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# 101 Ways to Try to Grow Arabidopsis: Does Growth Under 24-Hour Light Hasten Production? Can Plants Be Damaged by It?

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# Purdue Methods:


## Does growth under 24-hour light hasten production? Can plants be damaged by it?

**Short answer:**

Twenty-four hour photoperiod (continuous light) hastened production except as compared to greenhouse summer production. Plants can be damaged if grown under continuous light of 300 $\mu$mol/m2/s, whereas 100 $\mu$mol/m2/s is safe.

**Results:**
In our study, *Growth of Arabidopsis seedlings under continuous fluorescent/incandescent lighting*, continuous fluorescent/incandescent lighting at 100 $\mu$mol/m2/s resulted in a healthy crop with hastened production as compared to results documented in other studies we conducted.

Days until 50% of plants were in flower in our combined studies:

| | |
|---|---|
| Natural day sunlight in greenhouse, summer | 18 days |
| 24 hour light in growth chamber | 19 days |
| Natural day sunlight in greenhouse, spring | 26 days |
| 16 hour light in growth chamber | 26 days |
| Natural light in greenhouse supplemented to 16 hours, winter | 39 days |

Note that under continuous light fertilizer frequency was increased to using fertilizer at each irrigation, and that slow release fertilizer was ineffective.

A subsequent study compared growth under continuous light at 300 $\mu$mol/m2/s versus 100 $\mu$mol/m2/. Within these two groups, different fertilizer practices were compared, since plants in previous studies under continuous light exhibited deficiency symptoms. Plants under at 300 $\mu$mol/m2/s showed purpling of leaves, leaf margin necrosis, leaf twisting, and petiole elongating. More plants died by day 10 than died under the lower intensity. However, the plants that survived were further developed; 3 sets of leaves as opposed to the 2 sets of leaves on the 100 $\mu$mol/m2/s plants. They appeared to have more leaf hairs (data not taken). Increased liquid fertilization reduced the purpling somewhat at this 10-day stage, compared to "starter fertilizer only" and "slow-release fertilizer" treatments.

By day 30, plants under 300 $\mu$mol/m2/s had purple leaves with margin necrosis unless the plants were continuously sub-irrigated with fertilizer solution. These liquid-fertilized plants exhibited yellow leaf tips observed in other 24-hour light experiments. Slow-release fertilizer was no more

effective at providing nutrients than tap water controls throughout the experiment. For plants under the lower intensity, increasing the rate of slow release fertilizer improved plant vegetative growth, but they were not as healthy those constantly sub-irrigated with fertilizer solution.

**Discussion:**

This study suggests that a growth system can be designed to hasten production of *Arabidopsis* by 1-3 weeks using 24-hour lighting and increased fertilization. Over the course of a year, this might result in roughly 1 to 1.5 more plant generations produced.

However, there are many things that can go wrong. Plants will purple if not fertilized enough, can be damaged if light intensity is above 100 $\mu$mol/m2/s, and can quickly become water-stressed due to increased evapo-transpiration. We lost plants on two occasions due to water stress alone. It is our assumption that slow-release fertilizer granules did not result in healthy plants under continuous high lighting (300 $\mu$mol/m2/s) because the production period was too fast for the nutrients to be released in sufficient quantities for vigorous growth.

The most productive plants were grown under continuous 300 $\mu$mol/m2/s and constantly sub-irrigation with fertilizer solution. However, we doubt many researchers could afford the risk to plants involved, especially if available seed were limited.

For continuously lighted plants, we recommend the safer light intensity of 100 $\mu$mol/m2/s with constant sub-irrigation using fertilizer solution. Note that this constant sub-irrigation is not recommended for shorter photoperiods.


**Figure 1. From left to right: Young plants grown under short-day natural light; 16-hour greenhouse; 24-hour greenhouse; 16-hour fluorescent light shelf; 16-hour growth chamber; and 24-hour chamber.**


**Figure 2. From left to right: Plants at maturity grown under 16-hour greenhouse, 24-hour greenhouse and 24-hour growth chamber, respectively.**

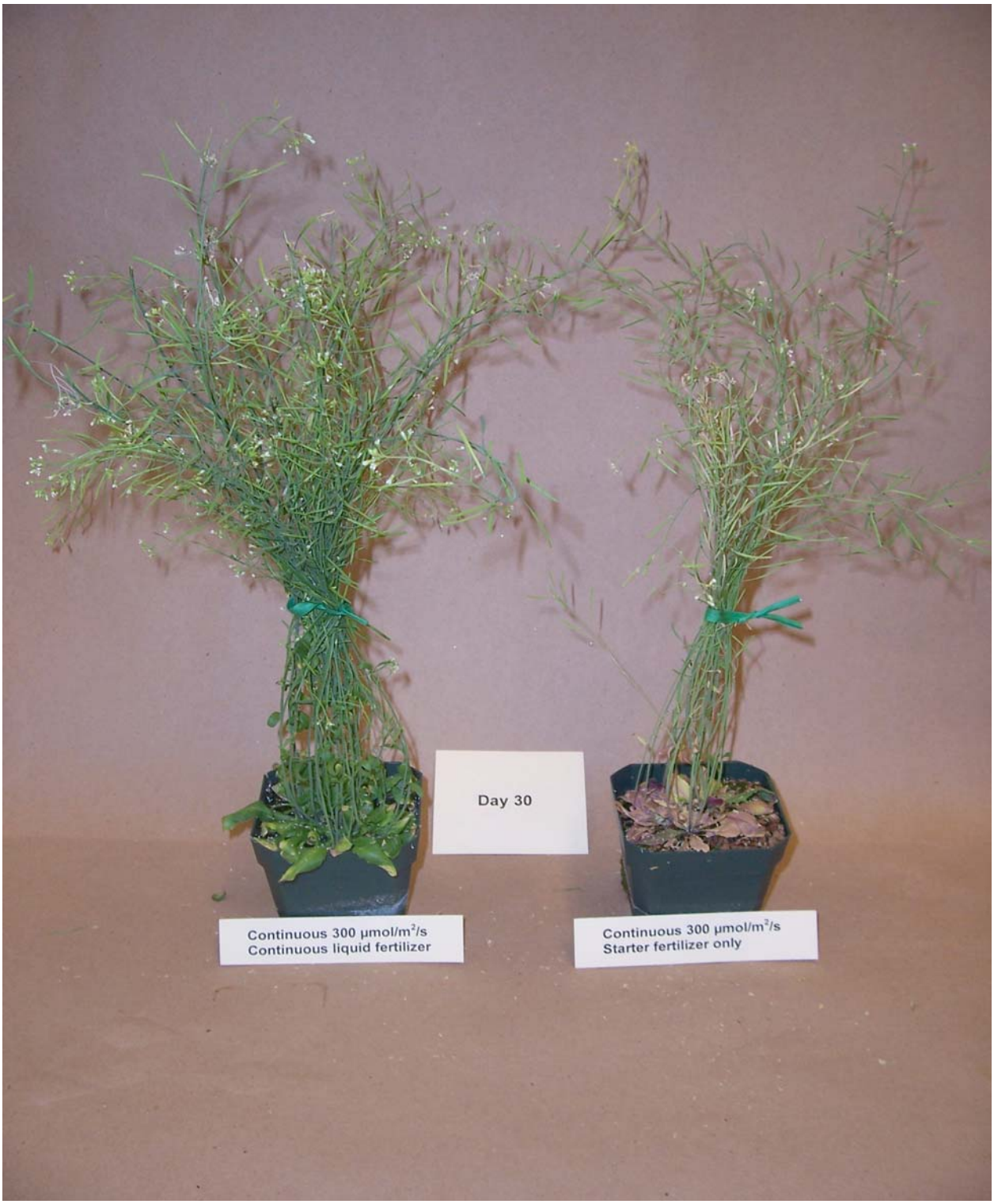


**Figure 3. Plants grown in a growth chamber under continuous light at 300 $\mu$mol/m2/s with continuous liquid fertilizer (left) and starter fertilizer only. Note purpling of leaves in starter fertilizer plants.**


**Figure 4. Plants grown in growth chambers with continuous liquid fertilizer under continuous light at 300 *µ*mol/m2/s (left) and 100 *µ*mol/m2/s.**


**Figure 5. Seedlings grown under continuous light at 100 $\mu$mol/m2/s.**


**Figure 6. Seedlings grown under continuous light at 300 $\mu$mol/m2/s. Note purpling leaves.**


**Figure 7. Plants grown under continuous light at 100 *µ*mol/m2/s under varying fertilizer treatments. From left to right: Starter fertilizer only; 14-14-14 slow release fertilizer at 1X, 2X and 3X recommended rate, respectively; and continuous liquid fertilizer by sub-irrigation. Note progression of leaf deficiency symptoms from right to left.**