HortScience 47(1):132–137. 2012.

UF-T3 and UF-T4: Two Sterile *Lantana camara* Cultivars

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Lantana camara L. (Verbenaceae) is native to the West Indies (Sanders, 2001) and was introduced to most tropical regions by 1900 (Howard, 1969). Plants of this species produce showy flowers year-round, attract numerous species of butterflies (Schemske, 1976), tolerate harsh environmental conditions (Schoellhorn, 2004), have low maintenance requirements, and are easy to propagate (Beaulieu, 2008; Grant and Parsons, 1989; Howard, 1969). These attributes make *L. camara* highly desirable for use in containers, hanging baskets, and landscapes (Beaulieu, 2008; Grant and Parsons, 1989; Schoellhorn, 2004). *Lantana camara* is widely available commercially, especially in the southern United States. For example, a 2003 survey of the Florida nursery industry, which consisted of more than 5000 nurseries, indicated that 19.0% of the responding nurseries grew *L. camara* and that the annual sales value in Florida was over $40 million (Wirth et al., 2004).

The majority of the *Lantana* spp. plants in commercial production belong to *L. camara*. However, this species has escaped cultivation through seed dispersal and has hybridized (as a pollen donor) with *Lantana depressa* Small, a now endangered species native to Florida [Florida Exotic Pest Plant Council (FLEPPC), 2011; Hammer, 2004; Langeland et al., 2008; Sanders, 1987]. Consequently, *L. camara* has been listed as a Category I invasive species for south and central Florida (FLEPPC, 2011). The invasiveness of *L. camara* has been evaluated by the Institute of Food and Agricultural Sciences, University of Florida, Assessment of Non-Native Plants in Florida's Natural Areas and its conclusion was that *L. camara* is not recommended for commercial production or landscape use in south and central Florida (<http://plants.ifas.ufl.edu/assessment/>). The assessment was primarily based on data collected from or observations on the "wild-type" (naturalized) *L. camara*.

A research program was initiated in 2004 at the University of Florida's Gulf Coast Research and Education Center (UF/GCREC) to develop new sterile *L. camara* cultivars. Initial efforts produced a number of highly sterile triploids from interploid crosses, but they had undesirable growth habits for ornamental uses (Z. Deng, unpublished data). To overcome this, existing tetraploid cultivars were identified from existing commercial sources and used in interploid crosses. Triploids produced from these crosses had desirable growth habits but produced more fruit (seed) than desired (Z. Deng, unpublished data). To improve the effectiveness and efficiency of genetic sterilization of *L. camara*, the male and female fertility of 26 *L. camara* cultivars was investigated (Czarnecki et al., 2008). The majority of the existing triploid commercial cultivars had pollen stainability below 10%, even as low as 1.8%. Thus, high levels of male sterility can be achieved in triploid *L. camara*. However, most existing triploid commercial cultivars produced as much fruit (or seed) as diploid or tetraploid cultivars (Czarnecki, 2011). Few of the existing commercial *L. camara* cultivars reached the high levels of male and female sterility desired. Therefore, there is a strong need for new sterile cultivars in *L. camara* (Wilson et al., 2012).

Twenty-two crosses were made in 2006 and 2007 between seven *L. camara* tetraploids (three cultivars and four breeding lines developed at UF/GCREC) and five *L. camara* diploids (two cultivars and three breeding lines). These crosses resulted in the generation of 393 triploids. Over a period of 4 years, the triploids were subjected to multiple rounds of evaluations and selections in the greenhouse and in ground beds for plant growth habit, leaf and flower characteristics, and/or male and female sterility. These evaluations resulted in the selection of UF-T3 and UF-T4, two promising triploids as potential new releases. These two triploids were submitted to the UF/Institute of Food and Agricultural Sciences (IFAS) Invasive Plants Working Group for assessment of invasiveness by the IFAS Infraspecific Taxon Protocol (ITP) (<http://plants.ifas.ufl.edu/assessment/infraspecific_taxon_protocol.html>) of the IFAS Assessment of Non-native Plants in Florida's Natural Areas (<http://plants.ifas.ufl.edu/assessment/>). The ITP concluded that UF-T3 and UF-T4 were not likely to be an invasive weed problem and that UF faculty and staff could recommend UF-T3 and UF-T4 for landscape use in north, central, and south Florida. Plants of UF-T3 and UF-T4 showed a mounding growth habit and performed and flowered better or comparable to existing commercial cultivars. Flowers of UF-T3 and UF-T4 are yellow/red and yellow/pink, respectively. These attributes should allow UF-T3 and UF-T4 to be desirable candidates to replace male- and female-fertile *L. camara* cultivars.

Origin

UF-T3 (Figs. 1 and 2) was selected in Oct. 2008 from the progeny of a cross between 'Dallas Red' and breeding line LAOP-9 made in Apr. 2007 at the UF/IFAS GCREC in Wimauma, FL. The selection was initially named 705b-3. UF-T4 (Figs. 3 and 4) resulted from a cross between 'Carlos' and breeding

Received for publication 14 Oct. 2011. Accepted for publication 30 Nov. 2011.
The development and evaluation of UF-T3 and UF-T4 were funded, in part, by the Southwest Florida Water Management District, the Alafia River, Hillsborough River, Manasota and Peace River Basin Boards, the USDA/Tropical and Subtropical Agriculture Research (TSTAR) program, the Florida Nursery, Growers and Landscape Association, and the Florida Department of Environmental Protection.
We thank Gail Bowman, Joyce Jones, Keona Nolan, James H. Aldrich, and Adam Moseley for their technical assistance.
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Fig. 1. Flowers and inflorescences of UF-T3 grown outdoors in ground beds in full sun. The plant was propagated by cuttings, grown in a soilless mix, and the grown outdoors in the ground bed (photograph taken at the University of Florida Gulf Coast Research and Education Center in Wimauma, FL, on 28 Sept. 2011).

Fig. 2. A single plant of UF-T3 lantana propagated by cutting, grown in a soilless mix for 50 d and grown outdoors in the ground bed for 70 d (photograph taken at the University of Florida Plant Science Unit in Citra, FL, on 29 July 2009).

Fig. 3. Flowers and inflorescences of UF-T4 grown outdoors in ground beds in full sun. The plant was propagated by cuttings, grown in a soilless mix, and then grown outdoors in the ground bed (photograph taken at the University of Florida Gulf Coast Research and Education Center in Wimauma, FL, on 3 Oct. 2011).

line LAOP-9 made in Mar. 2007 at the UF/IFAS GCREC in Wimauma, FL. The selection was made in Oct. 2008 and was initially named 702a-3.

'Carlos' and 'Dallas Red' are unpatented commercial *L. camara* cultivars; their flowers are yellow/pink and yellow/red, respectively. They were selected as the parents because of their tetraploidy and, most importantly, lack of the ability to produce unreduced female gametes (UFGs). UFG is a major reproductive trait of lantana contributing to the prolific seed production and potential invasiveness of *L. camara* (Czarnecki and Deng, 2009). Breeding line LAOP-9 was selected out of 'Lola' open-pollinated progeny. 'Lola' is an unpatented commercial *L. camara* cultivar producing yellow flowers. 'Lola' has a good growth habit and does not produce UFGs. Plants of LAOP-9 are more compact and have darker yellow flowers than 'Lola'.

The ploidy level of UF-T3 and UF-T4 was determined by flow cytometrical analysis (Partec I, Germany) as described by Czarnecki and Deng (2009) using several *L. camara* cultivars as internal controls in the analysis (diploid 'Cream', 'Lola', and LAOP-9 and tetraploids 'Carlos', 'Dallas Red', and 'Pink Caprice'). Both UF-T3 and UF-T4 are triploids.

Description

Description of color for plant parts was based on comparison with the Royal Horticultural Society Color Chart [Royal Horticultural Society (RHS), 1986)]. Plants used for describing color and other attributes were propagated from rooted cuttings and grown outdoors in the ground bed in Wimauma, FL. The plants were 16 weeks of age.

Plants of UF-T3 are multistemmed shrubs with a mounding growth habit, ≈179 cm wide and 75 cm tall. New stems are light green (RHS 143C), square, semiwoody, covered with soft hairs (scabrous) but not prickles; old stems are round, light brown (RHS 199D), smooth, with few hairs. Leaves are opposite, simple, with petioles 1 to 2 cm long and light green (RHS 143C). Mature leaf blades are ovate, 6.5 to 9.5 cm long, 4.5 to 6.5 cm wide, with serrated margins (30–60 teeth), a broadly truncated base, and an acute apex. The upper leaf surface is green (RHS 137A) covered with soft hairs. The lower surface is grayed–green (RHS 191B). Inflorescences are umbel-like, in the shape of a flattened semisphere, 3.5 to 4 cm wide across the top, bearing 25 to 30 flowers. Peduncles are yellow–green (RHS 144C), 4 to 7 cm long. Flowers are multicolored, bright yellow (RHS 17A) when initially opened, and then turning to bright orange (RHS 28A). Inflorescences rarely bear fruit (drupes).

Plants of UF-T4 are multistemmed shrubs with a mounding growth habit, ≈158 cm wide and 91 cm tall. Young stems are light green (RHS 143C), square, semiwoody, covered with soft hairs (scabrous) but no prickles; old stems are round, light brown (RHS 199D), smooth, with few hairs. Leaves are opposite, simple, with petioles 1 to 2 cm long and in yellow–green (RHS 145A). Mature leaf blades are ovate, 7.5 to 9.5 cm long, 5.5 to 7.0 cm wide, with serrated margins (40 to 60 teeth), a broadly truncated base, and an acute apex. The upper leaf surface is green (RHS 137A) covered with soft hairs. The lower surface is yellow–green (RHS 147B).

Fig. 4. A single plant of UF-T4 lantana propagated by cutting, grown in a soilless mix for 50 d, and grown in the field for 70 d (photograph taken at the University of Florida Plant Science Unit in Citra, FL, on 29 July 2009).

Inflorescences are umbel-like, ≈4 cm wide across the top, bearing 25 to 31 flowers, and with light yellow (RHS 144C) peduncles 5 to 8 cm long. Flowers are light yellow (RHS 7A) when opening initially and then turn red–purple (RHS 62C). Inflorescences rarely bear fruit.

Multisite replicated evaluations of fertility and plant performance

Four experiments were conducted simultaneously at the UF/IFAS Indian River Research and Education Center (IRREC) in Ft. Pierce, FL [southeast Florida, USDA hardiness zone 9B, and American Horticultural Society (AHS) heat zone 9 to 10)], at the UF/IFAS GCREC in Balm, FL (southwest Florida, USDA hardiness zone 9A, and AHS heat zone 10), at the UF/IFAS Plant Science Research and Education Unit (PSREU) in Citra, FL (northern Florida, USDA hardiness zone 8B, and AHS heat zone 10), and at the UF/IFAS North Florida Research and Education Center (NFREC) in Quincy, FL (northern Florida, USDA hardiness zone 8B, and AHS heat zone 9). The four experiment sites are located in three different hardiness zones (9B, 9A, and 8B) and in two different heat zones (10 and 9) (American Horticultural Society, 1998; National Gardening Association, 2011). The experimental design used in Ft. Pierce and Balm was a randomized complete block with three blocks. The distance between field blocks was at least 50 feet. Each plot within the block at these two sites consisted of two plants for each cultivar and one *L. depressa* plant (mixed planting of triploids and native lantana). *Lantana depressa* plants used in these experiments were provided and confirmed by Pro Native Consulting (Miami, FL). The spacing between plants within each plot was 6 feet. The same experimental design and the same number of blocks were used in Quincy and Citra, except that *L. depressa* plants were not installed between triploid plants (pure planting of triploid plants), because *L. depressa* does not naturally occur in these regions. At each experimental site, 'Pink Caprice' was included as a "resident species" taxon. It is commercially produced and very prolific in fruit (and seed) production (Czarnecki et al., 2008). Although a named cultivar, it is most similar to the escaped plants found along ditches and pastures (i.e., excessive fruiting, multicolored flowers, and vigorous plants). 'Pink Caprice' was planted at least 150 feet away from UF-T3 or UF-T4.

Plants installed at all sites were propagated at GCREC. Cuttings were taken on 14 to 16 Mar. 2009 and rooted in the greenhouse in 128-cell Speedling trays filled with a commercial potting substrate (Fafard 3B potting mix, Anderson, SC). The bottom ends of cuttings were treated with a rooting hormone (Dip'n Grow, 1:10 dilution, final concentration 0.1% indole-3-butyric acid and 0.05% 1-naphthaleneacetic acid) (Dip'n Grow Inc., Clackamas, OR). Rooted cuttings were transplanted to 10.2-cm plastic containers filled with Fafard 3B potting mix and grown in the greenhouse at GCREC (at 15 °C/night to 33 °C/d). When plants were ≈7 weeks old, they were distributed to each of the experimental sites and then transplanted to ground beds in full sun. Raised ground beds were fumigated at least 3 weeks before planting and covered with white-on-black plastic. Transplanting was completed in the week of 5 May 2009. Each plant was top-dressed with ≈15 g of the controlled-release fertilizer, Osmocote® ($15N–9P_2O_5–12K_2O$, 12–14 months; Scotts, Marysville, OH) and irrigated through drip tapes, twice a week, and 2 h per irrigation event.

Pollen stainability

Previous studies have shown that pollen stainability is a good indicator of lantana's male fertility (or sterility) and hybridization potential with *L. depressa* (Czarnecki et al., 2008; Czarnecki, 2011; Dehgan and Guy, n.d.). Three pollen staining experiments were conducted using fresh anthers collected from the plants grown at the GCREC site on 24 Sept. and on 16 Nov. 2009 and from the plants grown at the IRREC site on 6 Oct. 2009. In each staining experiment, three inflorescences were collected per plant and three to four anthers were isolated from each of the inflorescences, resulting in eight to 12 anthers for any given plant and 48 to 72 anthers for any given lantana cultivar (two plants per replicate and three replicates). Collected anthers were placed in ≈100 µL of cotton blue solution (Eng Scientific, Inc. Product No. 6730, Clifton, NJ) in a 1.5-mL Eppendorf tube and stained overnight at 65 °C. Stained anthers were rinsed three times with deionized water, placed on a microscope slide, squashed in a drop of 80% glycerol, and covered with a coverslip. Pollen grains were observed under 400× magnification on a BH-2 microscope (Olympus, Tokyo, Japan). Well-developed, full and deeply stained pollen grains were counted as stainable, whereas non-stained, partially stained, or abnormally shaped pollen grains were counted as non-stainable (aborted). The number of pollen grains examined for each lantana cultivar in each staining experiment was between 1752 and 5141. An analysis of variance (ANOVA) was conducted using the general linear model provided in SAS (PROC GLM; SAS Institute, 2010) to compare the pollen stainability of UF-T3, UF-T4, and 'Pink Caprice'.

The average pollen stainability of UF-T3 and UF-T4 was 5.1% and 3.2%, respectively, whereas the average pollen stainability of 'Pink Caprice' was 65.6% (Table 1), similar to previous results (Czarnecki et al., 2008). These results indicate that the pollen stainability (or male fertility) of UF-T3 and UF-T4 had been reduced substantially by 92.2% (UF-T3) and 95.1% ('UF-G4') from that of 'Pink Caprice'.

Female sterility

Previous studies have indicated that fruit (seed) production per peduncle and seed germination are the primary factors determining lantana's female fertility (or sterility) and that it is possible to factor these two characteristics into a female fertility index (FFI) by multiplying fruit production per peduncle and seed germination (Czarnecki, 2011).

Fruit production per peduncle. Every 4 weeks beginning in late July 2009 until mid-Dec. 2009, 20 peduncles were harvested randomly from each of the plants grown at the four experimental sites and drupes on each peduncle were counted. A total of six harvests was made for each plant at each experimental site. Thus, 120 peduncles were examined for each lantana cultivar in each experimental plot during a given harvest and 2880 peduncles were examined across the four experimental sites through six harvests (20 peduncles per plant × two plants within a block × three blocks × four sites × six harvests) for each cultivar. An ANOVA was

Table 1. Pollen stainability, fruit production, seed germination, and female fertility of UF-T3, UF-T4, and 'Pink Caprice' (*Lantana camara*) grown outdoors in ground beds in full sun (2009).

	Pollen stainability (%)[z]				Fruit per peduncle (no.)[y]					Seed germination[x]		Female fertility
Cultivars	Expt. 1	Expt. 2	Expt. 3	Overall avg	Quincy	Citra	Balm	Ft. Pierce	Overall avg	Seeds (no.)	Germination (%)	index[w] (FFI)
UF-T3	6.5 b[v]	6.4 b	2.4 b	5.1 b	0.008 b	0.008 b	0.026 b	0.031 b	0.019 b	27	24.4	0.005
UF-T4	3.1 b	4.6 b	1.9 b	3.2 b	0.081 b	0.003 b	0.007 b	0.003 b	0.023 b	25	0	0
Pink Caprice	62.0 a	65.1 a	69.9 a	65.6 a	15.038 a	13.199 a	7.481 a	6.086 a	10.451 a	400	63.3	6.615

[z]In Expt. 1 and Expt. 2, anthers were collected on 24 Sept. and 16 Nov. 2009, respectively, from plants grown in ground beds in Balm, FL, and in Expt. 3, anthers were collected on 6 Oct. 2009 from plants grown in Ft. Pierce, FL.
[y]The fruit production value for each site was the mean of 720 peduncles (six plants and six harvests between 12 and 32 weeks post-planting).
[x]Analysis of variance was not conducted as a result of the limited numbers of seeds for UF-T3 and UF-T4.
[w]Female fertility index = average fruit production per peduncle × seed germination (%)/00.
[v]Means with the same letter within the column are not significantly different by the least significant difference procedure at $P \leq 0.05$.

conducted using the general linear model provided in SAS (PROC GLM; SAS Institute, 2010) to compare the fruit production of UF-T3 and UF-T4 with that of 'Pink Caprice'.

'Pink Caprice' produced the greatest number of drupes among all the entries in the study (Table 1). Each peduncle bore an average of 1.143 to 22.838 drupes with an overall average of 10.451 across the four sites and six harvests. The number of drupes per peduncle on 'Pink Caprice' grown in Balm and Ft. Pierce ranged from 1.143 to 12.416, averaged to 6.783, whereas the number of drupes per peduncle on plants grown in Quincy and Citra was 7.150 to 22.838, averaged to 14.118, more than twofold greater.

The number of drupes UF-T3 produced per peduncle ranged from 0 to 0.074 and averaged to 0.019 across four experimental sites and over 6 months (Table 1). The number of drupes per peduncle for UF-T4 ranged from 0 to 0.358 and averaged to 0.023 across the sites and over the 6 months (Table 1). These levels of fruit production represent greater than 99% reduction from the fruit production of 'Pink Caprice'. UF-T3 and UF-T4 showed similarly low levels of fruit production regardless of whether they were planted purely (without *L. depressa* in Quincy and Citra) or interplanted with *L. depressa* (in Balm and Ft. Pierce).

Seed germination. Mature drupes were collected from each plant in the described experiments. Seeds were extracted, cleaned, and air-dried at each of the four test sites and shipped to IRREC. As a result of having few seeds for UF-T3 and UF-T4, seeds from different harvests at each site were combined before germination. Seeds were germinated in a 10.9-cm × 10.9-cm transparent polystyrene germination boxes (Anchor Paper Company, St. Paul, MN) containing two sheets of germination paper (Anchor Paper Company) moistened with 15 mL of water. Germination boxes were placed in temperature- and light-controlled chambers equipped with cool-white fluorescent lamps (Model 818; Precision Scientific, Winchester, VA). The germination condition was 12 h light at 25 °C (photosynthetic photon flux was 22 to 30 $\mu mol \cdot m^{-2} \cdot s^{-1}$ at shelf level) followed by 12 h dark at 15 °C. Germination of seeds was monitored every other day for a period of 60 d. An additional 5–10 mL of nanopure water was added to the germination boxes as needed. A seed was considered germinated when radicle emergence was 2.0 mm or greater. Seeds were removed once germination occurred to prevent inaccurate data collection.

'Pink Caprice' seeds germinated readily with an average germination percentage of 63.3 (Table 1). The number of seeds collected from each experimental site (six plants) over 6 months for UF-T3 ranged from 0 to 13 (data not shown). The germination percentage of these seeds was between 15.4 and 50.0 averaged to 24.4 (Table 1). A total of 25 seeds was collected from 24 UF-T4 plants over a period of 6 months, and none of the seeds germinated (Table 1). UF-T4 seeds appeared abnormal and were likely not viable.

Female fertility index. The FFI for UF-T3 and UF-T4 was 0.005 and 0.000, respectively (Table 1). These indices were less than 0.1% of the 'Pink Caprice's FFI (6.615), indicating an extremely high level of female sterility in UF-T3 and UF-T4.

Plant growth, performance, and flowering

Beginning in late July 2009 and continuing through mid-Dec. 2009, plants grown at the four experimental sites were rated every 4 weeks for their performance on a scale of 1 to 5 with 1 = few branches, open canopy, lacking vigor; 3 = performing fairly well and acceptably as ornamental plants; and 5 = full plants, dense canopy, desirable shape and color, very attractive. Flowering intensity was also rated every 4 weeks on a scale of 1 to 5 scale with 1 = 0% to 20%, 2 = 21% to 40%, 3 = 41% to 60%, 4 = 61% to 80%, and 5 = 81% to 100% of the maximum flower coverage of the plant. At the end of the experiments (mid-Dec. 2009), plant height and width in two directions were measured. The experimental design at each site was a randomized complete block with three blocks and two subsamples (two plants per plot). Data on plant performance, flowering intensity, and plant growth were analyzed using PROC GLM in SAS for Windows 9.2 (SAS Institute, Cary, NC) to determine the significance of differences among cultivars. When differences were significant, mean separation was performed using the least significant difference procedure in SAS.

UF-T3 plants performed well in Quincy, Citra, and Balm and received a performance rating of 3.2 to 5.0 and a flowering intensity rating of 3.3 to 5.0 in 15 out of 18 evaluations (data not shown). The average performance rating of UF-T3 in Quincy and Citra was 4.1 and 3.8, respectively (Table 2). These ratings were significantly higher than those of 'Pink Caprice' at the corresponding sites. The average flowering intensity rating of UF-T3 in Quincy and Citra was 4.2, significantly higher than that of 'Pink Caprice'. At the Balm site, UF-T3 and 'Pink Caprice' received similar performance (3.2 and 3.4, respectively) and flowering intensity ratings (3.1 and 3.4, respectively). At the Ft. Pierce site, UF-T3 received a similar plant performance rating with 'Pink Caprice' (2.6 and 2.3, respectively) but a higher flowering intensity rating (2.3 vs. 1.3).

Similarly, UF-T4 plants performed well in Quincy and Citra and received a plant performance rating of 3.5 to 5.0 in 17 out of 18 evaluations (data not shown). The average plant performance rating of UF-T4 in Quincy and Citra was 4.4 and 3.8, respectively, significantly higher than that of 'Pink Caprice' (Table 2). The average flowering intensity of UF-T4 in Quincy and Citra was 3.8 and 3.3, respectively, similar to that of 'Pink Caprice' (Table 2). In Balm and Ft. Pierce, UF-T4 performed and flowered similarly with 'Pink Caprice'. Their plant performance ratings were between 3.0 and 4.3 when grown in Balm and between 1.7 and 3.2 when grown in Ft. Pierce (Table 2).

Analysis of variance results for plant size indicated significant interactions between cultivars and experimental sites (data not shown). UF-T3 and UF-T4 plants were tallest (99.8 and 111.5 cm, respectively) and widest (251.7 and 228.5 cm) in Quincy, intermediate in Balm (74.5 cm for UF-T3 and 91.0 cm for UF-T4 in height, 178.9 cm for UF-T3 and 158.2 cm for UF-T4 in width) and Citra (72.5 cm for UF-T3 and 83.3 cm for UF-T4 in height, 197.3 cm for UF-T3 and 190.5 cm for UF-T4 in width), and shortest (50.5 and 60.7 cm, respectively) and narrowest (146.3 and 129.0 cm, respectively) in Ft. Pierce. 'Pink Caprice' grew to be the tallest and widest (110.3 cm in height and 297.9 cm in width) in Balm, intermediate in Citra (85.8 cm in height and 277.3 cm in width) and Quincy (75.8 cm in height and 257.5 cm in width),

Table 2. Plant performance ratings, flowering intensity ratings, plant height, and plant width of 'UF-T3', 'UF-T4', and 'Pink Caprice' (*Lantana camara*) grown in ground beds in full sun (2009).

		Plant performance[z]		Flowering intensity[y]		Plant ht (cm)[x]		Plant width (cm)[w]	
Cultivars	Expt. sites	Avg by site	Overall avg	Avg by site	Overall avg	Avg by site	Overall avg	Avg by site	Overall avg
UF-T3	Quincy	4.1	3.4 a[v]	4.2	3.5 a	99.8	74.3 NS	251.7	193.6 b
	Citra	3.8		4.2		72.5		197.3	
	Balm	3.2		3.1		74.5		178.9	
	Ft. Pierce	2.6		2.3		50.5		146.3	
UF-T4	Quincy	4.4	3.7 a	3.8	2.7 b	111.5	86.6	228.5	176.5 c
	Citra	3.8		3.4		83.3		190.5	
	Balm	3.9		2.5		91.0		158.2	
	Ft. Pierce	2.8		1.2		60.7		129.0	
Pink Caprice	Quincy	3.3	2.9 b	3.7	2.9 b	75.8	82.1	257.5	243.2 a
	Citra	2.7		3.3		85.8		277.3	
	Balm	3.4		3.4		110.3		297.9	
	Ft. Pierce	2.3		1.3		56.5		140.1	

[z]Plant performance was rated on a scale of 1 to 5 with 1 = performing very poorly, and plants unacceptable; 3 = performing fairly, plants acceptable as ornamental plants; and 5 = performing outstandingly and plants highly desirable. The average-by-site values are means of six plants and six evaluations between 8 and 28 weeks post-planting.

[y]Flowering intensity was rated on a scale of 1 to 5 scale, 1 = 0% to 20%, 2 = 21% to 40%, 3 = 41% to 60%, 4 = 61% to 80%, and 5 = 81% to 100% of the maximum flower coverage of the plant. The average-by-site values are means of six plants and six evaluations between 8 and 28 weeks post-planting.

[x]Plant heights were measured at the end of the experiments (≈7.5 months after planting).

[w]Plant widths were measured in two perpendicular directions at the end of the experiment.

[v]Means with the same letter within the column are not significantly different by the least significant difference procedure at $P \leq 0.05$.

NS = Nonsignificantly different at $P \leq 0.05$.

Table 3. Hybridization potential of UF-T3 and UF-T4 (*Lantana camara*) with *L. depressa* as compared with 'Pink Caprice'.

	L. depressa flowers pollinated (no.)		*L. depressa* fruit set (%)			Seed germination
Cultivars	Fall 2009	Spring 2010	Fall 2009	Spring 2010	Avg	(%)
UF-T3	64	114	2.8	0.0	1.4 ab[z]	0
UF-T4	133	107	0.0	0.0	0.0 a	0
Pink Caprice	305	93	1.6	16.1	8.9 b	10.0

[z]Means with the same letter within the column are not significantly different by the least significant difference procedure at $P \leq 0.05$.

and shortest (56.5 cm) and narrowest (140.1 cm) in Ft. Pierce.

Hybridization potential with *L. depressa* after hand pollinations

Two hand pollination experiments were performed in the greenhouse at the GCREC in Wimauma, FL, one in Fall 2009 and one in Spring 2010, to assess the ability of UF-T3, UF-T4, and 'Pink Caprice' to cause fruit set on *L. depressa* flowers. Stock plants were grown in #1 plastic containers filled with a commercial soilless mix (VerGro container mix A; Verlite Co., Tampa, FL) amended with a controlled-release fertilizer (Osmocote, 15N–3.9P–10K, 8–9 months release at 21 °C; The Scotts Company) at 7.12 kg·m^{-3}. Temperatures inside the greenhouse ranged from a low of 16 °C at night to a high of 29 °C during the day. No supplemental lighting was provided. Plants were drip-irrigated twice a week. Fresh anthers were collected from mature unopened flowers of UF-T3 or UF-T4 and applied immediately to emasculated *L. depressa* flowers.

UF-T4 pollen did not cause any fruit set on *L. depressa* (Table 3). UF-T3 caused 2.8% fruit set on *L. depressa* flowers in the first hand pollination experiment but no fruit set in the second pollination experiment. Two seeds were obtained but they did not germinate. 'Pink Caprice' effected an average of 8.9% fruit set. Seeds from *L. depressa* × 'Pink Caprice' had 65% germination. These results confirm the high level of pollen infertility in UF-T3 and UF-T4 compared with 'Pink Caprice'.

Conclusion

Compared with 'Pink Caprice', a cultivar of *L. camara* that is the closest to the species' resident taxon (wild or naturalized type), the pollen stainability of UF-T3 and UF-T4 has been reduced by 90% or more. These new triploid cultivars did not cause fruit set or produce viable progeny when used as male parents in cross-pollination with *L. depressa* flowers. Fruit production of these triploids has been reduced by greater than 99% and typically they did not produce viable seeds. The high level of male and female sterility of these triploids was stable from south Florida to north Florida, even with fertile *L. depressa* plants located in close proximity. These results indicate that UF-T3 and UF-T4 do not hybridize with *L. depressa* or produce viable interspecific progeny. Plants of UF-T3 and UF-T4 developed a mounding growth habit and performed and flowered better or comparable to 'Pink Caprice' in multisite replicated trials. Flowers of UF-T3 and UF-T4 are yellow/red and yellow/pink, respectively. These attributes should allow UF-T3 and UF-T4 to be desirable candidates to replace male and female-fertile *L. camara* cultivars.

Availability

A patent will be applied for UF-T3 and UF-T4 by the Florida Agricultural Experiment Station and production of these cultivars is to be with a licensing agreement with the Florida Foundation Seed Producers, Inc., P.O. Box 309, Greenwood, FL 32443. Information about plant materials and propagation agreements can be obtained from the Florida Foundation Seed Producers, Inc.

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