PHYLOGENY, BIOLOGY, BEHAVIOR, AND MANAGEMENT OF TEPHRITID FRUIT FLIES: AN OVERVIEW

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Summary

Tephritid fruit flies are a diverse group of phytophagous insects within Diptera with more than 4000 described species. Some tephritids have been thoroughly studied due to their economic importance. Nevertheless, Tephritidae includes numerous species and entire subfamilies that are harmless to man and that in some cases have been beneficial (weed biocontrol agents). Tephritids are acalypterate flies that exhibit a typical holometabolous life cycle (egg, larvae, pupae, adult). Behavior in this group is as diverse as the family itself, oviposition occurs in a number of substrates and different strategies can be used by different species. Different groups exhibit also different mating systems and different courtship repertoires. Due to their economic importance control methods have been developed and refined to deal with the more than 70 pest species, with a tendency to rely less on broad spectrum chemical applications moving towards biological control and other biorational methods integrated into management systems.

1. Phylogeny

1.1. Diptera

Diptera is the fourth insect order in terms of number of named species (120,000), and probably ecologically the most diverse. Indeed, dipteran diet encompasses all possible ranges from blood feeders, endo- and eco- parasites of vertebrates, and predators to all forms of mycetophages, saprophages and phytophages. Members of the order can be found in every zoogeographic region of the globe, inhabiting a wide diversity of habitats (Grimaldi and Engel 2005). Diptera are holometabolous insects undergoing complete metamorphosis, where immature stages are morphologically different and often have contrasting habitat and food requirements from adult forms. In holometabolous insects a pupal stage intervenes between the larval and adult instars (Romoser and Stoffolano 1994). Although some families, species, and sometimes members of one sex of flies are apterous (posses no wings), Diptera as a whole can be characterized for possessing only two functional front wings (the rest of Insecta typically possess four), and a pair of vestigial knobbed hind wings named *halteres* that have a function as organs of equilibrium during flight (Borror, Triplehorn and Johnson 1992)

Within Diptera, the suborder Brachycera can be characterized by adult forms that conform to the stereotype of a stout bodied fly (not mosquito like), and can be distinguished by their generally three segmented short antennae. Brachyceran larval forms have the posterior portion of the larval head capsule extended into the thorax and desclerotized (soft). Within Brachycera the infraorder Cyclorrapha is composed of species whose larval forms are commonly known as maggots, which are mostly saprophagous, and with the exception of their sclerotized mouth hooks, are soft bodied. Cyclorrapha are also characterized by the fact that puparation occurs within the tanned cuticle of the last larval instar, which is the *puparium*. Within the cyclorrapha the division Schizophora comprised the largest tertiary radiation of insects, with approximately 50,000 species (Grimaldi and Engel 2005). Schizophorans are characterized by possessing a membranous sac that expands like a balloon to rupture the puparium during adult emergence. Such structure, called *ptilinum*, is then invaginated into the head, and as a consequence, adult schizophorans can be identified by having a ptilinal fissure bordering the face. Within the schizophora the section Acalyptratatae includes species of flies that posses no calypteres on wings, which are lobes at the extreme base of the wing. Acalyptratatae includes families in the superfamily Tephritoidea.

For an excellent account on the Evolution of Diptera I refer the reader to (Grimaldi and Engel 2005), for classification and taxonomy of the Diptera at the family level Borror Triplehorn and Johnson (1992) can be consulted, while Romoser and Stoffolano (1994) is an introductory text on the study of insects in general.

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Biographical Sketch

Juan Rull is research scientist at the Instituto de Ecología A.C. in México. He worked in the Mediterranean Fruit Fly Eradication Program in Chiapas and obtained his PhD at the University of Massachusetts working on trap deployment strategies for behavioral control of Apple maggot fly. He is currently working on distribution and divergence of flies in the genus Rhagoletis in high elevation areas of México, improvement of sterile insect technique for use on fruit flies in the genus Anastrepha, and behavioral ecology of Ulidiidae associated to Agave.

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