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Evaluation of Twelve Genotypes of *Hibiscus* for Resistance to Hibiscus Sawfly, *Atomacera decepta* Rohwer (Hymenoptera: Argidae)[1]

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Abstract

Twelve genotypes of hibiscus were evaluated for resistance to hibiscus sawfly, a minor pest of hibiscus. Evaluations were conducted by counting eggs deposited on the hibiscus and larvae feeding on the hibiscus. Plants were evaluated at the end of the study with a damage rating. Three genotypes demonstrated resistance or tolerance to sawfly feeding: *Hibiscus acetosella*, *H. aculeatus*, and *H. grandiflora*. All three of these genotypes had few, if any, eggs or larvae and were given the lowest damage rating among the genotypes evaluated.

Index words: *Hibiscus* spp., hibiscus sawfly, *Atomacera decepta*, host plant resistance.

Species used in this study: *H. acetosella* Welw. ex Hiern., *H. aculeatus* Walt., *H. coccineus* Walt., *H. dasyclayx* Blake & Shiller, *H. grandiflora* Michx., *H.* x 'Hinagoya White', *H.* x 'Kopper King', *H. lasiocarpus* Cav., *H. militaris* Cav., *H. moscheutos* L., *H. mutabilis* L. 'Rubrus', *H. paramutabilis* Bailey, and *Atomacera decepta.*

Significance to the Nursery Industry

At least three genotypes of hibiscus, *Hibiscus acetosella*, *H. aculeatus*, and *H. grandiflora*, were determined to be good candidates for use in a sawfly resistance breeding program. Plant breeders will be able to use the information to develop hibiscus cultivars more tolerant to the hibiscus sawfly. The use of these tolerant species in landscapes fits in an IPM program. Plants tolerant to hibiscus sawfly can be marketed as such, and can provide higher consumer satisfaction.

Introduction

Hibiscus is the largest genera of plants in the Malvaceae (mallow) family, consisting of around 200–250 species (1). A tremendous amount of genetic diversity exists, consisting of tropical evergreen shrubs and small trees as well as a few deciduous, temperate-zone shrubs that have both annual and perennial life cycles. Flowers vary in size from 5.1 cm (2 in) in diameter up to 30 cm (12 in) across, with colors ranging from white to purple. The 1998 Census of Horticultural Specialties listed *Hibiscus* as the third highest ranking deciduous shrub in terms of wholesale value at 23.2 million dollars (www.nass.usda.gov).

The hibiscus sawfly, *Atomacera decepta* Rohwer, is a minor pest of ornamental *Hibiscus* spp. in the eastern and midwestern United States (3, 8). It is established from Connecticut to Florida, west to Missouri and Texas (5, 6) and has up to six generations a year (7, 8). Female sawflies lay eggs in the upper surface of hibiscus leaves along the leaf margin, causing a blister-like appearance. Typically, eggs are found in rows of six or more. Larvae hatch and move to the underside of the leaf where they begin feeding. Early instars feed only on the underside, causing a window-pane effect. Later instars feed on both sides of the leaf and all the way through, sometimes eating all but the larger veins. Prior to pupation, larvae move to the base of the plant and form a cocoon in soil or in leaf litter. The lifecycle of the hibiscus sawfly lasts about 28 days (8).

The sawfly has been collected from the following species of *Hibiscus*: *H. moscheutos*, *H. militaris*, and *H. lasiocarpus* (2, 5). Tippins (8) indicated that in laboratory studies, the hibiscus sawfly did not feed on *H. esculentus*, *H. rosa-sinensis*, or *H. syriacus*.

The breeding program at the Southern Horticultural Lab, Poplarville, MS, has a large collection of hibiscus germplasm. In one greenhouse, hibiscus sawfly larvae have been observed feeding on some hibiscus species and cultivars but not on others. The objective of this study was to determine the susceptibility or resistance of twelve genotypes of hibiscus to the hibiscus sawfly.

Materials and Methods

The following twelve *Hibiscus* genotypes were used in our evaluations: *H. acetosella*, *H. aculeatus*, *H. coccineus*, *H. dasyclayx*, *H. grandiflora*, *H.* x 'Hinagoya White', *H.* x 'Kopper King', *H. lasiocarpus*, *H. militaris*, *H. moscheutos*, *H. mutabilis* 'Rubrus', and *H. paramutabilis*. Six plants of each species (only five of *H. mutabilis* 'Rubrus') were potted from liners to #1 containers on August 11, 2003. Media used was a pine bark and sand mixture (3:1 by vol), amended with 1.8 kg (4 lb)/0.76 m^3 (cu yd) of 17–9–12 slow release fertilizer (Osmocote, Scotts Co., Marysville, OH), 1.8 kg (4 lb)/0.76 m^3 (cu yd) dolomitic lime, and 0.7 kg (1.5 lb)/0.76 m^3 (cu yd) minor elements (Micromax, Scotts Co., Marysville, OH).

Plants were arranged in a completely randomized design on August 13, 2003, in a hibiscus sawfly-infested greenhouse and they were watered daily with overhead irrigation. Beginning on August 21, 2003, the number of hibiscus sawfly

[1]Received for publication April 16, 2004; in revised form May 14, 2004. We thank Jennifer Carroll, Robin Hayes, and Darla Pastorek for competent technical assistance. Debbie Boykin (USDA, ARS) provided statistical assistance, for which we are grateful. We thank Drs. Cecil Pounders (Mississippi State Univ., Biloxi, MS) and Sandra Reed (USDA, US National Arboretum, McMinnville, TN) for providing comments on an earlier draft of the manuscript. Mention of trade names or commercial products in this article is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

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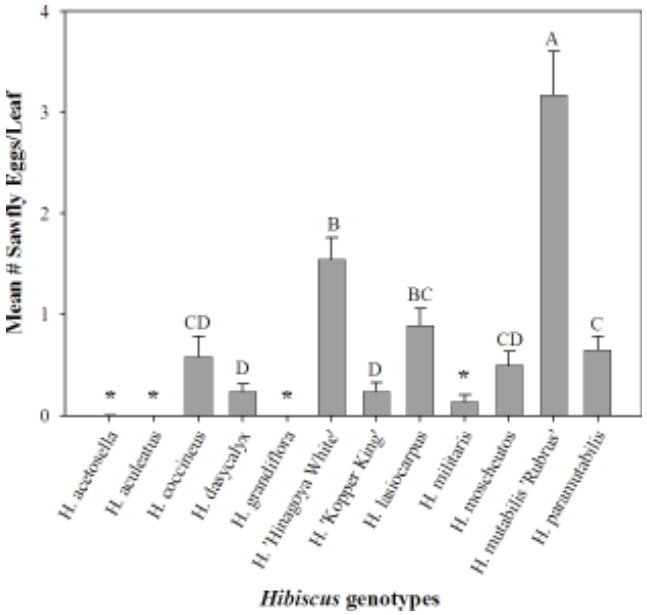

Fig. 1. Mean number of sawfly eggs per leaf on twelve genotypes of hibiscus. Bars with the same letter are not significantly different at P < 0.05 (Fisher's LSD test). Asterisks represent genotypes that were not used in the analysis due to failure to meet the assumptions of equal variance.

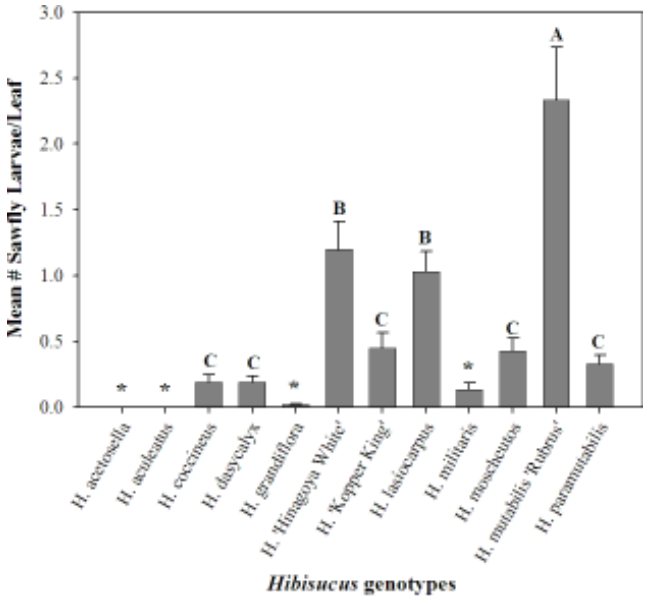

Fig. 2. Mean number of sawfly larvae per leaf on twelve genotypes of hibiscus. Bars with the same letter are not significantly different at P < 0.05 (Fisher's LSD test). Asterisks represent genotypes that were not used in the analysis due to failure to meet the assumptions of equal variance.

eggs and larvae on the first ten fully developed leaves from each plant were counted. During the second week only eggs laid after the previous sampling date were counted, assuming the previous week's eggs had hatched (8). Eggs and larvae were counted weekly until October 9, 2003. On October 15, 2003, a damage rating was assigned to all plants using the rating scale listed in Table 1.

Egg and larval counts were square root transformed after adding 0.5. The data were analyzed using PROC MIXED with repeated measures (4). Due to the high number of zeros and failure to meet the assumption of common variance, *H. acetosella*, *H. aculeatus*, *H. grandiflora*, and *H. militaris* were removed from the analysis and assumed to be equal to zero. The null hypothesis tested was that the rest of the genotypes were equal to zero and their means were compared among them using least squared differences (Fisher's). Non-transformed means are presented in the figures. Damage ratings were analyzed using ANOVA (4) without transforming the data. Means were separated with Tukey's test.

Table 1. Damage rating criteria used to rate hibiscus sawfly larval feeding damage on hibiscus plants in the greenhouse experiment.

Rating	Criteria
1	no damage
2	slight damage[z]
3	<20% moderately[y] damaged
4	20–39% moderately damaged
5	<20% severely[x] damaged or 40–59% moderately damaged
6	20–39% severely damaged or 60–79% moderately damaged
7	40–59% severely damaged or 80–99% moderately damaged
8	60–79% severely damaged or 100% moderately damaged
9	80–99% severely damaged
10	100% severely damaged

[z]slight damage = very little noticeable feeding damage.
[y]moderately = feeding damage on less than 25% of the leaf.
[x]severely = feeding damage on 25% or more of the leaf.

Results and Discussion

Egg and larval counts for all genotypes remaining in the analyses were significantly greater than zero (eggs, $P < 0.0001$; larvae, $P = 0.0009$), and there were differences among genotypes (eggs, $P < 0.0001$; larvae, $P < 0.0001$). The hibiscus sawfly females readily deposited eggs on all genotypes

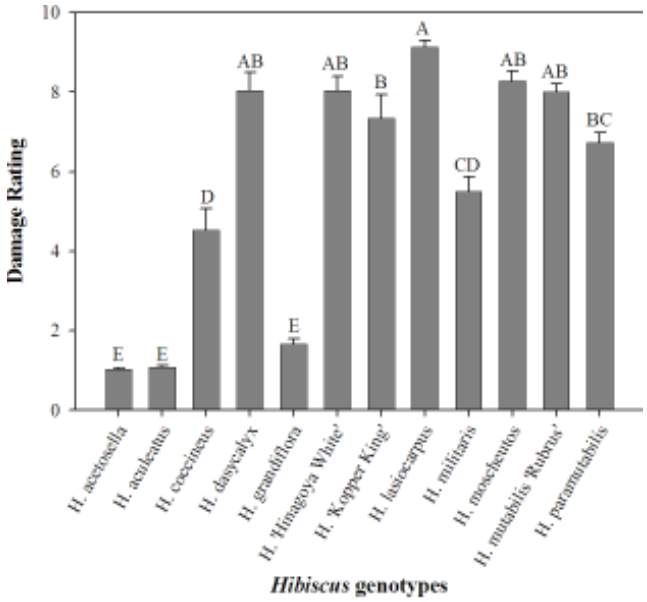

Fig. 3. Damage rating of twelve genotypes of *Hibiscus*. Bars with the same letter are not significantly different at P < 0.05 (Tukey's test).

except for *H. acetosella*, *H. aculeatus*, and *H. grandiflora* (Fig. 1). Although *H. militaris* was removed from the analysis, a few eggs were counted on this genotype. *Hibiscus mutabilis* seemed to be the most preferred genotype for oviposition. Eggs were laid evenly over time with the exception of September 4, 2003, when the total for all genotypes combined was below 0.3 eggs per leaf (data not shown). There were two generations of sawflies in this test, which was expected, because the sawfly has about six generations per year (8).

The number of larvae per leaf followed the same trend as the eggs with *H. acetosella*, *H. aculeatus*, and *H. grandilfora* having almost no larvae throughout the test. *Hibiscus mutabilis* had the highest number of larvae per leaf (Fig. 2).

Genotypes varied significantly in their damage ratings, generally following the same trend as the egg and larval counts ($P < 0.0001$) (Fig. 3). One obvious exception from the general trend was high damage rating of *H. militaris*. Leaves of *H. militaris* are slender and smaller than the other genotypes used in this study. One sawfly larva was able to consume more than one leaf, whereas in other genotypes multiple larvae were usually required for consumption of an entire leaf.

Three genotypes show promise in the consideration of breeding for hibiscus with resistance to the hibiscus sawfly: *H. acetosella*, *H. aculeatus*, and *H. grandiflora*. Future breeding programs should consider including these genotypes in order to develop new cultivars that have desirable horticultural traits and sawfly resistance.

Older literature lists *H. militaris*, *H. lasiocarpus*, and *H. moscheutos* as being susceptible to the hibiscus sawfly (2, 5, 8), each of which was highly susceptible in this test. These findings add *H. coccineus*, *H. dasycalyx*, and *H. paramutabilis* to the list of *Hibiscus* spp. that are susceptible to the hibiscus sawfly. These susceptible species of hibiscus need to be monitored on a regular basis in order to apply control measures in a timely fashion.

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