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Production of Chlorophyll in the Floral Segments of Orchidaceae.

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ABSTRACT

Orchidaceae, which have prepollination and postpollination chlorophyll in the floral segments, are examined. The importance in the life cycle is discussed.

The cost of reproduction is a compromise in the allocation of resources; current reproduction can have a negative effect on future reproduction and plant growth (Fox & Stevens, 1991; Reekie & Bazaz, 1992; Mendez & Obeso, 1993). The cost of reproduction can be low to the plant if it has photosynthetically active reproductive structures (Antlfinger & Wendel, 1997).

The postpollination production of chlorophyll in the floral segments of orchids is a rare occurrence. It has been reported in few genera. *Phalaenopsis* species of the section *Zebrinae* Pfitzer and several hybrids have been reported to produce chlorophyll in the floral segments as a postpollination phenomena (Tran et al., 1995). *Phalaenopsis lueddemanniana* perianth segments do not wilt, they become fleshy, turn green, and lose nonchlorophyllus pigments that are present in unpollinated flowers (Curtis, 1943; Duncan & Schubert, 1943; Ringstrom, 1968). Brazilian species of *Miltonia* have also exhibited this phenomena (Hayes, 1968). Arditti (1979) reported the greening of the perianth segments in *Menadenium labiosum* (Rich.) Cogn. (*Zygosepalum labiosum* (Rich.) C. Schweinf.). The sepals of *Cymbidium* hybrids (Dueker and Arditti, 1968), of *Paphiopedilum leeanum* (Kirichenko et al., 1989) and capsules of *Laeliocattleya* hybrids (Dogane &Ando, 1990) were all found to contribute to the carbon requirement of the plant.

In species of *Phalaenopsis* section *Zebrinae* Tran et al. (1995) observed that the dilution of pigments contained in regreening and wilting genomes indicates the involvement of dominant nuclear genes. Tran et al. (1995) observed that increases in chlorophyll levels are most pronounced within 40 days after pollination and thereafter increase moderately and decrease after 80 days. In addition, seed capsules and perianths of selfed species which had not dehisced, turned yellowish after 160 days and had reduced levels of chlorophyll a but not chlorophyll b.

Another genus with species having postpollination photosynthetic segments is *Huntleya* Bateman ex Lindl. Flowers with photosynthetic segments are common in the Orchidaceae but postpollination photosynthetic segments are rare.

Antlfinger & Wendel (1997) measured the reproductive effort and the in situ photosynthetic characteristics of *Spiranthes cernua* (L.) Rich. to determine the effect of reproduction on subsequent growth and reproduction. The study showed in *S. cernua* that the reproductive

structures are photosynthetic and they contribute to almost half of the plant's carbon requirements. The plants with the larger inflorescences flowered yearly where the plants with smaller inflorescences would skip flowering the following year. The role of the inflorescence as a source and sink for carbon assimilation lowers the cost of reproduction and supports frequent inflorescence production.

In the orchidaceae there are several genera with high numbers of green flowers. One notable genus is *Epidendrum* L. with over 1600 species. Approximately 40 % have flowers with photosynthetic segments. The photosynthetic segments may aid the success of this genus. If almost half of the plant's carbon requirements for reproduction are supplied by the inflorescence, as Antlfinger & Wendel (1997) found in *S. cernua*, this would give the plants a selective advantage in seed production and reproduction would occur with less stress to the plants. Many of the epidendrums with photosynthetic flowers will flower several times a year or can flower successively on a growth for several years. The genera *Encyclia* Hooker with over 250 species and *Anacheilium* Hoffmannsegg with over 90 species, have predominately green flowers. In the genus *Encyclia* a majority of the flowers have photosynthetic segments prior to pollination and a few postpollination. Also the genus *Pleurothallis* R. Brown with over 1200 species has a large percentage of green flowers.

In addition, almost all the species of Orchidaceae have photosynthetic seed capsules which act as a source of carbon assimilation, further lowering the cost of reproduction.

The presence of photosynthetic segments and seed capsules in the Orchidaceae could in part account for their evolutionary success with over 900 genera, over 28,000 species and accounting for 10 % of the flowering plants.

Huntleya burtii prior to pollination and postpollination flower becoming photosynthetic.

Huntleya burtii prior to pollination.

Huntleya burtii flower and seed capsule postpollination.

Photosynthetic postpollination flower and seed capsule of *Huntleya burtii* shortly after pollination.

Huntleya burtii prior to pollination and postpollination.

Huntleya burtii seed capsule dehiscing and floral segments losing chlorophyll.

Epidendrum carchiense Hágsater & Dodson

Epidendrum opiranthizon Hágsater & Dodson

Epidendrum sertorum Garay & Dunst.

Epidendrum scharfii Hágsater & Dodson

Epidendrum xanthoianthinum Hágsater

Epidendrum xanthoianthinum Hágsater with repeat flowering habit

Encyclia ceratistes (Lindl.) Schltr.

Encyclia diurna (Jacq.) Schltr.

Encyclia flower ten days after pollination with chlorophyll in floral segments.

Encyclia cyperifolia (C. Schweinf.) Carnevali & I. Ramírez

Encyclia chloroleuca [Hooker] Neumann

Anacheilium cochleatum (L.) Hoffmanns

Anacheilium grammatoglossum (Rchb.f.) Pabst, Moutinho & A.V.Pinto

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