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Efforts continue to expand and improve facilities for research and teaching in controlled environment plant production. A growing facility for demonstrating the opportunities to produce crops in enclosed controlled environments is in the process of being established on campus using a special grant from USDA/CSREES. The research will center on the production of raspberries, strawberries and other small fruit production in controlled environments.

High pressure sodium (HPS) lamps are used extensively to provide supplemental lighting in high latitude greenhouse and controlled environment production. Compared to natural light, the proportion far-red wavelengths of the spectral energy distribution is limited in HPS irradiance. The importance of far-red was evaluated for the development of *Rudbeckia hirta*. In a HPS production system of $8 \text{ mol}\cdot\text{d}^{-1}\text{m}^{-2}$ during 16 hours, a limited number of incandescent lamps was added to provide 15 to $20 \mu\text{mol}\cdot\text{m}^{-2}\text{s}^{-1}$. The red to far-red ratio decreased through the addition of incandescent lighting from approximately 2.2 of HPS to 1.2. The dwarf *R. hirta* cultivars Toto Gold, Toto Lemon and Toto Rustic, suitable as container or bedding plants, were transplanted into 10 cm containers one month after seeding and the experiment was initiated 3 weeks later. At this time, the plants had 7 to 8 leaves and were 3 to 4 cm in height. Flowering time decreased with 10 to 14 days for the *R. hirta* cultivars in the incandescent amended environment. The natural day length ($64^{\circ}49' \text{ N}$ latitude) from sunrise to sunset decreased from 8 hours and 34 minutes to 3 hours and 42 minutes at winter solstice to 4 hours and 38 minutes at the termination of the experiment.

Forget-me-not flowers are often requested at events commemorating companionship, romance and appreciation. As the state flower of Alaska, forget-me-not also generates local demand from visiting tourists, hotels, restaurants and other public establishments. Production guidelines outlining the optimal growing conditions are necessary to consistently and efficiently produce high quality forget-me-not flowers to meet local demand. Forget-me-not requires a cold treatment at approximately 4°C to flower. Some light is necessary for the plants to actively perceive the cold temperatures. Recent studies on other herbaceous perennials suggest the cold period is more efficient when combined with considerably higher irradiance than earlier recommended. Increasing the irradiance from approximately 1 to $10 \text{ mol}\cdot\text{d}^{-1}\text{m}^{-2}$ during six weeks of 6°C resulted in 8 to 10 days slower flowering at 16°C . The plants at high irradiance during the cold period produced flowers on sturdier stems making them more suitable for corsages, chaplets and other floral arrangements.

A controlled environment growing system provides opportunities to extend the growing season of locally produced fresh strawberries. Based on day length requirements for flowering, strawberries are classified as short-day (June-bearer), long-day (ever-bearer) or day-neutral cultivars or selections. For greenhouse production systems, day-neutral types are commonly recommended. Strawberries were evaluated for flowering and berry production under greenhouse conditions in Fairbanks from June to September. ‘Totem’ (short-day), ‘Quinault’ (long-day) and ‘Tristar’ (day-neutral) were grown at 8 hours, 16 hours and naturally long days. The 8-hour days resulted in no flowering or yield for any of the cultivars including ‘Totem’ classified as a short day type. ‘Totem’ only produced scarce flowering at naturally long days. Yield was significantly higher at naturally long days (1,130 grams) for ‘Tristar’ than at 16-hour days (340 grams) despite the day neutral classification. The long day type ‘Quinault’ produced similar yields at 16-hour and naturally long days (1,445 grams).

To study limited daily red light exposure, combinations of red light emitting diodes (LED, peak emission at 660 nm) and HPS lamps were used. Environments with 16 h of HPS at $7.5 \text{ mol}\cdot\text{d}^{-1}\text{m}^{-2}$ were supplemented with one hour exclusively of LED at the end of the dark period or one hour of LED in combination with the first daily hour of HPS. The additional daily irradiance from the hour of exposure to LED was limited at $15 \mu\text{mol}\cdot\text{m}^{-2}\text{s}^{-1}$. *R. hirta* ‘Toto Lemon’ flowered 4 to 5 days earlier with exposure to

one daily hour of LED exclusively or in combination with high pressure sodium. Head lettuce of the cultivar Alpha was seeded in plug flats and moved at germination (5 days from seeding) to the three HPS and LED environments. The limited daily exposure to LED resulted in altered morphology. The ratio between root and shoot dry weights increased from 0.13 in the HPS environment to 0.17 for the LED treatments. The hypocotyl length was 3 mm shorter following exposure to one daily hour of red LED exclusively or in combination with HPS compared to only HPS.

Publications

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