Section 14

Fuchsia

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Introduction

Commercial fuchsia cultivars (*Fuchsia* x *hybrida* L.; Onagraceae) originate from crosses between *F. fulgens* DC. and *F. magellania* Lam. *F. fulgens* is a 4- to 5.25-foot-tall shrub from Mexico (Bailey, 1976). *F. magellania* is a 12-foot shrub from southern Chile and Argentina. In addition to *F. hybrida*, there are several other *Fuchsia* spp. that are now commercially cultivated. *F. hybrida* (fuchsia) are grown for their pendulous flowers that vary in form and color. Fuchsia flowers have tubular or campanulate forms with four sepals and petals. Fuchsia exhibit both upright and prostrate growth habits with leaves that are simple and arranged in an opposite, alternate, or whorled orientation. Common flower colors include combinations of white, pink, red, and purple (Figure 14-1).

Figure 14-1. Pendulous flowers of *Fuchsia* x *hybrida* are commonly combinations of colors.

Propagation

Fuchsia are generally propagated from tip cuttings. The base of cuttings can be dusted with a 1% IBA powder or talc to encourage rooting of difficult-to-root cultivars. In general, however, IBA is not needed for successful rooting. It is critical to propagate fuchsia using "bottom-heat" (74 to 76°F) to encourage rapid root development. In addition, cuttings should be rooted under short-day conditions to encourage vegetative rather than reproductive development.

Flower Induction/Initiation

Fuchsia flower induction requirements, primarily photoperiodic, vary with cultivar and/or species. *F. hybrida* are primarily obligate long-day plants – meaning that long days are required for flower induction to occur (Roberts & Struckmeyer, 1938; Funke, 1948; Sachs & Bretz, 1962). However, there are some facultative long-day and day-neutral cultivars (Sachs & Bretz, 1960; 1962) – in other words, flowering will occur under any photoperiod, but it will occur faster under long-day conditions. Day-neutral fuchsia cultivars are often result from crosses with *F. tripetala* (day-neutral parent).

Most fuchsia are capable of initiating flowers after two true leaf pairs have unfolded (Haney, 1961). The number of long days required to initiate a flower varies from 5 to 25 days across cultivars (Haney, 1961). In general, the more long days that plants are exposed to, the greater the number of axillary (side) buds that become reproductive (Sachs & Bretz, 1962). Subsequent flower development is daylength independent. In other words, once flower initiation occurs, the rate that flowers develop is the same under long or short days (Sachs & Bretz, 1960; 1962). Most commercial fuchsia retain a vegetative apical meristem (tip) while developing reproductive lateral or side growth.

Temperature sensitivity of *Fuchsia* flowering/growth also varies with species/cultivar. Vegetative growth on *F. hybrida* 'Lord Byron' has an optimum temperature of 68 to 79°F (Sachs & Bretz, 1962). Flower initiation of *F. hybrida* occurs at a similar rate and extent with temperatures ranging from 50 to 79°F. Studies of diurnal temperature effects on fuschia flowering determined that a 70°F day (DT) and 61°F night temperature (NT) was optimal (Larson & Love, 1981). In contrast to flower induction/initiation, flower development was most rapid on 'Lord Byron' when temperatures ranged from 73 to 79°F. In comparison to *F. hybrida*, *F. tripetala* is considered more heat-tolerant and may have higher optimal temperatures.

Time to flower. Days to anthesis was a function of the average daily temperature (ADT) plants were grown under (Figure 14-2). Days to anthesis decreased from 110 to 50 days as ADT increased from 57 to 68°F. Further increasing temperature from 68 to 76°F did not significantly decrease the time to

flower. 'Dollar Princess' plants did not flower when ADT was below 57°F. Similarly, 'Dollar Princess' plants grown at 86°F day/50°F night temperature, 87°F day/86°F night temperature, and some plants grown at 76°F day/76°F night temperature did not flower. In other words, ADT above 76°F inhibited flower initiation or resulted in flower bud abortion.

Flower number per node and width. Both flower number per node and flower width were dependent on the ADT fuchsia were grown under. Flower number per node had an optimal ADT at 68°F (Figure 14-3). For example, flower number per node increased from 1.3 to 6.3 flowers as ADT increased from 50 to 68°F, then decreased from 6.3 to 2.9 as ADT was further increased to 76°F (Figure 14-3). In contrast to the effect of ADT on the number of flowers per node, flower width decreased linearly as ADT increased from 52 to 74°F (Figure 14-4, page 68).

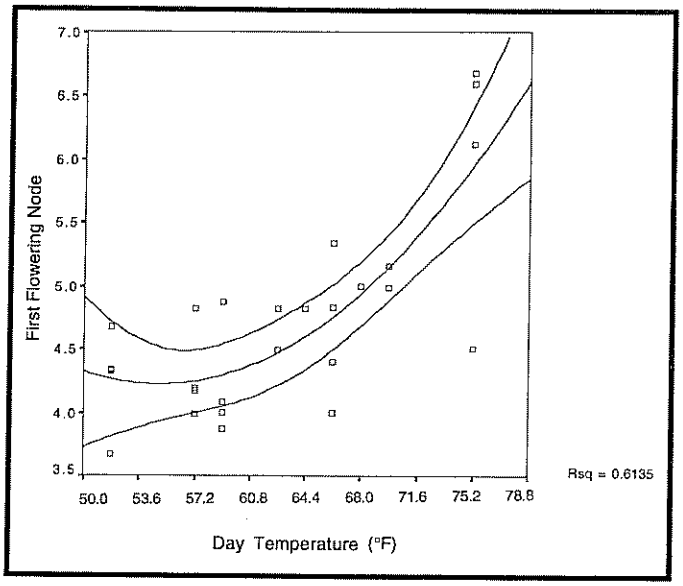

Figure 14-2. Effect of day temperature on the number of *Fuchsia* x *hybrida* L. 'Dollar Princess' nodes formed from initiation of inductive photoperiod treatments to the first flowering node under different day/night temperature regimes.

Nutrition

Fuchsia are relatively high-feeding bedding plant crops. The higher feed requirement is due in part to the desire to produce a larger finished plant than many other bedding plant crops. Recommended media levels for the two most common extraction methods are listed in Table 14-1.

The most common nutritional problems in fuchsia production include:

- soluble salts burn/browning along lower leaf margins, small leaves, poor rooting solution – leach media with clear water.

- ammonium toxicity/yellowing along lower leaf margins, poor growth solution – stop using fertilizer that contains either ammonium/urea and leach with clear water.

- underfeeding plants early in development/small leaves, yellow foliage, poor branching solution – feed initially with a balanced fertilizer containing 400 to 600 ppm nitrogen to elevate nutrient levels to recommended range early in development.

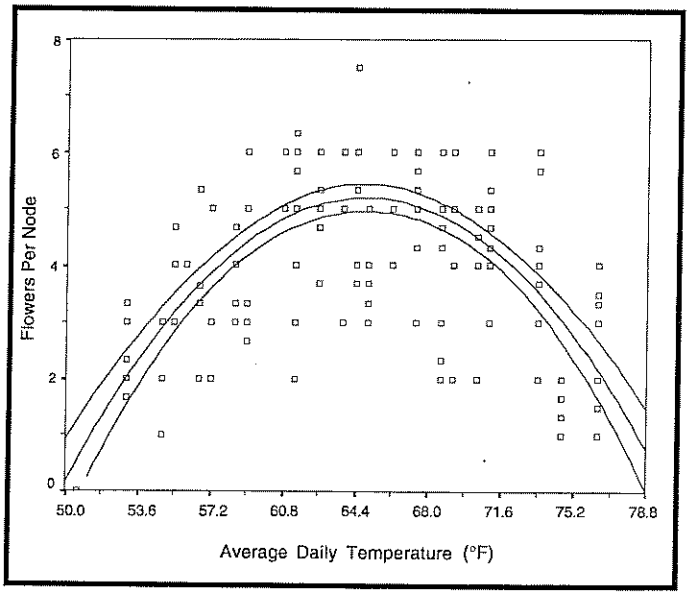

Figure 14-3. Effect of average daily temperature on the number of flowers in the first flowering node of *Fuchsia* x *hybrida* L. 'Dollar Princess.'

Table 14-1. Recommended soilless media nutrient levels for fuchsia baskets as determined by Spurway and saturated paste extraction procedures.

Method	pH	SS	NO_3	P	K	Ca	Mg	Fe	Mn	Zn	B
Spurway	6.2	125	180	7	60	150	40	0.25	0.25	0.25	0.15
Sat. Paste	6.2	1.0	100	7	100	150	40	0.40	0.40	0.40	0.15

• magnesium deficiency/interveinal chlorosis of lower leaves solution – drench with a solution containing 8 oz. magnesium sulfate (Epsom salts)/100 gallons of water.

In general, a low ammonium-based fertilizer (less than 20 percent ammonium nitrate + urea) should be used to inhibit excessive elongation and leaf expansion when growing fuchsia. This is especially important when growing crops in Northern climates. Early in fuchsia production, cool temperatures and low light levels will encourage ammonium buildup in the media that will result in "ammonium toxicity." Higher nitrate-based fertilizers that have worked well for fuchsia production include Peter's 15-0-15 Dark Weather Feed, 15-16-17 Peat-Lite Special, and 15-2-20 Plus Ca and Mg Pansy, Salvia, and Vinca Formula.

Higher applications of fertilizer are recommended early in development. Apply a balanced fertilizer containing micronutrients at 400 to 600 ppm N for the first and second fertilizer applications when a constant liquid feed program is employed. Remember, the goal is to increase media nutrient content to optimal levels as soon as possible. Decreased fertilizer application will be necessary once optimal media nutrient levels are reached.

Growth Regulators

In general, applying growth regulators to fuchsia for height control is not necessary. If growth retardants are necessary, A-Rest, Bonzi and Sumagic are effective and registered for use on fuchsia stem elongation control. Growth retardants can be applied as a spray or drench. In general, the best material applied as a spray for control of stem elongation in fuchsia is A-Rest. Spray A-Rest at a rate of 50 ppm.

In contrast to A-Rest, the best materials applied as a drench to control stem elongation in fuchsia are Bonzi or Sumagic. Apply a solution containing 5 to 10 ppm Bonzi or a Sumagic solution containing 2 to 5 ppm to control fuchsia stem elongation. Plants should be watered thoroughly the day prior to a drench application. Apply 4 ounces of either solution to a 6-inch pot. Apply 15 ounces of solution to a 10-inch pot.

Florel is a growth regulator that essentially applies ethylene to a crop. Ethylene will inhibit flowering, reduce stem elongation, and increase branching in many crops, including fuchsia. Florel is used as a "chemical pinching agent" in fuchsia production. Apply Florel when you would normally pinch a fuchsia crop. Florel application is now common in

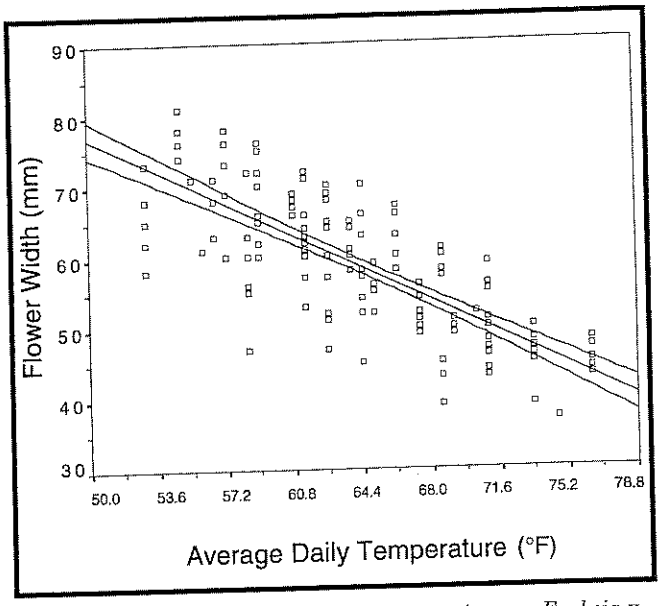

Figure 14-4. Effect of average daily temperature on *Fuchsia* x *hybrida* L. 'Dollar Princess' first flower width.

fuchsia stock plant production and early in fuchsia production as a replacement for the first and/or second pinch. Spray foliage until wet with a solution containing 500 ppm Florel for effective branching induction without pinching.

A Florel solution releases ethylene as the pH of the solution increases. An increase in solution pH occurs naturally when a solution is exposed to air on the leaf surface. Mixing Florel with water with high alkalinity can result in the ethylene being released in the spray tank rather than on the plant surface.

Scheduling

Successful fuchsia scheduling is based on 1) allowing enough time prior to flower induction to develop a strong/adequate size plant, 2) understanding that long-day conditions induce flowering in most cultivars, and 3) growing fuchsia after induction at temperatures that maximize flower number and result in flowering at the desired time. Often fuchsia plants initiate flowers before plants have achieved a desired size because growers have not allowed enough time to develop an adequately sized plant/have grown a crop at cool temperatures prior to induction.

Fuchsia stock plants should be grown in an environment that encourages only vegetative growth. Fuchsia are maintained in a vegetative state when grown under short-day conditions (8-hour daylength). Reproductive plants can be made vegetative by pinching off all actively growing meristems (shoot tips) and immediately placing plants under short-day conditions.

Most fuchsia are induced to flower in North America using natural photoperiod (daylength). Most fuchsia will induce flowers naturally when the daylength exceeds approximately 12 hours, i.e. after March 21. In contrast to using natural photoperiod, fuchsia flowering can be induced early by exposing plants to night-interruption lighting or extending the day to a minimum of 13 hours using supplemental lighting. Night-interruption lighting should be applied from 10 p.m. to 2 a.m. using incandescent lamps (mum lighting). Light intensity should be 10 footcandles at the canopy level. If day extension lighting is preferred, use high pressure sodium lamps, as incandescent lamp lighting at the end of the day will stimulate excessive stem elongation. Schedules using natural daylight for induction in different parts of the country are shown in Table 14-2. Mum lighting (10 footcandles, 2 umol m^{-2} s^{-1} from 2200 to 0200 hour) will induce flowering when applied for three consecutive weeks for most cultivars. Flowering will usually occur six weeks after long-day conditions are initiated when fuchsia are grown under normal greenhouse conditions (approximately 68°F day/65°F night temperature).

Fuchsia can be maintained in a vegetative state when grown under short-day (8-hour daylength) conditions. Reproductive plants can be made vegetative by pinching off all actively growing meristems (shoot tips) and immediately placing plants under short-day conditions.

As mentioned before, early flowering can be induced by exposing plants to night interruption lighting. Mum lighting (10 footcandles, 2 umol m^{-2} s^{-1} from 2200 to 0200 hour) will induce flowering when applied for three consecutive weeks for most cultivars. Flowering will usually occur six weeks after long-day conditions are initiated when fuchsia are grown under normal greenhouse conditions (68°F day/65°F night temperature).

Pests and Diseases

Diseases. Fuchsia are susceptible to the following common greenhouse diseases: *Pythium* root rot, *Rhizoctonia* crown and root rot, damping off, *Thielaviopsis* black root rot, and *Phytophthora*. Fungal root rots are typically encouraged by moist conditions and warm temperatures (*Rhizoctonia*, *Thielaviopsis*) or cool temperatures (*Pythium*). In addition, root rot can be a problem immediately following soluble salts injury. Inhibit water molds by not overwatering plants, having good sanitation, and/or applying chemical fungicides.

Botrytis grey mold is a common foliar disease on fuchsia. *Botrytis* on fuchsia will destroy foliage and flowers. In addition, fuchsia with *Botrytis* can spread the disease by dropping foliage and/or flowers on crops grown below baskets. *Botrytis* will proliferate when there is a combination of cool temperatures and moist conditions. Cultural control of *Botrytis* includes removing any plant debris from the greenhouse (source of spores) and making sure that foliage does not stay wet for extended periods of time.

Insects. Spider mites, whiteflies, and aphids are common pests in fuchsia production. It is essential that pest problems are taken care of prior to hanging fuchsia, because baskets can be a source for infesting other crops in the greenhouse and spraying of baskets for these pests is difficult once plants are hung. One of the most effective ways to control many of these pests is to apply a systemic pesticide such as Marathon.

Postproduction Considerations. Fuchsia baskets require regular watering. Regular watering can be uncommon with many consumers. Therefore, use media that have good water-holding capacity; i.e. media that contain rockwool can reduce watering frequency. Use nitrate-based fertilizer throughout production to encourage "harder" growth to increase the drought tolerance of a crop. Lastly, many consumers do not fertilize fuchsia baskets. Frequent watering can result in leaching of nutrients and subsequent nutrient deficiency. Therefore, inform the consumer as much as possible about fertilization of fuchsia baskets using a liquid feed,

Table 14-2. Specifics for production of 10-inch fuchsia x hybrida baskets in different areas of the country.

Business	State	Planting Date	Plants/ Pot	Pinch Date	Finish Date
Molbak's	Washington	11/4	4	12/5, 2/15	21 weeks
Weidner's	California	3/1	1	4/1, 5/5, 6/10	20 weeks
Possum Run	Ohio	10/1 – 1/1	4 to 5		≥ 14 weeks
Konjoian's	Massachusetts	2/15	4 to 5	3/1	15 weeks
Wagner's	Minnesota	1/15	5	2/1	14 weeks

and apply one to two tablespoons of resin-coated slow-release fertilizer (18-0-18) per 10-inch basket.

Cost/Profit. Can you make money growing fuchsia? Table 14-3, taken from *OFA's Tips On Growing And Marketing Hanging Baskets* (Robin Brumfield, 1994), provides an example for comparison as you evaluate the potential for this crop.

Practical Implications

Fuchsia stock plant yield and cutting quality are related to both photoperiod and temperature. Grow stock plants with an eight-hour photoperiod. Total fuchsia plant/flower dry weight (cutting quality) is greatest when fuchsia are grown at a 68°F day/54°F night temperature regime (ADT=59°F). Increasing ADT higher than this will increase cutting yield. Leaf unfolding rate increases as ADT increases to 76°F; therefore, do not allow plant temperatures to exceed 76°F or cutting yield will be decreased.

Table 14-3. Costs of producing fuchsia in 10-inch hanging baskets grown on 17-inch centers for 14 weeks, with 77 percent floor utilization.

	Size of Greenhouse Operation		
	Small	Medium	Large
Variable Costs:			
Rooted Cutting	$1.20	$1.02	$0.96
Basket	0.83	0.71	0.66
Medium	0.14	0.14	0.13
Labels	0.04	0.03	0.03
Fertilizer	0.23	0.19	0.18
Pesticide	0.09	0.08	0.07
Sleeve	0.12	0.10	0.10
Box	0.25	0.21	0.20
Labor	0.58	0.58	0.58
Interest in Variable Costs	0.16	0.14	0.13
Total Variable Costs	3.64	3.20	3.04
Overhead Costs	5.84	4.33	4.16
Loss Allocation	0.50	0.40	0.38
Total Costs per Pot	9.98	7.92	7.58
Sales Price/Pot (Wholesale)	8.00	8.00	8.00
Sales Prices/Pot (Retail)	16.00	16.00	16.00
Profit /Pot (Wholesale)	(1.98)	0.08	0.42
Profit/Pot (Retail)	6.02	8.08	8.42

[1] Three cuttings/pot

[2] Pesticide is applied four times

[3] Overhead costs are calculated at $0.208, $0.154, and $0.148 per square foot bench week for small (20,000 square feet), medium (100,000 square feet), and large (400,000 square feet) greenhouses respectively.

Fuchsia flowering is dependent on photoperiod and temperature. Grow fuchsia under long-day conditions to promote flowering (greater than 12 hours for three weeks). *F. hybrida* flowering is most rapid when grown at ADT of approximately 68°F. Further increasing day/night temperature can delay flowering. If grown with an ADT of 59°F, plants will require approximately 70 days to flower. We propose a compromise temperature of ADT=63°F, using a 68°F day temperature and a 61°F night temperature to produce the highest quality plants in a reasonable amount of time.

Fertilize fuchsia with 400 to 600 ppm N early in the production schedule. Decrease fertility once optimal media levels are achieved.

References

Bailey, L.H. 1976. Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada. MacMillan, New York. pp. 334-336.

Erwin, J.E., and R.D. Heins. 1991. Temperature and photoperiod effects on *Fuchsia* x *hybrida* morphology. J. Amer. Soc. Hort. Sci., 116(6):955-960.

Funke, G.L. 1948. The photoperiodicity of flowering under short day with supplemental light of different wavelengths, in Vernalization and Photoperiodism, Murneek, A.E. and R.O. Whyte, Eds. Chronica Botanica, Waltham, Mass. pp. 79-82.

Haney, W.J. 1961. Fuchsia daylength response. Mich. Flor., 370:1-6.

Sachs, R.M. and C.F. Bretz. 1960. Control of flowering in fuchsia. R. R. Hortic. Soc., 85(2):491-493.

Sachs, R.M., and C.F. Bretz. 1962. The effect of daylength, temperature, and gibberellic acid upon flowering in *Fuchsia* x *hybrida*. Proc. Amer. Soc. Hort. Sci., 80:581-588.

Sachs, R.M., A.M. Kofranek, and Shiow-Ying Shyr. 1967. Gibberellin-induced inhibition of floral initiation in Fuchsia. Amer. J. Bot., 54(7):921-929.

Wilkins, H.F. 1985. *Fuchsia* x *hybrida*, in CRC Handbook of Flowering, Ed. A. Halevey. Vol. 3, pp. 38-41.

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