APHIDS AND OTHER HEMIPTEROUS INSECTS | VOL.18 (2012) 5–11

Changes in the body proportions of the first-instar nymphs of *Kermes quercus* (Linnaeus 1758) (Hemiptera: Kermesidae) during growth

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ABSTRACT

Observations were carried out in 2008 and 2009 in Warsaw (Poland). The material was collected from *Quercus robur* L. It was found that the first-instar stage of *Kermes quercus* (Linnaeus 1758) lasted about 14 months, from the second third of June 2008 till the last third of August 2009. It was demonstrated that body size increased with age, while the size of appendages remained unchanged. Individuals also changed their body shape, owing to differential growth of particular body parts. The ratio of the length of labium, clypeolabral shield, antennae and legs III to the body length in various age groups of nymphs are given. First-instar nymphs from some age groups are illustrated. Characteristics of the first-instar nymphs that distinguish them from the second-instar nymphs are presented.

KEY WORDS: *Kermes quercus,* body proportions, first-instar nymphs

INTRODUCTION

Kermes quercus is a Palaearctic species, very common in many European countries (Kosztarab & Kozar, 1988), including Poland (Kawecki, 1985; Simon & Herczek, 2010). It lives on several species of oaks in the bark crevices of the

trunk and on thick branches, where it can reach a high density population causing deformation of infested plant parts and even the death of younger trees.

Saakjan-Baranowa & Muzafarow (1972) outlined the life cycle of *K. quercus* from the region of St. Petersburg and Schmutterer (1972) – that from Germany. According to these authors, *K. quercus* had one generation per year and overwintered as the 2nd instars. Such a view on *K. quercus* development has been generally accepted (Kosztarab & Kozar, 1988) and this is given in the Scale Net.

However, observations carried out in Poland have not confirmed the above mentioned life cycle of *K. quercus*. They revealed that, under the climatic conditions of Poland, *K. quercus* is not a univoltine species, but each generation probably develops over two years. In the first year, individuals overwinter as first-instar nymphs and in the second year – as second-instar nymphs (Podsiadło, 2011). It was found that the first larval stage of *K. quercus* lasted c. 14 months. Older nymphs of the stage differ in general appearance from the younger ones and may be erroneously identified as larvae of another stage.

The aim of this study was to facilitate the recognition of the first-instar nymphs at different phases of their growth.

MATERIAL AND METHODS

The observations were carried out between the beginning of June in 2008 and the end of August in 2009. The material was collected from *Quercus robur* L. in the Bemowo wood-park situated in the western part of Warsaw. The first-instar nymphs of *K. quercus* were sampled every 3-4 months from newly settled to fully grown individuals. Material was analysed in five age groups: 1 – that sampled on the 7th of July 2008 included newly settled individuals at the age of c. 3 weeks; 2 – that sampled from the 12th to the 18th of November 2008 included individuals entering winter diapause at the age of c. 5 months; 3 – that sampled on February 8, 2009 included overwintering individuals at the age of c. 8 months; 4 – that sampled from May 30 to June 30, 2009 included individuals reactivated after winter diapause at the age of c. 11 – 12 months; 5 – that sampled on August 23, 2009 included fully grown individuals at the age of c. 14 months just before moulting. Specimens were fixed in 70% alcohol and prepared for mounting in balsam. Ten individuals were examined in each group. The length and width of the body, labium and clypeolabral shield and the length of antennae and legs were measured. Sizes are given in μm. Drawings were made with a microscope drawing tube attached to a Zeiss microscope. For rapid diagnostics, the specimens were mounted in glycerine. Methods for mounting scale insects on slides can be found in Koteja (1966).

RESULTS

The observations revealed that the first larval stage of *K. quercus* lasted from the 2nd third of June 2008 till the last third of August 2009. During this period they greatly increased in size and changed their body shape due to differential growth of particular body parts. The dorsal surface expands much more than the ventral surface, so individuals become convex. As a result, various structures change their location, which may impede recognition of the stage. It is noteworthy that no new structures are formed during these changes and, therefore, diagnostic characters of the first-instar nymphs of different ages are the same.

Antennae stout 6-segmented. Legs well developed. Claw with a small denticle near tip (overlooked in descriptions of the first instar of *K. quercus* by Borchsenius (1960) and Podsiadło (2005)). Labium 3-segmented. Anal ring semicircular, anal lobes sclerotized but poorly developed. Dorsum with 2 pairs of longitudinal rows of simple pores, also with marginal and submedial rows of setae. Marginal and partly submedial setae tuber-like in shape. Anterior spiracle with 2 associated pores and posterior spiracle with 1 associated pore. Venter with 2 longitudinal rows of setae on each side of cephalothorax and with 4 longitudinal rows of setae on each side of abdomen. Two pairs of ventral submedian disc pores, 1 on prothorax and 1 on mesothorax, a side mouthparts; occasionally 1 unpaired disc pore on metathorax. Two pairs of ventral bilocular pores located marginally on meso- and metathorax; sporadically one pair of bilocular pores on abdomen.

Results of measurements of body and appendages are given in Table 1. As can be seen, only body size increases with age while the size of appendages remains unchanged. Figure 1 illustrates various forms of the first instar nymphs from different age groups, though the shape of older nymphs from the same age group can be highly variable. Figure 2 presents the ratio of the length of the labium, clypeolabral shield, antennae and legs III to body length in various age groups of the first-instar nymphs of *K. quercus*. All these proportions decrease with age.

Table 1. Measurements (in μm) of body size, labium, clypeolabral shield, antennae and legs in the first instar nymphs of *K. quercus*.

Date of sampling	07.07.2008	12.11-18.11.2008	08.02.2009	28.05-30.06.2009	23.08.2009
Growth phase	Newly settled	Entering winter diapause	Overwintering	Reactivated after winter diapause	Fully grown (just before moulting)
Age of nymphs	About 3 weeks	About 5 months	About 8 months	About 11-12 months	About 14 months
Body:					
length	477.5 (455-495)	571.2 (530-630)	595.0 (550-640)	686.3 (630-750)	723.7 (630-820)
width	252.9 (240-265)	447.5 (380-480)	434.0 (390-480)	516.3 (470-630)	562.5 (500-590)
Labium:					
length	70.0 (67.5-72.5)	70.0 (67.5-72.5)	70.4 (70.0-72.5)	71.0 (70.0-75.0)	70.0 (62.5-75.0)
width	49.1 (42.5-52.5)	50.5 (47.5-55.0)	51.2 (50.0-52.5)	53.9 (50.0-60.0)	50.4 (47.5-55.0)
Clypeolabral shield:					
length	105.2 (102.5-110.0)	105.4 (100.0-107.5)	104.5 (100.0-107.5)	105.7 (100.0-110.0)	105.0 (100.0-110.0)
width	67.5 (62.5-72.5)	70.0 (67.5-72.5)	72.0 (62.5-77.5)	71.7 (67.5-75.0)	70.0 (62.5-77.5)
Length of antennae	114.4 (110.0-120.0)	114.5 (112.5-120)	114.3 (110.0-122.5)	114.1 (110.0-117.5)	115.8 (110.0-120.0)
Length of legs:					
Leg I	189.9 (180.0-197.5)	192.8 (187.5-197.5)	188.7 (182.5-197.5)	190.8 (187.5-195.0)	192.0 (187.5-197.5)
Leg II	194.5 (187.5-202.5)	194.2 (187.5-197.5)	191.2 (182.5-197.5)	192.9 (190.0-200.0)	197.0 (192.5-205.0)
Leg III	201.2 (195.0-205.0)	200.5 (190.0-207.5)	200.2 (192.5-210.0)	201.6 (197.5-207.5)	201.4 (195.0-212.5)

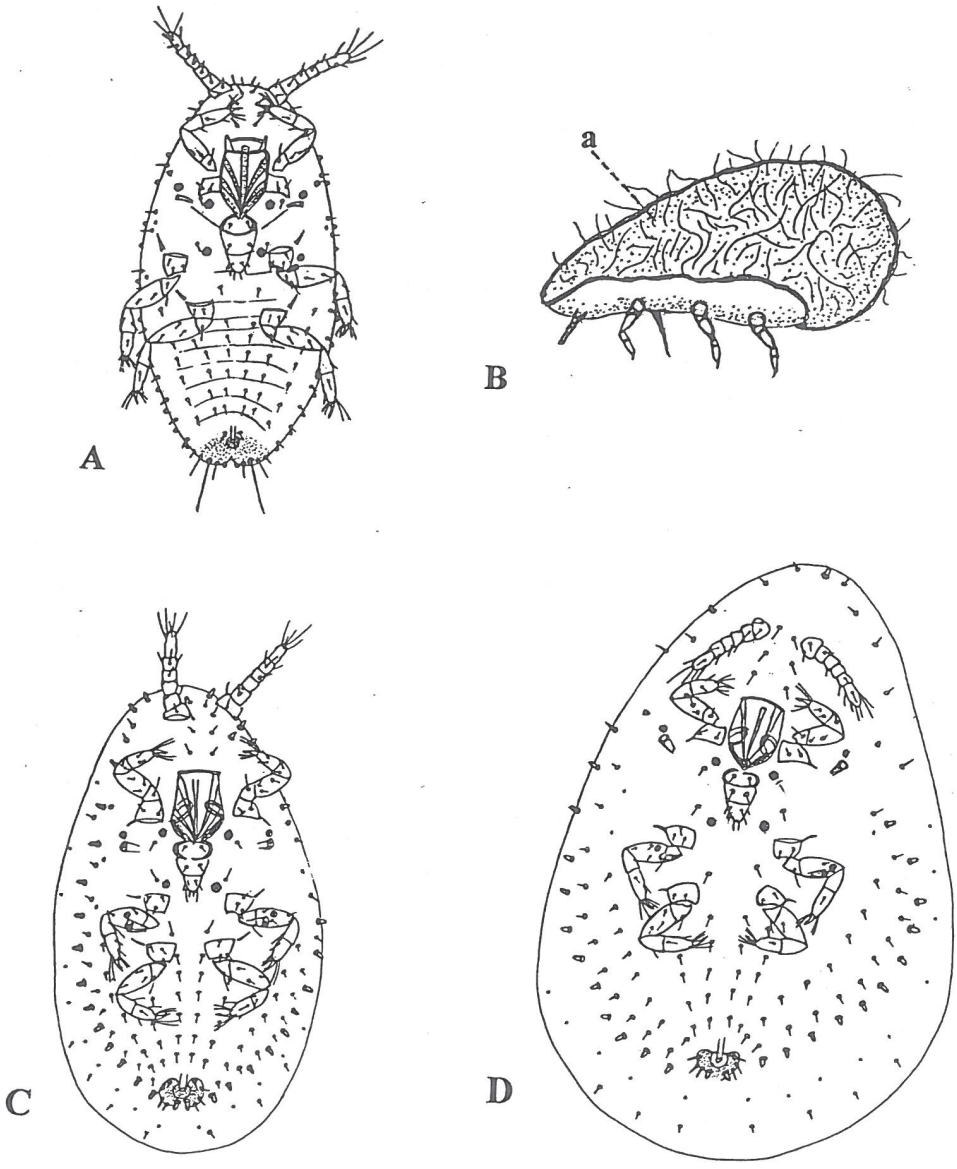

Figure 1. Various forms of the first-instar nymphs of *K. quercus* (ventral view); A – a newly settled individual, about 3 weeks old, sampled on 7.07.2008; B – unmounted, overwintering individual (scheme), a – test with white wax threads; C – overwintering individual, about 5 months old, sampled on 8.02.2009; D – individual reactivated after winter diapause, about 12 months old, sampled on 30.06.2009.

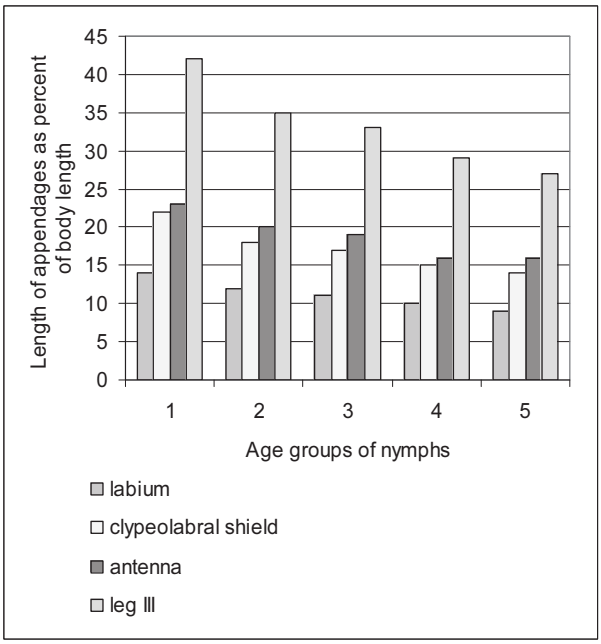

Figure 2. The ratio of the length of appendages to body length in different age groups of the first-instar nymphs of *K. quercus*: 1 – nymphs about 3 weeks old, 2 – nymphs about 5 months old, 3 – nymphs about 8 months old, 4 – nymphs about 11-12 months old, 5 – nymphs about 14 months old.

DISCUSSION

In the first-instar nymphs of *K. quercus* the gender was not determined. However, in the second-instar nymphs of this species the sex is determined with a distinct sexual dimorphism (Saakyan-Baranova & Muzafarov, 1972; Podsiadło, 2012). The most characteristic feature distinguishing the first-instar from the second-instar nymphs of both sexes is a lack of tubular ducts. This characteristic can already be seen on specimens mounted in glycerine.

Both the first-instar nymphs and the second-instar males have well developed legs but differ in the shape of antennae. The first-instar nymphs have 6-segmented antennae slightly tapering towards the end. The second-instar males have 7-segmented antennae, conical i.e. broad at the base and strongly tapering at the end. The second-instar females have strongly reduced antennae and legs. The difference may be seen in specimens soaked in 10% KOH solution or on specimens mounted in glycerine. Examination of other morphological structures requires microscopic analysis at a higher magnification.

REFERENCES

Borchsenius N.S. 1960. Fauna of USSR, Homoptera, Coccoidea, Kermococcidae, Asterolecaniidae, Lecaniodiaspididae, Aclerdidae. Akademia Nauk SSSR. Zoologicheskij Institut. (N.S. 77), 8: 1-282. [In Russian].

Kawecki Z. 1985. Scale insects, Coccoidea. Catalogue of Polish Fauna. Polish Academy of Sciences, Institute of Zoology, 21 (5): 1-108. [In Polish].

Kosztarab M., Kozár F. 1988. Scale insects of Central Europe. Akadémiai Kiadó, Budapest: 1-456.

Koteja J. 1966. Jak rozpoznawać czerwce (Homoptera: Coccinea) [How to recognize scale insects (Homoptera: Coccinea)]. [In]: Boczek J. (ed.) Diagnostyka szkodników roślin i ich wrogów naturalnych [Diagnostics of plant pests and their natural enemies]. Wydawnictwo SGGW, Warszawa, t.2: 139-231. [In Polish].

Podsiadło E. 2005. Morphology of the first instar of *Kermes quercus* (Linnaeus, 1758) (Hemiptera: Coccinea: Kermesidae). Polskie Pismo Entomologiczne, 74: 47-52.

Podsiadło E. 2011. Study on Larval Diapause Development of *Kermes quercus* (Linnaeus, 1758) (Hemiptera: Kermesidae) in Warsaw, Poland. Journal of Life Sciences, 5: 279-281.

Podsiadło E. 2012. Morphology of second instar nymphs of *Kermes quercus* (Linnaeus, 1758) (Hemiptera: Kermesidae). Polskie Pismo Entomologiczne, 81: 35-42.

Saakyan-Baranova A.A., Muzafarov S.S. 1972. Structure, biology and interrelationships of northern gall-like coccid *Kermococcus quercus* L. (Homoptera, Kermococcidae) and its parasites (Hymenoptera, Chalcidoidea), I. Entomologicheskoe obozrenye, 51: 498-519. [In Russian].

Schmutterer H. 1972. Unterordnung Coccoidea, Schildläuse. Kermesidae (Kermidae, Kermococcidae). [In]: Die Forstschädlinge Europas, by W. Schwenke, Paul Parey Publ. Hamburg-Berlin, 1: 418-420. [In German].

Simon E., Herczek A. 2010. Scale insects (Hemiptera: Coccoidea) of the Landscape Park "Cistercian Landscape Compositions of Rudy Wielkie". Katowice: 1-127.

Zmiany proporcji ciała u larw 1 stadium *Kermes quercus* (Linnaeus 1758) (Hemiptera: Kermesidae) podczas wzrostu

STRESZCZENIE

Obserwacje prowadzono od początku czerwca 2008 do końca sierpnia 2009 w Parku Leśnym Bemowo, położonym w zachodniej części Warszawy. Materiał zbierano na *Quercus robur* L. Stwierdzono, że 1 stadium larwalne *Kermes quercus* (Linnaeus 1758) trwa około 14 miesięcy od drugiej dekady czerwca 2008 do trzeciej dekady sierpnia 2009. Larwy 1 stadium *K. quercus* zbierano w odstępach 3-4 miesięcznych, od świeżo osiadłych do wyrośniętych w pełni. Materiał analizowano w 5 grupach wiekowych: 1 – zebrana 7.07.2008 obejmowała osobniki w wieku około 3 tygodni, świeżo osiadłe; 2 – zebrana

12-18.11.2008 obejmowała osobniki w wieku około 5 miesięcy, wstępujące w diapauzę zimową; 3 – zebrana 8.02.2009 obejmowała osobniki w wieku około 8 miesięcy, zimujące; 4 – zebrana 30.05-30.06.2009 obejmowała osobniki w wieku około 11-12 miesięcy, uaktywnione wiosną; 5 – zebrana 23.08.2009 obejmowała osobniki w wieku około 14 miesięcy, w pełni wyrośnięte, tuż przed linieniem. W każdej grupie badano 10 osobników. Mierzono długość i szerokość ciała, wargi dolnej i płytki klypeolabralnej oraz długość czułków i odnóży (Tab. 1). Stwierdzono, że z wiekiem, wzrasta jedynie wielkość ciała, natomiast wielkość przydatków pozostaje bez zmian. Zmienia się też kształt ciała osobników, wskutek czego następuje przemieszczenie różnych struktur. Zilustrowano larwy 1 stadium z niektórych grup wiekowych (Fig. 1). Podano cechy rozpoznawcze larw 1 stadium odróżniające je od larw 2 stadium. Podano stosunek liczbowy długości wargi dolnej, płytki klypeolabralnej, czułków i odnóży 3 pary do długości ciała w różnych grupach wiekowych larw 1 stadium *K. quercus* (Fig. 2).