The Enlightened Way

Text and Photographs by Ernie Gemeinhart

Growing Orchids in Two Areas Expands Options for Success

EVER SINCE I BEGAN GROWING orchids, I've dreamed of having a sizeable state-of-the-art greenhouse. I'm sure we've all had that dream at some point, but my circumstances have thus far prevented mine from materializing. In many moments of clarity, I've realized how lucky I am to be an under-lights grower. Having precise control over your growing conditions is a luxury greenhouse growers don't usually enjoy; especially in the Midwest. So, many times, the mental image of the ideal greenhouse gets replaced by a spacious basement with plenty of power outlets, a floor drain and a thick coat of cement sealer.

With current utility prices, I'd be curious to compare the running costs of my operation with those of a greenhouse with comparable bench space. Light is free for greenhouse growers. Their major expense in our area of the world is heating. My major consumer is, of course, electricity for running the lights. I'd like to think the difference of utility appropriation balances out between the greenhouse and lights grower, but I am not sure the truth needs to be elucidated … it's a hobby; it's supposed to be expensive.

My reason for growing under fluorescent lights is simple: startup costs are comparably small compared with other types of lights, and with fluorescents, I can grow three-dimensionally, utilizing space from wall to wall and floor to ceiling. High Intensity Discharge (HID) light gardens are usually two-dimensional and the ballasts and bulbs emit a considerable amount of heat. Additionally, the types of plants I like — phalaenopsis and paphiopedilums — don't need terribly bright light to bloom. When considering your light garden, be grounded as to the limitations of your setup. I'd be unrealistic to attempt growing light-loving orchids such as full-size vandas, so I take lots of pictures of them at shows.

At the moment, I grow orchids in a spare second-floor bedroom and in an insulated portion of the garage. In the summer, a handful of my orchids go outside, but this can be a dangerous move because that freed-up bench space rarely remains vacant. Most of the orchids I keep are intermediate to warm growers, so I maintain winter nighttime lows at or above 55 F (13 C). In the summer, I try to get down to 65 F (18 C) at night. Daytime high temperatures are usually about 75–80 F (24–26 C) in winter and 84–88 F (29–31 C) in summer. I aim for as much humidity as possible without creating a stale environment; about 40 percent is average. The challenges to reach these basic conditions in each of the indoor areas are different, and I've constantly made adjustments to overcome them — or at least to minimize their negative impact.

ABOVE Shoplight fixture with alternating warm and cool white 4-foot (1.2-m) long 40-watt bulbs. The bulbs are dated with the installation date and are replaced in rotation (not all at once) after 12 months of operation.

THE SECOND-FLOOR ROOM It does not need to be heated in winter because the lights generate heat, but it gets warm in the summer. To create a breeze, 20-inch (50-cm) box fans run continuously. Two fans aim into opposite corners of the room, forcing air up along the ceiling and gently down evenly around the plants to cool the leaves. A ceiling fan would do equally well.

Humidity is an issue, being low in the summer, but making the windows weep in winter to the point of forming monstrous icicles outside. Pans of water in front of the fans mentioned above add a small amount of humidity while cooling as the water evaporates. In late autumn, shrink-to-fit plastic window insulation is installed to eliminate condensation on the windows. I use ionic air purifiers to discourage mold, fungus and bacteria.

The room is carpeted, necessitating extreme care when watering. Shelves are about 18 to 20 inches (45 to 50 cm) from the walls to prevent water damage from overspray.

Chemicals sprayed quickly seem to fumigate the rest of the living space. No harsh chemicals are used in this room, so pest and disease prevention is critical. Soaps and oils are the first lines of offense when critters are detected. They do work when used properly. Good culture generally discourages fungal and bacterial infections.

THE GARAGE This area requires heating in winter. Two-inch (5-cm) styrofoam insulation is effective, and the lights throw off a decent amount of heat during the day. An electric heater (and a backup on a different circuit) maintain temperatures at or above 55 F (13 C) at night. Automatic overheat reset is a must on such heaters. Most of the more common portable household electric heaters do shut off if they become too hot, but not all of them restart automatically once they reach a safe operating temperature. Verify that the one you choose will restart without your being present. The garage grow-room demands cooling in summer. A 20-inch (50-cm) box fan mounted in the wall opposite the door blows air outward, and the door is propped open. On hotter days, the door is propped open only a couple inches. Air forced through the smaller opening is cooler. On more moderate days, the door is completely open to simply allow air of ambient temperature to circulate through the enclosure. The door and floor of the area are dampened for cooling and humidification.

Humidity is easy to maintain through damping down as mentioned above. Watering is less precise as far as aim is concerned because it is not living space. Sprayed chemicals for pest and disease control are more easily tolerated because there is some segregation from the living space.

LIGHT GARDEN SETUP The design had to be simple yet reliable, and construction had to require only rudimentary tools because our modest home does not have the space for the coexistence of both an extensive orchid collection and large power tools.

Generally, the basic setup of the two areas is similar. I use 2-feet-wide by 4-feet-long (60 × 120 cm) industrial, metal-framed shelving units with particle board shelves. The shelving beams are installed counter to the manufacturer's instructions, such that the shelves sit down inside the well made by the inverted beams instead of on top of them. The shelves are then lined with double layers of 4-millimeter-thick clear plastic sheeting and secured in place with clear heavy-duty packing tape. Seems primitive, but it's a reliable cost-effective method. Some long-term caution is necessary so as not to damage the plastic. Black plastic was considered, but avoided because it does not allow you to visually detect leaks. The waterproof trays formed make great reservoirs so plants can be watered in place, and they provide local humidity as the runoff water evaporates. To the tray, I add some sort of risers that will support egg crate light diffusers several inches from the tray bottom. The risers I use include inverted 10 × 20-inch (25 × 50-cm) lattice flats, trimmed plastic cups, PVC pipe sections, inverted plastic Azalea pots, etc. The idea is to hold the plants above the reservoir without letting them sit in water. Egg crate is available inexpensively in the lighting or ceiling tile section of most hardware stores and conveniently comes in 2 × 4-foot panels that match the shelf dimensions. It is easily cut with heavy shears if needed. In the future, I intend to switch to either commercial plastic trays or sealed custom wood trays with drains. Metal eyelets are screwed into the underside of the shelves above, or the ceiling for the top shelf, provided you are tall enough to reach there, to hold chains supporting fluorescent shoplight fix-tures. I recommend a minimum of four 40-watt bulbs above each shelf giving a minimum of 20 watts per square foot of bench space. With this simple setup, you'll be off and running in no time.

FLUORESCENT LIGHT GARDENS The cultural factors under-lights growers must consider are identical to those faced by greenhouse and windowsill growers: light, temperature, water, humidity, air, repotting, pest and disease control and nutrition. What's unique about growing under lights is the myriad approaches growers use to confront challenges.

Regardless of where one grows plants, the most important idea to remember, and the one that took me longest to comprehend, is that all of the conditions you provide for your plants are interconnected. Temperature is a clear example. If you do something to increase the temperature in your grow area, all other cultural considerations are affected as follows:

◆ At higher temperatures, bright light becomes damaging to plants, so precautions must be taken to cool leaves in order to prevent burning.

◆ Water evaporates from pots faster at higher temperatures, and plants more actively "drink" water from the pots as their metabolism increases with temperature, both factors dictating more frequent watering.

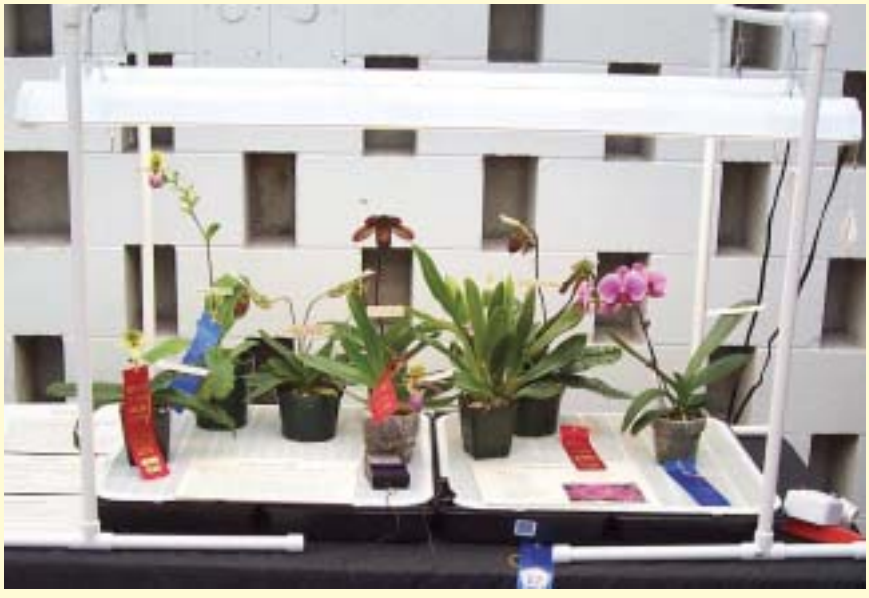
◆ As water is now applied at more frequent intervals, it evaporates from the pots and surrounding structures, thus increasing humidity. Depending on how long the humidity increase lasts, it may call for decreased pot-watering frequency.

◆ More air movement and additional fresh air will help keep leaf surfaces cooler, thus possibly preventing leaf burning and refreshing still, humid air, thus preventing stagnant conditions that harbor fungus and bacteria. Excessive air movement around pots will dry plants rapidly, demanding more frequent watering or higher humidity.

◆ Increased watering frequency and humidity described above may necessitate more frequent repotting as organic mixes will break down faster under wetter conditions. Alternatively, one could reconsider the choice of potting media ingredients or media component size.

◆ When plants are growing optimally, the conditions are usually

A Sample Light-Garden Setup



THIS educational display was set up for a local orchid society's show to demonstrate how easy and inexpensive it can be to construct a functional fluorescent light garden. Here, the frame was built with Schedule 40 PVC pipe, which is light weight, inexpensive, readily available and easy to cut. A timer turns the lights on and off automatically. The humidity trays are doubled-up 10 × 20-inch (25 × 50 cm) seedling flats. The grids over the trays are from inoperable box fans. The components of the light garden (excluding plants) cost less than $70. This unit took less than one hour to construct. Note that the lights are higher than recommended to allow the flowers to be displayed. Similar light stands can be constructed from wood or metal. — *Ernie Gemeinhart.*

ABOVE One shelf of a complete fully populated light garden. This unit holds four such shelves of plants.

equally optimal for pests, possibly requiring increased monitoring.

◆ Higher temperatures generally increase plant metabolism, possibly indicating increased fertilization rates or frequency.

CONCERNING LIGHT All of the cultural conditions mentioned are universal for orchid growers. Discussions on various potting materials and techniques, water chemistry and nutrition and pest and disease control are numerous. As such, I shall concentrate further only on artificial light and lighting systems to keep in focus of the main topic of this series. Specifically, light intensity, quality, and day length and how they apply to standard fluorescent lighting.

INTENSITY Light intensity is likely the most limiting factor for growers utilizing fluorescent lights. I use and recommend a minimum of four 40-watt, 4-foot, T-12 fluorescent tubes suspended less than 10 inches from the leaves. This typically gives enough light to grow and flower low- to medium-light-requiring plants such as paphiopedilum and phalaenopsis. I reliably bloom and rebloom multifloral paphiopedilums and miniature and compact cattleyas under such lighting. Bulb choice is important. Many growers have contacted me about energy-saving fluorescents: 32- to 34-watt, 4-foot (1.2-m) bulbs called T-8s. My recommendation is to really pay attention to bulb packages to make an informed decision. Light output is usually represented on bulb packages as lumens. Less commonly, foot-candles or lux are used to represent light output. Regardless of the unit, the more the better. A 32-watt bulb may produce more lumens per watt, but you are concerned with the overall output of the bulb. You might find 32-watt tubes at your neighborhood hardware store with a higher output than locally available 40-watt tubes. Use them. There are certainly online bulb vendors as well, but take into consideration the cost of shipping and handling for a certainly oversized and fragile package.

If you want to bloom orchids with higher light requirements, you can 1) place plants toward the middle of the fluorescent tubes where output is greatest, 2) get plants closer to the lights by boosting them up, 3) get the lights closer to the plants by lowering the fixtures, 4) add additional fixtures or 5) consider a lamp type with higher output such as longer T-12 fluorescents (8-foot [2.4-m] tubes), specialty 4-foot T-12s such as VitaLite PowerTwist bulbs, T-5 fluorescents, power compact or high output (VHO) fluorescents marketed for coral reef aquariums, or high intensity discharge (HID) (metal halide and high pressure sodium). Note that T-5s, power compacts, VHOs and HID bulbs require specific fixtures and ballasts and cannot be used in traditional shoplight fixtures.

Pay attention to the growth habit of the plants you choose too. Cymbidiums and zygopetalums are usually poor choices for fluorescent light gardens because the leaves are long and upright. Light intensity decreases rapidly as distance from the bulb increases, so for upright plants, only the tips of the leaves may be actually receiving the desired amount of light. With this in mind, bifoliate cattleyas, which appreciate bright light, do surprisingly well for us because the leaves are essentially horizontal and the entire upper leaf surfaces are exposed to maximum light.

Output intensity from standard T-12 fluorescents is fairly steady for about one year after installation. After that, bulbs should be replaced even if they still fire up. I rotate replacement so as to keep a fairly constant output intensity year round. Mark installation dates directly on bulbs with a permanent marker. If the plants you grow appreciate a seasonal shift in light intensity, by all means adjust your lamp replacement schedule to their advantage.

LIGHT QUALITY Plants have green leaves for the most part. This tells us that they reflect green light back to us and keep the other colors for themselves. The sun produces bright light in the entire spectrum, so greenhouse growers do not worry about light quality. Under-lights

Lumens vs. Foot-Candles vs. Lux

FOOT-CANDLES and lumens are usually used in the United States. One foot-candle (fc) is the amount of light one candle will cast on 1 square foot of surface. A lumen is a point measurement of foot-candles. Lux is the amount of light a candle can shed on a square meter of area. Because a foot (12 inches) is approximately 30.5 cm, 1 square foot is 144 square inches or about 930 square centimeters. A meter, slightly longer than a yard, is 100 cm, so a square meter is 10,000 square centimeters, or about 10 times more area than a square foot. Thus, 1 lumen is approximately 10 lux; more applicably, 1,000 lumens is equal to about 10,000 lux. — *Ernie Gemeinhart.*

Construction of an Inverted Shelf to Form a Water Reservoir

Step 1 Using keyhole and pin-type shelving is crucial for inverted construction.

Step 2 An unlined shelf (shown) is lined with a double layer of plastic.

Step 3 Once the shelf is lined with plastic, position improvised risers.

Step 4 Place the egg crate light diffuser on the risers.

Step 5 The completed shelf with egg crate grid is ready for plants.

Step 6 Finished, although the lights have not been dropped to the desired height (less than 10 inches [25 cm] above the leaves).

growers, however, should concentrate on providing red and blue light because these two colors are the most photosynthetically active; plants use these colors efficiently to grow and bloom. A lamp can have an extremely high lumen output, but if the emitted light is primarily green, little of it is actually useful to the plants. You are putting your electricity dollars into providing light your plants cannot use. Bulb companies have conducted plenty of research to design and manufacture superb horticultural bulbs. They work effectively and do what they are supposed to. I seem to get great results using warm and cool white fluorescent tubes alternated in equal numbers.

Warm white bulbs provide light strong in red output for flowering; cool white bulbs emit light with a primarily blue color for general growth. If you cannot find bulbs specifically labeled warm or cool white, watch for the bulbs' "temperature" in Kelvin (K). Warm white bulbs are rated at about 3,000 K; cool whites at about 4,100 K.

Another aspect of artificial light quality is color rendering index, or CRI. This tells you little about the intensity of the emitted light or the quality as far as the plants are concerned. It gives you only an idea of how plants and flowers will look under that particular bulb. A CRI closer to 100 will represent colors true to natural noonday sun. Many bulbs have a CRI between 60 and 75, meaning flowers may look off-color under the bulb, but they will look normal under natural light. Do not let CRI affect your bulb choice unless you intend to use the bulb to show off your collection. I've noticed that alternating warm and cool white tubes as described above gives a fairly natural color rendering even when the individual bulbs have low CRIs.

DAY LENGTH Finally, your day length, or photoperiod, should be determined by the plants you grow. Because I grow tropical orchids, it would be unreasonable for me to expose them to the extreme, seasonal, variable day lengths experienced naturally in the northern Midwest. Get to know your plants. Some cattleyas, for instance, are very day-length sensitive and require specific seasonal shifts for proper growth and blooming. In my mixed collection, I have good success providing between 14 and 16 hours of light year round. Running bulbs longer than 16 hours daily seems to give no added benefit for growth or flowering, only higher power bills.

Once you understand the basic concepts of light intensity, quality and duration, use your creativity to design a grow area to suit your needs and budget.

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