Reprinted from Vol. 103(5), September 1978
Journal of the American Society for Horticultural Science
Mount Vernon, Virginia 22121, USA

J. Amer. Soc. Hort. Sci. 103(5):687–689. 1978.

Influence of Photoperiod and Light Quality on Stolon Formation and Flowering of *Chlorophytum comosum* (Thunb.) Jacques[1]

R. D. Heins and H. F. Wilkins[2]
Department of Horticultural Science, University of Minnesota, St. Paul, MN 55108

Additional index words. fluorescent light, incandescent light, red light, far-red light, spider plant

Abstract. **Irradiating the all-green *Chlorophytum comosum* Thunb. with incandescent or red cellophane wrapped fluorescent lamps during the night increased the mean number of stolons formed per plant. A night interruption was more effective in stimulating stolon formation than irradiating the plants prior to sunrise or at sunset. There were no significant differences in stolon numbers formed between the two light sources within an irradiation treatment. Less and less time was required between the advent of subsequent stolons under all treatments during the 25 week experiment. Photoperiod treatments had no effect on time from visible stolons to anthesis. Plants in all treatments formed stolons and flowered.**

The spider plant, *Chlorophytum comosum* (Thunb.) Jacques, has frequently and incorrectly been identified as *C. elatum* R. Br. and *C. capense* (L.) Voss. in the floricultural industry and scientific literature (6, 7, 9). Both *C. elatum* and *C. capense* are incorrect as *C. elatum* is a synonym of *C. capense,* and *C. capense* is a separate species (1, 2, 3, 5). *C. capense* has firm glaucous leaves forming a rosette and a loose, much branched panicle (stolon) that rarely (3) or never (2) forms plantlets. *C. comosum* has soft, green, loosely arranged leaves and proliferous stolons (2, 3) which is characteristic of the 'spider plant'. Therefore, the name for the cultivated chlorophytum that forms plantlets is *C. comosum* (Thunb.) Jacques (with additional cultivar names for the variegated forms).

Hammer (7) reported that the time to form visible stolons by *C. comosum.* 'Vittatum', the variegated chlorophytum, was greatly reduced by photoperiods of 12 hr or less. Plants of *C. capense, (C. comosum)*[3], the all green chlorophytum, were not significantly affected by photoperiod.

Trippi (9) reported that the type of stolon formed by *C. elatum* (Ait.) R. Br., var. *variegatum (C. comosum)*[4] was controlled by photoperiod, but photoperiod had no effect on the time to form stolons. Stolons with plantlets but without flowers were produced under a 10 hr photoperiod while stolons with flowers developed in continuous light. His experiments were conducted under fluorescent light supplemented with incandescent lamps (13 klx). His experiments were started on Oct. 9 in Mendoza, Argentina (33°S latitude).

The time required to form the initial and subsequent stolons is important when growing a salable plant. Hammer reported the no. of stolons formed on 'Vittatum' plants over a 7 week period (6) but for all green chlorophytum *(C. comosum)* he only evaluated the time to visible stolon formation (7). Trippi (9) worked only with the variegated plant 'Vittatum'. Our purpose was to study the effects of both the photoperiod and light qualities treatments on stolon formation over a 25 week time period on the all green chlorophytum.

Materials and Methods

Terminal stolon plantlets were removed from a stock plant on Oct. 15, rooted under mist, potted Nov. 3 in 10 cm pots in a mixture of 2 peat: 1 perlite: 1 soil (by vol) and placed in a greenhouse at 18°C night/21°C day. Nutrients were applied when required as shown by soil tests. Treatments (Table 1) were started on Nov. 5.

The no. of stolons, date stolons became visible, and time span required for stolons to flower were recorded for 6 months (Nov. 5 – May 1). Data from the first 2 generations of stolons were discarded as they may have been affected by the previous environment.

Normal day lengths (ND) between Oct. 15 and Nov. 5 in St. Paul, Minnesota (45° parallel N) were decreasing from 11 hr, 1 min to 9 hr 59 min (10). Light sources were suspended 55 cm above the bench with either a 100 watt incandescent (I) bulb (303 μW cm^{-2}, 650-700 nm; 395 μW cm^{-2}, 700-750 nm) or a General Electric cool white fluorescent tube (20 W) wrapped with 2 layers of red cellophane (2.9 μW cm^{-2}, 650-700 nm; 0.6 μW cm^{-2}, 700-750 nm). The ND varied from 9 hr 59 min on Nov. 5 to 8 hr 47 min on Dec. 21 to 14 hr 15 min on May 1 (10). During the treatment period plants were separated by 6 mil black plastic. Short day plants were totally enclosed; light treatments compartments had open tops.

Table 1. Lighting treatments applied to the all-green *Chlorophytum comosum.* The time of irradiance was adjusted on the 15th and the last day of each month to compensate for changes in sunrise and sunset.

Treatment	Remarks
I Normal Day (ND)	Nov. 5 to May 1. Daylength varied from 9 hr 59 min to 8 hr 47 min to 14 hr 15 min.
II Short Day (SD)	8 hr light (0800-1600); 16 hr dark (1600-0800).
III Day Continuation (DC)	Lamps started 30 min prior to sunset and continued for 4 hr. Time adjusted every 15 days.
IV Night Interruption (NI)	Irradiated 2200 to 0200.
V Pre-dawn (PD)	Lamps started 3 hr 30 min prior to sunrise and continued for 30 min after sunrise (total 4 hr). Time adjusted every 15 days.
VI Day Continuation and Pre-dawn (DC + PD)	Combination of III and V above (sum of 8 hr).

[1]Received for publication November 25, 1977. Scientific Journal Series Paper No. 10,119. Minnesota Agricultural Experiment Station.
The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper must therefore be hereby marked *advertisement* solely to indicate this fact.

[2]Graduate Student and Professor, respectively.

[3]This green plant used in his work was undoubtedly *C. comosum,* the same plant used in this paper.

[4]In Trippi's (5) article the plant is called *C. elatum* (Ait.) R. Br., cv. *variegatum.* However, from the pictures in the article, it is undoubtedly *C. comosum* 'Vittatum'.

Table 2. The mean no. of stolons formed on *C. comosum* under light sources and irradiation periods.

Illumination period[z]	Mean no. of stolons: Source of light[y] Fluorescent wrapped with red cellophane	Incandescent	Period mean
DC	5.8	6.9	6.3
NI	8.1	8.1	8.1
PD	5.8	6.8	6.3
DC + PD	7.1	7.5	7.6
Source mean	6.7	7.5	

Controls.
a. Normal day = 5.5 stolons
b. Short day[x] = 6.1 stolons
SE = 0.72, 10 plants per treatment

[z]4 hr continuous irradiation starting: a) DC = 30 min prior to sunset; b) NI = 2200 hr; c) PD = 3 hr 30 min prior to sunrise.

[y]20W GE cool white florescent lamp wrapped with 2 layers red cellophane 2.9 μW cm^{-2} 650–700 nm; 0.6 μW cm^{-2}, 700–750 nm, 100W incandescent bulb, 303 μW cm^{-2}, 650–700 nm; 395 μW cm^{-2}, 700–750 nm.

[x]16 hr dark 1600–0800.

There were 5 plants per treatment which were replicated twice in a randomized complete block design. The data means were compared by using linear contrasts. There were 100 plants in the experiment.

Results and Discussion

The mean no. of stolons formed by plants grown under all the light treatments was significantly (5%) greater than the ND or SD treatments (Table 2). The night interruption (NI) treatments formed significantly (1%) more stolons compared to the day continuation (DC) or pre-dawn (PD) light treatments but not the treatment consisting of both DC and PD. These data indicated that long day (LD) treatments stimulated greater stolon formation compared to SD. There were no differences in the response to the 2 light sources.

There was a tendency towards faster stolon formation in plants grown under LD compared to SD photoperiods as the plants formed succeding generations of stolons (Table 3). Irrespective of photoperiod treatment (SD or LD), stolons formed at a more rapid rate as the experiment progressed. The faster stolon formation may be attributed to greater solar radiation as the sun's azimuth increased, higher greenhouse temp, or larger plant size.

Photoperiod treatments did not affect the no. of days from visible stolon formation to date of anthesis (Table 4). However, time to anthesis from visible stolon appears to be related to temp as plants grown in the warmer statistical block (section of greenhouse) flowered quicker than those in the cooler section.

Stolon formation in the all-green chlorophytum appears to respond differently to photoperiod when compared to the variegated 'Vittatum'. While plants of 'Vittatum' form their initial stolon faster under SD (3), plants of the all-green cultivar form consecutive generations of stolons faster under a LD photoperiod. The no. of stolons forming on the 'Vittatum' over an extended time span such as in this experiment has never been reported. Trippi (9) stated that the variegated plant produced vegetative stalks after 160 LD's, although he concluded, *"Short days determine only asexual reproduction and long days, asexual propagation."* The no. of days from visible stolon to anthesis is not affected by photoperiod in either the variegated (8) or the all-green chlorophytum.

Since the cultivated all green and variegated chlorophytum are classified as same species, it is interesting to speculate as to why there may be a difference in photoperiodic response between them. In the natural environment, we would expect the all-green form to have a competitive advantage over the variegated forms due to its increased phytosynthetic capacity. Sexual progeny of the variegated forms are either totally green (in *C. comossum variegatum*) or totally white (in *C. comosum 'Vittatum'*) except for very rare cases (4), thus precluding efficient sexual reproduction of variegated forms in nature. Therefore, the variegated forms probably exist because of human selection and culture.

Assuming the variegated forms were protected selections, several explanations for the different photoperiodic responses can be suggested. The all-green plant may have been selected from a different latitudinal ecotype than the variegated.

Table 3. The mean interval (days) between the succeeding generations of stolons on *C. comosum* plants grown under irradiation spans and light qualities.

Treatments: Light quality[z]	Irridiation span[y]	Interval between succeeding generation of stolons (days): Succeeding generations of stolons formed 3	4	5	6	7	8	Mean
Red	DC	26.8	16.0	10.3	10.1	3.7	5.5	16.3
	NI	22.0	14.2	23.2	3.7	7.7	4.6	13.6
	PD	20.6	12.3	19.9	7.4	7.4	7.0	13.6
	DCPD	21.1	22.9	10.9	11.6	5.8	5.8	15.0
Incandescent	DC	22.3	16.0	10.3	6.6	6.8	4.5	12.0
	NI	23.6	23.6	12.6	6.3	6.8	6.0	14.4
	PD	24.3	18.1	6.3	8.0	7.2	3.3	12.1
	DCPD	19.3	25.9	18.4	5.6	9.1	6.2	15.0
	ND[x]	29.1	17.8	6.2	11.6	7.5	10.5	16.9
	SD[x]	29.5	18.8	13.0	11.1	11.6	6.5	17.0
Standard error		4.8	3.1	w	w	w	w	w

[z]Red: 20 W GE cool white fluorescent lamp wrapped with 2 layers of red cellophane 2.9 μW cm^{-2}, 650–700 nm; 0.6 μW cm^{-2}, 700–750 nm; incandescent: 100W incandescent bulb, 303 μW cm^{-2}, 650-700 nm; 395 μW cm^{-2}, 700–750 nm.

[y]4 hr continuous irradiation starting: a) DC = 30 min prior to sunset; b) NI = 2200 hr; c) PD = 3 hr 30 min prior to sunrise.

[x]ND = normal day; SD = short day, 16 hr 1600-0800.

[w]SE not presented due to unequal sample size.

Table 4. The mean interval (days) between the date stolons were first observed and the date flowers on these stolons reached anthesis for the succeeding generations of stolons formed on *C. comosum* plants when grown under irradiation spans and light qualities.

Treatments		Interval between stolon formation and anthesis (days)							
		Succeeding generations of stolons formed							
Light quality[z]	Irradiation span[y]	2	3	4	5	6	7	8	Mean
Red	DC	28.1	30.5	27.5	27.8	26.7	28.6	30.3	26.3
	NI	25.1	26.4	28.6	26.3	38.4	25.4	29.6	27.5
	PD	25.0	29.6	27.5	27.5	27.2	32.6	24.5	28.1
	DCPD	24.7	27.8	26.7	26.8	27.4	26.0	25.6	26.6
Incandescent	DC	27.4	27.0	27.1	27.6	25.4	28.8	25.8	26.6
	NI	27.2	28.4	27.1	26.9	27.6	26.0	25.3	26.6
	PD	26.0	26.4	27.5	26.2	27.6	26.6	27.0	26.7
	DCPD	24.3	24.0	29.3	25.9	26.9	25.9	25.5	26.2
	ND[x]	29.4	25.0	26.1	27.0	25.6	27.0	27.0	26.7
	SD[x]	25.3	27.0	26.3	24.4	29.0	29.0	27.5	27.1
	Mean	26.2	27.2	27.4	27.0	27.3	27.1	26.8	
	Standard error	1.6	1.2	0.6	w	w	w	w	

[z]Red: 20 W GE cool white fluorescent lamp wrapped with 2 layers of red cellophane 2.9 μW cm^{-2}, 650–700 nm; 0.6 μW cm^{-2}, 700–750 nm; incandescent: 100W incandescent bulb, 303 μW cm^{-2}, 650–700 nm; 395 μW cm^{-2}, 700–750 nm.

[y]4 hr continuous irradiation starting: a) DC = 30 min prior to sunset; b) NI = 2200 hr; c) PD = 3 hr 30 min prior to sunrise.

[x]ND = normal day; SD = short day, 16 hr 1600–0800.

[w]SE not presented due to unequal sample size.

Photoperiodic differences would then be a function of original source materials. Or, because variegated forms cannot easily reproduce true to form sexually (4) while green can, chance seedlings of all green chlorophytum occurring during cultivation may have been unintentionally selected for LD response. Obligate asexual propagation of variegated forms would prevent sexual recombination and slow change due to selection.

Another possibility is that variegated chlorophytum plants, which make stolons during the SD of winter, would be considered superior by propagators so that any somatic mutations conferring this trait would be selected. There could be some association between variegation or no variegation and a photoperiodic response. No evidence for this exists at the present time.

The white-centered *'Vittatum'* produces all white progeny but an occasional green seedling occurs (4). Assuming this to be true, one should be able to select a SD responsive all-green chlorophytum plant. This also suggests an interesting inheritance study using the SD-responsive all-green plant and the faculative LD plant we observed.

Literature Cited

1. Dress, William. 1961. *Chlorophytum* (Lilaceae) in cultivation. *Baileya* 9:29-50.
2. _____. 1961. *Chlorophytum capense* and *C. Comosum*. *Baileva* 9:105-108.
3. Bailey, L. H. 1976. Hortus third, a concise dictionary of plants cultivated in the United States and Canada. MacMillan, New York.
4. Collins E. J. 1922. Variegation and its inheritance in *Chlorophytum elatum* and *Chlorophytum comosum*. *J. Gen.* 12:1-17.
5. Graf, A. B. 1976. Exotica 3, 8th ed. Roehrs Co., E. Rutherford, N.J.
6. Hammer, P. Allen. 1975. Asexual reproduction of Spider Plant, *Chlorophytum elatum*, by daylength control. *Focus on Floriculture* 3(2):2-5.
7. _____. 1976. Stolon formation in *Chlorophytum*. *HortScience* 11:570-572.
8. _____. 1977. Flower formation in *Chlorophytum*. *Acta Hort.* 68:75-77.
9. Trippi, Victorio S. 1965. Studies on ontogeny and senility in plants. X. Photoperiodic effect on propagation of *Chlorophytum elatum* (Ait.) R. Br. var. *variegatum*. *Phyton* 22:111-112.
10. U. S. Naval Observatory. 1945. Tables of sunrise, Sunset and twilight, (supplement to the American Ephemeris, 1946), U. S. Government Printing Office, Washington, D.C.