

**Morphology of second instar nymphs of *Kermes quercus* (LINNAEUS)
(Hemiptera: Kermesidae)**

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ABSTRACT. The second instar male and female of *Kermes quercus* LINNAEUS are redescribed and illustrated. Sexual dimorphism is demonstrated. The second instar male is distinguished by 7-segmented antennae, well-developed legs, thin and long body setae, quinquelocular pores on both surfaces, bilocular pores only on the venter near the sub- and marginal setae, and by the lack of simple pores. The second instar female has shortened antennae, annular segments reduced to 5-6, very much reduced legs, short and stout body setae, quinquelocular pores only on the venter, bilocular pores on both surfaces, but those on the dorsum distributed throughout the derm, while those on the venter are located as in the male, and by having a few simple pores in the posterior and marginal areas of the dorsum. The presence of tubular ducts is the most noticeable morphological feature of second instar nymphs distinguishing them from first instar nymphs.

KEY WORDS: Hemiptera, Kermesidae, second instar, morphology, sexual dimorphism.

INTRODUCTION

Kermes quercus (LINNAEUS) is a very common species in Poland (KAWECKI 1985) and in many European countries (KOSZTARAB & KOZAR 1988). It lives mainly in the bark crevices of the trunk and on thick branches of oaks (*Quercus* spp.) and can be a serious local pest.

The first instar nymph of *K. quercus* was described by BALACHOWSKY (1950), BORCHSENIUS (1960) and PODSIADŁO (2005a). The second instar nymphs of this species were described by SAAKJAN-BARANOVA & MUZAFAROV (1972), but their descriptions were not comprehensive. They did not describe certain morphological structures given in the descriptions of the second instar nymphs of Nearctic Kermesidae (BAER & KOSZTARAB 1985).

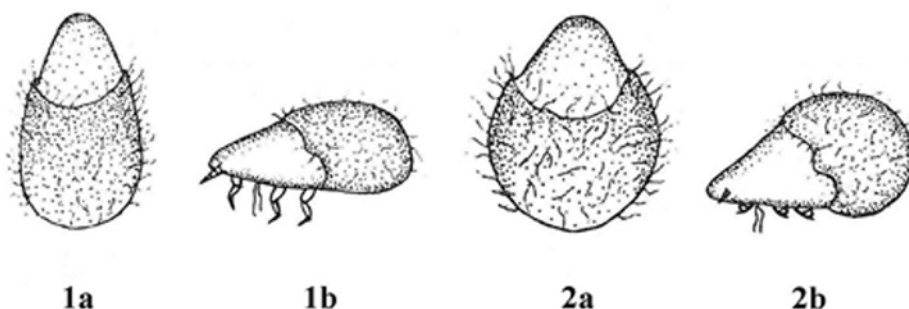
The morphological studies presented here complement these descriptions and contribute to knowledge of the second instars of Palaearctic Kermesidae.

MATERIALS AND METHODS

Second instar nymphs were collected in 2004, 2008 and 2009 on *Quercus robur* L. from Warsaw (Poland). Slide mounts were made from 16 male and 28 female specimens. The number of setae and other structures is given for one body half. Measurements (in micrometres) are presented as averages followed by ranges in parentheses. Drawings were made by using a microscope drawing tube attached to a Zeiss microscope.

MORPHOLOGY

Habitat and the covering test (Figs 1-2). The second instar nymphs of both sexes live with the anterior part of their bodies pressed into the bark crevices of oak trees and the posterior part protruding from the crevice. The protruding part is enveloped in a semi-transparent yellowish-brown test, which in winter is covered with white wax threads.



Figs 1-2. General appearance of second instar nymphs of *Kermes quercus* (LINNAEUS) (scheme): 1 – male, 2 – female, a – dorsal view, b – lateral view.

The second instar male

(Fig. 3)

Body convex, ovoid, more or less widened in the posterior part, dark yellow in colour, 940 (780-1080) long and 606 (520-680) wide.

Dorsum. Setae thin, setaceous, arranged segmentally in 3 longitudinal rows: marginal (a) consisting of about 19 setae, 80 (60-100) long; mesolateral (b) consisting of about 9 setae, 43 (32-55) long; medial (c) consisting of about 11 setae, 37 (22-57) long. Quinquelocular pores (d) ca 5.5 in diameter, distributed sparsely over the derm. Tubular ducts (e) 18 (15-22) long, 6 (5-7) wide in the head, numerous on nearly the entire surface except for the middle part of the head. Bilocular pores absent. Simple pores absent. The last

(eighth) abdominal segment, consisting of anal lobes, folded ventrally. Anal ring (f) sclerotized, oval, 21 (20-22) long, 36 (35-37) wide, usually with 2 pairs of setae, occasionally with 1 additional unpaired seta. Setae of anal ring poorly developed. Anal lobes membranous, without definite margins, each with apical seta (g) 129 (125-138) long and four accompanying setae, 32-75 long.

Venter. Antennae (h) 7-segmented, stout, wide at the base, strongly tapering to the tip. Each segment, except for the last one, wider than long. Dimensions in Table 1.

Table 1. Dimensions (in μm) of antennae in male second instar nymphs of *Kermes quercus* (LINNAEUS).

Number of segment	Length	Width
I (scape)	29 (25-33)	53 (50-58)
II	18 (15-23)	38 (35-40)
III	23 (20-25)	32 (30-35)
IV	16 (15-18)	28 (26-30)
V	15 (12-18)	24 (21-25)
VI	16 (15-18)	21 (20-23)
VII	29 (25-33)	16 (15-16)
Total	146 (138-150)	

Segment I with 3 slender setae, II with 2 slender setae and 1 sensory pore, III without setae, IV with 1 slender seta, V with 1 fleshy seta, VI with 4 slender setae and 1 fleshy seta, VII with 3 fleshy setae and 5 slender setae. Eyes present (i). Legs stout, well developed. Dimensions in Table 2.

Table 2. Lengths (in μm) of legs in male second instar nymphs of *Kermes quercus* (LINNAEUS).

Leg segments and claw	Prothoracic legs	Mesothoracic legs	Metathoracic legs
Coxa	75 (70-80)	75 (70-83)	76 (70-88)
Trochanter + femur	117 (110-118)	119 (112-125)	119 (107-128)
Tibia	60 (55-65)	63 (60-65)	63 (62-63)
Tarsus	74 (70-78)	79 (77-83)	83 (77-85)
Claw	20 (17-23)	21 (20-23)	21 (18-23)
Entire leg	346 (330-353)	357 (347-368)	362 (352-368)

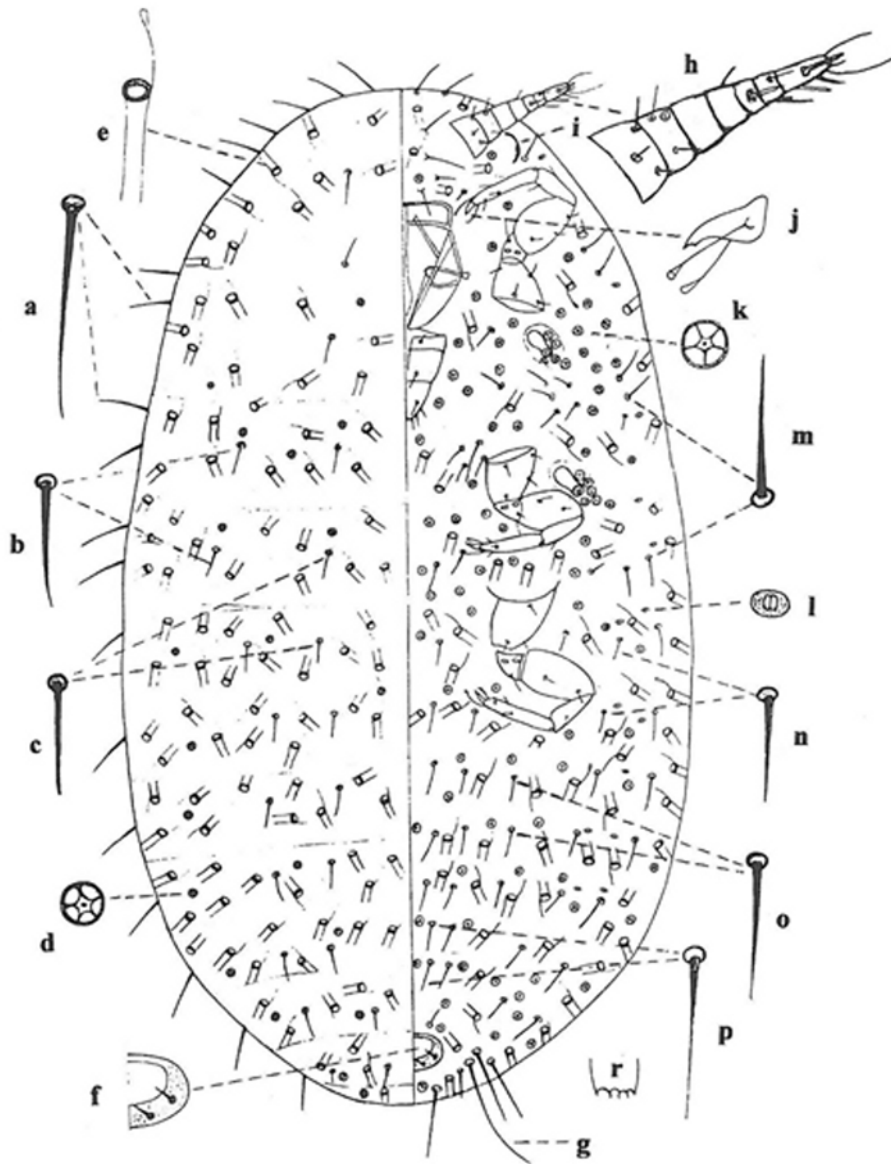


Fig. 3. The male second instar of *Kermes quercus* (LINNAEUS): a – dorsal marginal setae, b – dorsal mesolateral setae, c – dorsal medial setae, d – dorsal quinquelocular pore, e – dorsal tubular duct, f – anal ring, g – apical seta, h – antenna, i – eye, j – claw, k – ventral quinquelocular pore, l – ventral bilocular pore, m – ventral marginal setae, n – ventral submarginal setae, o – ventral submedial setae, p – ventral medial setae, r – ventral spine-like projections of the derm.

Coxa with 5-6 setae, trochanter with 2 elongated setae, 2 short setae and 2 sensilla on each side, femur with 4-5 setae, tibia with 3-4 setae, tarsus with 4-5 setae and sensory pore on proximal margin. Claw with a denticle (j). Tarsal digitules 36 (32-40) long, claw digitules 23 (22-25) long. Clypeolabral shield 140 (125-150) long and 122 (110-130) wide. Labium triangular, 95 (90-100) long and 88 (82-92) wide, composed of three segments. The basal segment with 1 pair of setae, the middle segment with 1 pair of setae, and the apical segment with 4 pairs of setae. Anterior and posterior spiracles similar in size, with peritreme 11 (10-12) in diameter, aperture ca 6.5 in diameter, and 4-9 quinquelocular pores near each spiracle. Quinquelocular pores (k) ca 6.5 in diameter, numerous, scattered throughout the derm. Tubular ducts, similar in size to those on dorsum, present on entire venter, but most frequently in submarginal zone. Bilocular pores (l) ca 4 long and 3 wide, located near sub- and marginal setae, about 15 pores along each body margin. Body setae morphologically similar to dorsal setae, arranged segmentally in 4-5 longitudinal rows on abdomen and partly on thorax and head: marginal (m), submarginal (n), submedial (o) and double medial (p) rows. Marginal setae 47 (32-60) long, submarginal setae 34 (24-40) long, submedial setae 47 (32-60) long and medial setae 57 (39-71) long. Small, spine-like projections (r) of the derm present on abdominal segments and on metathorax and mesothorax between coxae.

The second instar female

(Fig. 4)

Body convex, ovoid, strongly widened in the posterior part, dark yellow in colour, 1126 (840-1250) long and 874 (650-1040) wide.

Dorsal surface, much larger than the ventral surface, expands over lateral body sides and is folded ventrally. So the margin between the dorsum (tergum) and the venter (sternum) occurs on the underside, probably somewhere near the row of marginal ventral setae (m).

Dorsum. Body segments fused. Setae stout, spine-like, arranged in 3 longitudinal rows: marginal (a) consisting of about 18 setae, 24 (12-45) long, located on the underside; mesolateral (b) consisting of 6-8 setae, 9 (7-10) long, beginning on the upper surface of abdomen and probably ending on the underside; submedial (c) consisting of about 11 setae, 10 (7-15) long, located on upper surface. Quinquelocular pores absent. Tubular ducts (d), 43 (30-58) long, 9 (8-10) wide in the head, numerous on nearly the entire surface except for the middle part of the head. Bilocular pores (e), ca 4 long and 3 wide, composed of a sclerotized ring, distributed throughout the derm. Simple pores (f), ca 1.5 in diameter, few, detectable in posterior and marginal areas of the body. Anal ring (g) sclerotized, oval, 30 (27-32) long, 39 (37-42) wide, usually with 2 pairs of poorly developed setae, occasionally with 1 additional unpaired seta. Anal lobes membranous, without definite margins, each with apical seta (h) 100 (90-115) long, and four accompanying setae 12-43 long.

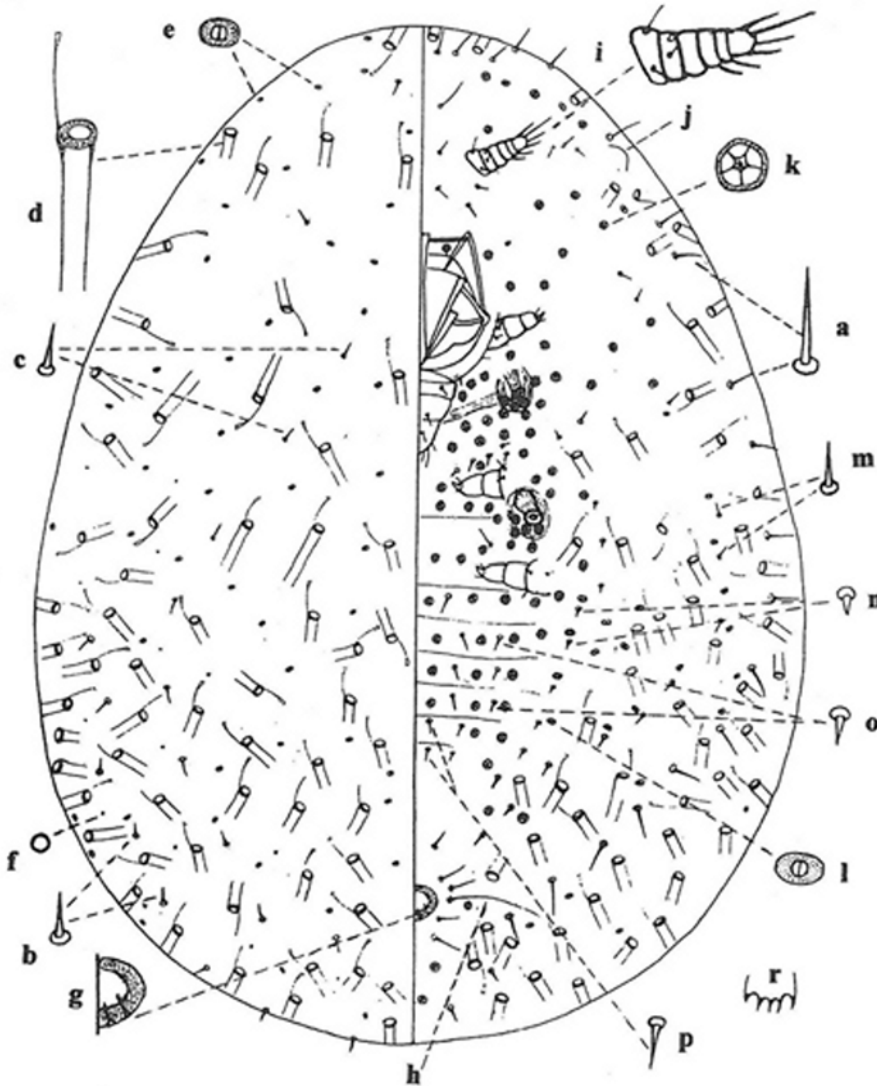


Fig. 4. The second instar female of *Kermes quercus* (LINNAEUS): a – dorsal marginal setae, b – dorsal mesolateral setae, c – dorsal submedial setae, d – dorsal tubular duct, e – dorsal bilocular pores, f – dorsal simple pore, g – anal ring, h – apical seta, i – antenna, j – eye, k – ventral quinquelocular pore, l – ventral bilocular pore, m – ventral marginal setae, n – ventral submarginal setae, o – ventral submedial setae, p – ventral medial setae, r – ventral spine-like projections of the derm.

Venter. Antennae (i) 5- or 6-segmented, strongly shortened, wide at the base, tapering to the tip, 57 (52-67) long. Eyes present (j). Legs reduced, composed of three segments: coxa, trochanter + femur, tibia + tarsus and claw. Tarsus rounded at the tip. Entire length: prothoracic 58 (55-63), mesothoracic 61 (57-65), metathoracic 65 (62-68). Clypeolabral shield 151 (145-155) long and 120 (115-125) wide. Labium triangular, 100 (88-107) long and 85 (80-92) wide, composed of three segments. The basal segment with 1 pair of setae, the middle segment with 1 pair of setae and the apical segment with 4 pairs of setae. Anterior spiracles with peritreme 13 (12-15) in diameter and aperture ca 6.5 in diameter. Posterior spiracles with peritreme 14 (13-15) in diameter and aperture ca 6.5 in diameter. Seven – thirteen quinquelocular pores near each spiracle. Quinquelocular pores (k) ca 7 in diameter, numerous on entire venter, but most frequent in spiracular area, arranged in rows on abdominal segments. 3-locular and 7-locular pores occur sporadically among the 5-locular pores. Tubular ducts, similar in size to those on dorsum, few, present in marginal area of abdomen and thorax. Bilocular pores (l) ca 5 long and 4 wide, located near sub- and marginal setae along each body margin but most frequently on abdominal segments. Body setae stout, spine-like, needle-like or conical, arranged in 4 longitudinal rows on abdomen and partly on head and thorax: marginal (m), submarginal (n), submedial (o) and medial rows (p). Marginal setae 11 (7-16) long, submarginal setae 5 (5-7) long, submedial setae 7 (5-8) long and medial setae 11 (10-12) long. Small, spine-like projections of the derm (r) present on abdominal segments and on metathorax and mesothorax between coxae.

DISCUSSION

The second instar nymphs of *K. quercus* are dimorphic. Both sexes have a similar arrangement of body setae and possess tubular ducts on both surfaces. The second instar male is distinguished by 7-segmented antennae, well-developed legs, thin body setae and long, quinquelocular pores on both surfaces, bilocular pores only on the venter near the sub- and marginal setae, and by the lack of simple pores. The second instar female is distinguished by shortened 5-6 segmented antennae, very much reduced legs, short and stout body setae, quinquelocular pores only on the venter, bilocular pores on both surfaces (those on the dorsum distributed throughout the derm while those on the venter are distributed as in the male), and by possessing a few simple pores in the posterior and marginal areas of the dorsum.

KOZÁR (1998) listed 33 species in the genus *Kermes* occurring in the Palearctic Region, with 5 species in Central Europe (KOSZTARAB & KOZÁR 1988). Two species were recorded in Poland: *K. quercus* (LINNAEUS) and *K. roboris* (FOURCROY) (KAWECKI 1985), but the occurrence of the latter requires verification (PODSIADŁO 2005b). The second instars

of these species are practically unknown. Descriptions only of the second instars of *K. bytinskii* (STERNLICHT 1969) from Israel were found in the available literature. Additional studies on this stage are needed to assist in the identification of the species and to initiate future taxonomic, biological and ecological studies.

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