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The Biology and Taxonomy of the Aphids Transmitting Barley Yellow Dwarf Virus

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Abstract

All the cereal-feeding aphids are potential vectors of cereal viruses, as indeed are aphids feeding on other Gramineae and Cyperaceae. At least 24 species of aphids belonging to 15 different genera have been shown experimentally to transmit viruses of the barley yellow dwarf group. This paper reviews the biologies of the main Gramineae-feeding genera, with more detailed consideration of the principal vectors of barley yellow dwarf virus. Several of the vectors belong to complexes of species that are difficult to separate, for example Melanaphis sacchari/sorghii, Rhopalosiphum maidis and Sitobion fragariae/miscanthi. These problems of species recognition and their agricultural implications are discussed.

The objective of this paper is to summarize present knowledge of those aspects of the biology and taxonomy of cereal aphids that influence their ability to transmit barley yellow dwarf virus. Many aspects of aphid biology are relevant to virus transmission. We shall be mainly concerned with updating and filling any gaps in previous reviews (Plumb 1983; Gildow 1984). About the taxonomy of cereal aphids we will have more to say, as we wish to draw particular attention to the problems and uncertainties that exist in both the conceptual and the practical recognition of "meaningful taxonomic units" in most cereal aphids. By "meaningful taxonomic units" we mean groups of individuals or populations that have in common a set of correlated traits, such that the knowledge of one trait enables one to predict others. In those aphids that have an obligatory annual sexual phase, the smallest meaningful taxonomic units may be the species. On the other hand, in those aphids that reproduce continuously throughout the year by parthenogenesis, the smallest meaningful taxonomic unit may be a single clonal lineage, or a set of clonal lineages derived from a single clonal lineage, or a set of clonal lineages derived from a common ancestor and therefore having shared properties.

The term "biotype," as applied to aphids by economic entomologists, cannot be regarded as a meaningful taxonomic unit, because biotypes are recognized by only the single trait that happens to be of interest to the observer, such as the

ability to colonize a certain crop variety. A biotype may be a single clone, but on the other hand, it might consist of any number of clones with just the single trait in common, especially if the trait in question is determined at a single genetic locus. The designation of a population as "biotype A" does not necessarily imply any relationship with other populations of "biotype A," nor does it enable one to predict any other properties for the population, other than the one by which it was recognized. Studies on biotypes, if they fail to give full consideration to this limitation, can result in endless confusion in the literature.

We will deal first, in alphabetical order, with the aphid genera containing the principal vectors of barley yellow dwarf virus (BYDV), and then discuss the other aphids that may possibly bring virus into the crop.

Cereal Aphids Transmitting BYDV Within the Crop

Anoecia (and other root aphids)

Some species of the main aphid subfamily Aphidinae colonize Gramineae at or below soil level (e.g., *Rhopalosiphum insertum* (Walker), *R. rufiabdominalis* (Sasaki), *Aphis maidiradicis* Forbes), but the true root-feeding groups are in two other subfamilies, the Anoeciinae (*Anoecia* spp) and the Pemphiginae (e.g., *Tetraneura*, *Forda*, *Aploneura*, *Geoica*). Aphids of these subfamilies can be recognized by

