Plugging Along Without a Greenhouse: The Unbeatable Bareness of Lighting

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I don't have a greenhouse. Or a hoophouse, high tunnel or low tunnel, for that matter. And even if someone gave me one (free, of course, and installed), I'm not so sure I'd use it even then, not for starting plugs at least. It's about the light. Those structures are all, out of necessity, pretty thin-skinned affairs, which of course is what it takes to let that light in, when (and if) the sun shines. But this is Wisconsin, 44 degrees North latitude, and I gear up for an early start and a short growing season in the cold, dim dead of winter. Thin skin doesn't get you very far here, and the sun doesn't shine through goose down or wool.

What I do have, however, is a nicely insulated, unheated, unfinished basement, a water supply unfazed by freezes, and a steady source of clean, affordable energy. We pay a 2 to 4 cent premium for 100% green energy, a total of about 18 cents per kilowatt hour (KWH). Yours may cost a little more or a little less, but when used wisely, it is still a good deal. Last year, for example, to power one germination chamber, 160 square feet of lighted plant shelving, an air circulation fan and 3 to 4 small space heaters for my 4 cold frames as the weather moderated, I spent $608.64 on 3250 KWH of power. And for that, from January to May, I produced 350 trays or about 84,000 plugs. That's an energy expenditure of $1.74/tray (averaging 240 plugs each), less than a penny a plug, and not at all bad as I see it.

I can't imagine getting away that cheaply burning LPG in a hoophouse, though I don't have the data to support my argument, but I'll bet many of you do. The advantage I have, of course, is explained by the use of an insulated building and the efficient use of vertical space, something that can't be done in natural light. Just in case you're wondering, all of my expendable inputs exclusive of labor (seed, soil, paper chain pots, miscella-neous materials plus electri-city) averaged $9-$10/tray or about 4 cents/plug. That's also exclusive of the propagation setup, which easily paid for itself some 15 years ago, but the details of which, you will soon understand, are mostly irrelevant.

The other advantage I have is a totally controlled environment for my plugs, from temperature, to moisture, to air circulation, light levels and day length, an advantage but also a weighty responsibility. I, a non-plant form of life, have to figure out what's best for those plugs, and frankly, finding good information can be pretty crazy-making. Generally I prefer to learn from those who have been there, done that, as they say. And, arguably, that would be the largest, most successful group of indoor growers to be found (though not literally), cultivators of *Cannabis*. But there's a problem. While reading their forums and blogs can indeed be addicting, much of what is written is too often either contradictory or overly pricey and, shall we say, pretty hazy at best. That leaves us at the mercy of horticultural lighting manufacturers, each with an agenda to promote their own particular technology and products, and university research, which is scarce for this application.

Long Day's Journey into Night

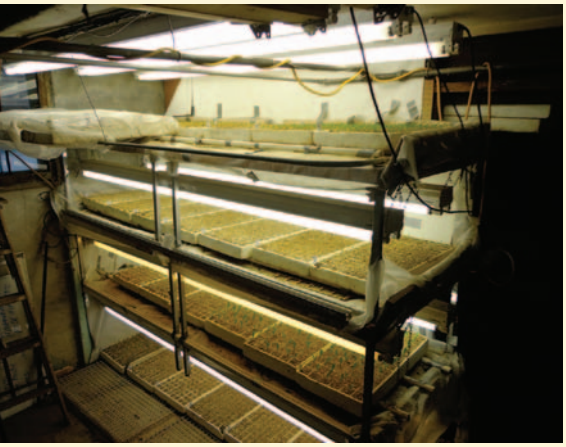
Where university research can be most helpful is on the subject of optimal day length for your crop, whether it is a long day, short day or day-length neutral plant, and whether that response is obligate (as in "I'll hold my breath until get my way.") or facultative (as in "Yeah whatever, we'll get there, no big whoop."). One caution is that much of university lighting research has been devoted to getting bedding plants to bloom in cell packs at three inches tall, not exactly the advice a cut flower grower wants. For a reasonably understandable exposition on the topic, from Michigan State University see: Use of Lighting to Accelerate Crop Timing, by Erik Runkle and Matthew Blanchard.

In practical terms, however, most of what we grow will benefit from 14 to 16 hours of light a day. It's the "little light lie" that has your plugs thinking, "April already? Who knew?" Meanwhile it's 6 degrees

Strip light detail - note PVC rails

Shop-lite array detail - note reflective surfaces

Stage 2 shop-lite array



Strip light array nearly full

outside and the sun actually set at 4:30. The effect of that extended light on most plugs is considerable. They grow faster, stockier, stronger and even better rooted, all very desirable attributes in a transplant, making them pullable earlier as well, freeing up bench space and boosting your efficiency. They will also, in many cases, come into bloom quicker than plants that have not received this treatment.

There are a few exceptions to this rule, generally confined to early-blooming hardy annuals and first-year blooming perennials, both triggered into bloom by somewhat shorter "long days", if that makes any sense. Spring-sown bachelor buttons (Centaurea cyanus) is a notable example. These I place in cool conditions and natural light (12-hour days) immediately, to keep them vegetative, to "bulk up" before shifting to a blooming stage. That produces a plant nearly matching fall-sown plants in size and side breaks, but timed to bloom just as fall-sown plants are winding down. On the other hand, these same plants could also be cleverly manipulated by long day lighting to produce single stem cuts in a lot fewer days under high density greenhouse conditions. See this intriguing study out of the University of Kentucky: http://www.uky.edu/Ag/CDBREC/bachbut.htm (now I'm sorry I turned down that free greenhouse—is it too late?).

The ideal lighting for vertical growing is a fixture thin in profile, cool enough to be close to the plants, bright but spread out over a large area, cheap and efficient. And it should also be suitable for damp environments. For years I have used both supercheap 4-foot, two-tube fluorescent shoplights and 8-foot, two-tube high output strip lights, but that doesn't really matter. I might as well be using whale oil lamps. They're both history.

Brother Knows Best

As of Bastille Day last year (July 14 - you don't celebrate?), the manufacture of T-12 fluorescent tubes and also fixtures stopped, in compliance with the Energy Independence and Security Act of 2007 (EISA) and the latest Department of Energy efficiency standards. You could, I suppose, still rush out and buy them today (they continue to be sold while inventories last) and one of the reasons for dumping them is one of the reasons I like them, the "waste" heat they produce. A significant part of enhanced growth from plant lighting can be attributed to that "waste" heat. But that would be short-term thinking and a truly wasted opportunity to do something even better for your bottom line and trim your carbon footprint at the same time. So what are some viable alternatives? To answer that, I went straight to my source for questions like these, my big brother Tom.

Tom says, "T-5 fluorescents." Specifically, four foot F54T5 high output, cool white, single-tube strip lights. While using almost exactly the same number of watts per foot as my 8-foot high output 110W T-12 tubes, they produce twice the light (though very little heat) and therefore should require only half the number of tubes. So, my 2-tube 8-foot fixture is replaced by 2 single-tube 4-foot fixtures installed end to end (I assume T5's are not made in 8 foot lengths because of how thin they are, only 5/8 of an inch). The initial cost ends up being remarkably similar. And, according to one manufacturer, Sunlight Supply, plants love them:"T5 lamps provide the ideal spectrum for plant growth. Photosynthesis rates peak at 435 nm and 680 nm. A 6500K T5 lamp has a spectral distribution with relative intensity peaks at 435 nm and 615 nm. This equates to very little wasted light energy in terms of plant growth".

If you really want to delve into nanometers of wavelength or degrees Kelvin of color temperature, check back with the *Cannabis* boys; they give those subjects much more than…uh… a token pass? Me, I'll take Sunlight Supply at their word.

Tom also had a good word for several other technologies. Did I mention that he's a lifelong Master Electrician, and has never lied to me? LED has been getting

Random Representative Sources
(no endorsements implied)

T5 horticultural fixtures
www.sunlightsupply.com

LED retrofit tubes
www.EagleLight.com

General horticultural lighting
www.PARsource.com

High tech LED solutions
www.lighting.philips.com

Horticultural induction lighting
www.inda-gro.com

* http:// /p-12140-sunblaster-t5-ho-fluorescent-strip-lights.aspx

a lot of attention lately for horticultural uses, and may well be what we'll all be using in years to come. But it remains so specifically tuned to particular crops that I can't help feeling it's the equivalent of making a super-vitamin to replace all human nutritional needs. How do you know you aren't missing something important? Besides, fuchsia-colored light does nothing for my complexion. That said, there are companies offering affordable LED tubes to retrofit into old fluorescent fixtures, at 33W/8 foot tube, cutting your electric bill in half yet again. "You'll have to bypass the ballast," says Tom. "And you may have to swap out the tombstones." Those are the little white plastic tube holders at the ends of fixtures. For growing plugs, by the way, always choose the Cool White option, the one with the higher color temperature (Don't ask, just take Tom's word for it.). There are also other LED configurations specifically for plant lighting, but all seem to me prohibitively expensive.

The rest of your plant lighting options are much more suited for use as supplements in a natural light setting, in a greenhouse or hoophouse, by virtue of their physical size and the intense concentration of their light down to a small point source. With outputs from 200W to 2000W and prices to match, they are usually suspended well above a crop to allow the light to spread over as wide an area as possible. Examples include metal halide (MH), high pressure sodium (HPS), and high intensity discharge lighting (HID).

However, the one to really keep an eye on in coming years, according to Tom, is induction lighting. In a case of Steampunk meets Star Wars, this 19th century invention of Nikola Tesla is finally getting the attention it deserves. Adaptable to all of the lighting technologies I've discussed so far, it simply removes the electrodes from inside the bulb and instead excites the gasses or phosphors from without, with radio frequencies or magnetic fields. This allows for more options in light quality, very high conversion efficiencies and up to ten years of lamp life. Very pricy for the time being but remember, you heard it here first (and if you already knew, welcome to the Nerd Club).

Well, you may have nothing better to do, but I need to go rotate and water my plugs. I forgot to mention that one of the down sides to T12 tubes is their uneven light from end to end. To keep my plugs from reaching toward the center, I rotate my trays every day. That's not supposed to be an issue with T5's but I'd probably continue to shift trays nonetheless. I use PVC pipe rails under my trays to allow them to air-prune, so pulling out one tray and sliding the rest down is quick and easy. Besides providing a good opportunity to pay closer attention to your plants, it also compensates for any bad habits you might have in your watering technique. The end result (usually), picture-perfect plugs.

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