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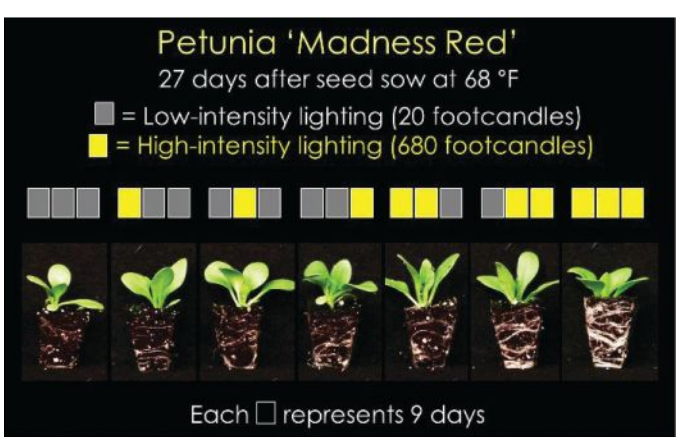
Lighting Plugs at Different Growth Stages

January through March can be considered young plant season — a period in which seeds of many garden plants are sown and grown in plugs. Ornamental cuttings are also harvested, stuck and rooted as liners. During this time, the days are short and light intensities are low in northern locales, so many young plant producers provide supplemental high-intensity lighting to increase photosynthesis, and thus, plant growth. As researchers at Michigan State University (MSU), Purdue University and others have shown, there are many advantages to lighting young plants. Most importantly, plants develop more biomass (roots and shoots) when the low natural light levels are increased from supplemental lighting.

In an ideal world, most seedlings would be provided with supplemental lighting whenever the daily light integral (DLI) is low (less than 10-12 $mol \cdot m^{-2} \cdot d^{-1}$), from germination until transplanting. Many greenhouses have high-intensity lamps but not enough to light their entire young-plant production space. A question then arises: If supplemental lighting can only be provided to plugs during a portion of the production cycle, when does one obtain the most benefit?

To best address this question, controlled greenhouse research can provide data that is unbiased and objective. With Dr. Wook Oh (former post-doctoral research associate at MSU, now professor in Korea) and Dr. Ryan Warner at MSU, we addressed this issue by performing research with several young plant seedlings to determine the relative benefit to lighting young plants for limited periods of time. In such experiments, it's important to carefully monitor and control environmental and cultural parameters to ensure that plant responses can specifically be attributed to the treatments.

__Figure 1.__ Growth of petunia plugs under a 16-hour day provided by low- or high-intensity lighting. Generally, shoot and root growth increased the most when high-intensity lighting was provided during the later plug stages.



Seeds of geranium, marigold, pansy, petunia and salvia were sown by C. Raker and Sons into 288-cell plug trays and transported to MSU the same day. Plug trays were placed under a 16-hour day provided by sunlight plus low-intensity lighting (3 $\mu mol \cdot m^{-2} \cdot s^{-1}$, or 20 foot-candles) or high-intensity lighting (90 $\mu mol \cdot m^{-2} \cdot s^{-1}$, or 680 foot-candles) from high-pressure sodium lamps. The lamps turned on from 6 a.m. to 10 p.m. when the outdoor light intensity was less than 400 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (2,000 foot-candles). Seedlings were grown at 68° F under the low- or high-intensity lighting for the entire seedling stage, or were exposed to high-intensity lighting for one-third or two-thirds of the seedling stage. The duration of the seedling stages depended on the crop, from 24 to 33 days. Experiments were performed twice, once early in the winter (January-February), the other in spring (March-April).

A very brief summary of the results follow:

- Shoot and root growth increased as duration of supplemental lighting increased (Figure 1). In other words, plants that received high-intensity lighting the entire time were the largest, and those that received only low-intensity lighting were the smallest.
- During the winter, the high-intensity lighting increase media and plant temperature by 4 to 5° F, so plants under the high-intensity lighting developed faster. During spring, media and plant temperature was only about 1° F warmer under the higher light.
- Plant responses to the high-intensity lighting were greater during the winter than in the spring.
- High-intensity lighting generally had greater effects on transplant quality and subsequent flowering when provided later in the plug stage than if provided earlier in production.

In summary, plants that received supplemental lighting during the entire plug stage were of highest quality and were pullable earliest. However, if one can only provide high-intensity lighting during a portion of the plug stage, the greatest benefit occurs when seedlings are lighted during the later stages. g

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