

**INTRASPECIFIC VARIATION IN THE SCALE INSECTS
(HOMOPTERA: COCCINEA)**

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ABSTRACT

This paper discusses intraspecific variation in the Coccinea, mainly with reference to the soft scale *Parthenolecanium corni* (Bouche). The most important morphological variation is found in the number of submarginal tubercles in adult females and 2nd-instar nymphs. In addition to this polymorphism, *P. corni* also shows heterogeneity between populations in sex ratio and in the number of generations. Thus, *P. corni* populations show morphological and biological characteristics which vary both within and between geographic regions, depending on the host plant, thus creating a complex of local populations, each with a different combination of characters.

KEY WORDS: scale insects, Homoptera, Coccinea, Coccidae, intraspecific variation, *Parthenolecanium corni*.

The range of intraspecific variation in scale insects is often remarkably wide, probably as a result of polyphagy, parthenogenesis and the wide distribution of many species. This variation is displayed by both morphological and biological characters, with the result that several morphs have been described as separate species.

Variation in the external appearance of many soft scales appears to depend on a number of environmental factors. For instance, parasitism has been shown to reduce the number of wax-secreting pores on the dorsum in *Pulvencirra vitis* (Danzig, 1966). However, in most soft scales — in particular, *Parthenolecanium corni* (Bouche) — the major factor appears to be the host plant. In some armoured scales, such as *Chionaspis*, *Lepidosaphes* and related genera, and also *Diaspidiotus ancylus* (Putnam), polymorphism has been shown to be determined by the part of the plant producing different leaf and stem forms, on which the insects feed. Experiments of insect transfer to new host plants, or from one part of a plant to another, have transformed one host-induced form into another (Lupo, 1943; Stafford and Barnes, 1948). In addition, different plant species have been found to modify such biological characters as the sex ratio of *Ericerus pela* (Chavannes) (Danzig, 1980) and the sex ratio and phenology of *Pulvinaria vitis* (L.) (Danzig, 1980; Drozdovsky, 1960; Schmutterer, 1952).

Intraspecific variation has been extensively studied in *P. corni*. Along with differences in the basic external appearance, *P. corni* has been found to show much variation in microscopic characters, the most important being the number of submarginal tubercles in adult females and

2nd-instar nymphs. In the Palaearctic region, this criterion varies in adult females from 0 to 8 or 9 pairs (Šulc, 1932; Borchsenius, 1957; Dziedzicka and Sermak, 1967). These tubercles are often deformed, although in Czechoslovakia Šulc found females with 9 pairs of well-developed tubercles. On the other hand, up to 12 pairs of well-developed tubercles have been found in adult females on different plants from Korea, China and Japan; on the basis of this character, the Far-Eastern form was treated by Borchsenius (1957) as a separate subspecies, *P. corni orientalis*. However, only one female from the vast amount of material collected from the adjacent Russian Far East has been found to have even as many as 7 pairs of well-developed tubercles (from Vladivostok on *Spiraea*) (Danzig, 1980).

In North America, a complex of species close to *P. corni* (the “*corni*-complex”) have been recognized (Richards, 1958; Phillips, 1965a; Williams and Kosztarab, 1972; Hamon and Williams, 1984; Gill, 1988), again differing mainly in the number of submarginal tubercles in adult females. In addition to *P. corni*, this complex includes *P. quercifex* Fitch, *P. pruinorum* Coquillett, *P. cerasifex* Fitch and *P. putmani* Phillips. However, Nakahara (1981) was unable to distinguish morphologically with certainty between these species.

The number of well-developed pairs of submarginal tubercles in 2nd-instar nymphs usually varies from 0 to 5, but numerous studies in northern latitudes revealed that this variation depends on the geographic distribution of the population and on the host plant. Thus, most nymphal populations feeding on species of *Prunus*, *Corylus*, *Ulmus*, *Fraxinus*, *Malus* and *Caragana* (only in the north) have tubercles; on the other hand, tubercles are extremely few or absent in nymphs on arboreal Fabaceae such as *Robinia* and *Gleditsia* (Saakyan-Baranova et al., 1971). In addition, the number of tubercles is relatively stable in some populations but varies in others. For instance, populations in the vicinity of St. Petersburg, Moscow, in the Sakhalin Island as well as in Great Britain (Habib, 1957) and Switzerland (Suter, 1950) appear to have a rather constant 4 pairs, whereas in Moldova, Crimea, Armenia, Kazakhstan (in the vicinity of Alma-Ata), the Russian Far East (Saakyan-Baranova et al., 1971) and also in Poland (Kawecki, 1958; Bielenin, 1958; Dziedzicka and Sermak, 1967), Czechoslovakia (Blattny and Novicky, 1926) and southern France (Canard, 1958), the usual number of tubercles is 5, although quite large variations have been noted. A subspecies from Italy on *Vitis* sp. (*P. corni apulia*) has been described which has more tubercles (Nuzzaci, 1969); although the total number varied between 10 to 13, 67% of the insects had a total of 12 tubercles, i.e. 6 pairs. In some other populations on *Prunus* sp., the tubercles have been found to be usually absent in female nymphs but present in male nymphs (Saakyan-Baranova et al., 1971).

The polymorphism found in populations of *P. corni* is also associated with heterogeneity in sex ratio and phenology, as shown by Saakyan-Baranova et al. (1971). These aspects are briefly considered below.

Reproduction

As in many other coccids, *P. corni* is predominantly parthenogenetic and the sex ratio is extremely variable, apparently depending on feeding conditions. For example, the proportion of males is generally much higher on *Prunus* sp. than on arboreal Fabaceae. Some authors (Thiem, 1933a, 1933c; Canard, 1958) have also related fluctuations in the sex ratio to climatic conditions and altitude.

Thomsen (1929) considered the type of parthenogenesis found in European *P. corni* to be

thelytoky, whereas the species in the “*corni*-complex” in North America appear to differ in their type of parthenogenesis (Phillips, 1965b): *P. cerasifex* is characterized by deuterotoky and *P. putmani* by diploid arrhenotoky. However, Nur (1972, 1980) showed that both types of parthenogenesis occur in these two species — indeed he also noted thelytoky in *P. cerasifex*. Clearly, therefore, cytogenetic data are no better at separating these species than morphological characters. Variations in the type of parthenogenesis have also been noted in *P. vitis* (Malumphy, 1991).

Seasonal development

Depending on geographic position and host plant, *P. corni* may produce from one generation in the north to three generations in the south. Northern populations inhabiting forest and forest-steppe are always monovoltine. Further south, the number of generations observed varied depending on host plants. In southern France (Canard, 1958), Romania (Săvescu, 1943, 1944), Moldova, the Caucasus and in the valleys of Central Asia (Saakyan-Baranova et al., 1971), only one generation normally develops on species of *Prunus*, *Crataegus*, *Diospyros*, *Corylus* and on *Acer negundo*, whereas two generations develop on species of *Caragana*, *Robinia*, *Gleditsia*, *Morus*, *Persica* and *Maclura*. However, this pattern is broken in some localities. Thus, on *Robinia*, the second generation is facultative in southern France (Canard, 1958), although three generations have been found in the Caucasus (Dubrovskaya, 1959). In southern Moldova and in Central Asia, a facultative or even complete second generation may develop on *Prunus* sp. (Saakyan-Baranova et al., 1971).

It can be concluded from the above that in *P. corni* populations both biological and morphological characteristics vary within and between geographic areas, creating a complex pattern of local populations, each with a different combination of characters. It is here considered that the existence of many different morphs within *P. corni* is determined primarily by the bisexual populations and maintained by the different parthenogenetic clones.

The armoured scale insects *Lepidosaphes ulmi* (L.), *Aspidiotus nerii* Bouché, *Hemiberlesia cyanophylli* (Signoret) and some other species have both bisexual and obligate parthenogenetic forms which are morphologically similar. They differ from each other in their developing on different host plants, and in their phenology and fecundity. Indeed, a complex of biologically different forms has been shown to occur in *L. ulmi* populations (Danzig, 1959, 1993; Garret, 1973; Bouchra, 1978). The status of these biological forms has been discussed frequently and they have been considered to be subspecies (Thiem, 1933b; Schmutterer, 1952), sibling-species (DeBach and Fisher, 1956), or even separate species (Săvescu, 1955, 1957; Gerson and Hazan, 1979).

The soft scales *Coccus hesperidum* L., *Saissetia coffeae* (Walker), *P. corni* and *P. vitis* all have both parthenogenetic and bisexual-parthenogenetic forms with different types of parthenogenesis (Thomsen, 1927, 1929; Nur, 1979, 1980; Malumphy, 1991).

Polymorphism in the diaspidid species *Chionaspis salicis* (L.) and *Phenacoccus aceris* (Signoret) does not appear to depend on the host plants but to be related to their geographical distribution (Danzig, 1970, 1980, 1993).

As Gerson (1990) has noted, the majority of species with both bisexual and unisexual forms are important pests. It is possible that man's activity has led to a rapid differentiation of biological forms, the production of new biotypes and plants, and a sharp increase of the abundance of these species as a result of monoculture and other anthropogenic factors.

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