Streamlining Verbena

Every season growers struggle with rising production costs and dwindling profits. Research from Clemson University shows how improving production efficiency can help enhance greenhouse profitability.

By Jim Faust, Kelly Lewis and Renee Keydoszius

Shown here is the effect of B-Nine applied to verbena in propagation. B-Nine is on the left; the control is on the right. Early growth regulation is often required in propagation to prevent stretching prior to the first pinch or shearing. (Photos: Jim Faust)

This article is the third in a series on streamlining the production of vegetatively propagated annuals. The first two articles described how to streamline the production of New Guinea impatiens (*GPN*, October 2005) and osteospermum (*GPN*, July 2006); this one will focus on verbena. The underlying theme of these articles is that improving production efficiency can increase greenhouse profitability. Improving the predictability of crop growth and flowering, reducing greenhouse space requirements and improving uniformity of flowering can enhance production efficiency.

While verbena is not a difficult species to grow, it can be a challenge to produce at high density, which requires excellent control of stem elongation while maintaining sufficient leaf size and branching to fully cover the top of the growing media. Successful production of compact verbena requires control of shoot elongation, good branching and early flower initiation; otherwise, the plants become spindly and require extra space and time.

Our experiments were performed on the verbena Tropical Breeze series to determine the effect of growth regulators, pinching, photoperiod, supplemental lighting and temperature on verbena growth and flowering.

Vegetative Growth

A good verbena crop starts in propagation. While verbena will root very easily, the crop also stretches very quickly in propagation. It is critical to create as many nodes below the first pinch as possible. All too often, verbena will stretch in propagation; then when the first shearing takes place, only one or two node pairs are left below the pinch. These axillary buds cannot provide sufficient shoot numbers to produce a full plant from a single pinch. The result is that an additional pinch or shearing is required to achieve adequate branching.

The first key is to stick the cuttings so the first node is at the surface of the growing media and not one-half inch above the ➧

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media. Second, it is essential to keep the nodes stacked, so when the first pinch or shearing takes place, there are sufficient axillary buds left below the pinch. Preferably, 3-4 node pairs are left below the first pinch so 6-8 shoots develop from the first pinch. This will eliminate the need for a second pinch.

B-Nine (daminozide) was the most effective growth regulator in our trials for controlling verbena stem elongation in propagation. In a relatively warm climate (South Carolina), 2,000- to 3,000-ppm B-Nine used 1-3 times worked well for cultivars grown in 5-inch pots. Note that while 'Tropical Breeze Dark Blue' is a vigorous cultivar, it is also very responsive to B-Nine, so less is needed. A tank mix of B-Nine and Cycocel (chlormequat chloride) can work if stronger growth regulation is required.

Florel (ethephon) worked well at regulating growth early in the crop cycle; however, the final plant quality was inferior as a result of thinner stems, smaller leaves and more irregular ➧

Verbena Development

Weeks (from pinch)	Average Daily Temperature 58° F	68° F	78° F
	Development on a lateral stem		
1	1 node	1 node	2 nodes
2	2 nodes	3 nodes	4 nodes
3	3 nodes	4 nodes	6 nodes
4	4 nodes	6 nodes	Visible bud (2 mm)
5	5 nodes	Visible bud (2 mm)	6-mm bud
6	6 nodes	5-mm bud	12-mm bud
7	Visible bud (2 mm)	10-mm bud	Open flower
8	5-mm bud	17-mm bud	n/a
9	8-mm bud	Open flower	n/a
10	12-mm bud	n/a	n/a
11	18-mm bud	n/a	n/a
12	Open flower	n/a	n/a

Figure 1. Representative temperatures show the decreased timing from pinch to open flower when the temperature is increased. In this example, we assume that six nodes develop prior to a flower being initiated in the shoot tip. This number can vary from four to 10 depending on light levels, photoperiod and cultivar.

An Ecke QuickTurn 60-cell liner has two cuttings and one pinch. It is growth regulated to allow for high node count on the lateral stems so flowering occurs quickly after transplant.

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While verbenas respond well to plant growth regulators, cooler temperatures are the best growth regulator over longer periods of time. Temperatures from 60 to 70° F result in nicely toned growth, while temperatures between 50 and 60° F will hold verbena very tight while still allowing flower development to take place, albeit at a slower rate. Temperatures below 50° F can cause foliar damage on some cultivars, so these temperatures should be avoided.

Bud Meter For Verbena

Temperature (F)	Bud diameter (mm) 2	4	6	8	10	12	14	16	18	20	22	24
	Days to open flower											
58°	37	33	28	24	21	18	15	12	10	8	6	4
63°	32	27	23	19	16	13	10	8	7	5	3	n/a
68°	26	21	17	14	11	8	6	5	3	n/a	n/a	n/a
73°	23	19	15	12	9	7	5	4	n/a	n/a	n/a	n/a
78°	20	16	13	10	8	6	4	3	n/a	n/a	n/a	n/a

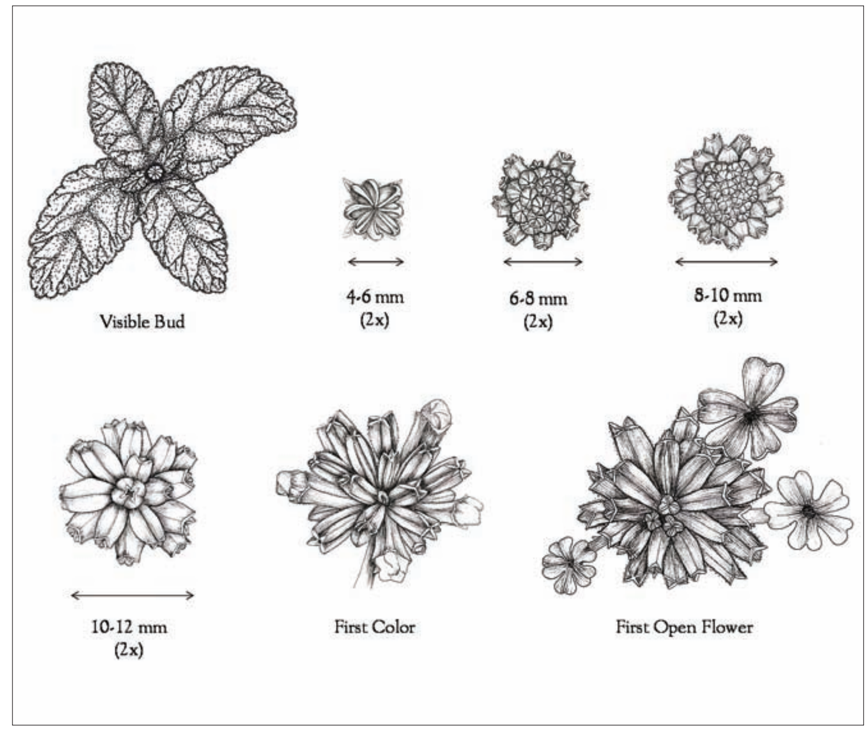
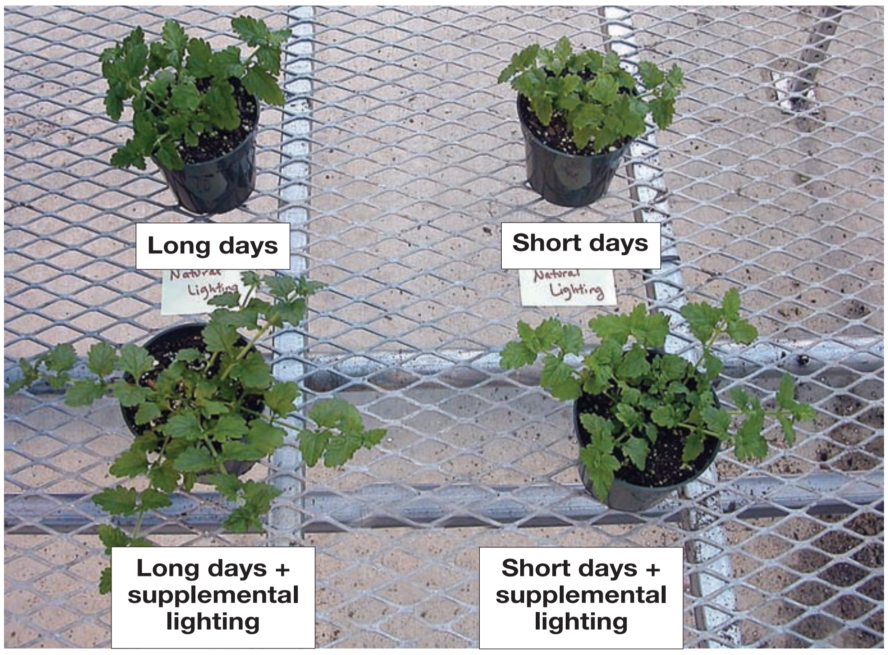


Figure 2. Time to open flower is estimated with a measurement of bud diameter and the average daily greenhouse temperature. Note that the days in this table refer to "first open flower" and not "fully open" inflorescence, although only 2-3 additional days are typically required for full inflorescence to open. Bud diameter (right) is measured across the widest part of the inflorescence. Visible bud typically occurs after 4-8 nodes have formed on a shoot, depending on photoperiod, light level, node position from which the shoot emerges and cultivar.



Verbena plants grown under four different combinations of photoperiod and supplemental lighting from November through January. Long days (16 hours) were created with daylength extension lighting with incandescent bulbs, while short days (9 hours) were the natural winter daylength. Supplemental lighting was provided with metal halide lamps turned on during the natural short-day photoperiod (9 hours) when ambient light was less than 200 w per sq.m. Both long days and supplemental lighting increase vigor (node development rate) and reduce time to flower.

Pinching Technique

The more space a verbena has following the pinch, the better the branching will be. If plants are crowded at the time of pinching, lateral branching is reduced due to poorer light penetration into the axillary buds. Thus, the best branching is typically achieved if the pinch occurs following transplant; however, this is impractical for many growers. A second option is to shear immediately before transplanting. If this cannot be done, two shears will likely be required. We performed the first shear with hedge trimmers at 1.18-1.38 inches and the second shear at 1.57-1.77 inches (measured above the top of the plastic tray). If two cuttings are stuck per liner, just one shear is necessary to achieve good branching.

On verbena, growers may notice the lowest node (i.e., the node closest to the soil) produces shoots that are more vegetative and prostrate than the shoots that develop from the higher node positions. If a verbena is pinched to a single node, the developing lateral shoots display a higher node count prior to flowering and a more prostrate habit, which are both undesirable. Therefore, pinching to 3-4 nodes is recommended to achieve a fuller plant with a more rounded habit.

Supplemental Lighting And Photoperiod

Verbena are facultative long-day plants. For Tropical Breeze varieties, increasing the day-length from 9 to 16 hours decreased time to flower by 3-4 days. Thus, flowering is slightly faster under long days but will occur under any photoperiod.

Flowering also occurs faster under higher light levels (greater ➧

than 10 moles per day). For example, providing supplemental lighting (high pressure sodium or metal halide) during the photoperiod decreased the time to flower by 4-5 days.

If both supplemental and day-length extension lighting was provided to create a 16-hour day, time to flower was reduced 7-9 days. Thus, the benefit of long days and supplemental lighting was additive. During this experiment the lighting treatments started at the time of the pinch. Flowering occurred eight weeks after pinch for the control (short days and no supplemental lighting) and seven weeks after pinch for the plants grown under both long days and supplemental lighting, which is a 12-percent reduction in production time (average daily temperature was 72° F).

Verbena grown at three average daily temperatures: left to right, 58° F (day/night), 68° F and 78° F. The photo was taken seven weeks after pinch.

The observed reduction in time to flower due to long daylengths and supplemental lighting is largely a result of flower initiation occurring at a lower node number. For example, 5-6 nodes may form on the stem below the flower during the summer (long days and high light), while 7-9 nodes may form on the stem below the flower during the winter (short days and low light).

It is also interesting to observe the change in vigor, leaf size and growth habit resulting from different lighting treatments. Short-day, ambient lighting treatments are smaller than the other treatments. Supplemental lighting and long days improve vigor and leaf expansion and reduce the time to flower.

Temperature

The amount of light intercepted and the photoperiod determine how many nodes develop prior to flower initiation, while the average daily temperature affects the rate at which these nodes develop. For example, under long daylengths and good light levels, a verbena may average six nodes below the terminal inflorescence (see Figure 1, page 22). At 58° F, a plant will take 6-7 weeks to develop those six nodes, at 68° F it will take 4-5 weeks and at 78° F it will take 3-4 weeks to develop the same six nodes. Once visible bud appears, the remaining time to flower is once again a function of the average daily temperatures provided to the crop. The photo opposite shows the effect of average daily temperature on verbena growth and flowering.

Flower Bud Meter

Bud meters provide growers with a tool to predict the time of flowering. A simple measurement of bud diameter can be used to estimate the time of first open flower based on the current greenhouse temperatures (see Figure 2, page 24). If crops are projected to flower ahead of or behind the scheduled market date, then greenhouse temperatures can be manipulated to adjust the flowering time. This technique can be used to save on fuel costs by reducing the greenhouse heating set point if the crop is ahead of schedule.

The appearance of visible bud for verbena can be anticipated by counting the nodes on a lateral shoot, since the terminal inflorescence typically appears in the fifth through the eighth node. A visible bud of verbena is typically seen with the naked eye when it is 2 mm in diameter. Once visible bud is achieved, the time to open flower can be estimated with the chart in Figure 2, page 24. For example, if a verbena plant has three shoots with 2-, 4- and 6-mm buds and the average daily greenhouse temperature is 68° F, the plants will have open flowers in 17-26 days. If three flowering shoots are the market spec, the crop should be ready in 26 days. If the market date is not for another 32 days, the greenhouse temperatures can be dropped to 63° F and the plants will still make the market date.

Notice that verbena grown at cooler temperatures (58° F) achieves larger bud diameters prior to first open flower. This is typical of many species that have multiple flowers in an inflorescence, since cooler temperatures result in longer periods of time for flower development during which time the plant intercepts more light. The result is a larger inflorescence that contains more individual flowers per inflorescence.

In summary, high quality, compact verbena plants require an aggressive growth regulation strategy starting in propagation and proper timing and technique for shearing. Flowering can be manipulated with temperature, photoperiod and supplemental lighting. The flower bud meter can be used to properly time the crop with the scheduled market date. GPN

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