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Deception as a Pollination System in some Orchids

The Problem

Deception of the pollinator is known in many plant groups. The pollinator may be attracted by strong odors, colors or forms which resemble a natural substrate visited normally by the animal. In many fly-pollinated flowers odor and color seem to attract the vectors while no actual food is presented. Similar phenomena, playing on the sex-instincts of the pollinator, have been reported in the orchids (Correvon & Pouanne 1916, on Ophrys; Coleman 1927-30, on Cryptostylis; Dodson 1962, on Trichoceros and Oncidium). In pseudocopulation in Ophrys and Cryptostylis the senses of the pollinators which are effected in the attraction are primarily sight and smell with tactile sensation playing a minor role. In Trichoceros and Oncidium visual stimuli elicit the necessary reactions on the part of the pollinators.

Similar phenomena occur in orchids pollinated by bees of the Tribe Euglossini; however, evidence is accumulating that the attraction of male bees only is not simply deceit in this case. The bees apparently receive a necessary chemical product for their life cycle by scratching at the surface of the flower and sopping up the exuding liquids.

Some members of Epidendrum (and many other higher orchids) apparently attract their pollinators on the basis of the deception for their nectaries are dry. No studies have been made of this subtle system, if indeed it exists. If it does, it may indicate a pathway through which the more striking systems such as pseudocopulation, pseudoantagonism, etc., have evolved. Epidendrum radicans ex Ldl. Pavon is a common roadside plant in disturbed areas in Tropical America and may provide an excellent example for study. In color and form of its inflorescences it closely approximates that of Lantana camara L. and Asclepias curassavica L. The three species are commonly found growing together and may form extensive populations.

PROCEDURE

Select populations of the three species where they are found growing together and determine the following points:

1. Density of the populations by counting the number of inflorescences, fresh flowers, total flowers, fruits produced and number of seed in each fruit for each kind of plant.
2. Which are the pollinators of each species and do they overlap?
3. Compare seed production of each species.
4. Is Epidendrum radicans really a mimic of either lantana camara or Asclepias curassavica or both?

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5. Compare the pollination system of Epidendrum radicans with other species of Epidendrum.

6. Capture the pollinators of each species and look for pollen of other species attached.

EQUIPMENT

Watch, Insect net, envelopes for butterflies, football uniform.

RESULTS

1. Nectar production.

Twenty-five fresh flowers were selected at random and examined for presence and abundance of nectar on each of the three similar species and Epidendrum paniculatum R & P, a species not closely related to E. radicans but which occurs in the same regions. All flowers of Lantana camara had abundant nectar while those of Asclepias curassavica had a moderate quantity in each nectary. Epidendrum radicans flowers were absolutely without nectar in the nectar-tubes and rupturing of the walls would require more strength than could be expected from the proboscis of a butterfly. Epidendrum paniculatum flowers had a moderate quantity of nectar produced freely at the bottom of the nectar-tube.

2. The populations.

Three populations each of Lantana camara, Asclepias curassavica and Epidendrum radicans were selected. Each population contained a number (generally reduced) of the other 2 kinds of plants. Since both Lantana camara and Epidendrum radicans are scendant diffusely branched plants it was not possible to count the actual number of plants. The number of inflorescences, the number of fresh flowers, the number of fruits, and the number of seeds were determined (Table 1). Two plants of Epidendrum paniculatum with four inflorescences were selected.

3. The inflorescences.

The total aspect of the inflorescence of each of the three kinds of similar plants is striking. In Lantana camara the flowers are small and tubular. About 35 are produced in an inflorescence but only about 9 are fresh at a given time (see Table I). The total flower is yellow when fresh turning red with age. New flowers mature daily from the center of the inflorescence leaving a yellow central core of flowers while the periphery is red.

Asclepias curassavica produces an average of 9 flowers per inflorescence with about 5 flowers fresh at a given time. The center of each flower is yellow and is composed of 5 raised nectaries forming a corona. The blades of the petals are red but are folded downward. As flowers age the coronas turn red. The inflorescences of Asclepias curassavica and Lantana camara appear so similar that they are difficult to distinguish at a few feet.

Epidendrum radicans produced very similar inflorescences in color and form yet the individual flowers are quite distinty. Approximately 1 to 2 fresh

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flowers in the center of the inflorescence have a yellow lip and red sepals and petals. The 1 to 7 older or pollinated flowers are entirely red.

Epidendrum paniculatum has dense inflorescences of light green flowers with a purple spot at the base of the lip. Each inflorescence has an average of 41 flowers with 12 fresh flowers.

4. Fruit and fruit set.

The number of fruits produced per inflorescence varies greatly. The Lantana produces an average of 6.9 fruits per inflorescence with one seed in each fruit. Asclepias curassavica produces an average of 1.1 fruits per inflorescence with an average of 63 seeds in each fruit. Epidendrum radicans produces an average of 1.5 fruits per inflorescence with as many as a half a million seeds in each fruit.

Epidendrum paniculatum had a average of 5 fruits per inflorescence with very numerous seeds produced.

5. Behavior of pollinators.

Observation indicated that the basic food plant of the pollinators is the Lantana. Seventeen species of butterfly, 2 species of bee and one hummingbird appeared to be effective pollinators. The bees and hummingbird visited rarely and probably do not act as principal pollinators. The pollen apparently is collected on the proboscis of the pollinator. The butterflies landed on an average of 6 inflorescences during each visit and worked each fresh flower spending an average of 13 seconds at each flower. The visitors to the Asclepias were 4 species of butterfly all of which were observed visiting the Lantana. The pollen is formed into pollinia and attached to the feet of the butterflies. Eight butterflies were captured on the Lantana carrying pollinia of the Asclepias. The butterflies land on the inflorescences and insert their proboscis into each of the 5 nectaries of an average of 4 of the fresh flowers occurring. They visit an average of 1.7 inflorescences during each visit and spend an average of 25 seconds on each flower.

The visitors of Epidendrum radicans were seven species of butterfly all of which visited the Lantana. The pollinia of the orchid are attached to the proboscis of the butterfly when it is inserted in the nectar-tube. Three butterflies were captured on the Lantana carrying pollinia of the orchid. The butterflies land on the inflorescence of the Epidendrum while passing from one population of Lantana to another. Four of the seven species of butterfly were also visitors to the Asclepias. They visit an average of 1.2 inflorescences with each visit and spend 3.8 seconds examining an average of 1.5 flowers on each inflorescence. In Epidendrum paniculatum three species of butterfly visited them regularly and pollinated then by inserting the proboscis into each nectar tube whereupon the pollinia are attached near the base of the proboscis. The butterflies visited 5 flowers on each of three inflorescences at each visit spending 3 minutes at each flower. The butterflies were not observed visiting any of the three other kinds of plants studied.

CONCLUSIONS

It seems clear from observation and from the data collected that Epidendrum radicans depends on a pollination system whereby the pollinators of Lantana camara and Asclepias curassavica are deceived by the general similarity of the inflorescence of the three kinds of plants. The pollinators consist of only a limited number of the species which visit the Lantana indicating that some butterflies are more susceptible to deception. The pollinators are rarely fooled for long and only visit one or two flowers before moving on to Lantana. This rather infrequent visitation seems adequate for occasional production of a single fruit means a total production of seed far greater than that of the Lantana or the Asclepias. Though few of the seed germinate the populations seem completely successful. When compared with the effectiveness of the pollination system in Epidendrum paniculatum where particular pollinators are strongly attracted and provided with food it seems strange that E. radicans should give up the production of nectar for a system which, though effective in the overall picture, seems wasteful of bioenergy in the production of flowers. Epidendrum radicans though its particular growth habit and habitat selection is a far more abundant and apparently successful species than E. paniculatum. Perhaps a certain degree of laxity in effectiveness of pollination systems is possible where vegetative reproduction takes over from sexual systems and their complications.

Table I. COMPARISON OF FLOWER AND FRUIT PRODUCTION

	<i>Epidendrum radicans</i>	<i>Lantana camara</i>	<i>Asclepias curassavica</i>	<i>Epidendrum paniculatum</i>
Infl. per population	1,026	1,713	22	4
Fresh flowers	1,765	11,507	90	93
Fresh flowers per infl.	1.6	9	5	12
Total flowers per infl.	16.5	35.9	9	41
No. flowers pollinated	1,809	13,875	20	32
No. seed per fruit	\pm 500,000	1	63	\pm 500,000

Table II. ACTIVITY OF THE POLLINATORS

	<i>Epidendrum radicans</i>	<i>Lantana camara</i>	<i>Asclepias curassavica</i>	<i>Epidendrum paniculatum</i>
Number of visitor	40	405	11	38
Hours observed	9	6	6	4
Average length of visit to each flower	3.8 sec	13 sec	25 sec	3 min
Number of flowers visited each visit	1.5	6	4	5
Number of inflorescences visited each visit	1.2	3.6	1.7	3
Number of visitors carrying pollinia	3	-	8	12

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Table III. KINDS OF VISITORS WITH NUMBER OF VISITS TO EACH KIND OF PLANT

	Epidendrum radicans	Lantana camara	Asclepias curassavica	Epidendrum paniculatum
Papilio sp. 1	3	57	3	
Papilio sp. 2		12		
Monarch	6	5	2	
Pseudo-monarch	1	3	2	
Admiral	10	1244	8	
Sulpher sp. 1	17	32		
Sulpher sp. 2	8	27		
Orange	5	54		
Orange-tiger		32		
Heliconia sp. 1				36
Heliconia sp. 2				2
Other butterflies (9 sp)		36		
Bees		4		
Hummingbird		1		