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Whitefly and Lace Bug Performance on *Lantana* spp. Cultivars in the Greenhouse[1]

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Abstract

Performance of greenhouse whitefly, silverleaf whitefly, and lantana lace bug for eleven cultivars of *Lantana* spp. was assessed in greenhouse experiments. Insect population growth was monitored for seven weeks in three experiments. Relative damage at three weeks post-infestation with lantana lace bug was also evaluated. All cultivars supported growth and development of all insect species evaluated. Initial population development occurred differentially on cultivars with larger leaves, e.g., 'Miss Huff' and 'Confetti'. However, by week seven all cultivars supported high populations of greenhouse and silverleaf whitefly and lantana lace bug.

Index words: host plant resistance, integrated pest management, IPM, silverleaf whitefly, greenhouse whitefly, lantana lace bug.

Species used in this study: silverleaf whitefly (*Bemisia argentifolli* Bellows and Perring), greenhouse whitefly (*Trialeurodes vaporariorum* (Westwood)), lantana lace bug (*Teleonemia scrupulosa* (Stal)), lantana (*Lantana camara* L. cvs., 'Confetti', 'Cream Mound', 'Dallas Red', 'Irene', 'Lemon Drop', experimental proposed name 'Mabel Rogers', 'Miss Huff', 'New Gold', 'Pink Caprice', and 'Radiation'; *Lantana montevidensis* (K. Spreng.) Briq. 'Purple Trailing').

Significance to the Nursery Industry

No evidence for complete resistance among lantana cultivars examined was found. However, an apparent preference for certain cultivars suggests a potential monitoring strategy to facilitate early detection of potential insect pest problems in production and landscape settings. Greenhouse and silverleaf whitefly populations in the greenhouse increased more rapidly on 'Miss Huff', 'Confetti', and 'Radiation', the large-leaf cultivars. 'Dallas Red' demonstrated the least susceptibility to both species of whitefly. Similarly, pest population establishment on the other small-leaf cultivars 'New Gold', 'Cream Mound', and 'Lemon Drop' was comparatively delayed. 'Miss Huff', 'Confetti', 'Irene', and 'Pink Caprice' experienced the highest initial lace bug population growth, also suggesting that these large-leaf cultivars may serve as indicator plants for these pests in commercial production or in the landscape.

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Introduction

The perennial shrub, *Lantana camara* L. (Verbenaceae) is a native of the tropical and subtropical Americas. In some areas (e.g., Australia, South Africa), since its introduction as an ornamental, it has escaped and is now considered a pest (3, 4). However, the highly colored flowers and attractiveness to butterflies and hummingbirds have made this species valuable in residential landscape settings. Lantana is prone to infestation by lace bug and whiteflies in the landscape and in greenhouses, respectively. The greenhouse whitefly,

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Table 1. Mean number of adult, immatures and exuviae for silverleaf whitefly on *Lantana.*

Cultivar	Week 3	Week 4	Week 5	Week 6	Week 7
Adults					
Miss Huff	52.5a[z]	36.5a	14.0a	10.2a	20.8a
Confetti	48.8ab	32.6a	14.3a	8.5a	12.5ab
Irene	32.5bc	17.5b	14.1a	8.1a	12.5ab
New Gold	26.0cd	13.0bcd	2.0b	3.2b	4.5b
Radiation	17.3de	9.8bcd	5.8b	2.5b	3.3b
Lemon Drop	16.0de	5.8bcd	6.5b	0.7b	8.3b
Cream Mound	12.3de	16.6bc	3.0b	2.0b	8.3b
Pink Carprice	9.0e	5.3cd	2.5b	0.5b	6.2b
Dallas Red	7.6e	3.0d	0.8b	0.3b	22.5a
F value	11.9	8.7	5.7	6.2	2.4
P value	0.0001	0.0001	0.0001	0.0001	0.03
Immatures					
Miss Huff	25.6a	74.6a	189.0a	435.4a	532.0a
Confetti	6.1a	20.1bc	146.3ab	228.1b	294.5b
Irene	10.0a	12.6bc	62.0c	37.5c	176.2bcd
New Gold	10.0a	21.0bc	67.0c	45.5c	150.0bcd
Radiation	12.8a	36.0bc	64.8c	120.3bc	181.3bcd
Lemon Drop	9.8a	26.3bc	82.1bc	78.0bc	107.0cd
Cream Mound	9.6a	43.8ab	61.0c	8.1c	264.5bc
Pink Caprice	5.0a	36.0bc	74.3bc	97.1bc	178.7bcd
Dallas Red	1.3a	7.0c	21.6c	35.3c	86.2d
F value	1.4	3.5	4.0	5.0	4.9
P value	0.2	0.004	0.002	0.0003	0.0002
Exuviae					
Miss Huff	6.5a	4.8a	0.3a	3.5a	22.5abc
Confetti	0.5a	0.0a	2.8a	0.1a	16.2abc
Irene	6.4a	2.3a	3.0a	0.0a	6.2c
New Gold	0.0a	0.8a	0.0a	0.2a	6.2c
Radiation	1.3a	0.6a	1.6a	1.0a	6.6c
Lemon Drop	2.0a	0.0a	3.0a	0.0a	27.0ab
Cream Mound	1.0a	0.0a	0.6a	0.0a	21.6abc
Pink Caprice	3.1a	0.3a	1.3a	0.5a	12.0bc
Dallas Red	4.6a	1.1a	2.0a	0.0a	32.5a
F value	1.3	1.6	0.6	1.7	2.1
P value	0.3	0.1	0.8	0.1	0.05

[z]Means followed by the same letter within a column are not significantly different, P > 0.05, LSD.

Table 2. Mean number of adult, immature and emerged pupae greenhouse whitefly on *Lantana.*

Cultivar	Week 3	Week 4	Week 5	Week 6	Week 7
Adults					
Miss Huff	24.5a[z]	25.5a	25.5a	59.3a	190.0a
Confetti	22.3ab	21.3ab	15.0a	27.8b	112.9bc
Irene	11.5bc	9.6bc	4.0a	15.6b	177.5ab
New Gold	12.8abc	8.8bc	11.3a	29.3b	63.3cd
Radiation	6.0c	10.5bc	16.1a	28.1b	103.3c
Lemon Drop	6.3c	3.3c	2.8a	5.3b	35.4d
Cream Mound	15.0abc	4.6c	5.6a	7.1b	27.0d
Pink Caprice	12.8abc	8.8bc	7.0a	8.3b	79.5cd
Dallas Red	7.3c	2.1c	5.3a	9.0b	74.5cd
F value	2.5	3.2	1.8	3.3	6.3
P value	0.03	0.01	0.10	0.01	0.001
Immatures					
Miss Huff	26.3a	65.6a	116.6a	521.5a	463.3a
Confetti	1.1a	27.6b	40.8bc	108.8bc	173.8bc
Irene	0.0a	19.6b	98.1ab	243.0b	227.5bc
New Gold	0.3a	18.6b	33.8c	82.0c	110.0c
Radiation	2.8a	25.3b	80.3abc	114.0bc	373.3ab
Lemon Drop	2.0a	24.5b	55.5bc	78.3c	73.3c
Cream Mound	3.0a	29.1b	71.1abc	103.5c	123.3c
Pink Caprice	1.0a	25.6b	32.3abc	102.5c	169.2c
Dallas Red	1.6a	11.0b	33.3c	98.8c	138.8c
F value	1.1	2.8	2.0	9.1	3.4
P value	0.40	0.01	0.06	0.001	0.01
Exuviae					
Miss Huff	1.6a	10.8a	13.5a	58.0a	110.0a
Confetti	3.1a	0.3a	3.8b	5.3b	57.9abc
Irene	2.6a	0.1a	1.1b	8.3b	77.0ab
New Gold	5.8a	4.0a	5.8b	23.0b	53.7bc
Radiation	0.1a	0.0a	1.6b	18.3b	46.2bc
Lemon Drop	1.6a	0.3a	1.6b	5.6b	66.2abc
Cream Mound	4.1a	0.0a	1.1b	3.3b	23.3c
Pink Caprice	0.3a	1.0a	2.8b	6.6b	36.2bc
Dallas Red	2.0a	0.3a	1.0b	6.8b	52.9bc
F value	0.6	1.0	2.8	3.1	1.9
P value	0.7	0.4	0.01	0.01	0.09

[z]Means followed by the same letter within a column are not significantly different, P > 0.05, LSD.

Trialeurodes vaporariorum (Westwood) and the silverleaf whitefly, *Bemisia argentifolli* Bellows and Perring, are important pests of ornamental plants and other agricultural crops (8). Nymphal stages and adults extract plant sap and excrete honeydew, which contributes to the growth of unattractive sooty mold. Insecticides are the most commonly used method to suppress whitefly infestations on greenhouse-grown ornamental plants (5). Whiteflies are less problematic in the landscape. Lantana lace bug, *Teleonemia scrupulosa* (Stal), extracts plant sap causing a stippled or bleached appearance in affected foliage and reduced bloom. Plants are further disfigured by tar-like fecal deposits.

Host plant resistance is a valuable integrated pest management strategy. Insect and disease problems and associated economic and environmental costs in the nursery and landscape can be minimized by selecting relatively pest-resistant species or varieties that are well suited to local growing conditions. Publications listing ornamental plants with documented resistance to specific insects and diseases (10) assist and encourage propagation, use, supply and demand for resistant varieties. Resistance among plant species and cultivars to some key pests of ornamentals has been identified (e.g., 1, 2, 6, 7, 9, 11, 12). Often, however, resistance properties of available cultivars to key pests are not well characterized. Studies were conducted to determine the potential for resistance to whiteflies and lace bugs among ten lantana cultivars currently in commercial production and one experimental cultivar.

Materials and Methods

Greenhouse and silverleaf whitefly, experiment 1. Lantana were transplanted into 6 in ultra azalea plastic pots and granular fertilizer was added to pots at planting. Subsequently, plants were fertilized two times per week with Peter's 20:10:20 (Scotts, Marysville, OH). Plants were placed on

greenhouse benches in a randomized complete block design with six replications. Plants were inoculated in separate greenhouses with either greenhouse whitefly (greenhouse 1) or silverleaf whitefly (greenhouse 2) by placing infested leaves (approximately 50 individuals per plant) directly on experimental plants. Insect populations were allowed three weeks to establish. Populations were monitored by counting the number of adults, immatures, and exuviae (pupal remains following adult emergence) per 15 leaves per plant every week for five weeks beginning week three through week seven. Cultivars evaluated included 'Miss Huff', 'Confetti', 'Irene', 'New Gold', 'Radiation', 'Lemon Drop', 'Cream Mound', 'Pink Caprice', and 'Dallas Red'.

Greenhouse whitefly, experiment 2. Three cultivars were selected that had demonstrated the highest, medium, and lowest population levels of whiteflies during the previous trial. High population 'Miss Huff', medium 'Radiation', and low 'Cream Mound' were the three cultivars selected for further study. An experimental lantana cultivar 'Mabel Rogers' was also included in this trial. Rooted cuttings were transplanted into gallon pots, fertilized with osmocote and maintained as described previously. A randomized complete block design with six replications was arranged on greenhouse benches adjacent to lantana infested with greenhouse whitefly (approximately 8.6 m from greenhouse source of whitefly inocculum) This allowed each cv equal opportunity to become infested. Population levels were determined weekly for six weeks.

Lantana lace bug, experiment 3. Rooted cuttings of eleven cultivars; 'Miss Huff', 'Irene', Pink Caprice', 'Mabel Rogers', 'Confetti', 'Red', 'Radiation', 'Purple Trailing', 'New Gold', 'Cream Mound', and 'Lemon Drop' were transplanted into gallon sized pots, fertilized with osmocote and maintained as described above. Plants were allowed to establish for eight weeks. They were then arranged in randomized complete block design with six replications on greenhouse benches and infested with four female lace bugs per plant. Three weeks after infestation, plants were divided into quadrants and the number of nymphal and adult lace bugs per quadrant was determined for each plant. Percent damage was also determined as number of infested leaves ¸ total number of leaves at that time. Population numbers were also evaluated at seven weeks post-inoculation.

Statistical analysis. Data were subjected to Analysis of Variance (SAS, GLM procedure). Percentage data were transformed prior to analysis using an arcsine squareroot transformation. Mean separation was accomplished using Fisher's protected least significant difference test.

Results and Discussion

Greenhouse and silverleaf whitefly, experiment 1. Three weeks after inoculation greenhouse and silverleaf whiteflies were more numerous on the large-leaf cultivars 'Miss Huff', 'Radiation' 'Irene' and 'Confetti' (Tables 1 and 2). The small-leaf cultivars: 'Cream Mound', 'Pink Caprice', 'New Gold', 'Lemon Drop', and 'Dallas Red' during the first weeks of the trial did not support the same high population level of greenhouse or silverleaf whitefly as their large-leaf counterparts. Our experimental design did not allow us to determine whether this was a preference by adult whiteflies for oviposition sites, or differential nutritional suitability among cultivars. By week seven, all cultivars did support high population levels of greenhouse and silverleaf whiteflies in all life stages.

Greenhouse whitefly, experiment 2. Three cultivars that demonstrated high, medium, and low whitefly populations, 'Miss Huff', 'Radiation', and 'Cream Mound', respectively, from the first trial were tested along with an experimental variety 'Mabel Rogers'. Few apparent differences were observed in number of adults or immatures on cultivars selected for the second trial with greenhouse whitefly (Table 3). Week 1 counts of the adults did show a slight preference for 'Miss Huff' and the experimental 'Mabel Rogers' but by week 6 no significant differences were seen among any of the cultivars examined. Immature populations followed the same trend as adults. 'Miss Huff' and the experimental cultivar had the highest populations of adults and immatures during the testing period.

Table 3. Mean number of adult and immature greenhouse whitefly on *Lantana sp*.

			Adults			
Cultivar	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**
Miss Huff	7.3a[z]	13.6ab	2.0b	1.8b	3.0a	7.0ab
Cream Mound	6.0a	8.0b	0.8b	1.2b	2.5a	1.0b
Radiation	9.6a	16.2ab	2.8ab	3.3ab	2.6a	3.8ab
Mabel Rogers	7.8a	23.7a	7.3a	6.3a	3.2a	17.0a
F value	0.6	2.5	2.7	3.1	0.2	2.1
P value	0.6	0.1	0.08	0.06	0.9	0.1
			Immatures			
Cultivar	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**
Miss Huff	1.0a	0.8a	3.5a	20.2a	13.0a	13.6a
Cream Mound	0.0b	0.5a	13.2a	10.5a	30.0a	9.8a
Radiation	0.0b	0.0a	3.6a	24.8a	22.3a	40.6a
Mabel Rogers	0.3b	0.0a	0.0a	17.7a	18.7a	51.8a
F value	3.3	1.7	0.6	0.2	0.7	1.8
P value	0.05	0.2	0.6	0.8	0.5	0.2

[z]Means followed by the same letter within a column are not significantly different, P > 0.10, LSD.

Table 4. Mean number of lantana lace bugs on *Lantana* cultivars three and seven weeks post-infestation.

	3-wks			7-wks		
Cultivar	**Adults**	**Nymphs**	**Total**	**Adults**	**Nymphs**	**Total**
Confetti	5.8a[z]	64.0a	69.8a	4.2a	13.8a	18.0a
Pink Caprice	2.0a	28.2ab	30.2ab	2.5a	2.5a	5.0a
Mabel Rogers	0.3	16.8b	17.2b	4.0a	10.7a	14.7a
Cream Mound	1.8a	14.7b	16.5b	8.0a	22.0a	30.0a
Miss Huff	2.2a	13.2b	15.3b	4.2a	5.0a	9.2a
Radiation	0.7a	12.0b	12.7b	2.8a	4.7a	7.5a
Lemon Drop	0.5a	9.8b	10.3b	3.2a	6.0a	9.2a
Red	0.8a	8.3b	9.2b	2.5a	3.7a	6.2a
Purple Trailing	0.7a	8.3b	9.0b	2.8a	7.7a	10.6a
New Gold	0.3a	7.7b	8.0b	3.2a	10.5a	13.7a
Irene	0.2a	7.8b	8.0b	1.8a	6.2a	8.0a
F value	1.26	1.54	1.56	1.2	1.2	1.2
P value	0.3	0.1	0.1	0.3	0.3	0.3

[z]Means followed by the same letter within a column are not significantly different, P > 0.10, LSD.

Lantana lace bug, experiment 3. Three weeks after infestation with lantana lace bugs, all eleven cultivars supported some level of population growth (Table 4). Nymphs and adult lace bugs were found on all cultivars. Average total lace bugs per quadrant per plant ranged from 8.0 ('Irene') to 69.8 ('Confetti'). Percent damage ranged from 26% ('Lemon Drop') to 79% ('Miss Huff') and was significant ($p \leq 0.05$) (Table 5). Small-leaf cultivars 'Lemon Drop', 'Cream Mound', 'Purple Trailing' and 'New Gold' exhibited much less damage than other large-leaf cultivars during this initial infestation period.

Seven weeks post-infestation all cultivars supported lace bug populations (Table 4). Small-leaf cultivars became heavily infested as the trial progressed at the decline of their larger leaved counterparts. All plants at the seven-week assessment exhibited 100% damage measured as number of infested leaves divided by total number of leaves.

'Miss Huff', 'Confetti' and 'Irene' were the first cultivars to become heavily infested with both lantana lace bug and whitefly. These cultivars were also the first to show noticeable damage. While it was beyond the scope of this study to clarify the mechanism underlying greater populations on large leaved cultivars, it is possible that these cultivars could all be used as monitor plants either in landscapes or in commercial production. These 'indicator' plants would alert the pest manager to first occurrence of lace bug and whiteflies as an early warning of pest populations. Although smaller leaved cultivars were less preferred by whiteflies or lacebugs, when planted in monoculture situations in greenhouse or landscape settings, our data indicate that they will support populations capable of inflicting significant damage.

Table 5. Mean percent damage inflicted by lantana lace bug three weeks post-infestation

Cultivar	**% damage**
Miss Huff	78.7a[z]
Irene	68.1ab
Pink Caprice	62.7abc
Mabel Rogers	61.1abc
Confetti	53.7abcd
Red	52.0abcd
Radiation	38.1bcd
Purple Trailing	34.3cd
New Gold	31.2cd
Cream Mound	26.6d
Lemon Drop	26.1d
F value	2.4
P value	0.02

[z]Means followed by the same letter within a column are not significantly different, P > 0.05, LSD.

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