Control of Flowering in Orchids

Marilyn H. S. Light
Adapted from a presentation to www.orchidsafari.org in November 2002

See archives at http://www.geocities.com/brassia.geo/OSTA.html

Plants use light to control many life processes including flowering but the induction of flower production in plants is incredibly complex and parts of the puzzle still remain a mystery. Flower induction was once thought to be regulated via plant nutrition. When nitrogen levels were high compared to carbohydrate production, the plant remained vegetative but when the ratio was reversed, this led to flowering. This theory fell by the wayside with the discovery of photoperiodism, the process whereby plants controlled the onset of flowering according the length of day. Actually, it was the length of uninterrupted dark period which was implicated and the sensing mechanism was found to be in the leaves. Plants can sense the day length through a complex pigment-based system effective in the red-far red parts of the light spectrum. The process is very sensitive and plants can be manipulated to bloom in time for specific events through manipulation of the day length. Recently, the genetic approach has been used to elucidate the role of genes in flowering induction in non-orchids such as *Arabidopsis*. This is proving useful in unravelling the mysteries of the process but there is clearly much for us still to learn and understand.

With orchids as with related monocotyledonous plants such as tulips and lilies, growth is initiated in special tissue (meristem) located at the base of the shoot bud. It is important to note that in monocots, unlike dicots, what forms in the shoot bud is what later expands to form the entire shoot including leaves, flowers and pseudobulb. The entire embryonic shoot is encapsulated in the shoot bud. Parts may not yet be fully constituted but they are formed months before they expand into mature parts. If you slice open a tulip bulb before fall planting, you will find the flower bud and leaf initials waiting to be released from their sleep. The same goes for a *Cypripedium* overwintering bud or even a shoot bud found at the base of a *Cymbidium* pseudobulb. Slice the bud vertically and you will find the structures that will later expand and grow when the bud begins to expand. Months before flowers even appear, the process of flower induction has already happened. If conditions were not appropriate for flower bud formation at that time, flowers will not be produced no matter what fertilizers, light or temperature treatment is provided later on. However, even if embryonic flower buds have been produced, a grower misstep could cause the buds to cease development. The presence of flower buds in the shoot bud does not necessarily guarantee future blooms but without buds, flowering cannot happen.

There are several factors controlling flowering in orchids. These are plant nutrition, photoperiod and temperature. Not all mature orchids are affected similarly by these factors so we will generalize.

Age of plant - Plants are termed juvenile and adult. There can be a short transition between these stages as in *Psygmorchis pusilla* where flowering can happen within a year of seed germination, or there can be a very extended juvenile period as we see in some Cattleyas and Cypripediums where ten or more years before reaching blooming size is not uncommon.

Nutritional status - Plants have evolved mechanisms whereby they can control reproduction until they have sufficient resources to support flowering and fruiting. Nutrient concentration of particularly nitrogen and phosphorus in roots and pseudobulbs may have to be in a particular ratio in order to cause one or more hormone signals to initiate flower induction. Generally speaking, nitrogen concentration must be low in contrast to phosphate concentration which must be high. But, the relative supply of carbohydrate reserve may also be important in certain orchids such as *Cymbidium*.

Light and Photoperiod - For an excellent presentation of this subject, I suggest the following:
http://www.biologie.uni-hamburg.de/b-online/e30/30.htm

Not all orchids are sensitive to day length and this is irrespective of where there natural range may be. Day neutral species bloom year round without any clear flowering season but they may bloom in harmony with weather conditions and seasons. There are short day species such as *Cattleya bowringiana* which bloom as the day length shortens (the dark period lengthens). Other genera in this category include *Oncidium*, *Miltonia*, and some Paphiopedilums. Healthy, mature short day specimens will not flower if they are not provided with 12 hours of uninterrupted darkness over several weeks to months before the usual blooming season. A daylength signal is perceived by a receptor system found in the foliage. The signal is in the red-far red light range. Moonlight will not affect short day plants but incandescent street light or even a short bout of flashlight every night can disrupt the sensing mechanism. There are orchids such as *C. aurantiaca*, and *C. skinneri* that bloom on the lengthening days of spring.

Temperature - Temperature, particularly at night, can influence flowering in many orchids. In *Phalaenopsis schilleriana*, too high a night temperature will override the flower induction process. In *Phal. schilleriana* and similar heat-sensitive, spring-blooming Phals, inflorescences may form but no flower buds will appear if the temperature has been too high. Instead, vegetative offsets or keikis will be produced either at the tip of the spike or elsewhere in place of flowers. A night temperature below 20C (68F) is needed to ensure reliable blooming. We see similar keiki formation in *Dendrobium* which may also be related to mixed signals arising from both inappropriate temperature conditions and carbohydrate status. Recently, investigators working with *Cymbidium niveo-marginatum* have looked at the various mechanisms controlling flower induction in this species. The goal is to see if we can speed up flowering such that plants could be propagated long before they would normally bloom for the first time. Where the usual interval is 4 to 7 years for this species, manipulation by various physical and chemical means induce early flowering in 90 days. The investigators found that a combined treatment of hormones, restricted nitrogen supply with phosphate enrichment, and root removal forced the Cymbidium plantlets to change from vegetative growth to flowering.

To read more about this interesting work, look for this article in a local university library.
Kostenyuk, I. et al. (1999) Induction of early flowering in *Cymbidium niveo-marginatum* Mak *in vitro*. Plant Cell Reports 19: 1-5.

For those of faced with reluctant bloomers, there are several possible options.

If the plant is an adult, grow it well, ensuring that there are adequate reserves to support eventual flowers.

Manipulate nutrient levels in the months prior to expected blooming. Restrict nitrogen while increasing light and phosphate fertilization.

You will not want to prune roots but you can manipulate the plant system by restricting water supply. When roots are no longer actively growing, movement of plant reserves will be limited.

Ensure that you vary the daylength exposure over the year. Twelve hours continual darkness in winter and 8 hours continual darkness in summer is a reasonable goal.

Assess the night temperature range in your growing area. Use a minimum/maximum recording thermometer. Some orchids will not flower unless the night temperature is below 68F (20C) or even lower for several weeks to months before expected flowering.

Control of flowering in orchids is a fine balance of many factors. Once you have found a winning formula for a particular plant, take careful note for future reference and share your findings with others..