Resistance Among *Lantana* Cultivars to the Lantana Stick Caterpillar, *Neogalea sunia* (Lepidoptera: Noctuidae)

Author(s): James A. Reinert, Steve W. George, Wayne A. Mackay and Carlos Campos
Source: Southwestern Entomologist, 35(1):51-58. 2010.
Published By: Society of Southwestern Entomologists
DOI: http://dx.doi.org/10.3958/059.035.0106
URL: http://www.bioone.org/doi/full/10.3958/059.035.0106

Resistance among *Lantana* Cultivars to the Lantana Stick Caterpillar, *Neogalea sunia* (Lepidoptera: Noctuidae)

James A. Reinert[1], Steve W. George, Wayne A. Mackay[2], and Carlos Campos

Texas AgriLife Research & Extension Urban Solutions Center, 17360 Coit Rd, Dallas, TX 75252-6599

Abstract. Lantana stick caterpillar, *Neogalea sunia* (Guenée) (Lepidoptera: Noctuidae), can be a serious, often undetected pest of *Lantana,* a landscape plant commonly grown for its heat and drought hardiness across the southern United States. This insect is often responsible for loss of flowering by *Lantana* plants in late summer and early autumn. Replications of 22 cultivars of *Lantana* plants in containers were evaluated for resistance to the lantana stick caterpillar in a greenhouse at Dallas, TX. A natural infestation of the pest developed in mid-July and dispersed through all the plantings. Larvae were sampled during autumn 1996. Most larvae (2.4 to 4.1) per plant were on 'Lemon Swirl', 'New Gold', 'Golden King', 'LSG Red Orange', 'Dallas Red', 'Pink Caprice', 'Gold Mound', and 'Samantha'. No larvae were found on 'Weeping Lavender' or 'White Lightning' and only means of 0.1, 0.3, and 0.3 larva per plant were recorded on 'Imperial Purple', 'Weeping White', and 'Confetti', respectively. Additionally, 0.5 or fewer larva was found per plant of 'Patriot Fire Wagon' and 'Patriot Rainbow'. All four cultivars of *L. montevidensis* (K. Spreng.) Briq. (mean of 0.1 larva per plant) were very resistant, whereas all cultivars of *L. camara* L. (except Lemon Drop', mean of 0.8), and all *L. hybrida* hort were susceptible and exceeded one larva per plant. Cultivars with purple, white, or red/yellow flowers were infested with fewer larvae than were cultivars with gold, red, orange/red, yellow, or bicolors of yellow with another color other than red.

Resumen. El gusano del tallo de la *Lantana*, *Neogalea sunia* (Guenée) (Lepidoptera: Noctuidae), es una plaga importante que puede pasar desapercibida en la planta de *Lantana,* la cual es una planta ornamental muy común en el sur de Estados Unidos por sus tolerancia al calor y sequía. Este insecto, es responsable en parte, de la pérdida de flores en el verano y a principios de otoño. La Resistencia de veintidós cultivares de Lantana fue evaluada en condiciones de invernadero utilizando plantas en maceta, y una infestación natural de la plaga a mediados de Julio, la cual estuvo presente en todo el vivero. En el estudio se realizaron muestreos de poblaciones de larvas por planta durante el otoño de 1996 en Dallas, TX. Los promedios de poblaciones de larvas más altos registrados fueron de 2.4 a 4.1 en las variedades 'Lemon Swirl', 'New Gold', 'Golden King', 'LSG Red Orange', 'Dallas Red', 'Pink Caprice', 'Gold Mound', and 'Samantha'. No se observo la presencia de larvas en

[1]972/231-5362, E-mail: j-reinert@tamu.edu.
[2]University of Florida, Mid-Florida Research & Education Center, 2725 S. Binion Road, Apopka, FL 32703-8504.

'Weeping Lavender' or 'White Lightning'. Promedios de 0.1, 0.3, 0.3 larvas por planta se obtuvieron para 'Imperial Purple', 'Weeping White' y 'Confetti', respectivamente. Asi mismo, para las poblaciones en 'Patriot Fire Wagon' y 'Patriot Rainbow' no registraron más de 0.5 larva por planta. Los cuatro cultivares de *L. montevidensis* (K. Spreng.) Briq. (con promedios de 0.1 larva por planta) se consideran altamente resistentes, mientras que todos los cultivares de *L. camara* L. (excepto Lemon Drop', con promedio de 0.8), y los cultivares de *L. hybrida* hort fueron susceptibles excediendo 1.0 larva por planta. Los cultivares con floración púrpura, blanco o rojo/amarillo tuvieron menos presencia de larvas que los cultivares con floración dorada, rojo, arananjado/rojo, amarillo, o bicolores de amarillo con otro color excepto las de color rojo.

Introduction

Many cultivars of *Lantana* (Verbenaceae) (hereafter referred to as lantana) are used as annuals or as herbaceous perennials for low hedges or foundation shrubs, or as containers and hanging baskets in urban landscapes. Most of the cultivated species are native to tropical or subtropical North and South America, but some are native to other warm regions of the Old World. As a landscape plant, lantana is valued for its profuse show of multi-color flowers throughout its long flowering season, which may include every month of the year in frost-free areas; its drought, heat, and salt tolerance; aromatic foliage; and attractiveness to butterflies (Everett 1981, Welch 1989, Arnold 2008) including migrating monarch butterflies, *Danaus plexippus* (L.) (Reinert et al., unpublished data).

Two species of lantana are commonly used by the landscape industry. *Lantana camara* L. is a robust, prickly shrub native to the southern United States and tropical America, whereas *L. montevidensis* (K. Spreng.) Briq. is a trailing or weeping lantana with slender pubescent stems 90 cm or longer (Staff, L. H. Bailey Hortorium 1976; Everett 1981). *Lantana hybrida* hort cultivars are considered to be a hybrid between South American, Mexican, and West Indian species, but some are probably hybrids between the former two species (Everett 1981). *L. hybrida* hort. cultivars exhibit characteristics of *L. camara* but are more compact and seldom exceed 30 cm in height. More than 600 cultivars of lantana exist worldwide (Howard 1969).

Much of the literature on lantana deals with its introduction as an ornamental and its subsequent escape to become a noxious weed in many countries of the world. Lantana has been reported as a weed competing with 14 crops and infesting millions of hectares in more than 50 countries throughout the tropics (Holm et al. 1977, Parsons and Cuthbertson 2001, Day et al. 2003).

The lantana stick caterpillar, *Neogalea sunia* (Guenée) (Lepidoptera: Noctuidae), is a leaf feeder on lantana and was introduced as a potential biological control agent from mainland United States into six countries but has only established in Hawaii, New Caledonia, and Australia (Julien and Griffiths 1998, Day et al. 2003). Most of the literature (other than taxonomic) on lantana stick caterpillar relates to its introduction and use for biological control. Its morphology and life cycle were investigated in Argentina by Baldo et al. (2004) who showed that the eggs are placed individually or in groups of three to five on the edges of leaves or on the petiole. The insect passes through six larval instars and requires from 27.1 (29°C) to 41.5 (25°C) days to develop between the time an egg hatches until the adult emerges.

In the southern United States, lantana stick caterpillar is an annual pest in late summer and autumn on lantana cultivated in ornamental plantings. In Texas and

much of the Southwest, as summer temperatures begin to warm and many plants begin to suffer from water stress, lantana plants thrive and flower profusely except where attacked by the lantana stick caterpillar or the lantana lace bug, *Teleonemia scrupulosa* Stal (Reinert et al. 2006). Larvae of lantana stick caterpillar are camouflaged on the plant. The chestnut brown caterpillars position themselves longitudinally along the stems during the day and are overlooked when trying to determine causes of defoliation and flower loss. The objective of the present study was to evaluate for resistance to the lantana stick caterpillar 22 cultivars of lantana widely used in the nursery trade.

Materials and Methods

Twenty-two cultivars of lantana were evaluated for resistance to lantana stick caterpillar in a greenhouse study at the Texas AgriLife Research and Extension Urban Solution Center at Dallas, TX. Lantana plants in 10 x 10 cm pots were purchased from local nurserymen and transplanted and cultivated in 11.3-liter plastic pots in a greenhouse in mid-May 1996. Cultivars were chosen because of their popularity with growers in Texas and the southwestern United States. Only a few of the cultivars were listed by Howard (1969) in his checklist of lantana at the Harvard University Arboretum, but many of the cultivars evaluated are recommended for Texas and the Southwest (Sperry 1991, Perry 1992, Brenzel 1997).

Plants were fertilized with Miracle-Gro All Purpose fertilizer [24-8-16 + B (200 ppm), Cu (700 ppm), Fe (1500 ppm), Mn (500 ppm), Mo (5 ppm), Zn (600 ppm)] (Scotts, Marysville, OH) when transplanted and bi-monthly and were watered as needed to prevent wilting throughout the study period. Pots with lantana plants 25 to 38 cm tall were spaced approximately 60 cm apart (plants not touching each other) in a randomized complete block design on greenhouse benches. Eight replications of each cultivar of lantana listed in Table 1 were used, except only seven replications of 'Confetti,' 'Pink Caprice', and 'Lemon Swirl' and six replications of 'White Lightning' were evaluated because of a shortage of plants.

Plants became naturally infested from a native population of lantana stick caterpillar that had developed on adjacent infested plants in the greenhouse and from a wild population on plants in the vicinity of the greenhouse in late summer 1996. The larvae were allowed to develop to near pupation before data were collected. All larvae on each plant were removed and counted on 30 October and 4 November 1996. Plants were again thoroughly examined on 12 November, and five overlooked larvae that had pupated were recorded. Data were collected by carefully examining all stems, leaves, and flowers for developing larvae on each sample date.

Numbers of larvae were analyzed using analysis of variance procedures (ANOVA and GLM) in PC-SAS for a randomized complete block design to determine differences in susceptibility among cultivars. Count data were transformed as □¥n + 0.001 to stabilize variances. Untransformed means are reported. Means were compared at the 5% level of significance using Fisher's protected LSD (SAS Institute 2009).

Results and Discussion

Most (2.4 to 4.1) lantana stick caterpillar per plant were on 'Lemon Swirl' > 'New Gold' > 'Golden King' > 'LSG Red Orange' > 'Dallas Red' > 'Pink Caprice' > 'Gold Mound' = 'Samantha'. No larvae were on either 'Weeping Lavender' or 'White

Table 1. Range of Susceptibility of *Lantana* Cultivars to Lantana Stick Caterpillars in a Greenhouse, Dallas, TX

Lantana cultivar	Species[1]	Mean number of larvae per plant
Weeping Lavender	Lm	0.00 a[4]
White Lightning[2]	Lm	0.00 a
Imperial Purple	Lm	0.13 ab
Weeping White	Lm	0.25 ab
Confetti[3]	Lc	0.29 ab
Patriot Fire Wagon	Lc	0.50 abc
Patriot Rainbow	Lc	0.50 abc
Miss Huff	Lc	0.63 a-d
Lemon Drop	Lh	0.75 b-e
Irene	Lc	1.13 c-f
Spreading Sunset	Lh	1.25 c-f
Radiation	Lc	1.38 d-g
Silver Mound	Lh	1.75 efg
American Red Bush	Lc	1.88 fgh
Samantha	Lc	2.38 ghi
Gold Mound	Lh	2.38 ghi
Pink Caprice[3]	Lc	2.86 hij
Dallas Red	Lc	2.88 hij
LSG Red Orange	Lc	2.88 hij
Golden King	Lc	3.00 hij
New Gold	Lh	3.38 ij
Lemon Swirl[3]	Lc	4.14 j

Means followed by a different letter in a column are significantly different by Fisher's protected LSD (. < 0.05).

[1]Lantana species in study: Lm = *Lantana montevidensis*, Lc = *L. camara*, Lh = *L. hybrida*.

[2]This cultivar was only evaluated in 6 replications.

[3]These cultivars were only evaluated in 7 replications, all others had 8 replications.

[4]Analysis was made on n + 0.001 transformation of the data: untransformed means presented.

Lightning' and only means of 0.3 larva/plant were recorded on 'Imperial Purple', 'Weeping White', and 'Confetti'. Additionally, 0.5 or fewer larva was found per plant of 'Patriot Fire Wagon' or 'Patriot Rainbow'. The four cultivars of *L. montevidensis* (mean 0.25 larva per plant) were very resistant, whereas all cultivars of *L. camara* L. (except 'Lemon Drop' (mean of 0.8) and all *L. hybrida* hort were not in the top statistical grouping, and were susceptible, with more than one larva per plant.

When cultivars were grouped by species and analyzed, *L. montevidensis* (four cultivars with a mean of 0.10 larva per plant) was very resistant. Additionally, several of the *L. camara* (Confetti, Patriot Fire Wagon, Patriot Rainbow and 'Miss Huff') and *L. hybrida* (Lemon Drop) cultivars were infested with 0.75 larva and could also be considered resistant. However, most cultivars of *L. camara* and *L. hybrida* were susceptible, with >1 lantana stick caterpillar per plant (Table 2). The tested cultivars of *L .montevidensis* produced either white or purple flowers.

Table 2. Impact of Species of Lantana on the Amount of Infestation by Lantana Stick Caterpillar

Lantana spp.	Number of cultivars[1]	Range of means for cultivars	Mean total number of larvae[2]
L. montevidensis	4	0.00-0.25	0.10 a
L. camara	13	0.29-4.14	1.86 b
L. hybrida	5	0.75-3.38	1.90 b

Means followed by a different letter in a column are significantly different by Fisher's protected LSD (. < 0.05).

[1]Number of cultivars evaluated for each species.

[2]Mean total lantana stick moth larvae per plant of each species.

Cultivars were analyzed separately by flower color. A cultivar with two predominant flower colors was analyzed as bicolor for the two colors. Cultivars with purple-, white-, or red/yellow-bicolor flowers were infested with fewer larvae (means of 0.07, 0.13, and 0.5, respectively) than were cultivars with gold, red, orange/red, yellow, or bicolors of yellow with a color other than red. Two cultivars infested with few lantana stick caterpillars (0.75) were also identified for pink/yellow- (Confetti and Patriot Rainbow) and yellow-flower colors (Miss Huff and Lemon Drop), but not for white/yellow-, orange/red-, red-, or gold-flower color (Table 3). Overall, it seemed that cultivars with gold, red, yellow, orange/red, or pink/yellow flowers were among the most infested plants and in the bottom statistical rankings.

Day et al. (2003) found lantana stick caterpillar on all lantana varieties except orange-flowering varieties in Australia, while Diatloff and Haseler (1965) reported that the larvae preferred red-, pink-edged red-, and white-flowering varieties rather than pink-flowering varieties. In the present study, we found that white-flowering cultivars were very resistant, but we only evaluated two white-flowering cultivars and they were both *L. montevidensis*. However, it is possible that the white-flowering cultivars of *L camara* and *L. hybrida* are very susceptible to this pest.

Flower color has also been implicated as an indicator of resistance of lantana to lantana lace bug (Reinert et al. 2006) and in other insect/ornamental plant relationships. In studies with *Canna* spp., cultivars with red, orange, or scarlet flowers were more susceptible to canna leafroller, *Calpodes ethlius* Stoll, than were those with yellow or rose flowers (Reinert et al. 1983). Also, in studies with oleander, *Nerium oleander* L., susceptibility to oleander caterpillar, *Syntomeida epilais jucundissima* Dyar, was much greater on cultivars with certain flower colors than on those with other flower colors (J. A. Reinert et al. unpublished data). Resistance may not be determined by flower color, but there seems to be a relationship to color, although not independent. Additional work is needed to fully understand the relationship between flower color and resistance to lantana stick caterpillar and other insects that show flower color preference.

Larvae of the lantana stick caterpillar are described in the literature as leaf defoliators (Day et al. 2003). However, removal of leaves is only part of the damage caused by this pest. Lantana stick caterpillar also can remove all of the flowers and developing buds from plants. One of the reasons this pest is so difficult to detect when it is scarce is that it feeds only on flowers and causes little or no noticeable damage to foliage. Even a few larvae on a plant can remove all the flowers in late summer and fall, thus reducing the potential color the plant adds to the landscape, especially during dry periods when most other plant species are not flowering.

Table 3. Impact of the Flower Color of Lantana Cultivars on the Number of Lantana Stick Caterpillars per Plant

Flower color (number)[1]	Cultivar	Species[2]	Larvae per plant: Highest count	Larvae per plant: Mean	Mean total larvae per plant of each flower color[3]
Purple (2)[3]					0.07 a[5]
	Weeping Lavender	Lm	0	0.0 a[4, 5]	
	Imperial Purple	Lm	1	0.13 ab	
White (2)					0.13 a
	White Lightning	Lm	0	0.0 a	
	Weeping White	Lm	1	0.25 ab	
Red/Yellow (1)					0.50 ab
	Patriot Fire Wagon	Lc	1	0.50 abc	
Pink/Yellow (4)					1.17 bc
	Confetti	Lc	1	0.29 ab	
	Patriot Rainbow	Lc	1	0.50 abc	
	Irene	Lc	2	1.13 c-f	
	Pink Caprice	Lc	6	2.86 hij	
White/Yellow (1)					1.75cd
	Silver Mound	Lh	3	1.75 efg	
Orange/Red (3)					1.83 cde
	Spreading Sunset	Lh	3	1.25 c-f	
	Radiation	Lc	2	1.38 d-g	
	LSG Red-Orange	Lc	7	2.88 hij	
Yellow (5)					2.13 cde
	Miss Huff	Lc	2	0.63 a-d	
	Lemon Drop	Lh	1	0.75 b-e	
	Samantha	Lc	8	2.38 f-i	
	Golden King	Lc	5	3.00 hij	
	Lemon Swirl	Lc	7	4.14 j	
Red (2)					2.38 de
	American Red Bush	Lc	3	1.88 fgh	
	Dallas Red	Lc	6	2.88 hij	
Gold					2.88 e
	Gold Mound	Lh	6	2.38 f-i	
	New Gold	Lh	8	3.38 ghi	

Means followed by the same letter in a column are not significantly different by Fisher's protected LSD (. < 0.05).

[1]Cultivars with two predominant flower colors were analyzed as bicolor for the two colors.

[2]Lantana species in study: Lm = *Lantana montevidensis*; Lc = *L. camara;* Lh = *L. hybrida*.

[3]Number of cultivars with the flower color.

[4]Data taken from Table 1.

[4]Number of cultivars with the flower color.

[5]Analysis was made on n + 0.001 transformation of the data: untransformed means presented.

In conclusion, information on the range of susceptibility among cultivars within the different flower color groups would be valuable to commercial growers, retail nurserymen, landscapers, and consumers. *L. montevidensis* has resistant purple- (Weeping Lavender and Imperial Purple) or white-flowered (Weeping White and White Lightning) cultivars. These data in conjunction with data on susceptibility to lantana lace bug (Reinert et al. 2006) should allow the consumer to install landscape plantings of lantana that have an array of flower colors but still provide much natural (genetic) protection against these primary destructive pests. Although there is good resistance to both lantana stick caterpillar and lantana lace bug among lantana cultivars, there is little correlation of the resistance to the two pests other than resistance to both pests expressed by cultivars of *L. montevidensis*.

Acknowledgment

Appreciation is extended to Joe McCoy and Dennis Hays for technical assistance during this study. John B. Heppner, Florida State Collection of Arthropods, Florida Department of Agriculture and Consumer Services, Gainesville, FL, is acknowledged for identifying the pest.

References Cited

Arnold, M. A. 2008. Landscape Plants for Texas and Environs, 3rd Edition. Stipes Publ. L.L.C., Champaign, IL.

Baldo, S. G., M. J. Pannunzio, and L. Artale. 2004. Morphological, biological traits and damage of *Neogalea sunia* Guenee (Lepidoptera: Noctuidae) on *Lantana camara* L. (Verbenaceae). IDESIA (Publicación Científica de la Facultad de Ciencias Agronómicas de la Universidad de Tarapacá, Chile) 22: 35-43.

Brenzel, K. N. [ed.]. 1997. Sunset National Garden Book. Sunset Books, Inc., Menlo Park, CA.

Day, M. D., S. Broughton, and M. A. Hannah-Jones. 2003. Current distribution and status of *Lantana camara* and its biological control agents in Australia, with recommendations for further biocontrol introductions into other countries. Biocontrol-News and Information 24: 63-76.

Diatloff, G, and W. H. Haseler. 1965. Varietal differences in lantana, p. 11-12. *In* Australian Weeds Conference, Toowoomba, Queensland, Australia. Vol. 1.

Everett, T. H. 1981. The New York Botanical Garden Illustrated Encyclopedia of Horticulture. Vol. 6. Garland Publ., Inc., New York.

Holm, L. G., D. L. Pucknett, J. V. Pancho, and J. P. Herberger. 1977. The World's Worst Weeds. Hawaii University Press, Honolulu.

Howard, R. A. 1969. A check list of cultivar names used in the genus *Lantana*. Arnoldia 29: 73-109.

Julien, M. H., and M. W. Griffiths. 1998. Biological control of weeds. A World Catalogue of Agents and their Target Weeds. 4th edition. CABI Publ., Wallingford, UK.

Parsons, W. T., and E. G. Cuthbertson. 2001. Common lantana, pp. 627-632. *In* Noxious Weeds of Australia. CSIRO Publ., Melbourne, Australia.

Perry, B. 1992. Landscape Plants for Western Regions, An Illustrated Guide to Plants for Water Conservation. Dai Nippon Printing Co., Ltd., Hong Kong.

Reinert, J. A., T. K. Broschat, and H. M. Donselman. 1983. Resistance of *Canna* spp. to the skipper butterfly, *Calpodes ethlius* (Lepidoptera: Hesperiidae). Environ. Entomol. 12: 1829-1832.

Reinert, J. A., S. W. George, W. A. Mackay, and T. D. Davis. 2006. Resistance among *Lantana* cultivars to the lantana lace bug, *Teleonemial scrupulosa* Stal. (Hemiptera: Tingidae). Florida Entomol. 89: 449-454.

SAS Institute. 2009. SAS system for Windows, release 9.1. SAS Institute, Cary, NC.

Sperry, N. 1991. Neil Sperry's Complete Guide to Texas Gardening. Taylor Publ. Co., Dallas, TX.

Staff of the Liberty Hyde Bailey Hortorium. 1976. Hortus Third. Macmillan Publ. Co., Inc., New York.

Welch, W. C. 1989. Perennial Garden Color for Texas and the South. Taylor Publ. Co., Dallas, TX.