experimental sites and distribution areas of *Tomicus destruens* (Wollaston, 1865).

Groups of trap logs were placed at 20 different locations at least 100 m distant from each other in each experimental site of 15 ha. Traps logs were prepared at different times, depending on elevation. Traps, the end of autumn at

lower in elevation, early and in the middle of winter at high altitudes have been prepared. Traps consisted of 12-16 logs of 15-22 cm diameter and 100-120 cm length. The logs were observed once a week. Detailed surveys were carried out in the area in the same period to determine the distribution of the beetle. For this purpose, drying, weakened and fallen trees damaged by the beetle were used. Using entrance holes and sawdust around the stems as a guide, main galleries were opened using knives and axes. Considering that *T. destruens* flies to the shoots of nearby trees for maturation feeding, their shoots were checked for evidence of beetles and feeding. Collected beetles were placed in 4.5 x 3 cm cylindrical plastic cups or 10 x 15 cm plastic tubes. Bark samples with beetles were placed in 35 x 25 cm sealed plastic bags and examined at the Entomology Museum of the Faculty of Forestry at Süleyman Demirel University in Isparta.

The flight period of *T. destruens* at each site was determined by using flat funnel and multi-funnel pheromone traps. The pheromone dispensers contained 1100 mg (+) α-pinen + 200 mg (-) α-pinen. The traps were placed on stands 50-80 m distant from each other, and the 10 traps in each area were checked weekly to establish the flight period of adults.

Results

Pinus brutia Tenore, 1811 and *Pinus nigra* Arnold, 1785 were determined as host plants of the beetle in Antalya (Akseki, Alanya,Çakırlar, Düzlerçamı, Finike, Gazipaşa, İbradı, Kaş, Kemer, Korkuteli, Kumluca, Manavgat, Serik), Burdur (Ağlasun, Bucak), Isparta (Eğirdir, Isparta, Keçiborlu, Sütçüler), Afyonkarahisar-Yaka and Muğla (Fethiye, Köyceğiz) forests (Figure 1). During our surveys, we observed that *Tomicus destruens* (Wollaston, 1865) is apparently capable of attacking trees stressed by biotic factors like damage of the pine processionary moth (*Thaumetopoea wilkinsoni* Tams, 1926), drought, poor site and related factors. The importance of the damage by this pest to the trunks and shoots of trees has increased, especially in *P. brutia* plantation areas. It was seen that many trees dried during our field studies.

Silinmiş:)

It was found that *T. destruens* had one generation per year and its flight period varied depending on the elevation. The flight period of the beetle at 0 and 300 m altitude started at the beginning of November; between 300 and 600 m in the second half of December, and at 600 m and higher elevations, at the beginning of February. At lower elevations (0-300 m), beetles started to lay eggs in the first week of November, and young adults were observed in the middle of April. At middle elevations (300-600 m), the first eggs were observed in the second half of December and the beetle reached the young adult stage at the beginning of May. At higher elevations (600 m - >), the females started to lay their eggs at the beginning of February and young adults appeared in the second half of June (Figure 2).

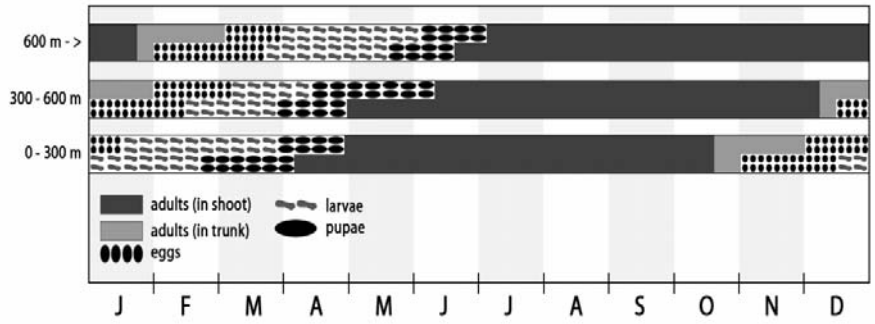

Figure 2. The biology of *Tomicus destruens* (Wollaston, 1865) in different elevation zones.

It was observed that the length of main galleries of *T. destruens* in *P. brutia* varied between 6.0-12.4 cm (9.8 cm average); starting with a cane-like shape and proceeding parallel to the fibers of the tree. Larval galleries opening vertically from the main gallery were 6-12 cm long and approximately 3 mm wide. The larvae pupated in chambers which were slightly embedded in cambium at the end of larval galleries. The current study revealed that the main galleries of *P. nigra* were shorter than those of *P. brutia.* The longest gallery was measured as 7.5 cm in *P. nigra*.

Young beetles which had reached the adult stage in pupal chambers then flew to the shoots of nearby trees for maturation feeding and fed on those shoots until the flight period. It was observed that the breeding activity of *T. destruens* caused the death of trees following stem attacks. Maturation feeding carried out in the shoots appeared to make the trees susceptible to stem attacks by following generations.

Discussion

In our study, *Tomicus destruens* (Wollaston 1865) was recorded on *Pinus brutia* Tenore 1811 and *Pinus nigra* Arnold, 1785 trees. These were among the first records concerning *T. destruens* on *P. nigra*, after the studies of Gallego et al. (2004) in Spain and Faccoli et al. (2005b) in Italy.

Faccoli et al. (2005a) and Faccoli et al. (2005b) collected *T. destruens* in Italy from *Pinus pinaster* Aiton, 1789, *P. pinea* Linnaeus, 1753 and *P. halepensis* Miller, 1768, which are Mediterranean ecosystem species. Vasconcelos et al. (2003) collected adult *Tomicus* spp. from trap logs and shoots on *P. pinaster*, *P. halepensis* and *Pinus pinea* areas in four different regions of Portugal. They found *T. destruens* in *P. pinaster* and *P. pinea* stands in three different areas. In the same study, *T. piniperda* was reported on *P. pinaster* in areas with lower winter temperatures and a more continental

climate. Gallego et al. (2004) indicated that *T. destruens* damaged the Mediterranean pine species *P. pinaster*, *P. halepensis*, *P. pinea*, *P. brutia* and *Pinus canariensis*, Smith, 1828. The beetle was recorded in *P. pinaster* in Tuscany (Peverieri & Faggi, 2005); in *P. halepensis* in Algeria (Chakali, 2005); in *P. pinaster*, *P. halepensis*, *P. pinea* and *P. radiata* in Portugal, Spain and southern France (Vasconcelos et al., 2006). Ciesla (2004) reported that *T. destruens* was the most common species at low elevations in areas close to Mediterranean in Cyprus. Pfeffer (1995) reported *T. destruens*, *P. canariensis*, *P. brutia*, *P. pinaster* and *P. halepensis* as hosts in Spain, France, Cyprus and Southern regions of Italy. Our results suggest that the beetle is especially associated with *Pinus brutia*, an important tree species in the Mediterranean ecosystem, rather than *P. nigra*, which supports the findings of these previous studies.

The results of the current study indicate that *T. destruens* is a univoltine species. The timing of the flight period of the beetle was inversely related with altitude; it was delayed with increasing elevation.

Lekander (1971) reported that the flight period of *T. destruens* took place in autumn. Nanni & Tiberi (1997) reported that *T. destruens* had two overlapping generations per year in Italy. According to their study, the flight period of the first generation was in April-May. The adults of the first generation emerged at the beginning of summer and flew to the shoots of the nearby trees at the beginning of June. After maturation feeding in these trees, the shoots begin to become reddish in August. In the same month, the matured adults copulated. They also reported that near the Adriatic coast in the north, maturation had a more irregular course. Ciesla (2004) stated that at low elevations in Cyprus, *T. destruens* had two successive generations per year. Unlike these studies; Gallego & Galián (2001) reported that the beetle had one generation per year and maturation feeding took place in January. Faccoli et al. (2005 b) reported one generation per year in northern Italy and an early spring flight period. In the studies of Peverieri & Faggi (2005) in northern Italy and of Peverieri et al. (2008) in central Italy, it was reported that the beetle had one generation per year; the breeding of the beetle continued from autumn to the middle of spring; and that the main activity occurred in the middle of autumn. Chakali (2005) mentioned that *T. destruens* had one generation per year in Algeria, and Vasconcelos et al. (2006) reported that *T. destruens* had one generation per year in Spain, Portugal and France. In the recent articles, data on the biology of *T. destruens* supported to each other.

Our determination of one generation per year confirmed most previous studies. Findings are mostly similar with approved actual articles, especially in last 5 years. In addition, our study indicated that the flight period of the beetle varied according to elevation. It can be see easily a clear difference on flight season between altitudes.

This study has provided valuable initial results, but further work will be needed to clarify distribution and life cycle of the pest in other regions of Turkey.

Özet

Türkiye'nin Batı Akdeniz Bölgesi'nde Akdeniz orman bahçıvanı *Tomicus destruens* (Wollaston, 1865)'in yayılışı ve biyolojisi

Batı Akdeniz Bölgesi *Pinus brutia* Tenore, 1811 ormanlarında *Tomicus destruens* (Wollaston, 1865) (Coleoptera: Curculionidae, Scolytinae) zararı nedeniyle kuruyan ağaç sayısı son yıllarda artış göstermektedir. Bununla birlikte böceğin yayılışı ve biyolojisi ile ilgili çalışmalar sınırlıdır. Bu nedenle, *T. destruens*'in biyolojisi ve yayılışını tespit etmek amacıyla ele alınan bu çalışma, 2006–2008 yılları arasında Batı Akdeniz Bölgesi *Pinus brutia* Tenore, 1811 (Kızılçam) ve *Pinus nigra* Arnold, 1785 (Karaçam) ormanlarında yürütülmüştür. Böceğin biyolojisini ve uçma zamanını belirlemek için yükselti farklılıkları da göz önünde bulundurularak 4 farklı deneme sahasında tuzak odunları ve feromon tuzakları kullanılarak gözlemler yapılmıştır. Buna ilave olarak bölge genelinde sörvey çalışmaları gerçekleştirilmiştir. Antalya, Isparta, Burdur, Afyonkarahisar ve Muğla ormanlarında kızılçam ve karaçam böceğin konukçuları olarak tespit edilmiştir. *T. destruens*'in biyolojisinde yükseltiye bağlı olarak belirgin farklılıklar gözlenmiştir. Batı Akdeniz Bölgesi'nde *T. destruens*'in yılda bir generasyona sahip olduğu, uçma zamanının alçak yükseltilerde kasım, daha yüksek yükseltilerde şubat aylarında olduğu belirlenmiştir. Böceğin, özellikle kızılçam ağaçlandırma alanlarında, ağaçların gövde ve sürgünlerinde verdiği zararla öneminin artmakta olduğu görülmüştür.

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References

Chakali, G., 2005. L'Hylesine des Pins, *Tomicus destruens* Wollaston 1865 (Coleoptera-Scolytidae) en Zone Semi-Aride (Algerie). **Silva Lusitana**, **13** (1): 113–124.

Ciesla, M., 2004. Forests and forest protection in Cyprus. **The Forestry Chronicle**, **80** (1): 107–113.

Faccoli, M., A. Piscedda, P. Salvato, M. Simonato, L. Masutti & A. Battisti, 2005 a. Genetic structure and phylogeography of pine shoot beetle populations (*Tomicus destruens* and *T. piniperda*, Coleoptera: Scolytidae) in Italy. **Annals of Forest Science, 62**: 361–368.

Faccoli M., A. Battisti & L. Masutti, 2005 b. Phenology of *Tomicus destruens* (Wollaston) in northern Italian pine stands. Proceedings of the international symposium: Entomological research in Mediterranean forest ecosystems, (6-11 May 2002, Rabat, Morocco), 185-193 pp.

Faccoli, M., 2006. Morphological separation of *Tomicus piniperda* and *T. destruens* (Coleoptera: Curculionidae: Scolytinae): new and old characters. **European Journal of Entomology, 103**: 433-442.

Gallego, D. & J. Galián, 2001. The internal transcribed scapers (ITS1 and ITS2) of the rDNA differentiates the bark beetle forest pests *Tomicus destruens* and *T. piniperda.* **Insect Molecular Biology, 10** (5): 415–420.

Gallego, D., F. Canovas, M. A. Esteve & J. Galián, 2004. Descriptive biogeography of *Tomicus* (Coleoptera: Scolytidae) species in Spain. **Journal of Biogeography, 31**: 2011-2024.

Horn, A., R. M. Morabito, F. Lieutier & C. Kerdelhue, 2006. Phylogeographic structure and past history of the circum-Mediterranean species *Tomicus destruens* Woll. (Coleoptera: Scolytinae). **Molecular Ecology**, **15:** 1603–1615.

Kerdelhue, C., G. Roux-Morabito, J. Forichon, J. M. Michel, A. Robert & F. Lieutier, 2002. Population genetic structure of *Tomicus piniperda* L. (Curculionidae: Scolytinae) on different pine species and validation of *T. destruens* (Woll.). **Molecular Ecology**, **11**: 483-494.

Kohlmayr, B., M. Riegler, R. Wegensteiner & C. Stauffer, 2002. Morphological and genetic identification of three pine pests of the genus *Tomicus* (Coleoptera, Scolytidae) in Europe. **Agriculture and Forest Entomology, 4**: 151–157.

Lekander, B., 1971. On *Blastophagus destruens* Woll. & a description of its larva (Col. Scolytidae). **Entomologisk Tidskrift**, **92**: 271–276.

Nanni, C. & R. Tiberi, 1997. *Tomicus destruens* (Wollaston): Biology and behaviour in Central Italy. Proceedings of Integrating cultural tactics into the management of bark beetle and reforestation pests. USDA Forest Service General Technical Report NE–236, 131–134 pp.

Peverieri, G. S. & M. Faggi, 2005. Determination of age in larvae of *Tomicus destruens* (Wollaston, 1865) (Coleoptera: Scolytidae) based on head capsule width. **REDIA**, **LXXXVIII**: 115-117.

Peverieri, G. S., M. Faggi, L. Marziali & R. Tiberi, 2008. Life cycle of *Tomicus destruens* in a pine forest of Central Italy. **Bulletin of Insectology, 61** (2): 337-342.

Pfeffer, A., 1995. Zentral und westpaläarktische Borken und Kernkäfer. Naturhistorisches Museum, Basel, 310 pp.

Sarıkaya, O. & M. Avcı, 2007. Türkiye kızılçam ormanları zararlı faunasından Akdeniz orman bahçıvanı *Tomicus destruens* (Woll., 1865) (Col.: Scolytidae). **Orman ve Av**, 4: 31-34.

Schedl, K. E., 1932. Scolytidae, Platypodidae. In Winkler A. (ed.): Catalogus Regionis Palaearcticae. Wien, 1632–1647 pp.

Schedl, K. E., 1946. Bestimmungstabellen der palaearktischen Borkenkafer, II – Die Gattung *Blastophagus* Eichh. **Zentralblatt für das Gesamtgebiet der Entomologie, 1**: 50-58.

Selmi, E., 1998. Türkiye Kabuk Böcekleri ve Savaşı, İ.Ü. Yayın No: 4042, Fen Bilimleri Enstitüsü Yayın No: 11, p. 196, İstanbul.

Vasconcelos, T., N. Nazare, M. Branco, C. Kerdelhue, D. Sauvard & F. Lieutier, 2003. Host Preference of *Tomicus piniperda* and *Tomicus destruens* for Three Pine species. proceedings of IUFRO Kanazawa 2003 "Forest Insect Population Dynamics and Host Influences (14-19 September 2003, Kanazawa, Japan, 19–21 pp.

Vasconcelos, T., A. Horn, F. Lieutier, M. Brancot & C. Kerdelhue, 2006. Distribution and population genetic structure of the Mediterranean pine shoot beetle *Tomicus destruens* in the Iberian Peninsula and Southern France. **Agricultural and Forest Entomology**, 8: 103–111.

Wollaston, T. V., 1865. Coleoptera Atlantidum, Being an Enumeration of the Coleopterous Insects of Madeiran, Salvages and Canaries. Voorst, London, 526 pp.