

Lighting Effects on Black-eyed Susan

High-pressure sodium lamps and incandescent light are put to the test in this University of Alaska-Fairbanks research.

By Meriam Karlsson
and Jeff Werner



'Toto Lemon' (Photos courtesy of Ernst Benary of America, Inc.)

The Toto series was developed and introduced as an exceptionally short-growing black-eyed Susan (*Rudbeckia hirta*). The short stature of 10-15 inches makes these plants an excellent choice for flowerbeds, interiorscapes and containers, with an expected production time of 12-16 weeks from seed to flower.

Continued breeding efforts have resulted in additional Toto selections that feature flowers in yellow and orange shades contrasted with dark brownish-black centers. The original cultivar Toto was re-named 'Toto Gold' to signify the intense yellow petals. In addition to Toto Gold, selections with petals in clear yellow ('Toto Lemon') or very dark orange, fading into yellow at the tips of the petals ('Toto Rustic') are now offered.

Black-eyed Susan responds strongly to the type or quality of incoming light. Natural light with a balanced wavelength distribution supports growth and development optimally in most plants. Under conditions with high reliance on supplemental light that differs from daylight, modifications in plant growth and rate of flowering may be expected. The choice and use of high-pressure sodium lamps for supplemental lighting is primarily based on energy efficiency compared to other lamp type options.

The light of high-pressure sodium is concentrated to the yellow and orange wavelengths and limited in blue (short) and far-red (long) wavelengths. During periods of restricted natural light, small amounts of light from regular incandescent bulbs improve the high-pressure sodium spectrum with additional long wavelengths.

We conducted this research to determine how much incandescent light was needed and what the benefit of that light actually was.

PROCEDURE

High-pressure sodium lamps as the sole light source compared to high-pressure sodium amended with limited amounts of incandescent light were evaluated for the growth of the three Toto cultivars. The study was conducted during restricted natural light and day lengths in a polycarbonate-covered greenhouse. The shortest natural day on December 21 in our location is three hours and 42 minutes between sunrise and sunset. The high-pressure sodium lamps were hung 4-5 feet above the plants and provided about 600-650 foot-candles during the 16 daily hours of supplemental light. In the amended treatments, incandescent bulbs provided 50 foot-candles throughout the 16-hour day.

Seed germinated at 64-72° F. Three weeks later, plants were transplanted into 4-inch pots filled with Premier Pro-Mix BX. Six weeks from seeding, on November 6, plants had 7-8 expanded leaves, and the incandescent lamps were turned on over half of the plants. Temperature was maintained at 64-72° F. Plants were spaced at four pots per square foot and watered once a day with fertilizer solutions of 100 ppm nitrogen using Peters' 15-16-17.

RESULTS

Time from seed to flower was recorded as petals reflexed on the first open flower and then again at three open flowers. There was no difference in time to flower or response to light quality in this study among the three Toto cultivars. ♦

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'Toto Rustic'

On average, the first open flower was observed 86 days from seeding for plants in the incandescent enhanced environment. Flowering under high-pressure sodium as the sole supplemental source was, on average, eight days slower at 94 days. Plants in the incandescent adjusted light had three open flowers one week after the initial flower. Nine or 10 additional days were required for two more flowers to open under high-pressure sodium alone. Subsequently, at the average time for three open flowers under the combination of incandescent and high-pressure sodium, the first flower in the high-pressure sodium setting was just beginning to open.

Since stem elongation and plant height are expected to increase under the conditions with lamps like incandescent bulbs that provide high amounts of long wavelength radiation, these lights are usually avoided. An important plant characteristic to observe when using incandescent bulbs is, therefore, the amount of stem elongation. Although the average plant height varied slightly among the three cultivars in this study, the increase in plant height due to the addition of incandescent bulbs was similar. Overall plant height under high-pressure sodium

alone averaged 9½ inches for Toto Lemon, just over 10 inches for Toto Rustic and 11 inches for Toto Gold. All three cultivars grew approximately 1½ inches taller by adding incandescent light (See Figure 1, page 40). Each plant had an average of four main branches and 14 developed flowers and flower buds, regardless of cultivar and light quality. The diameter of the flowers was measured. Unexpectedly, the average flower size was ¼ inch larger in environments with incandescent bulbs. The flower size increased from about 2½ to almost 3 inches for Toto Gold and Rustic, while the flowers of Toto Lemon increased to a diameter of 2½ inches in the incandescent amended treatments (See Figure 2, page 40).

APPLYING THE RESULTS

If increased height is a concern for altering the light spectrum to improve flower development with incandescent bulbs, techniques are available for managing overall plant appearance and quality. Close temperature monitoring, including the relationship between day and night (DIF), is commonly used, and growth regulators also effectively control internode and stem



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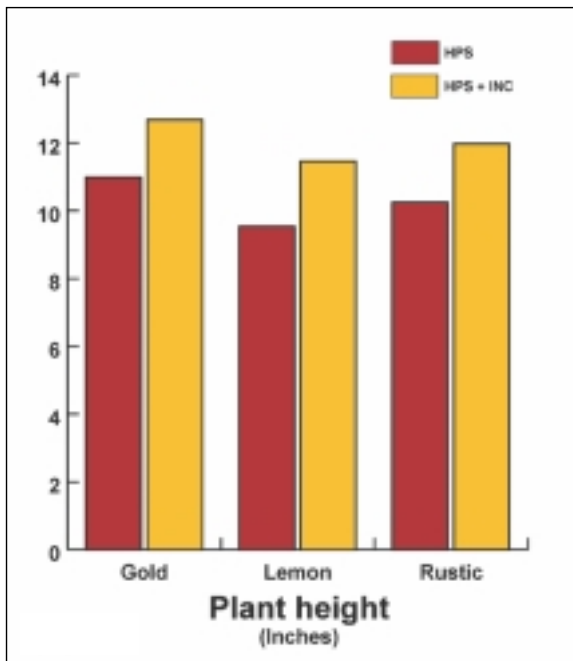
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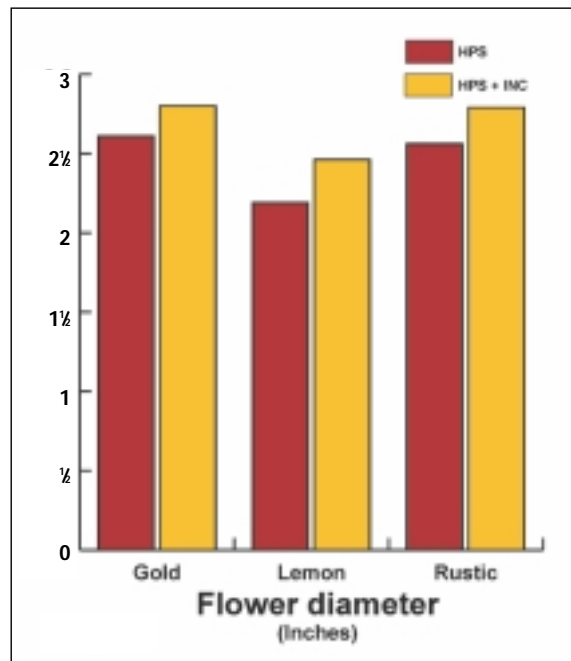
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Figure 1. Plant heights at flowering for the three cultivars Gold, Lemon and Rustic of the black-eyed Susan series Toto. Plants were grown under supplemental light from high-pressure sodium lamps as the sole source (HPS) or amended with a low amount of incandescent light (HPS + INC).



elongation. In an earlier study on Toto, a foliar spray of B-Nine, Bonzi or Sumagic successfully controlled height. The application rate for spray application was 5,000 ppm active ingredient for B-Nine, 20 ppm for Bonzi and 10 ppm for Sumagic. Application of growth regulator directly to the surface of the medium prior to planting is a promising, recently developed treatment technique. Sumagic, at the rate of 10 ppm, applied with 0.054 fluid ounces of solution per 4-inch pot

Figure 2. Flower diameter for the three cultivars Gold, Lemon and Rustic of the black-eyed Susan series Toto. Plants were grown under supplemental light from high-pressure sodium lamps as the sole source (HPS) or amended with a low amount of incandescent light (HPS + INC).




(about 12 sq. inches of surface area) was, in a previous study, found to be most effective for height control. In contrast to foliar sprays, the growth regulator media application did not slow overall plant development and flowering of Toto.

Pinching two weeks following transplant slightly reduced the overall plant height of Toto in an earlier study. Although a pinch delayed the opening of the first flower, there was no delay at the time three flowers were fully developed com-

pared to the intact control plants. The resulting more uniform flower and plant development indicates pinching is a successful cultural technique to produce high-quality, well-proportioned and balanced black-eyed Susan for marketing.

The difference between high-pressure sodium and amended high-pressure sodium light during production do point at the consequence and potential for adding specific light qualities to improve overall plant growth and flowering. Increasing the level of high-pressure sodium light may overcome some of the differences noted here and reduce the impact of adding incandescent light.

The Toto series is suitable for a variety of plantings, relatively pest free and exceptionally weather and heat resistant in the landscape. The newly added cultivars provide options for creating arrangements with more variations, types and contrasts for indoor and outdoor installations. The black-eyed Susan series Toto fits nicely into the now-available range of compact species and cultivars for instant color, landscaping and interior displays. 

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