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POLLINATION OF EULOPHIA CRISTATA (SW.) STEUD. (ORCHIDACEAE) IN SOUTHERN GHANA

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SUMMARY

The floral biology of *Eulophia cristata*, a common West African ground orchid, is described. The flowers have no obvious attractants other than their shape and colour, but are visited and pollinated by carpenter bees (*Xylocopa olivacea*). Few flowers are pollinated. Self-pollination appears to lead to the production of fewer seeds than cross-pollination.

1. INTRODUCTION

Observations on the pollination of orchids have been reviewed by VAN DER PIJL & DODSON (1966). It is clear from their list that very little attention has been paid to the pollination of tropical African orchids. They give only one record for the large genus *Eulophia*, that of KULLENBERG (1961) who observed *E. horsfallii* (Batem.) Summerh. being pollinated by carpenter bees (*Xylocopa* sp.). *Eulophia cristata* (Sw.) Steud. is a common ground orchid on the Accra Plains of Southern Ghana, where it grows abundantly between grass tussocks on well-drained soils, often among bushes. It flowers between March and May, after the first rains. The leaves appear later.

We studied a population about 2 km. south-east of Kwabenya village, 12 km. north-east of Accra. The plant was abundant in a grassland area of about 500 m^2.

2. FLOWER STRUCTURE

The inflorescence is about 1 m. tall, and bears up to 30 flowers. The flower (*fig. 1*) is zygomorphic, held horizontally at maturity. It is resupinate, reversing rapidly after pollination. The reflexed sepals, the upper petals and the spur are pinkish-violet, varying in depth of colour. The ovary and the centre of the labellum are deep violet, and the upturned edges of the labellum are greenish. Again, there is considerable colour variation. The sum of flower colour variation is such that groups of similar flower spikes, presumably from vegetative clones, can be distinguished. The ridged upper surface of the labellum and other features are shown in *fig. 1*. The column is pale green, bearing a yellow pollinium above the stigmatic surface.

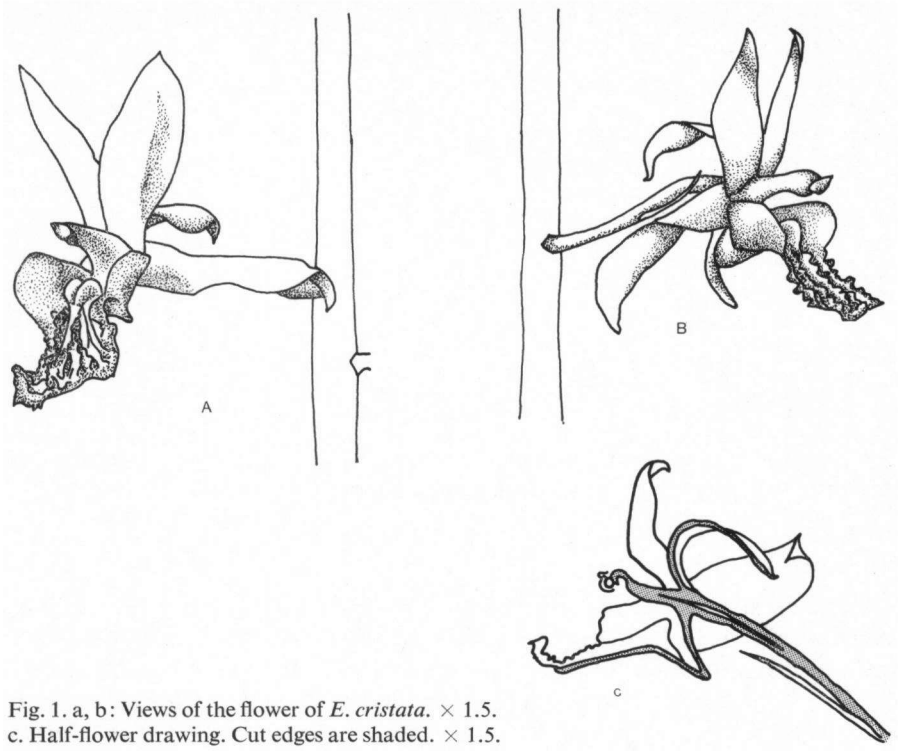

Fig. 1. a, b: Views of the flower of *E. cristata*. × 1.5.
c. Half-flower drawing. Cut edges are shaded. × 1.5.

3. FLORAL HISTORY

Ten spikes were examined regularly to record the history of individual flowers. Of 203 flowers, 86 were already open when observations began, and 24 remained at the end. 83 flowers were observed from anthesis to falling; the mean duration of opening was 10.4 days. Out of the 203 flowers, 63 (31 %) lost their pollinia. Of the rest, 120 still had the pollinia intact when the flowers fell, and 20 when observations ceased. Pollinia were lost at all ages of the flower. On one occasion a spike of 16 flowers lost 12 pollinia in 24 hours, but usually only one or two flowers in each inflorescence lost pollinia in any 24 hours. Only four flowers were fertilized during the period of observation. In one of these the pollinium was still intact.

4. POLLINATION AND FERTILIZATION

VAN DER PIJL & DODSON estimate that at least 200 species of orchid are known to be normally autogamous. We never observed this in *E. cristata*. Three spikes were hand pollinated, one with pollinia from the same flower as the stigma, another with pollinia from different flowers, and a third with pollinia from flowers of a different clone. All produced capsules which appeared sound. Ripe

Table 1. Presence of embryos in seeds from capsules resulting from cross- and self-pollination of flowers of *Eulophia cristata*. Self-pollination A: within the same flower. Self-pollination B: within the same inflorescence.

	with embryo	without embryo	% with embryo
Self-pollinated A	73	36	67
Self-pollinated B	57	31	65
Cross-pollinated	82	3	96

capsules were collected from each, and the seeds examined for the presence of an embryo. The results are shown in *table 1*. Self-pollination appears to give reduced fertility; the seeds were not tested for viability. It appears that some external agent is essential for pollination.

5. INSECT VISITORS

Several different insects visited the flowers, all in small numbers. Only one of these appears to be a regular pollinator. Butterflies, particularly *Danaus chrysippus* (L.) and *Pyrrhochalcia iphis* (Drury), visit the flowers occasionally, and probe into them. However, they alight on the labellum and do not try to enter the flower, so that they cannot pollinate it. Various wasps visited the inflorescences, but they often visited young ones bearing buds only, and were probably hunting. They did not enter flowers, and neither did the flies which often frequent the inflorescences. Four different bees were seen at the flowers. A species of *Anthophora* came twice, but although it appeared to orientate itself correctly, it flew away after touching the labellum. A species of *Megachile* was seen once. Two species of *Xylocopa* (carpenter bees) were seen to visit the flowers. A large unidentified species was seen once, and appeared to remove the pollinia. *Xylocopa olivacea* was the most regular visitor, and appeared to be the usual pollinator. It lands on the labellum and enters the spur. After 4–5 seconds, as the bee backs out of the flower, the pollinia become attached to the back of the bee's head. The bee often attempted to scrape off the viscidia with its front legs, but was usually not successful because of the sticky viscidium and elastic caudicles. As the bee enters a second flower the pollinium is transferred to the sticky rostellum. The mechanism is thus the same as that of many beepollinated orchids (DARWIN 1862, VAN DER PIJL & DODSON 1966).

The flowers of *E. cristata* are mauve-pink. Such colours are reported to be well seen by bees. However, there is no scent, and no free nectar in the spur. KULLENBERG (1961) observed bees (*Xylocopa* sp.) tearing at the labellum of *Eulophia horsfallii*, and licking the exposed tissues. No behaviour of this kind was seen. Sections of the labellum of *E. cristata* showed no obvious food deposits in the cells. Sections of the spur, however, showed that the epidermal cells project as papillae. The cells below these papillae contain many granules. These are not starch, and are probably not protein. Possibly these cells and

their inclusions represent a food source attractive to bees, but we saw no evidence of any attempt by the bees to use it.

Thus it is not clear why the flowers are visited at all. The observation that usually only one or two pollinia are removed from an inflorescence in 24 hours, and our observations of actual bee visits, show that visits are short. VAN DER PIJL & DODSON (1966) estimate that at least a third of all known orchids lack nectar, so that *E. cristata* is by no means abnormal. The flower does not seem to be mimetic, and the actions of the bees, and the butterflies, suggest that they expect to find nectar. It is possible that all the visits are stimulated by the promising appearance of the flower, and that relatively few flowers are visited because the bees learn quickly that nothing is to be gained from such visits.

6. CONCLUSIONS

E. cristata is normally pollinated by large carpenter bees (*Xylocopa*). The bees are attracted to the flower by its colour, but obtain no nectar or other food from it.

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