Relationship of Wheat Streak Mosaic and Barley Stripe Mosaic Viruses to Vector and Nonvector Eriophyid Mites*

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With 9 Figures

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Summary

Large amounts of wheat streak mosaic virus (WSMV) accumulate in the midgut of its mite vector Eriophyes tulipae reared on virus infected plants. Masses of flexuous rod shaped virus particles persisted in the midgut, without degradation, for at least 5 of the 6—9 day adult life of mites. WSMV particles also were found distributed in the body cavity and in salivary glands of mites suggesting that the virus is "circulative" in E. tulipae. Abacarus hystrix, a nonvector of WSMV, when reared on virus infected plants, occasionally contained a small number of virus particles in its gut only. Extracts of such mites were not infective. Barley stripe mosaic (BSMV)—a rod-shaped virus, was not transmitted by E. tulipae, although a large concentration of virus particles was found in the midgut of mites reared on virus infected plants. Extracts of such mites were infective and the virus particles were retained for several days in the gut of such mites held on virus-free plants. BSMV particles were also found in the body cavity of mites. Possible reasons for E. tulipae being a nonvector of BSMV are discussed.

Introduction

Wheat streak mosaic virus (WSMV) causes an economically important disease of wheat in many countries. It is a flexuous rod-shaped (700 × 19 nm) RNA virus, transmitted in a "persistent" manner by the eriophyid mite Eriophyes tulipae K. (= Aceria tulipae) (2). Barley stripe mosaic virus (BSMV) which has no known vectors, is also a RNA containing, rod-shaped (ca. 128 ×20 nm) virus that affects barley and wheat worldwide (1). E. tulipae and another eriophyid Abacarus

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hystrix N. commonly occur on wheat and other graminaceous hosts in nature. Both of these mites are minute (ca. 200 × 75 μm) wormlike primitive arthropods that feed on epidermal cells of plants. Between the two of them, they are responsible for transmission of 4 different viruses and one virus-like pathogen of plants (14). Because of their microscopic size, working with eriophyids poses problems not often encountered in studying virus-vector relationships of other arthropods (see 8, 12).

Little is known of the vector-virus relationship and mechanism of transmission of mite transmitted plant viruses except WSMV for which information has slowly accumulated over the last decade. WSMV is transmitted by E. tulipae for 6 to 9 days after removal from a virus source. Mites must acquire the virus as nymphs and infectivity of mites persists after a molt (see 8). Paliwal and SLYKHEUS (9) and STEIN-MARGOLINA et al. (16) showed that large amounts of virus occurred in the alimentary canal of mites that had fed on infected plants. Homogenates of such mites were highly infective and reacted positively with WSMV antiserum. There was no direct evidence of WSMV being "circulative" (i.e. transmission due to passage of ingested virus back into mouth parts via the gut, body cavity and salivary glands), in the mite and other possible mechanism of transmission of the mite borne virus to the plants were proposed (9, 15). TAKAHASHI and ORLOB (17) confirmed the pattern of localization of WSMV in the mite body and showed retention of the virus in the gut for 4 days. They found some viruslike particles in parenchyma tissue of a few mites but the appearance of these extraintestinal particles was erratic.

Preliminary work showed that A. hystrix was a nonvector of WSMV and neither E. tulipae nor A. hystrix transmitted BSMV although both feed and multiply on infected wheat plants. Since these mites probably ingest virus when feeding on infected plants, a study of behaviour of the virus in the body of these mites could provide useful information on the mechanism of virus transmission and vector specificity in this group of vectors. In the present work, sites of occurrence of WSMV in the body of its mite vector were reexamined with a view to understand the mechanism of transmission of the virus by E. tulipae. Also, the fate of virus ingested by the nonvector mites after feeding on WSSIV or BSMV infected plants was investigated using electron microscopy, serology and infectivity assays.

Materials and Methods

Viruses and the Mites

The cultures of WSMV and BSMV were maintained in wheat (Triticum aestivum cv. Kent) by sap inoculation and the infected plants were used as virus source for the mites. Sources of virus-free E. tulipae and A. hystrix were the same as reported earlier (9). Colonies of both mites established from eggs were maintained on wheat under mite proof cages at 24—27°C (12). Mites reared on virus infected plants (hereafter referred to as "exposed mites") were used in most experiments. To raise exposed mites, wheat plants were sap inoculated with WSMV or BSMV and 5—7 days later when symptoms of the disease appeared, virusfree mites were transferred (ca. 100/plant) to these plants and maintained at 24—27°C. Mites were used from these plants 4 weeks later when a good population had developed.