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OCCURRENCE OF IPSDIENOL IN FLORAL FRAGRANCES

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Key Word Index—Orchidaceae; Araceae; Apidae; Euglossini; floral fragrance; pollination; monoterpene; ipsdienol.

Abstract—Ipsdienol is a major component of the floral fragrance of several species of orchids and one aroid that are pollinated by male euglossine bees. Racemic ipsdienol attracts various species of euglossine bees in field bioassays.

INTRODUCTION

Ipsdienol, 2-methyl-6-methylene-2,7-octadien-4-ol, is best known as a pheromone of various species of bark beetles (Scolytidae). To our knowledge, it has not been reported previously from plants. During the course of a survey of the chemical composition of orchid floral fragrances, we found that ipsdienol is a major component of the fragrances of several species of neotropical orchids and one species of aroid. All of these species are known or thought to be pollinated by fragrance-collecting male euglossine bees [see (1) for a discussion of orchids and euglossine bees].

RESULTS AND DISCUSSION

Nine species of orchids and one species of aroid produce large percentages of ipsdienol in their floral fragrance (Table 1). Synthetic, racemic ipsdienol attracted nine species of euglossine bees in field bioassays in Panama, Mexico, and Peru (Table 2). The differences in the species and numbers of bees attracted probably reflect variation in the local bee faunas. These data suggest that ipsdienol is a biologically active fragrance chemical that serves to attract pollinators (male euglossine bees) to the flowers. The plants known to produce ipsdienol (Table 1) are taxonomically diverse, representing two plant families and four subtribes of orchids. This distribution suggests that ipsdienol synthesis has evolved repeatedly, and that we may expect to find ipsdienol as a natural product in other plant genera and families, especially those that are pollinated by fragrance-collecting male euglossine bees.

Table 1. Plant species which produce ipsdienol in floral fragrances

Family, genus and species	Per cent of ipsdienol
Orchidaceae	
Gongora tricolor (Lindl.) Rchb.f.	20–30
Cirrhaea aff. *dependens* (Lodd.) Rchb.f.	90
Stanhopea anfracta Rolfe	40–55
Huntleya burtii Endres & Rchb.f.	5
Notylia latilabia A. & S.	70
Clowesia warczewitzii (Lindl. & Paxt.) Dodson	30–70
Catasetum napoense Dodson	35
Catasetum purum Nees	50–60
Catasetum tenebrosum Kraenzl.	40–80
Araceae	
Anthurium ochranthum C. Koch	80–90

Ranges of per cent ipsdienol are given for those species for which several individuals were sampled.

Table 2. Euglossine bee species attracted to racemic ipsdienol

Site	Species	No. of bees
El Valle de Anton, Panama	*Euglossa cyanura* Cockerell	3
Rio Iguanita, Panama	*Eulaema nigrita* Lepeletier	1
	Euglossa crassipunctata Moure	1
	Euglossa cyanaspis Moure	2
	Euglossa cyanura Cockerell	3
	Euglossa despecta Moure	1
	Euglossa flammea Moure	14
	Euglossa tridentata Moure	2
Los Tuxtlas Biol. Station, Veracruz, Mex.	*Euglossa cyanura* Cockerell	94
Tingo Maria, Peru	*Euglossa ignita* Smith	2

All of the fragrances that contain ipsdienol also contained moderate amounts of myrcene. Myrcene is the precursor of ipsdienol in bark beetles [2], and the co-occurrence of these compounds in plant fragrances suggests a similar biosynthetic relationship.

Ipsdienol is chiral, and the enantiomers have very different biological activities in bark beetles [2]. Euglossine bees can distinguish enantiomers of some compounds; male *Eulaema nigrita* are attracted to (−)-α-pinene but not to (+)-α-pinene (Whitten, W. M., unpublished results). We have not determined the enantiomeric configuration of ipsdienol in these floral fragrances, nor have we determined whether male euglossine bees

can distinguish different enantiomers of ipsdienol. Chirality might play an important role in pollinator specificity in these plant species.

EXPERIMENTAL

Plants were cultivated at the University of Florida, Gainesville. Voucher specimens are deposited at FLAS. Fragrances were sampled from 0800–1300 hr, corresponding to the time of maximum odour production. The inflorescence was enclosed in a plexiglass box, and fragrance laden air was drawn from the box and through a trapping cartridge at 500 ml/min. The cartridge consists of a 9 × 75 mm glass tube filled with 150 mg of Tenax TA and 300 mg of activated charcoal. The two adsorbents are separated by a plug of silanized glass wool; the cartridge is oriented so that the fragrance-laden air passes first through the Tenax and then through the charcoal. The trapped fragrances are eluted with hexane; the first 1.0 ml of eluate constitutes the sample. Samples were analysed by EI GC-MS (70 eV) using a 30 m capillary DB-1 column, capillary direct interface, and He carrier gas (flow rate 1.0 ml/min). Oven temperature was programmed from 40 to 210° at 8°/min. Identification of compounds was based on comparison of MS and R_t with authentic standards. Percent composition is based on integration of total ion chromatograms. Synthetic ipsdienol (95% purity) was purchased from Orsynex Corp. Bioassays were performed from 0800–1300 hr in forested habitats. A 4 × 4 cm blotter pad containing 3–4 drops of 50% ipsdienol in hexane was tacked to a tree trunk. All bees visiting the pad were collected.

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