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**Concept of the species of *Asterodiaspis variolosa* (RATZEBURG, 1870) (Homoptera, Coccoidea, Asterolecaniidae)**

[With 1 figure in the text]

**Abstract.** It has been recognized that *Asterodiaspis quercicola* (BOUCHÉ) is a synonym of *Asterodiaspis variolosa* (RATZEBURG). The discontinuous individual variation recorded within colonies of this species is interpreted as an instance of polymorphism. Synonyms: *Asterolecanium quercicola* (BOUCHÉ): SIGNORET 1870; *Asterolecanium minus* LINDINGER (= *minus* RUSSELL): RUSSELL 1941.

**Introduction**

Until the monograph of RUSSELL (1941) was published, it had been assumed that the range of the morphological characters variability in the species of *variolosus* RATZEBURG had been very wide. Only a part of that taxon has been accepted by RUSSELL to be a true *variolosus* RATZ., while in the remaining part she recognized two species: *quercicola* BOUCHÉ and *minus* LINDINGER. PODSIADŁO (1974b) has united *quercicola* BOUCHÉ and *minus* RUSSELL into one species. But further investigations and consideration have led to a conclusion that all the three taxa distinguished are forms of the same species.

**The species names**

RATZEBURG (1870) described a species of scale insect named by him *Coccus variolosus* living on oaks in Kunersdorf near Potsdam. The description and illustration provided by RATZEBURG had been based on the external appearance

only, and led to wide interpretation of this species. COCKERELL (1899) placed *variolosus* RATZ. in the genus *Asterolecanium* TARGIONI-TOZZETTI, while BORCHSENIUS (1960) transferred it to the genus *Asterodiaspis* SIGNORET. As it has already been mentioned, according to RUSSELL, only some part of that taxon belonged to the species *variolosus* RATZ. As she reported, she had not investigated any type specimens of the species, probably none exist any longer (they have not been located in Eberswalde or Berlin). Her justification for considering the taxon recognized by her as identical with the species *variolosus* RATZ. is as follows: "The species treated here is so common in Germany, however, that there is strong possibility it is true *variolosum*".

In 1851 BOUCHÉ gave the name *Lecanium quercicola* to a species which he described as follows: "♀ fast kreisrund, erhaben, runzlich, dunkelbraun. Länge  $\frac{1}{2}$  Linie<sup>1</sup>. Auf Eichen selten". This description cannot be attributed positively to any scale insect species living on oaks and, what's more, as RUSSELL has reported, presumably no type specimens exist any longer. SIGNORET (1870) identified as *quercicola* BOUCHÉ specimens occurring on oaks in Paris and transferred that species to the genus *Asterolecanium*. SIGNORET in 1876 established the genus *Asterodiaspis* placing the species *quercicola* BOUCHÉ within this. A description and illustration given by SIGNORET (1870) provided a basis for regarding that species identical with *Asterolecanium variolosum* (RATZ.).

The name *quercicola* BOUCHÉ was used for a short time (GREEN 1895, NEWSTEAD 1895, 1901), and then forgotten till RUSSELL's investigations (1941). Many coccidologists did not recognize the identity of the species *quercicola* BOUCHÉ with one of *quercicola* SIGNORET. *Lecanium quercicola* BOUCHÉ was considered by COCKERELL (1899) to be a very doubtful *Asterolecanium*, by FERNALD (1903) an unknown species<sup>2</sup>, by SANDERS (1909) *Aspidiotus zonatus* FRAUENF., by LINDINGER first (1912) a doubtful *Kermes quercus* (L.) CKLL. and then in a later paper (1934) an unknown species. On the other hand, the name *quercicola* SIGNORET has been generally accepted as a synonym of *variolosum* RATZ. (COCKERELL 1899, NEWSTEAD 1903, FERNALD 1903, SANDERS 1909, LINDINGER 1912, GÓMEZ-MENOR 1937, BORCHSENIUS 1937).

RUSSELL (1941) adopted the interpretation of the species of *quercicola* BOUCHÉ given by SIGNORET (1870) i.e. she considered the species examined by SIGNORET to be *quercicola* BOUCHÉ. Moreover, after studying SIGNORET's specimens, she recognized *quercicola* BOUCHÉ to be a species different from *variolosum* RATZ. and included it into the genus *Asterolecanium*. Since then the name *quercicola* BOUCHÉ has become generally used. BORCHSENIUS (1960) transferred *quercicola* BOUCHÉ to the genus *Asterodiaspis*.

<sup>1</sup> Linie – a former unit of length. 1 L = somewhat more than 2 mm (Der Volks-Brockhaus, 1941, Leipzig).

<sup>2</sup> In "Corrections and Additions" of Catalogue.

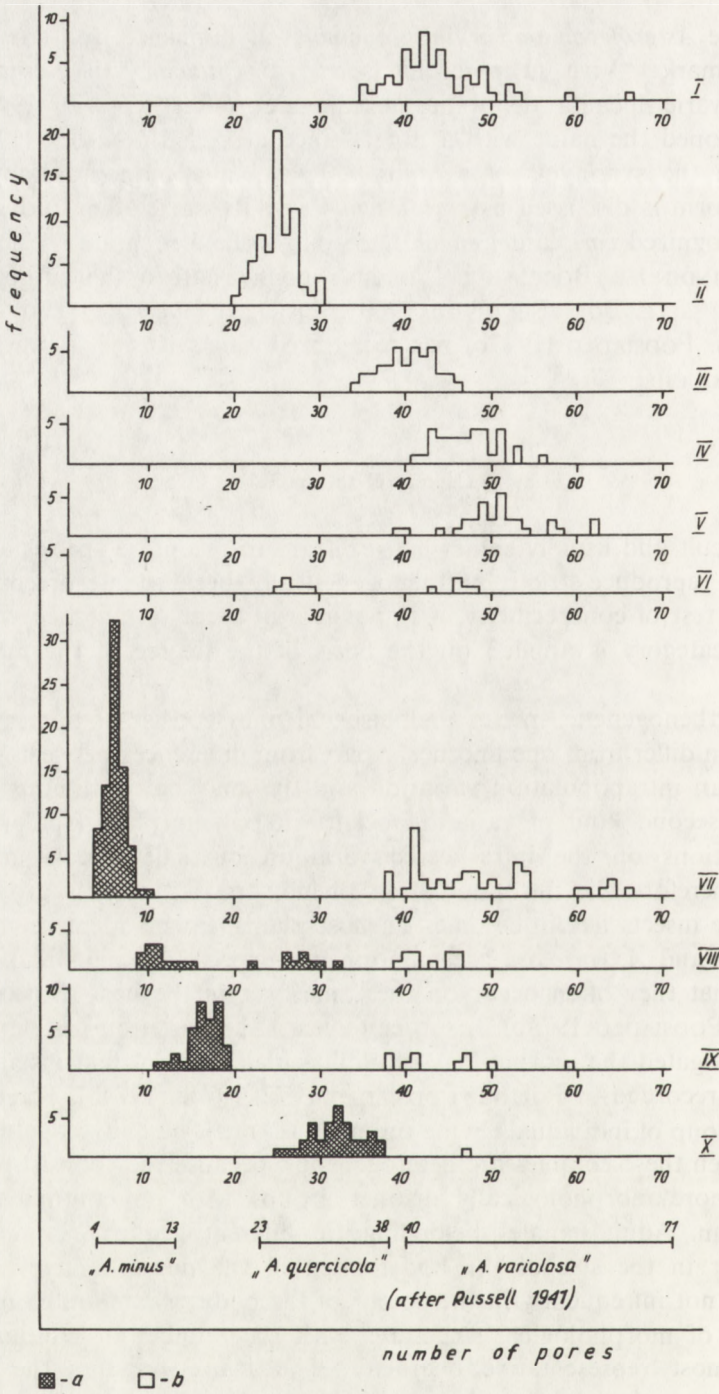
The name *Asterolecanium variolosum minor* was published by LEONARDI in 1909 with the remark: "Vive su parecchie specie di *Quercus*. Gli esemplari furono raccolti in varie località dell'Italia meridionale" (after RUSSELL 1941). SASSCER (1911) mentioned the name with a note: "since descr.". LINDINGER (1912) put the name within the synonyms of *variolosum* RATZ. In a monograph by LEONARDI (1920) that form is discussed as *variolosum* RATZ. RUSSELL, after studying the type material, recognized *variolosum minor* LEONARDI to be a separate species named by her *minus* LINDINGER. BORCHSENIUS, in his works, ascribed the authority for this species to RUSSELL. BORCHSENIUS in 1960 transferred *minus* RUSSELL to the genus *Asterodiaspis*. PODSIADŁO (1947b) has recognized *minus* RUSSELL as a synonym of *quercicola* BOUCHÉ.

#### Concept of the species

It is difficult and usually somewhat arbitrary to recognize species among those animals that reproduce strictly parthenogenetically, because interbreeding, which is the ultimate test of conspecificity, is impossible in them. In practice, in such cases the species category is applied on the basis of the degree of the morphological difference.

Both parthenogenetic species and bisexual ones consist of numerous populations that can differ from one another. Apart from differences between populations, there exists an intrapopulation variation and this may be continuous or discontinuous. The second kind of variation occurs in polymorphic populations.

Investigations on the infraspecific variation of scale insects are not very advanced, therefore the intrapopulation phenomena within this group are little known. Scale insects live in colonies on host plants. Forms identified as *A. minus*, *A. quercicola* and *A. variolosa* are monophagous species on oaks and, it has been found out that they often occur on the same twig of the host (BORATYŃSKI 1961, APEJI 1964, PODSIADŁO 1974b). In order to learn the variation of these forms, the author investigated the morphology of adult females and of first instar nymphs in ten colonies recorded in Poland (PODSIADŁO 1972, 1974a, 1974b). The term colony refers to a group of individuals living on one oak tree. These investigations revealed that very often these colonies are heterogeneous, because they consist of two, three or maybe more morphologically distinct groups with no continuous variation between them. Adult females belonging to different groups examined, in situ, usually differ in the size of the body, often in the degree of convexity of the dorsum and not infrequently in the colour of the body; the mounted ones differ in the number of morphological structures with the number of multilocular pores being the most representative character. The figure presents the number of multilocular pores in adult females in ten colonies investigated. The distribution of the size of the body and that of the number of quinquelocular pores in the spiracular bands are similar, although the histograms are less compact because the



Number of multilocular pores in females of *Asterodiaspis variolosa* (RATZ.) in ten colonies from Poland: I–X – particular colonies; a – the females producing the first instar nymphs with sublateral and submedian series of dorsal 8-shaped pores; b – the females producing the first instar nymphs without these series of pores.

ranges of individual variation within each group are much wider and there is a considerable overlap between them. An analysis of all the characters has revealed that colonies I–V are internally homogeneous, colonies VI, VII, IX and X consist of two distinct groups of individuals, and colony VIII consists of such three groups. Breeding experiments have revealed that these morphological characters are genetically determined and heritable. Due to asexual reproduction there is no possibility of any exchange of the genetic material between these groups.

It was precisely such morphs belonging to different groups that were considered by RUSSELL to be separate species. Female morphs having the lowest values of the morphological characters have been recognized as *A. minus*, those having the highest as *A. variolosa*, with *A. quercicola* being intermediate. However, the figure shows plainly that there are many more of these groups and there would be no point to raise each to the rank of a species. In previous papers of PODSIADŁO (1974a, 1974b) these groups have incorrectly been called populations. More likely they are phenons i.e. groups of phenotypically similar individuals occurring in polymorphic populations.

Some morphological characters of females and of their progeny in the first nymph stage are correlated. Namely, adult females with the smallest bodies and consequently with the smallest number of morphological structures produce nymphs possessing the sublateral and submedian series of 8-shaped pores. The progeny of the largest females possesses no such series but, at most, 1–3 single 8-shaped pores in the submedian area. Females belonging to intermediate phenons produce nymphs of the first type in some colonies, while the second one in others (see: Figure).

On this very basis PODSIADŁO (1974b) first retained the species rank of *A. quercicola* and *A. variolosa*. Nymphs with sublateral and submedian series of 8-shaped pores and their mothers were recognized as *A. quercicola* while nymphs without these series and their mothers as *A. variolosa*.

But in the light of additional investigations that conception appeared to be unfounded. The taxa distinguished may be recognized without doubt only in the first nymph instar, while any differences between adult females are indistinct. The same involves the second instar nymphs (PODSIADŁO 1989). Neither do these forms differ in biology.

Taxonomic problems concerning scale insects were sometimes solved when chalcidoid parasites were taken into consideration. Obviously, only those parasites whose host specificity is very high can be taken into consideration. ROSEN and DE BACH (1977) have given numerous examples of parasitic chalcidoids which discriminate the species of scale insects morphologically indistinguishable to taxonomists. In Poland, there have been found two species of specific parasites in *A. variolosa*: *Habrolepis dalmani* (WESTWOOD) and *Metaphycus asterolecanii* (MERCET) (*Encyrtidae*). They attack both forms of the host without discrimination (PODSIADŁO 1986).

What are the causes of polymorphism in *A. variolosa*?

In the author's opinion this has been developed as a result of different nutritive conditions on a host plant plus the limited dispersal possibilities of individuals from their hatching place over the host plant. It seems that also the physiological condition of the host plant influences the habit of individuals.

It has been found out that females settled at the terminal growing points of twigs reach somewhat larger dimensions of the body than those belonging to the same phenon but living on older sections of branches (PODSIADŁO 1974a), and that crawlers generally settle close to their mothers (PODSIADŁO 1976).

Therefore it may be assumed that phena consisting of the largest individuals have been formed under the most favourable nutrient conditions i.e. on new growths, while phena consisting of the smallest, so to say, dwarf individuals have been formed under the least favourable nutrient conditions i.e. on older lignified branches, and phena consisting of intermediate individuals – under intermediate conditions. This assumption seems to be confirmed by observations of BORATYŃSKI (1961) and APEJI (1964) who have recorded that *A. variolosa* is more frequent on new growths and at the terminal growing points of twigs, *A. minus* often occurs on older sections of twigs, *A. quercicola* being intermediate.

As it has already been pointed out small females produce first instar nymphs possessing a larger number of dorsal 8-shaped pores. This fact may also be interpreted as an adaptation to living on lignified sections of trees. These pores produce a test, and scale insects living on lignified sections of trees generally have a body covering stronger than those living on the soft tissue of plants.

While living on host plants, the individuals disperse. Some crawlers move from older branches to young twigs, or vice versa, and they also disperse passively on to other trees. They settle there, and develop into adults which give rise to new generations of individuals. That progeny, at first, is similar to their founder mothers. Therefore phenotypically different individuals, whose habit has been formed under different nutrient conditions, often occur together on the same twig of the host.

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[Tytuł: Koncepcja gatunku *Asterodiaspis variolosa* (RATZEBURG, 1870) (*Homoptera*, *Coccoidea*, *Asterolecaniidae*)]

Z dotychczas przeprowadzonych badań (PODSIADŁO 1972, 1974a, 1974b, 1976, 1986, 1989) autorka wyciągnęła wniosek, że *Asterodiaspis quercicola* (BOUCHÉ) i *Asterodiaspis variolosa* (RATZEBURG) stanowią jeden gatunek. W opinii autorki gatunkowi temu przysługuje nazwa *Asterodiaspis variolosa* (RATZ.). W niniejszej pracy autorka przedstawiła nową koncepcję tego gatunku. Według tej koncepcji *A. variolosa* (RATZ.) jest gatunkiem polimorficznym. Jego kolonie są często niejednorodne, bo mogą składać się z dwóch, trzech, a może i większej liczby odrębnych morfologicznie grup osobników (fenonów), między którymi nie ma zmienności ciągłej. Cechy morfologiczne tych grup są genetycznie utrwalone i przekazywane następnym pokoleniom. Ze względu na rozród aseksualny nie ma możliwości wymiany materiału genetycznego między tymi grupami.

Autorka przypuszcza, że polimorfizm u *A. variolosa* (RATZ.) wykształcił się wskutek zróżnicowanych warunków pokarmowych na roślinie żywicielskiej wespół z ograniczonymi możliwościami rozprzestrzeniania się osobników od miejsc ich wylęgu oraz że stan fizjologiczny rośliny żywicielskiej ma również wpływ na habitus osobników. Zgodnie z tą koncepcją fenony złożone z osobników największych wytworzyły się w optymalnych warunkach pokarmowych, t. j. na młodych pędach, fenony złożone z osobników najmniejszych, niejako skarłałych, ukształtowały się w gorszych warunkach pokarmowych, t.j. na starszych, zdrewniałych odcinkach gałęzi, a fenony złożone z osobników pośredniej wielkości – w warunkach pośrednich.

Możliwości przemieszczania się osobników na roślinie żywicielskiej są ograniczone. Zdolnością ruchu są obdarzone jedynie „wędrówce”, t.j. larwy I stadium w początkowym okresie rozwoju, toteż osiedlają się one na ogół blisko swoich matek. Niektóre z nich przechodzą jednak z gałęzi starszych na młode pędy i odwrotnie, bywają też biernie przenoszone na inne drzewa. Tam osiedlają się i rozwijają w postaci dorosłe, które zapoczątkowują pokolenia osobników początkowo podobnych do matek założycielek. Na tej samej gałęzi często występują więc razem różne fenotypowo osobniki, ponieważ ich habitus ukształtował się w odmiennych warunkach.

## РЕЗЮМЕ

[Заглавие: Концепция вида *Asterodiaspis variolosa* (RATZEBURG, 1870) (*Homoptera*, *Coccoidea*, *Asterolecaniidae*)]

Из проведенных исследований (PODSIADŁO 1972, 1974a, 1974b, 1976, 1986, 1989) автор сделала вывод, что *Asterodiaspis quercicola* (BOUCHÉ) и *Asterodiaspis variolosa* (RATZEBURG) составляют один вид, который должен носить



название *Asterodiaspis variolosa* (RATZ.). В настоящей публикации автор представила новую концепцию этого вида, согласно которой *A. variolosa* (RATZ.) является полиморфным видом. Его колонии бывают часто неоднородными, поскольку могут состоять из двух, трех, а может быть и из большего числа различающихся морфологически групп особей (фенонов), между которыми не наблюдается переходной изменчивости. Морфологические признаки этих групп генетически зафиксированы и передаются следующим поколениям. Поскольку размножение не происходит половым путем, нет возможности обмена генетическим материалом между этими группами.

Автор предполагает, что формирование полиморфизма у *A. variolosa* (RATZ.) наступило вследствие дифференциации условий питания на растении-хозяине, а также вследствие ограниченных возможностей миграции особей с мест их выведения. Физиологическое состояние растения также оказывает влияние на габитус особей. Согласно этой концепции феноны состоящие из наиболее крупных особей сформировались в оптимальных пищевых условиях, т. е. на молодых побегах; феноны состоящие из наименьших особей, как бы карловатых сформировались в худших пищевых условиях, т. е. на старых, одревеневших участках ветвей, а феноны состоящие из особей промежуточной величины — в средних условиях.

Возможности перемещения особей на растении-хозяине ограничены. Способны к передвижению только бродяжки, т. е. личинки I стадии в начальной стадии развития, поэтому они поселяются обычно поблизости своих матерей. Однако, некоторые из них переходят с более старых ветвей на молодые побеги и наоборот, бывает также, что пассивно переносятся на иные деревья. Там поселяются и превращаются в имаго, которые дают начало поколениям первоначально сходным с матерями — основательницами. На одной и той же ветви потому встречаются часто вместе различные фенотипически особи, поскольку их габитус сформировался в разных условиях.

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