

Hibiscus Resistance to Sweetpotato Whitefly

Robert L. Meagher, Jr.¹ and José Armando Estrada²

¹Assistant Professor

²Weslaco Independent School District, 319 West 4th Street, Weslaco, Texas 78596
Texas Agricultural Experiment Station, 2415 East Highway 83, Weslaco, Texas 78596

ABSTRACT

Twelve hibiscus cultivars (*Hibiscus rosa-sinensis* L.) were bioassayed against sweetpotato whitefly [*Bemisia tabaci* (Gennadius), biotype "B"] to determine relative variation in resistance. Cultivars were randomly placed within a ventilated shadehouse and infested with adults. Beginning two weeks after infestation, sweetpotato whitefly eggs and nymphs were counted weekly for four weeks. Trichomes were counted on the underside of upper leaves after sampling was completed. Results showed that among cultivars, statistically significant differences were found in egg and nymph populations. 'Cooper II' consistently had low numbers of sweetpotato whitefly eggs and nymphs. Although there were differences in leaf trichome density among cultivars, no relationship between the number of trichomes and the number of *B. tabaci* eggs or nymphs was detected ($P > 0.56$). Development of host plant resistance as an insect management strategy is discussed.

RESUMEN

Se realizaron bioensayos para determinar la variación relativa en la resistencia de doce cultivares de *Hibiscus rosa-sinensis* L. a la mosca blanca del camote [*Bemisia tabaci* (Gennadius), biotipo "B"]. Los cultivares se colocaron aleatoriamente dentro de un sombreadero y se infestaron con adultos. Dos semanas después de la infestación se inició el conteo semanal de los huevos y las ninfas de las moscas blancas y se continuó por cuatro semanas. Se contaron los tricomas en el envés de las hojas superiores después de terminando el muestreo. Los resultados mostraron diferencias estadísticamente significativas en las poblaciones de huevos y ninfas entre los cultivares. El cultivar "Cooper II" tuvo consistentemente cantidades bajas de huevos y de ninfas de la mosca blanca. Aunque hubo diferencias en la densidad de tricomas de la hoja entre los cultivares, no se detectó relación alguna entre el número de tricomas y el número de huevos o de ninfas de *B. Tabaci* ($P > 0.56$). El desarrollo de la resistencia de la planta hospedera como una estrategia de manejo de insectos es discutida.

Hibiscus has recently increased in popularity as a potted flowering plant (Miller 1987) and as an ornamental plant in subtropical landscapes due to its large, colorful flowers and dark green foliage. Unfortunately, hibiscus grown in ornamental or residential areas is susceptible to insect feeding and damage. One of the more important insect pests of field-grown plants in subtropical regions is the sweetpotato whitefly, *Bemisia tabaci* (Gennadius), biotype "B" (Riley and Wolfenbarger 1993).

Traditional approaches to insect management in ornamental and residential sites has included cultural (sanitation) and chemical (insecticides) control components. However, other integrated pest management (IPM) approaches, such as host plant resistance (HPR, using or breeding plants resistant to arthropod attack) and biological control (using native or exotic predators, parasites or pathogens) are now being studied (Heinz & Parrella 1990, Breene et al. 1992, Meagher 1993). A more detailed discussion of host plant resistance as a management approach for ornamental plants can be found in Meagher (1993).

Host plant resistance studies with whiteflies have shown that physical and biochemical characteristics of the plant can influence insect population densities (Bilderback & Mattson 1977). More specifically, studies have found differential responses of cotton cultivars to sweetpotato whitefly due to leaf trichome density (Butler & Henneberry 1984, Butler et al. 1991) or differing levels of leaf biochemical constituents such as tannins and phenolics (Butter et al. 1992). Research with various cucurbits suggested that

trichome density may not be as important as the spatial arrangement and length of trichomes (Kishaba et al. 1992). The objective of our study was to determine the relative resistance of hibiscus cultivars to sweetpotato whitefly using a shadehouse screening technique.

MATERIALS AND METHODS

Plants. Greenhouse-rooted cuttings of *Hibiscus rosa-sinensis* L. cultivars were planted in round 1.7-liter containers filled with a peat-lite medium (Sunshine Mix No. 1, Fisons, Vancouver, B.C., Canada) (Wang & Gregg 1989). The cuttings were pinched once to promote early lateral shoot development. Mature plants were transplanted into circular 2.6-liter containers and during summer 1992 and winter 1993 were pruned to a height of ≈ 30 cm. Plants were used July-August 1993.

Sweetpotato Whitefly. Ovipositional preference and *B. tabaci* development was tested by placing individual plants of each cultivar on four different platforms (blocks or replications) in a ventilated shadehouse. The twelve cultivars were randomly arranged on the platform in three rows of four plants each. Sweetpotato whitefly-infested plants (muskmelon, *Cucumis melo* L.) from stock cultures were placed on the platforms (six muskmelon plants per platform) for one week to infest the hibiscus. Two weeks after infestation, four weekly samples were taken (weeks 3, 4, 5, and 6). Populations of *B. tabaci* eggs and nymphs were sampled by cutting three 7-mm diameter disks (total sampled area = 1.15 cm²) from randomly-selected upper plant

leaves using a hole punch. The number of eggs and first through fourth instar nymphs on each leaf disk were counted using a stereomicroscope and numbers for each disk were combined to give a mean per plant (replicate).

Trichome Density. Trichome density was counted from 7.1 mm² areas of lower surfaces of fully expanded leaves. Three interveinal areas were counted per leaf on three leaves of four plants per cultivar. Each leaf was carefully "dusted" with talc powder (Johnson's Baby Powder, Johnson & Johnson, Skillman, NJ) before observation under a stereomicroscope at 65x.

Statistical Analysis. This experiment was designed and analyzed using analysis of variance (PROC GLM, General Linear Models, SAS Institute 1985) as a randomized complete block with four replications. The independent or class variables were replication, date, cultivar and date by cultivar interaction. Egg and nymph means were separated using the Waller-Duncan k-ratio t test. Pearson correlation analysis (PROC CORR, Correlation, SAS Institute 1985) was used to determine the relationship between leaf trichome density and egg or nymph numbers.

RESULTS AND DISCUSSION

Sweetpotato whitefly egg and nymph densities differed among hibiscus cultivars (both $P < 0.0001$). 'Cooper II' had numerically lower numbers of eggs and nymphs, while 'Joanne' and 'Butterfly' contained high numbers of eggs and nymphs (Table 1). Egg densities increased from early to late sampling (first sample = 51.0 ± 11.7 eggs per cm², last sample = 134.1 ± 20.0 per cm², $P < 0.0001$), but nymph densities did not ($P = 0.2079$). The nymph to egg ratio indicates establishment of nymphs following egg hatch, and low ratios suggest possible antibiosis effects (Wilson et al. 1993). Our results suggested relatively high ratios; only 'Gold Dust', 'Lutea' and 'Cooper II' had ratios under 1.0. Previous studies with *B. tabaci* on cotton indicated lower nymph to egg ratios (Wilson et al. 1993). Therefore, our

results may have been an artifact of our sampling technique, a factor that should be considered when future greenhouse or shadehouse research is attempted. These data provide a measure of preference and suitability for nymphal development in a choice situation.

There were differences in leaf trichome density among cultivars (Table 1), however, trichome density was not related to either *B. tabaci* eggs [Pearson' correlation coefficient ($r = -0.1738$, $P = 0.5891$) or nymphs ($r = -0.1839$, $P = 0.5673$). 'Ross Estey' had the highest trichome density but low numbers of eggs and nymphs. Removing 'Ross Estey' from the correlation analysis still produced nonsignificant correlations for both eggs and nymphs ($r = 0.5079$, $P = 0.1107$; $r = 0.436$, $P = 0.1801$; respectively). The effect of trichome density, size and type on whitefly species abundance has been debated. Butler & Henneberry (1984), Butler et al. (1986) and Butler et al. (1991) concluded that high leaf trichome density was related to high *B. tabaci* density. However, Kishaba et al. (1992) argued that trichome density was not as important as the spatial arrangement or length of trichomes. With greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood), Bilderback & Mattson (1977) and Castané & Albajes (1992) found significant relationships between trichome density and adult, nymph or egg densities. However, trichome size and structure was shown to also be important. High trichome density probably influences whitefly abundance by positively or negatively offering a protected environment, a more suitable microclimate, or more obstruction to movement and oviposition. It is likely there is an optimum number of trichomes that result in a variable equilibrium between these factors (Willmer 1986, Butler et al. 1991, Castané & Albajes 1992).

This study documented variation in response of sweetpotato whitefly to different hibiscus cultivars. The bioassay described can provide a technique for screening the most susceptible or resistant plant lines. In some cases, even

Table 1. Sweetpotato whitefly eggs, nymphs and nymph/egg ratio, and leaf trichomes on hibiscus cultivars in a shadehouse test.

Cultivar	Eggs per cm ² (SE) ^a	Nymphs per cm ² (SE) ^a	Nymph/Egg Ratio	Trichomes per mm ² (SE) ^{b,c}
Joanne	154.6 (42.7) a	175.1 (46.0) ab	1.13	0.9 (0.18) cd
Gold Dust	129.2 (37.5) ab	81.5 (17.9) cd	0.63	2.8 (0.70) b
Butterfly	122.4 (24.4) ab	177.4 (35.0) a	1.45	2.8 (0.52) b
Mary Morgan	115.7 (19.7) ab	148.7 (24.4) abc	1.29	1.9 (0.35) bc
Lutea	108.1(24.8) abc	91.2 (35.3) bcd	0.84	0.8 (0.15) cd
Lagas	67.5 (23.4) bcd	152.7 (49.2) abc	2.26	1.2 (0.21) cd
Kalalua	67.3 (16.6) bcd	87.0 (17.1) cd	1.29	2.5 (0.41) b
Debbie	51.4 (20.0) cd	61.8 (28.6) d	1.20	1.2 (0.21) cd
Fort Myers	48.2 (19.0) cd	57.4 (12.7) d	1.19	0.4 (0.07) d
Dainty White	40.1 (7.7) d	42.1 (10.5) d	1.05	0.6 (0.08) d
Ross Estey	36.1 (8.1) d	39.5 (9.6) d	1.09	11.5 (1.23) a
Cooper II	28.3 (8.0) d	24.6 (9.0) d	0.87	0.4 (0.06) d

^a Each egg or nymph mean represents per plant samples ($n = 16$). Means (SE) followed by the same letter are not significantly different, Waller-Duncan k-ratio t test.

^b Leaf trichomes were counted from the lower surfaces of fully expanded leaves.

though the numerical differences in whitefly numbers among cultivars were statistically significant, to a grower or customer, these differences may not be aesthetically important, but would be important for population control and spread of viruses. Thus, care must be taken in relating bioassay results to commercial or residential horticultural situations.

Meagher (1993) described the use of host plant resistance as an insect management strategy in bedding plant production systems. Future HPR research, using no-choice tests, should identify plant characteristics that enhance insect resistance and incorporate them into conventional breeding programs to create new resistant varieties and hybrids (Castané & Albajes 1992).

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