Pinching, Daminozide and Night-interrupted Lighting Start Date Affect Growth and Flowering of *Achillea* × 'Coronation Gold'[1]

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Abstract

A study was conducted to determine the effects of pinching and the plant growth retardant, daminozide (B-Nine), on plant size and flowering of 'Coronation Gold' yarrow (*Achillea* × 'Coronation Gold'). Greenhouse-grown plants were not pinched or were pinched by removing the apical bud from propagation offsets 3, 5 or 7 weeks after potting. One week after pinching, plants were provided night-interrupted lighting (NIL). Five weeks after pinching, a single application of daminozide was applied at 5,000 ppm to half the pinched and non-pinched plants. Pinching decreased inflorescence stem length by 6.4% and increased the number of flowering and total offsets by 33.3 and 9.1%, respectively. Daminozide application decreased inflorescence stem length and the number of flowering offsets by 7.9 and 40%, respectively, but increased the time to first open inflorescence and the number of non-flowering offsets by 6 days and 28.6%, respectively. Pinching at 7 weeks after potting resulted in the highest number of flowering, non-flowering, and total offsets, the fewest days to flower, and an intermediate flower stem length. In a second experiment, the effects of beginning NIL at different times after pinching the offset from propagation on offset production and flowering were evaluated. All plants were uniformly pinched and NIL was started 0, 1, 2, 3, or 4 weeks after pinching. Starting NIL at 4 weeks after pinching resulted in the fewest days to flower, the highest flowering offset number that was similar to starting NIL at 3 weeks, and a flower stem length about equal to all other NIL treatments.

Index words: plant growth regulator, greenhouse production, yarrow.

Chemicals used in this study: B-Nine (daminozide) [butanedioic acid mono (2, 2-dimethylhydrazide)].

Species used in this study: 'Coronation Gold' yarrow (*Achillea filipendulina* Lam. × *Achillea clypeolata* Sibth. & Sm. 'Coronation Gold').

Significance to the Horticulture Industry

'Coronation Gold' yarrow is a popular herbaceous perennial that has potential as a flowering potted crop for greenhouse production if plant height can be controlled and flowering improved. Pinching the plant following propagation increased flowering and non-flowering shoots and total offset number and decreased flower stem length without affecting days to flower, but decreased inflorescence diameter. Pinching at 7 weeks after potting resulted in the highest number of flowering and non-flowering shoots and total offsets, the fewest days to flower and intermediate flower stem length. Although pinching increased the number of flowering, non-flowering, and total offsets, it was labor intensive and difficult to remove the apical buds because of the close spacing of the nodes in the vegetative offsets, hence, the practice may not be economical. Daminozide decreased flower stem length without affecting inflorescence diameter or total offset number, but increased days to flower. To be marketable as a potted crop, greater height suppression in this species would be desirable, which may be obtainable with multiple applications of daminozide, but further delays in flowering should be expected. Starting NIL at 4 weeks after pinching resulted in the fewest days to flower, the highest flowering offset number, and a flower stem length about equal to starting NIL treatments earlier, but the effects on flowering offset numbers was not of horticultural importance.

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Introduction

'Coronation Gold' yarrow (*Achillea* × 'Coronation Gold'), a hybrid cross of *Achillea filipendulina* Lam. and *Achillea clypeolata* Sibth. & Sm., is probably the best-known yarrow (Armitage 1997). Plants grow 76 cm (2.5 ft) to 91 cm (3 ft) tall with tight clusters of 7.6 to 10 cm (3 to 4 in) inflorescences composed of golden yellow florets in May or June. The foliage is finely dissected, gray-green, and aromatic (Nau 1996). Widely grown as a garden perennial or cut flower, 'Coronation Gold' yarrow has potential as a potted crop if compact, well-branched flowering plants can be produced.

Achillea filipendulina 'Cloth of Gold' has an obligate requirement for long photoperiods and vernalization to flower, but must attain a minimum age or number of leaves to be responsive to flower-inductive treatments (Cameron et al. 1996, 2003). *Achillea* × 'Moonshine', *Achillea* × 'Anthea', and several *Achillea millefolium* cultivars also have an obligate requirement for long photoperiods but a facultative requirement for vernalization to flower (Cameron et al. 2003). *Achillea* × 'Coronation Gold' flowered fastest when provided at least a 16-hour photoperiod or 4-hour NIL, while vernalization resulted in an increase in the number of lateral shoots in greenhouse production (Nausieda et al. 2000).

'Coronation Gold' yarrow is usually propagated from single shortened, thickened stems of rosette-like appearance that develop from the base of a main stem or crown, commonly referred to as offsets (Hartmann et al. 2002). During vegetative growth, offsets arise from the crown and root system. The authors have observed that at flowering, the original propagule elongates more than secondary offsets formed following propagation and is taller than the surrounding floral canopy, which decreases perceived quality. This phenomenon is an example of apical dominance, the control exerted by the shoot apex over the outgrowth of the lateral

buds (Cline 1994). Apical dominance is regulated by auxin, which diffuses basipetally from terminal buds and inhibits the development of lateral buds (Tamas 1987). In contrast, cytokinin application to lateral buds often overcomes apical dominance, resulting in lateral bud outgrowth (Cline 1991). Lateral bud growth is generally prevented by a correlative signal from the apical meristem; removal of the apical bud eliminates this signal and allows shoot development (Mok 1994). Therefore, to develop well-branched plants, apical dominance must be disrupted (Cline 1991).

Pinching the central shoot apex, which breaks apical dominance and stimulates the development of lateral shoots, often results in well-branched plants and improved plant aesthetics. Many florists' crops require growers to apply a manual pinch (Hamrick 2003). Pinching induced branching in *Rhododendron* 'Molly Ann', 'Paprika Spiced', and 'Travis' (Lohr and Sudkamp 1989), *Euphorbia pulcherrima* Willd. ex Klotzsch (poinsettia) (Berghage et al. 1989), *Delphinium* × *belladonna* 'Völkerfrieden' (Garner et al. 1997), and flame azalea [*Rhododendron calendulaceum* (Michx.) Torr] (Malek et al. 1992). However, once- and twice-pinched treatments of *Euphorbia pulcherrima* (poinsettia) delayed floral initiation, bract color development, and finish dates compared to non-pinched plants, and the delays were greater when pinching was later (4 weeks after potting) in production compared to early (2 weeks after potting) (Abdullah and Seng 2003). Generally, the longer the period of time allowed from pinching to floral initiation in poinsettia, the larger the size of the finished plant (Ecke Ranch 2011).

Application of plant growth retardants (PGRs) to potted plants suppresses height growth and often result in shorter, more rigid stems and darker green foliage, characteristics that increase the perceived value of the plant (Gianfagna 1995). The PGR B-Nine (daminozide) is labeled for use on herbaceous perennials under greenhouse and nursery conditions (OHP, Inc. 2011). Generally, foliar sprays of 5,000 ppm are applied every 10 to 14 days as necessary. Frequency of application may need to be increased to weekly for more vigorous cultivars grown outdoors (Latimer 2006).

Latimer (2001) reported that multiple applications of daminozide at 5,000 ppm reduced plant stem length of *Achillea* × 'Moonshine', *Achillea millefolium* L. 'Summer Pastels', and 'Paprika', but details on treatments and methods were not reported. Burnett et al. (2000) applied daminozide at 2,500, 5,000, or 7,500 ppm to 'Coronation Gold' yarrow in a nursery setting over 2 years. In 1998, daminozide provided little growth suppression of yarrow; however in 1999, when plants were pruned just prior to treatment and thus were less reproductively developed, height at the most effective concentration of 7,500 ppm was reduced 33% when compared to untreated plants. Increasing daminozide rates from 2,550 ppm to 7,650 ppm resulted in a linear decrease in shoot height and a linear increase in the number of days to first open flower, but had no effect on flower diameter or quality rating of 'Coronation Gold' yarrow. The highest daminozide rate of 7,650 ppm reduced shoot height by 36% but increased time to first open inflorescence by 5 days when compared to controls (Kessler and Keever 2008).

Židovec (2002) evaluated pinching *Lavandula angustifolia* Mill. (lavender) at the beginning of the growing season, treating plants twice with daminozide sprays or both. The shortest plants were pinched and treated with daminozide, while those with the most lateral branches were only pinched. In another study, potted rooted cuttings of *Euphorbia pulcherrima* (poinsettia) were treated with a single and/or double pinch, chlormequat chloride and daminozide applications (Karunananda and Peiris 2010). The most stem height control was obtained from a double pinch plus chlormequat chloride and daminozide or a double pinch plus chlormequat chloride, whereas pinching, chlormequat chloride and daminozide applied singly did not suppress plant height when compared to the nontreated control. The most lateral shoots were produced by a double pinch plus chlormequat chloride and daminozide application or a double pinch plus chlormequat chloride application; however, when daminozide was applied to double pinched plants, the shoot number was higher than those of plants double pinched only.

Bulking, the growth period before a perennial is forced into flower, can be used to ensure a plant has passed through the juvenile phase and is mature enough to flower (Keever et al. 2014, Pilon 2013b, Whitman and Runkle 2012); to increase plant size before forcing (Pilon 2013a); or to increase the root system, allowing the plant to become well established before forcing (Chong et al. 2000). Increasing the bulking duration was shown to increase the number of shoots of *Rudbeckia fulgida* 'Goldsturm' ('Goldsturm' black-eyed Susan) and *Coreopsis verticillata* 'Moonbeam' ('Moonbeam' coreopsis) of sufficient developmental size to respond to inductive photoperiods, resulting in more flowers and/or flowering shoots (Keever et al. 2014). However, the effects of varying the duration following pinching before initiating photoinductive conditions on growth and flowering is unknown. The objective of this study was to determine the effects of combinations of pinching the offset from propagation before the beginning of NIL and daminozide application and timing of the start of NIL following pinching on growth and flowering of 'Coronation Gold' yarrow.

Materials and Methods

Experiment 1, 2011. Offsets of 'Coronation Gold' yarrow were removed from stock plants on January 14, 2011, and stuck in 72-cell flats [6.1 cm (2.4 in) depth, 70 cm^3 (4.7 in^3) vol] containing germinating medium (Fafard Super Fine Germinating Mix, Sun Gro Horticulture, Agawam, MA). Offsets were removed by cutting just below the medium surface with a knife. Offsets were rooted under intermittent mist propagation set initially to 5 sec every 5 min in a shaded (72% light reduction), glass-covered greenhouse with a heating set point of 23.3 C (74 F) and a ventilation set point of 26.7 C (80 F) under natural photoperiods. Adjustments for changing environmental conditions were made as needed to maintain turgid foliage. Bottom heat was provided at 29.4 C (85 F) during propagation using electric heating mats.

Rooted offsets were removed from propagation on February 4, 2011, and were grown in an unshaded, polycarbonate-covered [8 mm (0.3) twin-wall] greenhouse with a heat set point of 18.3 C (65 F) and a ventilation set point of 25.5 C (78 F). One hundred twenty offsets were transplanted into 16 cm (6.3 in) round, plastic pots [11 cm (4.3 in) depth, 1475 cm^3 (90.0 in^3) vol] containing growing medium (Fafard Mix No. 4-P, Sun Gro Horticulture), and initially spaced pot-to-pot on a greenhouse bench on February 11, 2011, for a first run of the experiment; a second group of 120 offsets from the same propagation were transplanted on February 25, 2011, for a second run of the experiment.

Throughout the experiment, liquid fertilization was applied two out of every three times the plants required water at 150 ppm N using a 20N-4.4P-16.6K (Pro Sol 20-10-20, Frit Industries, Inc., Ozark, AL) fertilizer formulation. Fertilizer applications began when roots appeared on the sides and bottom of the containers. Plants were watered or fertilized by hand when the medium appeared dry, but before plants wilted.

At 3, 5, and 7 weeks after potting in the first run, 20 randomly selected plants were given a soft pinch of the offset from propagation using small scissors and 20 remained un-pinched. Difficulty was encountered in removing the apical buds because of the close spacing of the nodes in the vegetative offsets. Two or 3 days after initial pinching, many plants had to be re-pinched because new leaves were emerging, indicating that complete removal of the apical bud had not occurred. The 40 plants were exposed to NIL from 10:00 PM to 2:00 AM using a minimum of 10 ft-c from incandescent lamps (100 W) beginning 1 week after 20 plants in that group were pinched. Plants were spaced on greenhouse benches 22.9 cm (9 in) on center. Five weeks after each pinching treatment, daminozide was applied at 5,000 ppm to half the pinched and non-pinched plants. The same procedures were used in the second run. Temperature and relative humidity were 19.4 C (67 F) and 97.4% on April 8 (3-week pinch, run 1), 27.8 C (82 F) and 45% on April 22 (5-week pinch, run 1; 3-week pinch, run 2), 21.7 C (71 F) and 86% on May 6 (7-week pinch, run 1; 5-week pinch, run 2), and 25 C (77 F) and 67% (7-week pinch, run 2). Spray treatment was applied uniformly at a rate of 0.2 liter·m^{-2} (equivalent to 2 qt·100 ft^{-2}) using a pressurized CO_2 sprayer with a flat spray nozzle (XR TeeJet 8003 VK, TeeJet Technologies, Wheaton, IL) calibrated at 138 kPa (20 psi).

Leaf number on the offset from propagation and total offset number per pot were recorded at pinching. At the time of the first fully opened inflorescence, the date, first open inflorescence stem length, inflorescence diameter at the widest point, flowering offset number, and non-flowering offset number were recorded. Flowers were considered fully open when all florets on an inflorescence were showing gold color.

An analysis of variance was performed on all responses using PROC GLIMMIX in SAS version 9.3 (SAS Institute, Cary, NC). The experimental design was a split-split-plot with weeks after potting as the main plot, pinching as the sub-plot, and daminozide application as the sub-sub-plot factor. Either initial leaf number or initial offset numbers were used as covariates in the models using methods in Milliken and Johnson (2002). Experiment replication (run) was treated as a random variable in the model. Counts of flowering, non-flowering, and total offsets were analyzed using the Poisson probability distribution. Where residual plots and a significant COVTEST statement using the HOMOGENEITY option indicated heterogeneous variance, a RANDOM statement with the GROUP option was used to correct heterogeneity. Linear and quadratic trends over pinching dates were tested using orthogonal polynomials in CONTRAST statements. Differences in pinching and daminozide treatments were based on the main effects F-tests. All significance were at $\alpha = 0.05$.

Experiment 2, 2011. Methodology similar to the first experiment was used unless otherwise noted. Forty rooted offsets of 'Coronation Gold' yarrow were potted, 20 on February 25, 2011, for a first run of the experiment, and a second group of 20 offsets from the same propagation on March 11, 2011, for a second run. Offsets of all plants were uniformly pinched 4 weeks after potting. Four plants from each run were moved under NIL 0, 1, 2, 3, or 4 weeks after pinching and provided NIL until the end of the experiment. Treatments were arranged in a completely randomized design. Experiment run was treated as a random variable in the model. Linear and quadratic trends over pinch dates were tested using orthogonal polynomials in CONTRAST statements. All significances were at $\alpha = 0.05$.

Results and Discussion

Experiment 1, 2011. The pinching main effect was significant for first open inflorescence diameter, first open inflorescence stem length, flowering offset number, and total offset number, but not for days to first open inflorescence or non-flowering offset number (Table 1). At the time of the first fully opened inflorescence, pinching decreased inflorescence stem length and inflorescence diameter by 6.4 and 8.9%, respectively, but increased the number of flowering offsets and total offsets number by 33.3 and 9.1%, respectively, when compared to non-pinched plants, without affecting days to first open inflorescence or non-flowering offset number. The decreases in inflorescence stem length and inflorescence diameter were considered too small to affect marketability, while the increase in total offset numbers in response to pinching was only one offset and was not considered of horticultural significance. These results agree with reports that pinching increased the number of lateral shoots and decreased plant height in *Rhododendron* 'Molly Ann', 'Paprika Spiced', and 'Travis' (Lohr and Sudkamp 1989), *Euphorbia pulcherrima* Willd. ex Klotzsch (poinsettia) (Berghage et al. 1989, Karunananda and Peiris 2010), *Delphinium* ×*belladonna* 'Völkerfrieden' (Garner et al. 1997), and *Lavandula angustifolia* Mill. (lavender) (Židovec 2002). The lack of effect of pinching on days to first open inflorescence may have been due to how early in the production cycle plants were pinched, although these results do differ from a previously reported delay in flowering of poinsettia following pinching (Abdullah and Seng 2003).

Main effects for the number of weeks after potting that pinching was applied were significant for all responses except first open inflorescence diameter (Table 1). Increasing the number of weeks after potting that pinching was applied resulted in a quadratic change in the number of days to first open inflorescence with the highest at 3 and 5 weeks and the lowest at 7 weeks, a difference of 10 days; a quadratic change in flower stem length with the longest at 5 weeks and the shortest at 3 weeks, a difference of 8.4 cm; a quadratic change in flowering offset number with the highest at 5 and 7 weeks and the lowest at 3 weeks; and linear increases in the number of non-flowering offsets and in the number of total offsets. However, the range in flowering, non-flowering and total offsets were only one, two, and one, respectively, and were not considered of horticultural significance.

Pinching at 3 weeks resulted in the shortest flower stem lengths, but the lowest number of flowering, non-flowering, and total offsets and an intermediate days to flower (Table 1). Pinching at 5 weeks resulted in the highest number of flowering and total offsets, and an intermediate number of non-flowering offsets, but the shortest flower stems and a longer time to flower than pinching at 7 weeks. Pinching at

Table 1. The effects of pinching the offset from propagation at different times after potting and daminozide application on offset production and flowering of *Achillea* × 'Coronation Gold'.[z]

Days to first open inflorescence[y]				First open inflorescence diameter (cm)[x]			
Daminozide[w]		Weeks after potting		Pinch		Daminozide	
No	73b[v]	3	79	No	5.9a	No	5.5a
Yes	78a	5	79	Yes	5.1b	Yes	5.3b
		7	69				
Significance[u]			Q***				

First open inflorescence stem length (cm)[t]					
Pinch		Daminozide		Weeks after potting	
No	56.3a	No	56.7a	3	49.7
Yes	52.7b	Yes	52.2b	5	58.1
				7	55.6
Significance					Q***

Flowering offset number at first open inflorescence					
Pinch		Daminozide		Weeks after potting	
No	3b	No	5a	3	3
Yes	4a	Yes	3b	5	4
				7	4
Significance					Q*

Non-flowering offset number at first open inflorescence[s]				Total offset number at first open inflorescence[r]			
Daminozide		Weeks after potting		Pinch		Weeks after potting	
No	7b	3	7	No	11b	3	11
Yes	9a	5	8	Yes	12a	5	12
		7	9			7	13
Significance			L**				L***

[z]The experimental design was a split-split-plot with weeks after potting in the main plot, pinch in the sub-plot, and daminozide in the sub-sub-plot.

[y]Only the daminozide and weeks after potting main effects were significant at α = 0.05. Open inflorescence was when all florets on an inflorescence were showing color.

[x]Only the pinch and daminozide main effects were significant at α = 0.05.

[w]Daminozide (B-Nine) was applied once (Yes) as a foliar spray at 5,000 ppm 5 weeks after pinching or not applied (No).

[v]Least squares means comparisons using the main effects F-test at α = 0.05 for daminozide and pinch.

[u]Significant (Sign.) linear (L) or quadratic (Q) trends using orthogonal polynomials at α = 0.05 (*), 0.01 (**), or 0.001 (***).

[t]Only the pinch, daminozide, and weeks after potting main effects were significant at α = 0.05.

[s]Only the daminozide and weeks after potting main effects were significant at α = 0.05.

[r]Only the pinch and weeks after potting main effects were significant at α = 0.05.

7 weeks resulted in the highest number of flowering, non-flowering, and total offsets, the lowest days to flower, and an intermediate flower stem length. Pinching at 7 weeks after potting resulted in the most improvements in plant qualities related to marketability with the fewest drawbacks.

Daminozide main effects were significant for days to first open inflorescence, first open inflorescence diameter and stem length, flowering offset number, and non-flowering offset number (Table 1). Daminozide-treated plants had decreased flower stem length and flowering offset number of 7.9 and 40%, respectively, but increased days to first open inflorescence and number of non-flowering offsets by 6 days and 28.6%, respectively, when compared to non-treated plants. First open inflorescence diameter and total offset number were not affected by daminozide application. Daminozide application may have delayed or prevented some shoots from flowering because its application decreased flowering shoot number while increasing non-flowering shoot number. In agreement with Kessler and Keever (2008), daminozide applied at 5,100 ppm to 'Coronation Gold' yarrow reduced stem length by 17.4% without affecting inflorescence diameter, but increased days to first open inflorescence by 2 days when compared to non-treated plants. Also, increasing daminozide rates from 2,550 ppm to 7,650 ppm resulted in a linear decrease in stem length and a linear increase in the number of days to first open flower, but offset production was not reported. Burnett et al. (2000) did not find a difference in stem length of 'Coronation Gold' yarrow in 1998 using daminozide at 5,000 ppm, but stem length reductions were found in 1999. Unlike in this study, Burnett et al. (2000) found no difference in number of days to first open inflorescence in either year. Karunananda and Peiris (2010) found

a small reduction in stem length of *Euphorbia pulcherrima* using daminozide at 5,000 ppm, but when plants received daminozide after pinching, stem length decreases were larger. However, daminozide was less effective than pinching in stem length reduction. Likewise, there was no difference in shoot production by using daminozide. Židovec (2002) found when *Lavandula angustifolia* received daminozide at 2,000 ppm, plant height was reduced, but much less than when pinched. After plants were pinched, there was little effect of daminozide in reducing plant height. Unlike this study, when plants received daminozide at 1,000 or 2,000 ppm, the number of lateral shoots decreased.

Experiment 2, 2011. Increasing the number of weeks between pinching and beginning NIL resulted in a quadratic change in the number of days to first open inflorescence with the highest at 2 weeks and the lowest at 4 weeks (Table 2); a quadratic change in first open inflorescence stem length with the longest at 4 weeks and the shortest at 0 week; a quadratic change in flowering offset number with the highest at 3 and 4 weeks and the lowest at 0 week; and a quadratic change in total offset number with the highest at 2 weeks and the lowest at 0 week. Days to first open inflorescence were highest when NIL was started 2 weeks after pinching and decreased with later starts of NIL, possibly allowing plants to regenerate new growing shoots that were more advanced with the later NIL start dates. Pinching was reported to delay floral initiation, and the delay was greater when pinching was later in the production cycle (Abdullah and Seng 2003), which would correspond to shorter periods between pinching and the start of NIL in our study. However, this rationale does not support the earlier flowering of plants exposed to NIL immediately after pinching compared to those with 1, 2, and 3 weeks between pinching and the start of NIL. Inflorescence stems were the shortest when NIL was started immediately after pinching, which was the shortest bulking duration, but changed little with later start dates or longer bulking periods. Bulking is often practiced to increase plant size to a size more suitable for forcing (Pilon 2013a) or to build the root system (Chong et al. 2000), and the shorter flowering stems may have resulted from a smaller root or shoot system. Similar to first open inflorescence stem length, flowering and total offset numbers were the lowest when NIL was begun just after pinching, the shortest bulking period, but changed little with longer intervals between pinching and the start of NIL. However, the percentage of total offsets that flowered increased with increasing intervals between pinching and the start of NIL; 25, 50, 42, 55, and 60% with 0, 1, 2, 3, and 4 weeks, respectively. Increasing the bulking duration has recently been shown to increase the number of shoots of *Rudbeckia fulgida* 'Goldsturm' and *Coreopsis verticillata* 'Moonbeam' of sufficient developmental size to respond to inductive photoperiods, resulting in more flowers and/or flowering shoots (Keever et al. 2014). Starting NIL at 4 weeks after pinching resulted in the fewest days to flower, the highest flowering offset number and percentage, and a flower stem length about equal to all other NIL treatments.

In this study, a foliar spray of daminozide was effective on 'Coronation Gold' yarrow in improving plant attributes. Daminozide application decreased flower stem length without affecting inflorescence diameter or total offset number, but increased days to flower, all responses that should enhance marketability. However, daminozide may have delayed or prevented some shoots from flowering because its application decreased flowering offset number while increasing non-flowering offset number. Pinching decreased flower stem length nearly as much as daminozide application, but decreased inflorescence diameter. Although pinching increased the number of flowering, non-flowering, and total offsets, it may not be economical. Also, it was impractical to pinch the short offsets from propagation because hand pinching was difficult, unreliable and labor intensive.

Table 2. The effects of beginning night-interrupted lighting (NIL) at different times after pinching the offset from propagation on offset production and flowering of *Achillea* × 'Coronation Gold'.

Weeks after pinching					Significance[z]
0	**1**	**2**	**3**	**4**	
Days to first open inflorescence after beginning NIL[y]					
68[x]	77	80	70	65	Q**
First open inflorescence stem length (cm)					
49.1	59.9	60.8	58.1	61.0	Q**
Flowering offset number					
2	5	5	6	6	Q**
Total offset number					
8	10	12	11	10	Q*

[z]Significant quadratic (Q) trends using orthogonal polynomials at $\alpha = 0.05$ (*) or 0.01 (**).

[y]Open inflorescence was when all florets on an inflorescence were showing color; NIL: night-interrupted lighting.

[x]Least squares means.

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