

Examination of the Expansion of the Host Range of the Sweet Potato Whitefly

David N. Byrne & William B. Miller

ABSTRACT

A Florida strain of sweet potato whitefly, Bemisia tabaci (Gennadius), was found to have an expanded range which includes several new food crops. To determine why, we examined how it processes plant nutrients. The amino acid and carbohydrate content of phloem sap from poinsettia and pumpkin and of honeydew produced by the Florida strain were analyzed. Honeydews produced by a strain from Arizona feeding on both plants were also analyzed. Poinsettia phloem sap contained 15 amino acids; 14 of these were in pumpkin phloem sap. Almost all the same amino acids were in the honeydews produced by the two strains on the two hosts. Carbohydrates in phloem sap and honeydew were common transport sugars, like sucrose. Both honeydews contained trahalulose, a disaccharide not previously associated with insects. Both strains processed phloem sap and honeydew from both plants in the same manner, but the Florida strain produced significantly larger quantities of honeydew; it is therefore assumed to process more phloem sap. Since this strain has access to more phloem sap it also has access to more of the amino acids, which are in short supply in the phloem sap of some plants, allowing it to broaden its range.

INTRODUCTION

Bemisia tabaci (Gennadius), the sweet potato whitefly, has a long history as a pest of vegetables. This insect serves as a vector for a number of viral pathogens, causes direct feeding damage and, through its honeydew, provides a medium for several photosynthesis-inhibiting sooty mold fungi.

A new strain from Florida has entered our state which has a broader host range. To find clues concerning why the Florida strain has developed a wider host range, we were interested in examining whether it processes the nutrients, obtained from the plants on which it feeds, differently from other strains.

We examined the carbohydrates and amino acids found in the phloem sap of poinsettia and pumpkin, *Cucurbita maxima* Duchesne (a field crop traditionally attacked by *B. tabaci*). These results were compared to findings concerning the carbohydrate and amino acid content of honeydew produced by the Florida strain of *B. tabaci* and a strain found in Arizona. We also determined the total honeydew production by both strains.

RESULTS

The phloem sap of poinsettia contained a total of 15 different amino acids. For the most part, the amino acids in the phloem sap of poinsettia and pumpkin also were found in the honeydew of the whiteflies feeding on that host, regardless of strain. For seven amino acids, the concentrations in the honeydew were significantly lower than concentrations in the phloem sap indicating whiteflies are metabolizing these compounds.

In addition to the 15 amino acids found in poinsettia phloem sap and the 14 in pumpkin phloem sap, six additional amino acids were found in the honeydew produced by the two whitefly strains.

The honeydew produced by the Arizona strain contained a small portion (approximately 4% of the total carbohydrates) of stachyose. They converted a large portion of the carbohydrates found in phloem sap to the disaccharide, trehalulose. The same carbohydrates found in poinsettia phloem sap were in the phloem sap of pumpkin. We also detected raffinose and galactose.

In terms of total dry weight of the honeydew produced by the four feeding combinations, the Florida strain feeding on poinsettia produced significantly more than any other combination ($p < 0.01$) (Table 1). It produced almost five times the amount produced by the Arizona strain feeding on the same plant.

A noteworthy discovery was that of the disaccharide trehalulose. Although it has been synthesized in the laboratory and appears to be produced by certain microorganisms, its production has never before been associated with members of Insecta.

The information obtained on specific carbohydrates and amino acids provides little help in answering the initial question about the expanded host range of the Florida strain of *B. tabaci*, since the same carbohydrates and amino acids are found in the honeydew of both strains, and seem to be processed in much the same way. The question of why the Florida strain has been able to expand its host range may have a more simple answer - that it processes more phloem sap than the Arizona strain. This assumption is based on the fact that it produces significantly more honeydew. Because it processes more phloem sap, it has access to more of the amino acids which may be in short supply in a particular plant.

Table 1. Dry weight of honeydew produced by 40 *Bemisia tabaci* strains feeding on different hosts for 48 h (n=4).

Whitefly/host combination	Mass ^a (ug)
Florida strain/poinsettia	17.2 ± 5.1a ^a
Florida strain/pumpkin	10.0 ± 2.7 b
Arizona strain/pumpkin	5.5 ± 1.9 b
Arizona strain/poinsettia	3.5 ± 2.4 b

^aMean plus or minus standard deviation.

^bNumbers in the same column followed by the same letter are not significantly different from one another (SNK) ($P < 0.01$).