**Growing Tropical Slippers Under Florescent Lights**

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I am not a lighting engineer so don't profess to be an expert regarding this topic, but I have grown orchids under lights for over 40 years, so I hope this information that I have gleaned over the years will be helpful to a newcomer who would want to grow orchids under lights. My adventure with growing under lights started when I my father bought for me a few orchid plants from Albert's and Merkel, when we were on a family vacation in Florida. He had one light fixture hung in our basement to grow these plants under. It was like having my own private magical indoor garden. From that point on, I continued growing plants under lights because it fit well with my lifestyle of moving frequently for various jobs. I could always take my plants with me and I didn't have to worry about where I would put a greenhouse or how much it would cost to do so. Light gardening has served me and my plants well over these years.

It seems like most of the more recent articles on growing orchid under lights emphasize the use of HID (high Intensity Discharge) lamps rather than florescent setups. When greater working distances or very high light intensities are required for large growing orchids or one requiring high light intensities, HID's are useful. However they can be an expensive purchase and give off quite a bit of ambient and radiant heat. There is also much attention drawn these days to LED's, which do have intriguing future possibilities, especially for their energy savings, but are presently very expensive and not as readily available in the sizes and types most useful for amateur growers.

Compared to these newer light sources, florescent light gardening may seem like old news and may be considered by some to be passé, but this is far from the truth. With newer, more efficient

florescent lights or lamps that are readily available, this way of growing orchids, particularly those with modest light requirements like most of the slippers, is very viable. I have grown these orchids under these florescent lights for years and have found it a very successful and satisfying.

Most folks have their light setups in the basement or some workspace. This location, unlike most greenhouses, does not have the potential for plants being parboiled if the ventilation system fails during a hot sunny day or for the plants to freeze in a cold snap when the heater fails. Also, the light intensity is uniform and constant. Only in extreme cases, like if the plant leaves actually touch the lamps, do the leaves ever burn. And with T8 bulbs the leaves don't burn even then.

**Choosing the "Right" Size of Bulb or Lamp and Fixture**

Although some people use the spiral, compact florescent bulbs, these are not usually practical for growing very many plants, since they produce a narrow circle of light. The standard linear bulbs are the most useful and economical choice. The most common and readily available length is 48". Any lamp shorter is more expensive and, since light intensity decreases significantly for all florescent lamps for 6" at the end of the tubes, it's not a very efficient choice. Lamps can be purchased that are eight feet long, but this is a less convenient size to accommodate in most home situations and the bulbs are not readily available in as many variations.

**T12, T8, T5**

With energy costs always going up, it pays to invest in the most efficient light sources. New, high efficiency, 34 watt T-8 florescent lamps are quickly replacing the standard 40 watt, T-12 florescent lamps in the United States. These tubes will be the commercial standard very soon so if you are shopping for a new light setup you might consider starting with the T-8's.

The “T” designation is referring to the lamp being tubular and the numbers after the “T” indicate the diameter of the bulb or lamp expressed in 1/8 inch increments.T12 is 12/8” around, T8 is 8/8” and so on. The T12 tube, introduced in the 1930’s, is the most common bulb size, but this is rapidly changing. In fact by law, these will be phased out to be replaced commercial by the T8. These newer lamps, introduced in the 1980’s, are much more energy efficient, produce more light per watt, contain less harmful mercury, produce less heat, and are usually powered by silent, instant-start, flicker-free, buzz-free, electronic ballasts. Unlike the older lamps, these newer ones burn at their full light output for longer.

If you have older fixtures with T-12 tubes, their ballasts will not properly power the T-8’s. The T-8’s will burn in such units but, since the wattage of the ballast is higher than these tubes require, the lamps will age prematurely evident from the black rings that will form at the end of tubes.

Older light units that burn T-12 lamps can be converted to light T-8 lamps by replacing the ballasts with those designed for T-8’s. Your electrician can do this or, if you are handy and can read simple wiring diagrams, you can attempt it yourself. The lamp holders in these older units will still work with the T-8’s, so they don’t have to be replaced. However, the newer lamp holders are better designed and have a mechanism that locks the bulbs into place.

T-5 tubes are the next generation of florescent technology. T5’s were introduced in the 2000’s and are very bright, especially the HO (high output) types. Of course, there is a tradeoff---the T5 fixtures and lamps are quite a bit more expensive than the T8’s and the T5 HO bulbs use twice the electricity of the standard T8’s.

I used a unit that contained four- 54 watt high output tubes and was amazed at the light output of this unit. It produced 5000 foot candles 6” from the tubes! And they have a modest heat output and no ballast buzz. The disadvantages are that these units are relatively expensive and are not easily retrofitted into T-12 or T-8 units since they require different ballasts and the tubes are slightly shorter. They are a great choice as a “blooming light” where they are suspended 18”or so from the plants to allow the spikes to develop and still have the leaves receive adequate light.

**The author’s adjustable “blooming lamp” allows room for flower spikes to develop.**

When all things are considered choosing a 4 tube T8 fixture with electronic ballast is probably going to be your best bet for growing slippers and other compact growing , lower light requiring orchids.

Although some people have reported success with growing the orchids under two tube units, I prefer the four tube units. Because the light from the four tubes over lap each other the end result is more than double the light produced. The additional light that they supply permits the grower to place the plants further from the lights (easier access for watering and handling) and will provide more light, especially in center of the tubes for the light-loving hard-leaved paphs and phrags.

The fixtures themselves come in a variety of types and styles. In most cases, the ones called "shop lights" are the cheapest and most readily available at hardware or home stores. If you choose these, make sure to get the ones with bright white, not gray reflectors, since they will make your lights more efficient. If you have older fixtures in which the reflectors have discolored over time, it is worth the effort to spray-paint them with glossy or flat white enamel paint. Oil based paints will stand up best to the moisture that the light fixtures will likely encounter. The even more ideal reflector is one that is mirrored. Units with this type of reflector are more expensive, but even more effective.

**Choosing Specific Lamps**

This is probably the most confusing and sometimes highly debated topic in light gardening. It can be difficult to distinguish between science and advertising hype by the various bulb producing companies.

Years ago the only real choice was cool white and warm white tubes. Some people still feel that a 50/50 mix of these tubes is the best option because they are bright and very inexpensive. Then Sylvania manufactured Gro-Lux® tubes that were designed to provide light that more closely replicated the spectrum of light that plants used in photosynthesis, the process that plants use to

produce their own food. This started a new race to produce the “best” plant bulb. The evolution of lamps has gone from the Gro-Lux® to “wide spectrum” types and now to the “full spectrum” bulbs. Reputedly the light cast by the full spectrum lamp most closely resembles natural sunlight. Viewed under these lamps, colors of the flowers are rendered more accurately.

For a better understanding of lamps being sold, it is helpful to define a few terms used by the manufacturers. Unfortunately, much of this information for each type of lamp or bulb is not commonly available at the hardware or home store. You need to check it out on the web sites of the various lamp producers.

**CRI**. This acronym stands for “Color Rendering Index”. It is on a scale of 1 to 100. One hundred is roughly the color of sunlight. The closer the bulb is to 100 the more “natural” the light and color of your flowers will look. Try to choose bulbs that have a CRI in the 90’s.

**Kelvin Degrees**. This indicates the color of the light emitted. This is determined by the powdery phosphors that are incorporated in the tube of the lamp. The lower the Kelvin number, the redder (warmer) the light; the higher it is, the bluer (cooler) of the light. This table lists a few of the most common lights with their various color designations, CRI ratings and color temperature, expressed in Kelvin (K).

| Numeric color code | Approximate Color | CRI | Color temperature (K) |
|---|---|---|---|
| 927 | Warm white | ~95 | 2700 |
| 941 | Cool white | ~95 | 4100 |
| 950 | Sunlight | ~98 | 5000 |
| 965 | Cool daylight | ~95 | 6500 |

Those tubes with called “sunlight” with a high CRI and color temperature of 5000-5500 are the closest equivalent to noon sunlight. These are the ones commonly referred to as “broad spectrum” or “full spectrum” bulbs and the ones promoted as most desirable for plant growing.

PAR (**Photosynthetic Available Radiation)**

This is a measure of the light’s relative efficiency in promoting photosynthesis. It is a more sophisticated way of measuring light that requires a special light meter. Even though this may be useful for professional growers, it is over-the-top complicated for the average amateur and is one less measure to worry about. All the lamps recommended will provide light very suitable for photosynthesis.

**Lumens and Foot-candles**

There is a lot of confusion between these terms. This quote from Craig Smith on eHow clearly explains the difference between them.

*“A ‘foot-candle’ is a unit of measure for quantifying the intensity of light falling on an object. A "lumen" is a unit of measure for quantifying the amount of light energy emitted by a light source. In other words, foot-candles measure the brightness of the light at the illuminated object, while lumens measure the power of the light radiated by the light source.”*

The higher the lumen rating of the bulb the brighter it is. See the chart below for comparisons.

| **4' Linear Florescent Bulbs** | **Lumen Output** |
|---|---|
| 28 Watt T5 | 2900 lumens |
| 54 Watt T5 | 5000 lumens |
| 25 Watt T8 | 2209 lumens |
| 32 Watt T8 | 2850-3100 lumens |
| 34 Watt T12 | 1930-2800 lumens |
| 40 Watt T12 | 1980-3300 lumens |

The relative amount of light a bulb produces for the energy that it consumes used is referred to as luminous efficacy. The higher the value, the more energy efficient the lamp is. The luminous efficacy of T5 lamps is about 100 lm/W, while those of T8 and T12 lamps are about 90 lm/W and 78 lm/W respectively.

The amount of light (lumens) produced is also related to the wattage of the bulbs. There is also some variation within each of these bulb types.

**How Much Light is Best?**

There are plenty of opinions on how much light slippers need to grow and flower well. One of the problems is that sometimes the recommended foot-candle range is made based on natural light in a greenhouse not under florescent lights. Greenhouse light intensity and color varies dramatically depending on the time of day, cloud cover, and time of year, latitude, etc. Florescent lights provide steady, constant illumination. For that reason, the amount of light intensity,

commonly measured in foot-candles with florescents can be quite a bit lower that that recommended for greenhouse growing.

Florescent lights for growing orchids are usually burned for 12 to 16 hours per day. Obviously this is longer than the average natural day length. The reason for this is that, generally speaking, florescent lights have a lower light intensity that that found by natural light in a greenhouse, so to compensate for this lower light intensity the duration of the light is increased.

Modestly priced light meters that are reasonably accurate can be purchased to measure foot-candles. If you decide to get one make sure that is has a reading scale specifically for florescent lights.

Recommended foot-candle range for slippers under florescent lights is from 500 to over 1000 foot-candles. This will vary depending on the type of slipper grown. Phrags and hard-leaved paphs require light intensities on the higher side, while the Maudiae types and most of the other types do fine in the lower range.

According to Mr. Bergman in his cited article on his light systems he read 1250 foot-candles 6" from the center 4 tube T-12 strip unit and 780 foot-candles at 12". Since 32 watt T 8's have a similar light output, so these values will be close. These light intensity levels are perfectly suited for slippers.

In general, the slippers should be placed with their foliage 4" to 6" from the tubes. Those requiring the most light should be placed in the center of the tubes.

Of course, the real test is how your orchids perform. If the foliage is too dark green and floppy, and the growth habit of the plant is not compact but "leggy", and if the orchids don't bloom on

schedule with flowers of good substance and size, then the orchids are not receiving enough light. If this is the case, they should be moved closer to the lights, moved to the center of the tubes, and/or have the duration of the lighting increased.. If the leaves are taking on a yellowish cast, indicating too much light, the plants can be placed further way from or on the ends of the tubes and/or the duration of the lights should be decreased.

**Floppy foliage like this indicates insufficient light**

**Cultural Tips**

1. Since the light intensity of under florescents can be lower than those found in many greenhouse, this can be somewhat compensated for by increasing the duration of light. On average lights can be burned 12-16 hours per day. Some growers vary the length of lighting depending on the natural season---a few hours shorter during the winter and few

hours longer during the summer. I have not found this to be necessary, since I have not noticed any of the slippers being sensitive to or requiring seasonal light duration changes.

2. The brightest light is under the center of the tubes. Keep this in mind when placing plants with various light requirements.
3. The modest heat from the tubes and ballast may cause a reduction in humidity. This can be an advantage in a cooler location. To conserve heat wrap three sides of the growing area with polyethylene.
4. Muffin fans, available at computer supply stores, are great for creating gentle air circulation around the plants.
5. Plastic light diffusion panels, sometime referred to as egg crate louvering, is a great material to insert in the growing trays under the lights so the plants that are suspended above the water in trays that have been filled with water to increase humidity.
6. Start replacing your lamps on a staggered basis your lamps every 12 months or so. Don't wait until they burn out to replace them. All of the lamps eventually degrade and start to lose their light intensity. This will be evident by dark rings forming at the ends of the tubes. When this happens you will be using the same amount of electricity to produce less light.
7. Keep the bulbs clean. They can quickly become coated with light reducing dust or sediment from watering.
8. Use ground fault outlets; electricity and water don't mix!
9. In multiple tiered light gardens the temperature can vary 5 degrees F from the top shelve to the bottom one. Keep this in mind when deciding the best spot to place your plants.

Maximum-minimum thermometers placed on the shelves are very helpful in determining what this temperature differential is.

**Multiple Tiered Light Carts**

One of the great advantages of florescent light setups is that they can be stacked in tiers. Commercially made, multiple-tiered light carts are highly versatile, space-efficient, and practical. Most of them are about 2’ wide by 4’ long so their three shelves provide 24 square feet of growing area. With compact and multifloral slippers this will be enough space to have at least one or more of them in bloom year around. For small growing species, it will provide a convenient growing space that is adequate for an entire collection. You can place the growing structure in a heated garage, in the basement or a spare bedroom.

**One of the author's light carts. Note the plastic egg crate louvering to support the plants above the water filled tray used for increasing humidity. Also the cart is wrapped in plastic to raise humidity and keep in the heat from the ballasts and lamps.**

For some helpful information on making your own multiple tiered light cart see the reference on-line article by Sherri Arnaiz.

**Recommendations**

I have grown orchids well under all types of lamps and fixtures, so there are many options that work. For those who want to have the flowers appear most naturally colored under the lights and don't mind paying a slight premium for the lamps I would recommend:

**A four-tube fixture, with a white or mirrored reflector and with an instant start electronic ballast (that will save you electricity). Purchase 48", T8, 32 watt lamps or tubes with a Kelvin temperature between 5000 and 5500 (wide spectrum) with a high CRI (in the 90's) with high lumen output.**

The most economical and still satisfactory pick is the 50/50 ratio of warm white to cool white lamps. If you have some natural light supplementing these artificial lights this combo will work very well. A compromise in terms of economy and light quality would be a blend of 1/4 warm white, 1/4 cool white and ½ wide or full spectrum lamps.

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