Orchid Culture — Part 4 — Light and Temperature

Text by STEPHEN R. BATCHELOR

Undeniably, light has a vital role in plant life. By means of photosynthesis, plants convert light energy into the stored chemical energy of sugars and starches. These energy (or food) reserves are then released through respiration for use in maintenance of existing tissue, growth, and reproduction. A proper balance between photosynthesis and respiration is essential if a plant is to grow and flower well.

IN THEORY

The goal of the orchid grower, like that of our modern world, should be to encourage energy production while at the same time minimizing energy use. Higher light intensities of longer duration can be given to a plant to increase photosynthesis and energy production. Because it is greatly influenced by temperature, while photosynthesis is not, respiration can be slowed down by lower temperatures to a rate at which energy release is less than the rate of energy production. This allows for some accumulation of reserves for future needs — such as flowering.

This explanation, though certainly theoretical and oversimplified, is very much reflected in contemporary orchid-growing experience and practice. Orchids are well known to need a certain minimum amount of light to flower. Best flowering generally occurs under higher light intensities of longer duration. These are conditions which (other essentials well provided) lead to a greater accumulation of the food reserves needed for flowering. At the same time, high-light conditions may tax an orchid's light tolerance. Standard recommendations for temperature call for conditions at least 10-15°F (5.5-8°C) cooler at night than during the day, with the restriction that temperatures not be much less than 45-50°F (7-10°C) or more than 90-95°F (32-35°C) for any prolonged period. The consensus seems to be that a daily range of 55-75°F (13-25°C) is generally the most ideal. Cooler temperatures at night, when respiration continues while photosynthesis does not, slows down the rate of energy expenditure, keeping it apace with the production of energy reserves during the day.

LIGHT AND TEMPERATURE TOLERANCE

Many orchids can tolerate temperatures well down into the 40's F (4-10°C), even into the upper 30's (3-4°C), without significant damage, but at these temperatures both respiration — and growth — occur at a snail's pace. At or near the freezing point, severe damage can take place, ice crystals acting like countless, tiny knives in susceptible plant tissue. Anyone who has had the misfortune of having their orchids exposed to freezing temperatures, or, to a less disastrous extent, has had a leaf come into contact with the icy surface of exterior glass in the wintertime, knows the horrible result. The dying tissue usually becomes soft, limp, and black. Towards the other extreme, many orchids can withstand temperatures well into the 90's F (low 30's C) for some time. Hobbyists nearly everywhere, particularly in the summer, can't help but believe this! The "thermal death point" for cattleya leaves, for example, has been determined to be around 110°F (43°C), but this depends on the duration of exposure and other considerations. The actual temperature of the plant tis-

sue itself is the real concern, and one deciding factor, besides ambient temperature, is light.

ABOVE, Freezing temperatures in a South Florida shadehouse caused the bleached and sunken areas on these Ascocenda leaves. Photos: Greg Allikas
BELOW, In contrast, the necrotic patches on this Rlc. Goldenzelle is a result of searing greenhouse temperatures induced by high light intensities. The hard and rough feel of this dead tissue distinguishes it from the soft, limp character of recently frost-damaged, succulent tissue. Photo: Greg Allikas

"Light is more often than not the limiting factor in the orchid environment. Or, perhaps, one should say increased greenhouse air temperature and increased leaf temperatures by light are limiting, not light per se." (Withner, 1964) All of us are familiar with this phenomenon, having been outside on a sunny day. Sunlight can warm orchid leaves far above the temperature of the surrounding air, as it does us.

So while the air temperature on a sunny, warm day may not seem too extreme for orchids, the combination of warm air temperatures and solar heating can in no time bake an unprotected plant. The resulting heat build-up in the exposed tissue causes scorched patches to develop, which blacken with continued overexposure. This of course should be avoided, as it reduces an orchid's food manufacturing ability — and is persistent and unsightly.

ORCHID RESPONSES

Short of cooking or freezing to a lifeless, black mess, orchids have characteristic responses to light and temperatures shy of intolerable. Being highly adaptive plants, they can, after a period of gradual adjustment, tolerate a wide range of conditions. In general, orchids become shorter and stockier if given higher light. Leaves under these conditions frequently become less green, more yellow, and may even become reddish. Growing pseudobulbs and flower stalks are known to exude a sugary substance under such bright situations. The most desirable high-light reaction, though, is increased flowering (assuming that other factors in growth are kept fairly in balance). On the other hand, lower light intensities cause a general elongation of plant tissue. Orchids will not only become somewhat more extended under low light, but less robust. Leaves tend to become greener. Flowering will decrease, or not occur at all, as a consequence of the decline in photosynthesis and a dwindling of the energy reserves it provides.

Flowering is also likely to be poor under high temperatures, but for a different reason. Particularly at night, warm temperatures can cause respiration to occur at such a quickened pace as to outrun the rate of photosynthesis during the day. This can lead to a depletion of energy reserves, in turn bringing about a decline of vigor, and poor, erratic flowering. Towards the opposite extreme, low temperatures, in part by slowing down the respiration rate, can slow growth and delay flowering.

***C. trianaei* 'Mary Fennell' HCC/AOS is encouraged to bloom when days get shorter in the autumn. Early growers of cut flowers would use day length to control flower production to coincide with holidays and periods of peak demand. Photo: Greg Allikas**

FLOWER INDUCTION BY DAYLENGTH AND TEMPERATURE

Flowering can be affected by daily light duration, or photoperiod, as well. Certain orchid species appear to be sensitive to day length (or, rather, the duration of uninterrupted darkness). For example, a number of *Cattleya* species (*C. labiata, C. mossiae, C. trianaei*, and others) have been found to be encouraged to flower by "short days" and discouraged from flowering by "long days". Other *Cattleya* species in contrast (including *C. dowiana, C. intermedia, C. granulosa*] are considered by some to be "long day" plants, tending to initiate buds during longer daylight periods. At the same time, however, many of these same species declined flowering, regardless of day-length, when subjected to night temperatures no lower than 65°F (18°C). A minimum night temperature of 55°F (13°C) was frequently necessary for any flowering. This phenomenon in orchids seems neither independent of temperature, nor clearly understood. The majority of orchids commonly grown have not been properly tested, though a great many hybrids appear to be "day neutral", flowering at no particular day or night length.

A number of orchids also tested, while insensitive to daylength, were found to be "low temperature responders", flowering only after a night temperature of 55°F (13°C) or less had been provided for a period of time. Several cymbidiums, dendrobiums, and a *Paphiopedilum* species have been put into this category. For a survey of the rather scanty information on the subject of flower induction by photoperiod or temperature, see REFERENCES: Rotor, 1959; Arditti, 1966, 1967.

ABOVE, The plant on the left has received adequate light and is producing the expected number of flowers. The plant on the right has not received enough light to produce any flowers. Both are the same clone of *C. intermedia*. Photo: Greg Allikas

IN PRACTICE

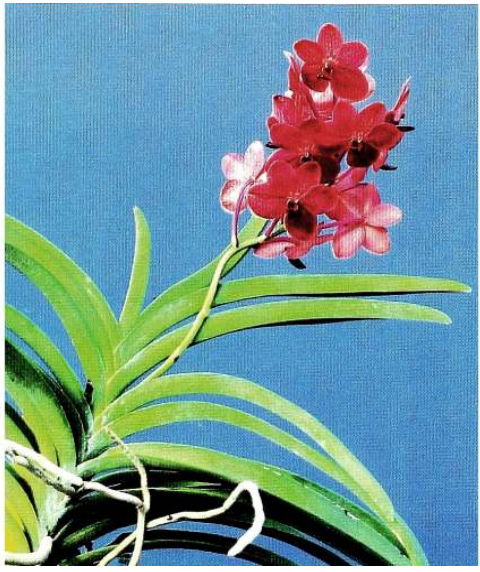
Light and temperature tolerance are terribly conditional characteristics in orchids. Both the inherent tendencies of a species and its hybrids, and the conditions in which the plant is grown, are determining factors. For example, a species which has evolved in a natural environment characterized by high light intensity (such as exposed rock, open meadow, or the upper branches of trees) will of course require higher-than-average light intensities to flower properly in an artificial environment, as well. Even so, that very same species could actually burn in culture under the same light intensities encountered in its habitat, if, for instance, the surrounding air is hot, dry and stagnant. The growing environment of any plant, whether it be out in the wild or in the relatively tame surroundings of the indoors, is a result of the complex interaction of multiple factors. No one factor is free from the influence of another. Light and temperature, as apparent from this discussion, certainly are not.

In this regard, guidelines found in the literature indicating light and temperature (as well as other) needs of the various genera are approximations at best, and cannot take into account the strong influence of other factors in an individual's particular growing environment. A beginner's only recourse, once these general guidelines have been followed, is to closely observe the responses of his plants to their total environment, and to act accordingly.

To act accordingly begins with an understanding of how orchids respond to varying conditions. The review of temperature and light responses provided here comes largely from personal experience; similarly a beginner's own experiences will be his ultimate — and most convincing — teacher. To respond properly once you have perceived that your plants are "unhappy" requires an "intuition" also developed through experience. Nevertheless, the experiences related by others are of some help.

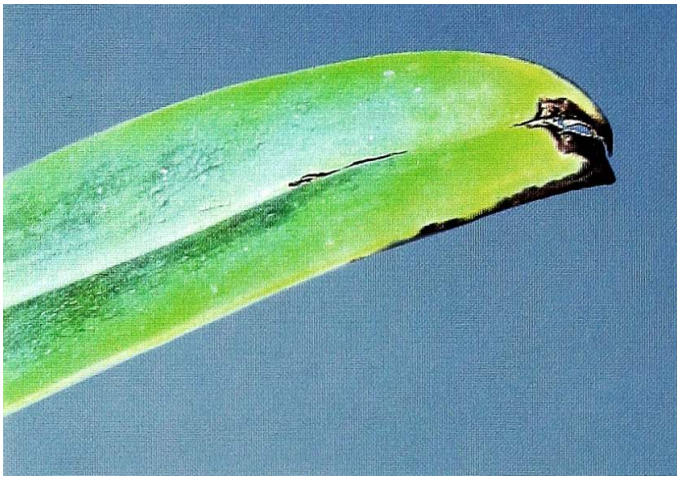
This *Dendrobium capituliflorum* reacts to high light by taking on a reddish cast of anthocyanin. For someorchids, this is an indicator that the plant is receiving the proper amount of light. Photo: Greg Allikas.

Too much light, causing the obvious response of varying degrees of burning or stunting, can be fairly easily remedied by shading. Growers outdoors or in greenhouses usually cannot do without some shading, especially in the summer. Those who grow orchids in windows only occasionally are faced with too much sunlight, but burning can be more insidious under these conditions. Windowsill hobbyists who are not careful to observe all sides of their plants, and to rotate them periodically, may discover to their dismay (as I did, with the ascocenda pictured in Part 2 of this series) that while the side of the plant facing inward may show no signs of light stress, the less apparent — and most exposed — side facing the window may be cooking to a crisp. Regular rotation of plants will prevent this — and lopsidedness, since orchids grow toward light. It is best not to disturb a plant while in spike, however, so as not to confuse the orientation of the flowers.



The temptation, once a spike has opened, naturally towards the window and away from the windowsill grower, is to turn it around to enjoy the flowers. If left in the window, a contorted spike can result, as in the case of this *Ascocenda* Mangkiatkul. Orchids in flower should be removed and enjoyed away from direct light to avoid this difficulty. Photo: Stephen Batchelor.

Window areas which receive few hours of direct sunlight a day may bring about the low-light response of weakened growth and poor flowering. Summering outdoors can compensate for this somewhat, but growers under these limitations might be more satisfied with a selection from the lower-light-requiring genera, over those more demanding. If flowering by these more light-tolerant genera is still unacceptable under these conditions, then the wisest action would be to grow under lights. Good flowering of the low-light genera under lights is well substantiated.



Leaf-tip die-back on this paphiopedilums grown under lights was a problem associated with high temperatures at the former A.O.S. Cambridge office. Photo: Stephen Batchelor.

Providing the recommended growing temperatures can present even more of a challenge to the indoor grower. During the winter months, adequate heating need only be given to keep day and night temperatures from going below the beneficial range. Most hobbyists, in these times of high heating costs, are more than happy to allow night temperatures to fall into the 50's F (10-15°C) in their homes! (Energy conservation can be taken too far with orchids, however. While warm-blooded humans can survive, albeit perhaps not happily, with a sweater or two in temperatures never crawling above 50 or 55°F, most orchids may only persist in a state of suspended growth. On sunny days, though, sunlight again will go far in warming the plants.) On the other hand, achieving these same temperatures, indoors or outdoors, in the summertime during a heat-wave may be out-of-the-question in most parts of the country. Higher light intensities and longer days can compensate for the resulting increase in the respiration rate at night by increased food production during the day — for those who grow in windows, greenhouses or outdoors and depend on natural light. But those who grow under lights cannot vary their light conditions considerably, and some decline can be noted in plants under lights which are subjected to nighttime temperatures no lower than the high 70's F (25-26°C).

Here at the Cambridge office, a protracted hot spell last summer during which nighttime temperatures did not fall below 80°F (27°C) for days on end (the sunshine through our abundant window area causing a tremendous build-up of heat, despite the airconditioning) caused the paphiopedilums especially to suffer. Leaf tips, even on newer leaves, began to brown and die back (a symptom which ceased with the cooler late-summer, early-fall weather). And even though the plants en-

dured the heat with fairly good new growths which matured and produced sheaths in response to the cooler weather that following fall, flowering was poor during the winter, nearly half the buds blasting in sheath. No wonder many grow under lights in basements not so subject to these extremes!

All orchid growers are occasionally faced with conditions, particularly those of light and temperature, largely out of their control. Even while this can be the case, other important factors in orchid culture — water, nutrients, air movement and, to a lesser extent, humidity — are very much subject to the discretion of the grower. Provided with care, they can help compensate for, or lessen the negative impact of, other inadequacies or excesses in culture. These other vital aspects in orchid growing will be considered in the next article for this series. — *84 Sherman Street, Cambridge, Massachusetts 02140.*

REFERENCES

Arditti, Joseph. 1966 and 1967. **Flower Induction in Orchids, I and II**. *The Orchid Review*. 74: 208-217; 75: 253-256.

Northen, Rebecca Tyson. **Control of Flowering in Cattleyas**. in *Home Orchid Growing*, Third Edition, pages 65-70.

Rotor, Jr., Gavino B. 1959. **The Photoperiodic and Temperature Responses of Orchids**, in *The Orchids — A Scientific Survey*, Carl L. Withner, Editor, Ronald Press Company, New York, pages 397-417.

Withner, Carl L. 1964. **The Importance of Light for Orchid Growth**. *Amer. Orchid Soc. Bull.* 33: 218-220, 284-285, 372-373, 579-581.

Withner, Carl L. 1974. **Developments in Orchid Physiology**, in *The Orchids — Scientific Studies*, Carl L. Withner, Editor, John Wiley & Sons, New York, pages 150-153.