

Biosystematics of Aleyrodidae (Homoptera: Insecta)

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Abstract. The scarcity of positively associated stages of adults of both sexes and the remarkably little variation shown by the adults of a very few species studied have naturally led to the recognition of the so-called pupal cases, the exuviae of the IV instar nymphs in the matter of generic and specific classification of the aleyrodids—a rather unusual procedure in the taxonomic study of these insects. This stage is the one most often collected and known in the species world over and also possesses a multitude of diagnostic features than in any other stage.

Keywords. Biosystematics; Aleyrodidae.

1. Introduction

The importance of host association in the taxonomy of Aleyrodidae was first stressed by a few workers in the year 1933. Mention may be made of the reported variations in setae in *Bemisia tabaci* (Gennadius) by Husain and Trehan (1933) and in *Aleyrodes lonicerae* Walker by Deshpande (1933). The correlation between the structure of the aleyrodids and that of the leaves upon which they lived has been noticed in a number of aleyrodids from Formosa by Takahashi (1933). Trehan (1940) demonstrated the difference in number and size of the setae of *A. lonicerae* when this species developed on *Rubus* rather than on *Lonicera*, and noted a difference in their development in *Asterobemisia carpini* (Koch) when the latter was reared on blackberi (*Rubus*) rather than on hornbean (*Carpinus*). Russell (1948) stressed that conspicuous difference in the size of setae and development of papillae, and in the size of the anal organ found in some species of *Trialeurodes* was apparently or due largely to changes in the insect environment. More plastic species have been developed on diverse types of leaves and the appearance of such insects may be altered conspicuously by a change of host. Species showing such plasticity with regard to the hairy and glabrous nature of host plants in relation to variations in the morphological features of the pupal cases has been stressed in a number of species occurring in India such as *Acaudaleyrodes citri* (Priesner and Hosney), *Trialeurodes ricini* (Misra), *Bemisia tabaci*, *Dialeurodes bassiae* David and Subramaniam, *Dialeurodes vulgaris* (Singh) and *Pealius simplex* (Singh).

2. Host-correlated variations in aleyroid taxonomy

Russell (1948) stressed based on her study of specimens of pupal cases of *Trialeurodes vaporariorum* (Westwood) on various host species that considerable variation could be noticed in its structure. This variation was correlated with the structure of the host leaf, on hairy leaves the pupal case bearing large papillae and long setae, and on glabrous leaves, small papillae and short setae. This host-correlated variation has led to the erection of a number of synonymous species. Such host-correlated variations

were observed by her in *T. vaporariorum*, *T. packardi* (Morill), *T. vittata* (Quaintance), *T. abutilonea* (Haldeman), etc.

Russell (1957) synonymised several described species of *Bemisia* with *B. tabaci*. However, Mound (1963) demonstrated experimentally by raising several forms from a single virgin female whitefly by allowing her progeny to develop on different species of plants. He showed that the two forms from tobacco and cassava differed significantly in shape as well as size and it is likely that these variants are induced phenotypically or morphological characters of the host plant leaves such as cuticle irregularity and hairiness. Eastop (1969) further demonstrated that in the case of *B. tabaci* viscous globules appear on the pupal case in the position where the setae will appear and after about 16 h these globules are replaced by large setae. It was thought that the setae may be formed around a thread of wax extruded from the base of the microseta into the globule. He demonstrated that if all the globules are removed from one side of the body, no setae are produced and a normal set develop on the other. It is thought that the setae on genera like *Aleurocanthus* and *Siphoninus* are formed in the normal way before the moult.

Mound (1965) observed the variable shape of the rhachis in specimens of *Acaudaleyrodes citri* (Priesner and Hosney) from populations of Egypt and Sudan. In the same polyphagous species Bink (1983) observed host-correlated variations such as oval to subcircular pupal case, the absence or presence of median tubercles on 1st abdominal segment, sub median setae being from minute to long in nearly every population, etc.

3. Host-correlated variations in Indian Aleyrodidae

David and Ananthkrishnan (1976) and David and Subramaniam (1976) reported on the host-correlated variation in *Trialeurodes ricini* Misra and *B. tabaci*. The observations revealed that the pupal cases developing on hairy leaves are comparatively smaller in size with deeply indented margin, more number of subdorsal papillae and elongated dorsal setae as against large sized pupal cases with smooth margin, less number of subdorsal papillae and very short setae. Alexander (1987) studied in detail the intraspecific diversity in *B. tabaci* on different varieties of cotton. He observed the pupal cases from the varieties of cotton viz Amaravathi, MCU 5, AV 3373/4, ACP 71-42 and L 389 were slightly smaller in size with as many as 8 pairs of dorsal setae whereas those from Sangam, AV 3649, DCH, LKH 71, LPS 141 and LRA 5166 possessed 4-7 pairs of dorsal setae. His study also confirmed that pupal cases from hairy leaves of cotton were much reduced in size than those from non-hairy varieties. Further, the pupal cases from upper surfaces of leaf of cotton resembled the one that was from non-hairy varieties of cotton.

David and Subramaniam (1976) and Alexander (1987) based on a detailed study of *Pealius* spp. showed that the pupal case of *Pealius simplex* (Singh) from the upper surface of leaves of *Ficus glomerata* and *F. bengalensis* was bigger in size with smooth margin and minute subdorsal setae. On the other hand the pupal cases from the under surface of leaves were slightly smaller in size with margin deflexed at several places and long subdorsal setae.

In the case of *Dialeurodes bassiae* the subdorsal setae on the pupal cases were capitate (David and Subramaniam 1976). In a few instances the pupal cases from the

under surface of leaf had elongated, pointed, slender hair like setae in the place of a few of the short capitate setae.

Selvakumaran (1986) observed that the pupal cases of *Dialeurodes vulgaris* Singh from *Jasminum pubescens* differed from *J. sambac* in being smaller in size, irregular and constricted margin, longer cephalic setae; well developed caudal setae; submargin with 10 pairs of minute setae (having 2 pairs of additional setae in mesothoracic and fifth abdominal segment) as against 8 pairs, dorsum and cephalothorax not densely granulated but with distinct median tubercles and vasiform orifice comparatively smaller and notched towards the caudal end.

4. Discussion

It may be seen from the above that a few species belonging to the genera *Trialeurodes* and *Dialeurodes* show remarkable variation in the morphological features on the hairy or glabrous nature of the host plants. Similar intraspecific variations as influenced by host plants has also been reported in the whitefly species viz *A. citri*, *B. tabaci* and *Pealius simplex*. However, the morphological features also show distinct variation when they occur on the upper as well as lower surface of leaves, in the case of *B. tabaci* and *P. simplex* on the same host. These observations emphasise caution in aleyrodid taxonomy and the need for study of a large number of specimens associated with different hosts and establish whether the species is a stable one or capable of showing plasticity.

5. Future areas of research

It will be seen that in aleyrodid taxonomy so far stress has been laid on morphological characteristics of the pupal cases in relation to the hairy and glabrous nature of the host plant and the texture of the leaves. The following areas in relation to biosystematics of this group of insects need immediate attention: (i) Cytotaxonomy of whiteflies, (ii) biochemical approach to taxonomic study of whiteflies, (iii) the biology of the eggs of whiteflies of various taxa and (iv) numerical taxonomic approach.

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