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SHADING AND POT COLOR INFLUENCE GROWTH AND FLOWERING OF STRAWBERRY FIRETAILS

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Abstract. **Experiments were conducted to study the influence of shading and pot color on shoot growth of strawberry firetails (*Acalypha hispaniolae* Urb.). Four rooted liners with at least 13 cm stem length were potted in either green or white 20-cm hanging baskets filled with Pro-Mix BX™. Ten days after potting, shoot tips were pinched leaving six nodes on each plant, and plants were fertilized with 12 g SierraBlen™ 18N-2.6P-10K as a topdressing. Plants were grown under 60 or 80% shading with daily irrigation for 10 weeks. Flowers developing on stem tips were removed by hand once a week for 6 weeks following pinching. Stems of plants grown under 80% shade were 8, 9, and 12% longer 4, 6, and 10 weeks after pinching, respectively, compared to plants grown under 60% shade. Six weeks after pinching, stem lengths were 9% longer in plants grown in green pots compared to white pots. After 10 weeks growth, plants grown in green pots under 60% shading had 10% longer shoots, 10% more shoot dry weight and 23% larger flowers compared to plants grown in white pots under 60% shading. Strawberry firetails had 22% more shoot weight and 48% larger flowers when grown under 60% shading compared to 80% shading. Production using less than 60% shading may be beneficial, but light penetration through white pots may reduce growth and flowering with less shading.**

Acalypha hispaniolae (Euphorbiaceae), a native of the island of Hispaniola, has been given a variety of common names including: strawberry firetails (Walter, 1992), dwarf chenille plant (Herwig, 1987), pendulous chenille plant, and summer love (Macaboy, 1988). Strawberry firetails are often mistakenly sold as chenille plants (*Acalypha hispida* Burm. f.). The species is not listed in Hortus Third (1976) or the New Royal Horticultural Society Dictionary of Gardening (Huxley et al., 1992). Commercially, botanical names used have included: *A. pendula* (Herwig, 1987; Walter, 1992), *A. pendula* 'Firetails,' *A. hispida* 'Pendula,' *A. reptans* (Macaboy, 1988), and *A. repens*. Related plants include chenille plant and copperleaf (*Acalypha wilkesiana* Mull. Agr.). Unlike most ornamental acalypha which have a more upright, shrub-like growth habit and produce flowers from their leaf axils, strawberry firetails is an herbaceous, spreading, tropical perennial that produces showy, red terminal catkins or racemes. Computer and hand literature searches found no previously published research on strawberry firetails.

Commercial growers generally propagate strawberry firetails by sticking four to eight, 10 to 15 cm long cuttings directly into 20 or 25 cm hanging baskets. Alternatively, rooted liners are available for purchase year-round. Several growers have described the occurrence of foliar chlorosis during and immediately following propagation, and again from 3 to 6 weeks after propagation. Previous studies (Svenson, unpublished) have shown that proper fertilization of stock plants, and fertilization during propagation, prevents foliar chlorosis during and immediately following propagation. Growers who described chlorosis during production used white pots, while growers who did not report chlorosis used dark-colored (usually green) pots. The objective of this study was to determine if pot color would influence the growth, flowering, or development of foliar chlorosis of strawberry firetails.

Materials and Methods

Four rooted liners of *A. hispaniolae* with at least 13 cm stem length were potted in either green or white 20 cm diameter hanging baskets filled with Pro-Mix BX™. Plants were fertilized immediately after potting, and then once every 4 weeks, with a solution containing a 20N-8.6P-16K liquid fertilizer at 200 mg N/liter, and 10 mg Fe/liter from Sequestrene™ 138Fe. Ten days after potting (25 July 1992), shoot tips were pinched leaving six nodes on each plant, and plants were fertilized with 12 g SierraBlen™ 18N-2.6P-10K as a topdressing. Plants were grown under 60 or 80% shading with daily irrigation for 10 weeks. Temperatures averaged 35/26 C (maximum/minimum). Unshaded full sun at solar noon averaged 2050 $\mu mol\ m^{-2}s^{-1}$ of photosynthetically active radiation (400-700 nm) as meas-

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ured with a LI-COR Line Quantum Sensor. Flowers developing on stem tips were removed by hand once a week for 6 weeks following pinching.

The experiment was a 2 X 2 split-plot factorial treatment arrangement in a completely randomized design, with two levels of shade and two pot colors. The length of the two longest stems was recorded 0, 2, 4, 6, and 10 weeks after pinching. Plants were harvested 10 weeks after pinching, and divided into racemes, stems, and leaves before drying at 60 C for 72 hours. The number of racemes on each plant was recorded. Data were analyzed by analysis of variance (ANOVA).

Results and Discussion

Foliar chlorosis was not observed during this study. It may be that higher light intensities are required to produce symptoms, or that the fertilization regime used was sufficient to prevent symptom development. This study provides no evidence that pot color is responsible for the development of foliar chlorosis. Infrequent aphid infestations were observed on flower racemes and expanding leaves, causing premature dehydration and "blackening" of the flowers, and downward cupping of leaves.

Plants grown under 60% shading had the same number of flowers as plants grown under 80% shading, but raceme elongation appeared to be faster under 60% shade.

Stem length was not influenced by shading or pot color until 4 weeks after pinching (Table 1). Stems of plants grown under 80% shade were 8, 9, and 12% longer 4, 6, and 10 weeks after pinching, respectively, compared to plants grown under 60% shade. However, at 6 weeks after pinching, stem lengths of plants grown in white pots under 80% shade were not different from stem lengths of plants grown in green pots under 60% shade, because of the shorter stem lengths of plants grown in white pots.

There was a significant interaction between shade percentage and pot color at 10 weeks after pinching (Table 1). Pot color did not influence stem length of plants grown under 80% shade, while plants grown in white pots under 60% shade had 10% shorter stems compared to plants grown in green pots under 60% shade.

Larger flowers were observed on plants grown under 60% compared to 80% shade, and, under 60% shade, on plants grown in green compared to white pots. There was a significant interaction between shade percentage and pot color for whole shoot dry weight and raceme dry weight (Table 2). After 10 weeks growth, plants grown in green pots under 60% shading had 10% more shoot dry weight and 23% more raceme dry weight compared to plants grown in white pots under 60% shade, and 22% more shoot weight and 48% more raceme dry weight than plants grown under 80% shading.

Pot color did not influence the dry weight of stems and leaves (Table 2). Under 60% shading, plants grown in white pots had less shoot dry weight, and less raceme dry weight compared to plants grown in green pots. Neither shade nor pot color influenced the number of racemes produced (ranging from 16 to 20 per pot), so the increased dry weight of racemes was the result of larger individual racemes rather than an increased number of racemes. Under 80% shade, pot color did not influence the dry weight of any portion of the plants.

Less root growth on the surface of the rootball was observed for plants grown in white pots under 60% shade. The apparent influence of light penetrating through the sidewall of white pots to the roots was to reduce visible root growth, shorten stem lengths and reduce flower size, without influencing stem or leaf dry weights. While this suggests that a more compact and aesthetically appealing potted plant could be produced using white pots, the benefit of shorter stems is offset by the smaller flower size.

The interactions between shade percentage and pot color on stem length, shoot dry weight, and raceme dry weight 10 weeks after pinching showed that growth and flowering of strawberry firetails was inhibited when grown in white pots at higher light levels. Stem length of plants grown in white pots under 80% shade was inhibited 6 weeks after pinching, but not 10 weeks after pinching. Shading of the white pots as the canopy of the plants became larger may have prevented growth inhibition under 80% shade. The longer stems of plants grown under 80% shade would provide canopy-shading of white pots more rapidly compared to the shorter stems of plants grown under 60% shade. A similar canopy-shading response may have been observed for plants grown in white pots under 60% shade if the duration of the study had been longer.

In conclusion, shoot dry weight and flower size of strawberry firetails were enhanced using 60% compared to 80% shade, suggesting that production using higher light intensities should be investigated. However, flower size is smaller, and flower color is faded, when plants are

Table 1. Average length (cm) of the two longest stems of *Acalypha hispaniolae* grown at two levels of shading in green or white pots. Means and standard errors, n = 10.

Percentage Shade	Pot color	Weeks after potting 0	2	4	6	10
60%	Green	14.4 ± 0.6	26.4 ± 2.0	47.2 ± 3.4	71.2 ± 3.0	102.7 ± 3.2
	White	14.3 ± 0.9	27.0 ± 2.5	46.8 ± 3.3	64.0 ± 2.0	91.8 ± 2.2
80%	Green	13.1 ± 0.5	22.3 ± 2.1	52.6 ± 3.0	76.2 ± 2.7	12.1 ± 4.0
	White	13.1 ± 0.5	26.5 ± 2.3	49.1 ± 2.3	71.5 ± 2.4	110.9 ± 2.5
Significance[z]						
Shading		ns	ns	0.025	0.026	<0.001
Pot Color		ns	ns	ns	0.033	0.056
Interaction		ns	ns	ns	ns	0.047

[z]Not significant (ns), or P>F based on Analysis of Variance.

Table 2. Total shoot dry weight, total bloom dry weight, and leaf and stem dry weight of *Acalypha hispaniolae* grown under two levels of shading in green or white pots. Means and standard errors, n = 10.

Percentage shade	Pot color	Whole shoot dry wt(g)	Stem and leaf dry wt(g)	Raceme dry wt(g)
60%	Green	35.9 + 0.5	27.1 + 0.4	8.6 + 0.4
	White	32.2 + 0.3	25.6 + 0.5	6.6 + 0.2
80%	Green	28.2 + 0.9	23.5 + 0.7	4.7 + 0.2
	White	28.1 + 1.1	23.7 + 0.9	4.3 + 0.2
Significance[z]				
Shading		<0.001	0.005	<0.001
Pot Color		0.037	ns	0.003
Interaction		0.038	ns	0.047

[z]Not significant (ns), or P>F based on Analysis of Variance.

grown in full sun (data not shown). Dark-colored pots should be used to prevent growth and flowering inhibition, as the roots of strawberry firetails appear to be sensitive to light penetration through container sidewalls. Light penetration through container sidewalls is progressively reduced as the foliage canopy provides an increasing amount of shade as shoots elongate. No evidence was found to support the hypothesis that pot color influences the development of foliar chlorosis.

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PHOTOPERIOD AFFECTS MERISTEM DEVELOPMENT OF *LIATRIS SPICATA* 'CALLILEPSIS'

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Abstract. **Corms of *Liatris spicata* 'Callilepsis' produced significantly more reproductive shoots when grown under an 8-hr photoperiod as compared to 12 and 16-hr photoperiods. Plants grown under 12 and 16-hr photoperiods produced significantly more vegetative shoots than plants grown under an 8-hr photoperiod. The total number of both types of shoots produced per corm did not differ significantly between the photoperiods. The reproductive, vegetative and total lengths of the terminal shoot were greater when grown under a 16-hr photoperiod as compared to an 8 or 12-hr photoperiod. The increased length was due to an increase in the number of reproductive, vegetative and total nodes formed by the meristem when grown under a 16-hr photoperiod. Internode lengths were not significantly affected by photoperiod.**

Liatris spicata (L.) Willd. is a species of commercial value as a cut flower and a landscape plant. It is a member of the Asteraceae family and forms underground corms for overwintering (Liberty Hyde Bailey Hortorium, 1972). Production and division of corms are the major method of commercial propagation and most cut flower production is accomplished using corms (Evans, 1993). The corms of *L. spicata* require a cold treatment prior to emergence and flowering (Zieslin, 1985). When the cold requirement of the corm has been met and external conditions are suitable, the corm meristems will develop. Usually, depending upon environmental conditions, only the terminal meristem, and possibly a secondary meristem, will produce a shoot that will eventually become reproductive. The other meristems give rise to shoots that develop only vegetatively. As the terminal meristem develops, it only forms leaves. However, in the axils of these leaves, additional vegetative meristems form. After the terminal meristem forms between 90-150 nodes (unpublished data), it forms several inflorescences through catastrophic floral initiation. Floral initiation and development then proceeds basipetally and the vegetative meristems in the leaf axils form inflorescences.

Most research on *Liatris* has focused on the cold requirement and the effect of photoperiod on the development of the corm meristems and the terminal shoot. Although the cold requirement is well understood, the effect of photoperiod is not clear. Long days (LD) have been reported to reduce the number of flowering shoots by 50% compared to plants grown under short days (SD) (Espinosa and Healy, 1990; Espinosa et al., 1991). Further, the time to flower was reduced when plants were grown under LD as compared to SD (Espinosa and Healy, 1990). Based upon the reduction in days to flower under LD, Espinosa and Healy concluded that *Liatris* was a facultative long-day plant. However, Garner and Allard (1923) concluded that *Liatris* was a facultative short-day plant. Their conclusion was based on the increase in the average number of flowering shoots produced per corm under SD.

In addition to the reduction in the days to flower for *Liatris*, Espinosa and Healy (1990) reported that plants

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