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Replacing Incandescent Lamps

Incandescent lamps are on their way out — or at least the traditional ones. Beginning in 2005, countries began to phase out the manufacturing, importation and/or sales of incandescent lamps simply because they are so inefficient at converting energy into visible light. Their energy efficiency is less than 10 percent — the rest of the energy consumed is lost as heat. This means that incandescent lamps are more effective as a heat source than a light source. (To get around the sales ban on incandescent lamps for lighting in some countries, some folks have been marketing them instead as personal heaters!)

More energy-efficient incandescent lamps have recently been developed, and they also have a longer lifespan. However, they are also more expensive. Compact fluorescent lamps (CFLs) were made specifically to replace incandescent lamps. The technology for fluorescent tubes was adapted for a screw-in fixture. The cost of CFLs has come down significantly since they were first introduced, they have a longer life, and most importantly, they are approximately four times more energy efficient than incandescents.

CFLs also have some downsides. They contain hazardous metals including mercury, so the lamps should be recycled and disposed of properly if broken or after failure. Also, unlike incandescent lamps, the lifetime of CFLs is negatively influenced by the number of on/off cycles. Finally, their emitted spectrum of light is quite different from incandescent lamps; CFLs emit somewhat similar amounts of blue and red light, and very little far-red light. In contrast, incandescent lamps emit little blue, a moderate amount of red, and a lot of far-red light. Why is this important?

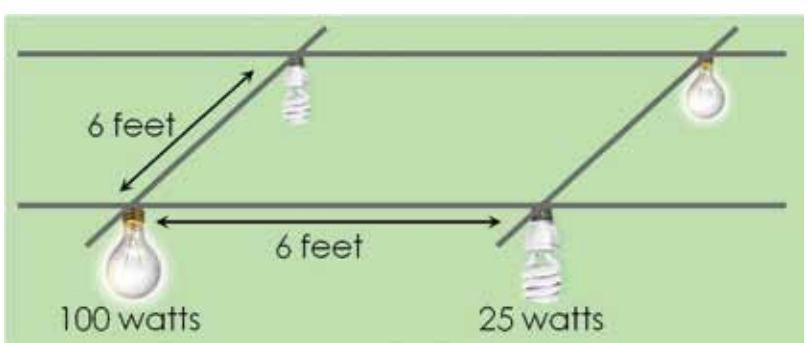

Figure 1. *Replacing every other incandescent lamp with a compact ("curly Q") fluorescent lamp can reduce energy costs while still controlling flowering in a broad range of floriculture crops.*

Flowering of some long-day plants is sensitive to the spectrum of light. Incandescent lamps happen to emit an effective spectrum at regulating flowering in daylength-sensitive plants. The ratio of red and far-red light (0.7) inhibits flowering in short-day plants and promotes flowering in long-day plants. In comparison, CFLs emit about four times more red than far-red light.

A few years ago, my colleagues Sonali Padhye and Wook Oh performed experiments at Michigan State to determine the efficacy of CFLs at inducing flowering compared to incandescent lamps. Another treatment was an equal combination of both lamps. In our study, 60-watt incandescent lamps were replaced by 15-watt CFLs and the light intensity delivered to plants was similar. What did we learn? Many plants flowered similarly under the lighting treatments, but flowering of a few plants (particularly petunia and pansy) was delayed under the CFLs. Treatments with alternating CFLs and incandescents flowered similarly as plants under only incandescent lamps. Therefore, in the short term, growers can save energy costs without having an effect on flowering by replacing about half of their incandescents with CFLs (Figure 1).

I've been asked many times whether one should use cool-white or warm-white CFLs. The primary difference between these two lamps is the amount of blue light emitted (cool-whites emit more blue), and the red to far-red ratio is somewhat similar. Therefore, I would predict that flowering responses under warm- or cool-white CFLs would be similar. In light of that, one could choose which CFL to use based on price.

In the near future, it is likely that incandescent and CFL lamps will be replaced by LEDs. LED fixtures are already available as screw-in bulbs, their prices are coming down, and their electrical efficiencies continue to improve. One of our research projects at Michigan State is to determine an effective spectrum of red and far-red light that regulates flowering of a range of plants, so that lamps developed for photoperiodic lighting are effective. Philips has already developed "flowering lamps" for horticulture applications, and we're experimenting with those now too. Preliminary results look promising.

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