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APHID-HOST PLANT INTERACTIONS IN PECAN

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The blackmargined aphid, *Monellia caryella* (Fitch), yellow pecan aphid, *Monelliopsis pecanis* Bissell, and black pecan aphid, *Melanocallis caryaefoliae* (Davis), comprise the complex of aphid species infesting pecan, *Carya illinoensis* (Wang.) K. Koch, throughout the southeastern United States (Tedders 1978, Dutcher 1985). Interactions among these aphid species and their pecan host plants have been investigated primarily from the perspective of the effects of aphid feeding upon the pecan host. Expressions of these effects, which may be immediate, short-term, and/or long-term, include clogging of phloem tubes and disruption of translocation, loss of chlorophyll and suppression of photosynthesis, and reduced nut quality and production (Tedders and Wood 1985; Wood and Tedders 1982a, 1982b, 1986).

Because aphid-host plant interactions also involve the reciprocal effects of the host plant upon the aphid, earlier research from this perspective was largely observational and descriptive in nature, relying heavily upon monitoring of aphid densities on various pecan cultivars throughout the growing season. These observations are summarized in Table 1.

In recent years, however, quantitative evaluations of pecan aphid responses to various host plants are being conducted. In the first report of a systematic, phylogenetically-based approach, Smith and Severson (1992) compared the developmental biology and behavioral activity of *M. caryella* among four plant species; pecan, pea [*Pisum sativum* L.], fig [*Fiscus benjamina* L.], and peach [*Prunus persica* (L.)]. We concluded that *M. caryella* is restricted to the Juglandaceae family of nut trees, and provided evidence that its host plant specificity may be governed phytochemically.

Subsequently, biological performance and behavioral responsiveness of *M. caryella*, *M. pecanis*, and *M. caryaefoliae* among Juglandaceae species native to North American (including walnut, hickory and hican species) showed that Juglandaceae species most clearly related to pecan within the Apocarya (pecan hickories) were the preferred and/or most suitable host plants. Most Juglandaceae species were totally rejected as host plants (Smith et al. 1992; Smith et al. 1993).

Recently, Walid and Dutcher (1994) reported on the probing behavior and population density of all three pecan aphid species on a select group of 13-yr-old pecan cultivars. They have found varying degrees of preference and non-preference among cultivars (Table 2), and showed probing behavior on detached leaves to be correlated with aphid population density in the field. However, their probing behavior studies were only performed between 15 and 27 September, and aphid population density was only reported from early July and early October.

Finally, unpublished biological and behavioral studies of all three aphid species have been conducted with the added dimension of seasonal development of the Juglandaceae species and a select group of pecan cultivars. These evaluations were performed at regular time intervals over a given season and indicate that the degree of host acceptance/rejection of the various plant species changes over the plants' phenology. Further, ongoing comparative leaf chemical analyses indicate that various plant species may change phytochemically over the season. Comparative leaf morphological analyses (surface and interior) are also in progress.

The primary objective of these most recent aphid-host plant interaction studies has been to identify sources of aphid resistant germplasm. A combined result of these studies is to emphasize the importance of using more definitive methodology when evaluating sources and mechanisms of host plant resistance. Two of the three mechanisms of resistance include antibiosis and non-preference. Painter (1951) defines antibiosis as those adverse effects on insect life history which result when a resistant host plant variety or species is used for food. He defines non-preference as insect responses that lead to or away from the use of a particular plant or variety, for oviposition, for food, or for shelter, or for combinations of the three. Methodology used to evaluate antibiosis involves confining aphids on the various plants and measuring survival, development, and reproduction. Methodology used to evaluated non-preference involves placing aphids onto various plant types, and observing and measuring aphid response by various techniques. While aphid density on plants in the field may provide an indication of the plant's suitability as a host, factors unrelated to the plant (biotic and abiotic) also influence aphid population density and distribution. Therefore, conclusions of aphid resistance should not be based strictly upon field observations of aphid density, but should be supported with direct measurement of aphid biology and behavior.

Finally, the ongoing work by Smith, Severson, and Gueldner show the dynamic nature of the host plant's phytochemistry and aphid biology and behavior. Therefore, investigations of aphid-plant interactions should avoid the narrow view that the plant, serving as a food source, is a

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static unchanging entity, and take into account the dynamic nature of the host plant over a growing season.

The primary emphasis of current investigations is the identification of key phytochemical and/or morphological plant characteristics which control host plant resistance. Development of bioassays of these characteristics, as well as screening for their presence in various germplasms, are in progress. As new basic information is developed it will be utilized in pecan breeding, orchard design, and aphid resistance management programs.

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Table 1. Pecan Aphid Response to Various Pecan Cultivars Based Upon Observed Aphid Population Levels. (BPA=black pecan aphid; BMA=blackmargined aphid; YPA=yellow pecan aphid).

PECAN CULTIVAR	PECAN APHID	APHID RESPONSE	REFERENCE
Schley	BPA	Preferred	Moznette et. al. 1940
Alley	BPA	Preferred	Moznette et. al. 1940
Van Deman	BPA	Preferred	Moznette et. al. 1940
Stuart	BPA	Preferred	Moznette et. al. 1940
Gloria Grande	BPA	Susceptible	Madden 1972; Worley 1978
Peruque	BPA	Susceptible	Madden 1972; Worley 1978
Moneymaker	BPA	Escape	Moznette et. al. 1940
Curtis	BPA	Escape	Moznette et. al. 1940
Moore	BPA	Escape	Moznette et. al. 1940
Success	BPA	Tolerant	Nakayama 1964
Pawnee	BMA,YPA	Resistant	Thompson et. al. 1992

Table 2. Pecan Aphid Response to Various Pecan Cultivars Based Upon Behavioral Observations (Yellow Pecan Aphid includes both M. caryella and M. pecanis; Black Pecan Aphid refers to M. caryaefoliae) (Revised from Walid and Dutcher, 1994).

PECAN CULTIVAR		
YELLOW PECAN APHID	BLACK PECAN APHID	RELATIVE APHID APHID RESPONSE
Cheyenne	Oconee	Preferred
Shoshoni	Cheyenn	|
Tejas	Shoshoni	|
Oconee	Gloria Grande	|
Kiowa	Tejas	|
W. Schley	Kiowa	|
Gloria Grande	61-6-67	|
61-6-67	W. Schley	|
Cape Fear	Cape Fear	|
Pawnee	Pawnee	Non-Preferred