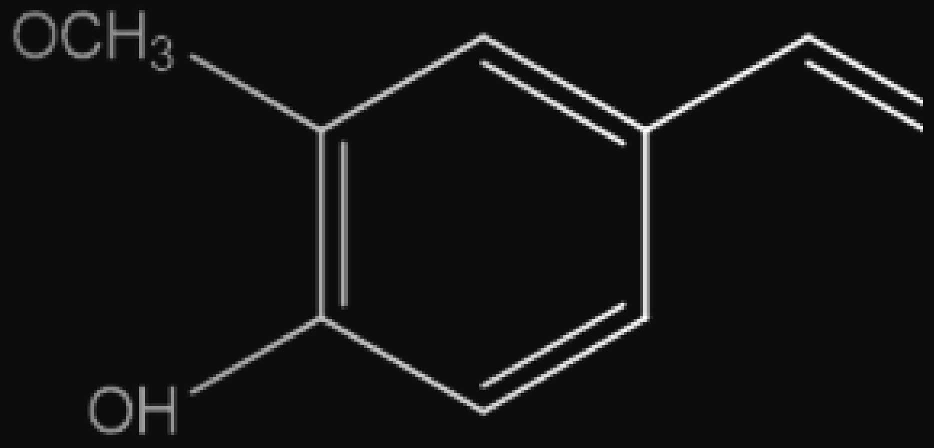


Comunicação Planta-Inseto

Carlos E. P. Nunes

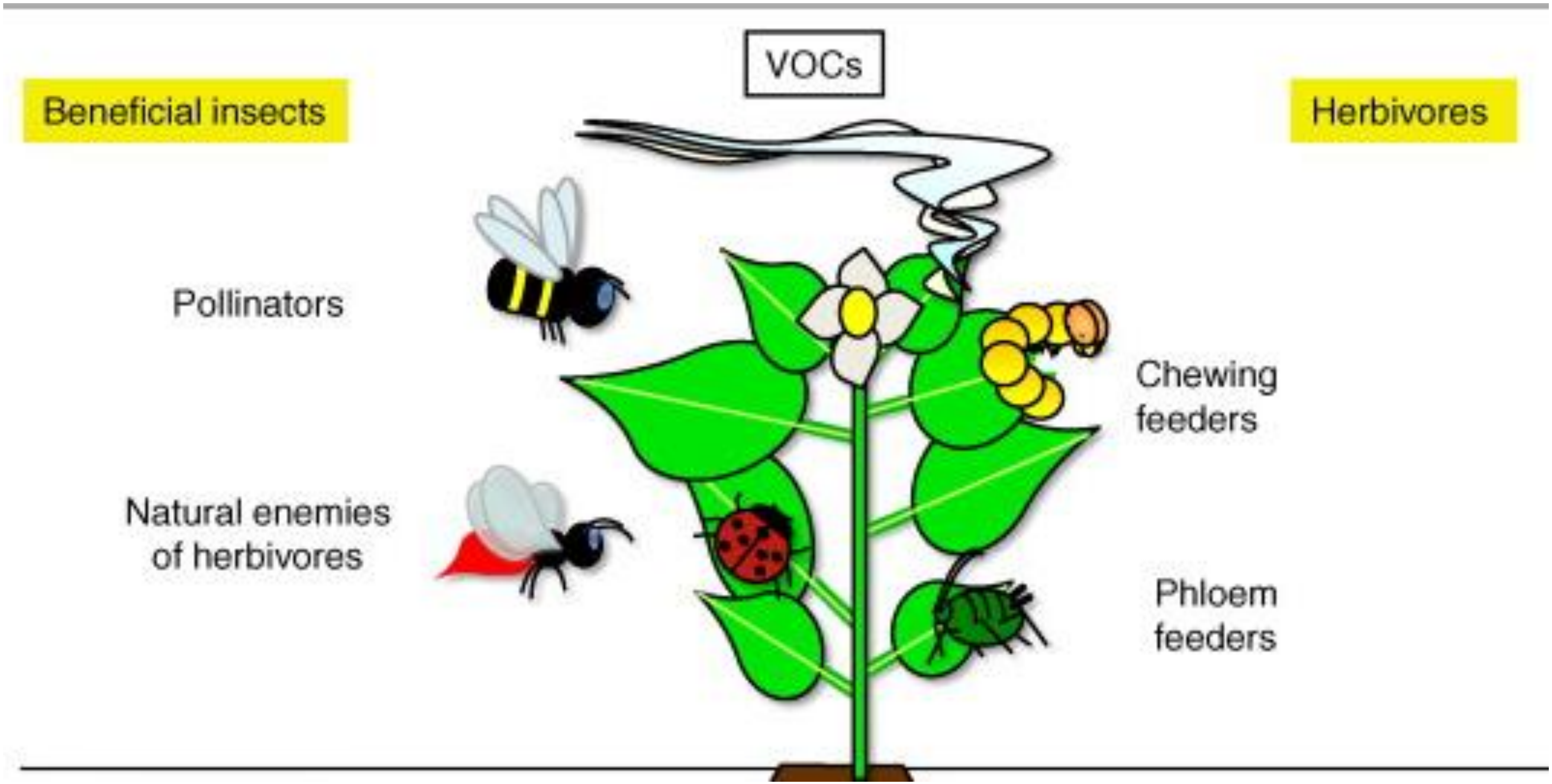
Introdução às Interações Inseto-Planta (BIE5797)

Universidade de São Paulo

Abril de 2023

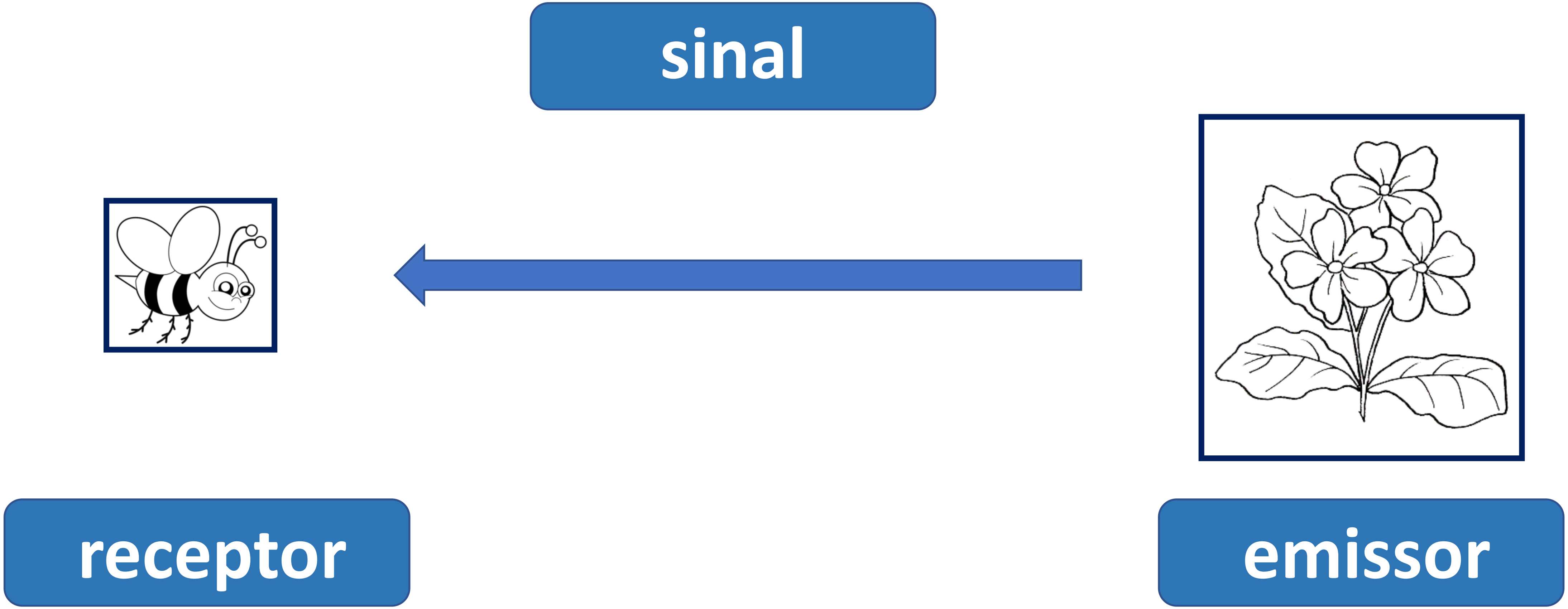
Conteúdo

- Introdução sobre comunicação e cognição
- Compostos químicos na comunicação planta-inseto
- Comunicação visual (flores e polinizadores)
- Honestidade na comunicação
- Outros canais de comunicação



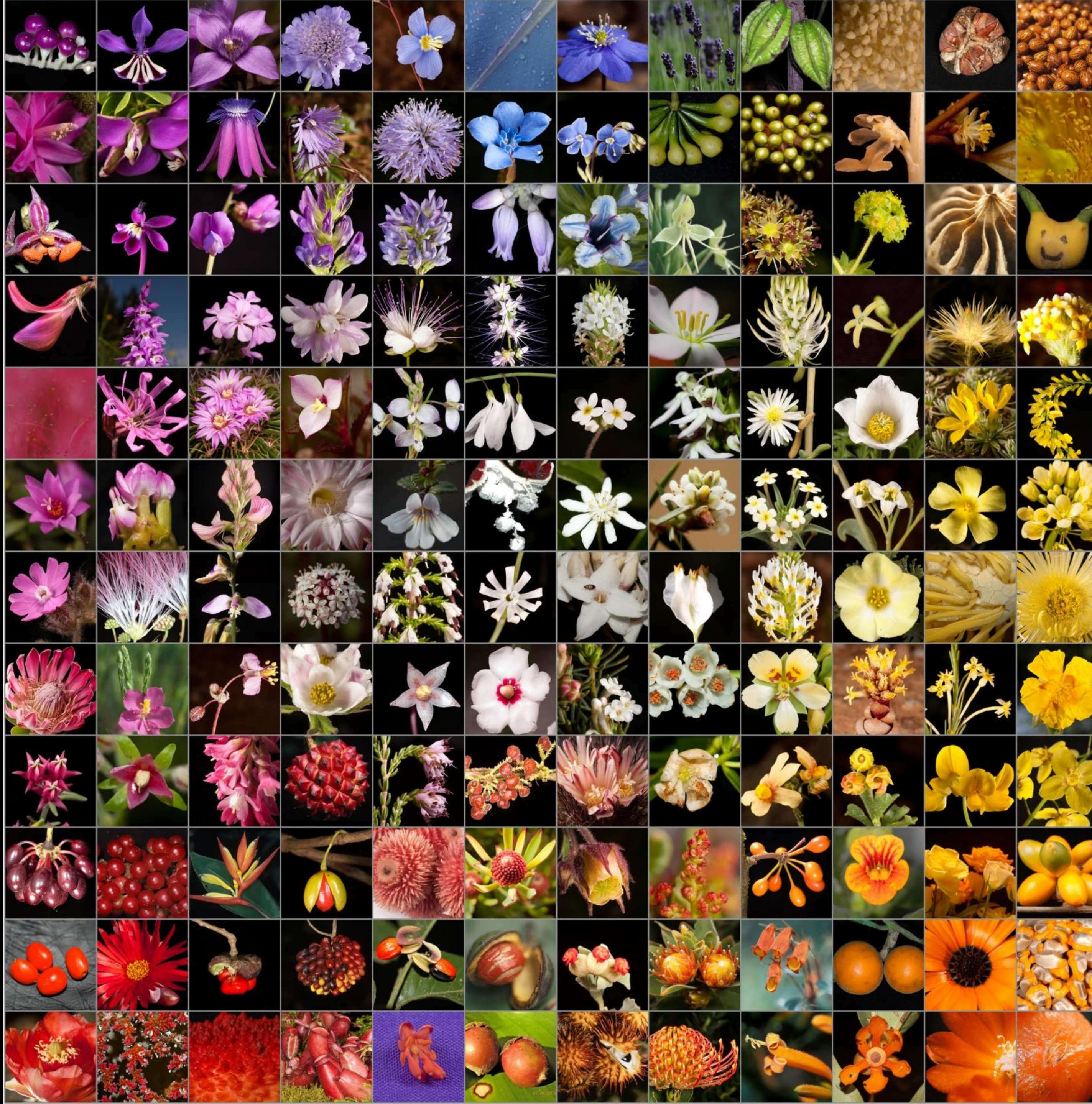
Modificado de Pineda et al. 2010 Trends in Plant Science 15(9): 507-514

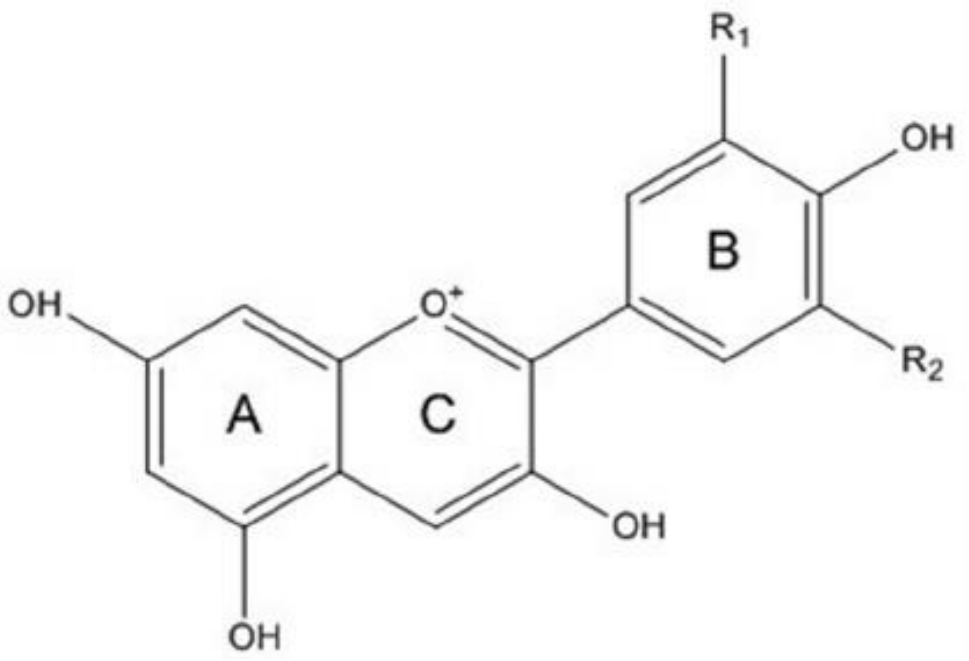
Comunicação Planta -> Inseto



Tipos de sinais

visuais	químicos	táteis	elétricos
cor	voláteis	texturas	cargas elétricas
tamanho	não-voláteis	estruturas	
forma			



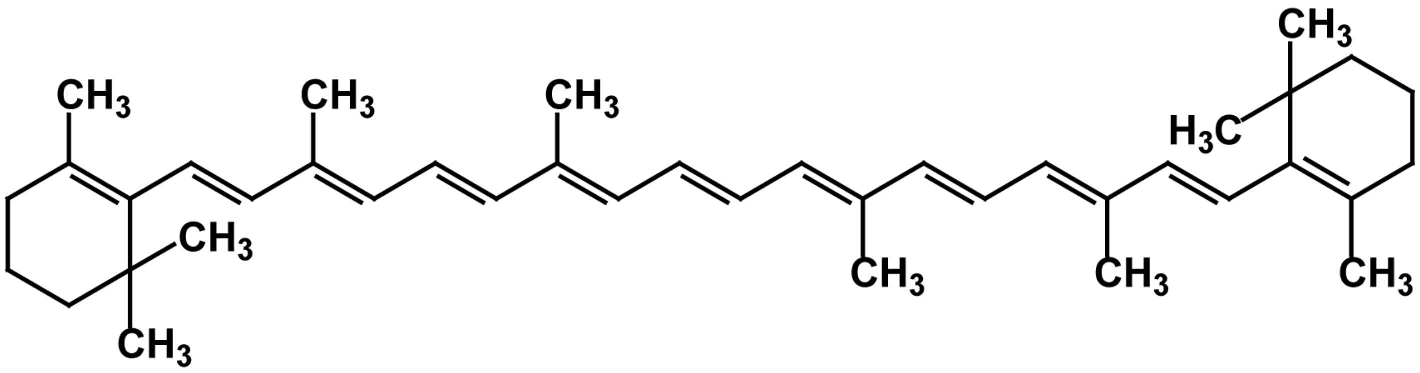


Anthocyanidin

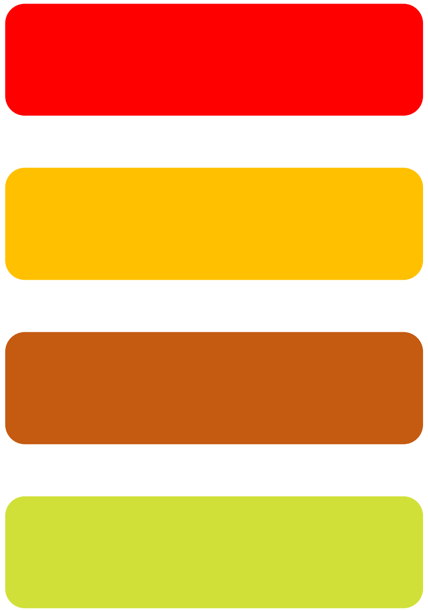
Cor

Willmer 2011

Cor

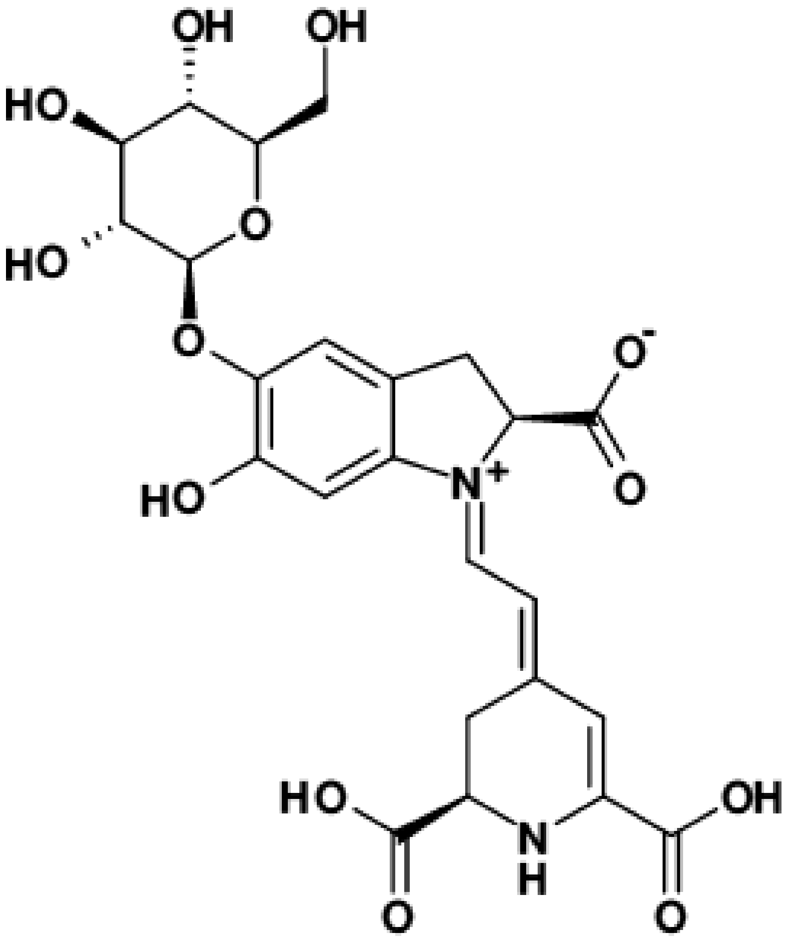


Carotenoids

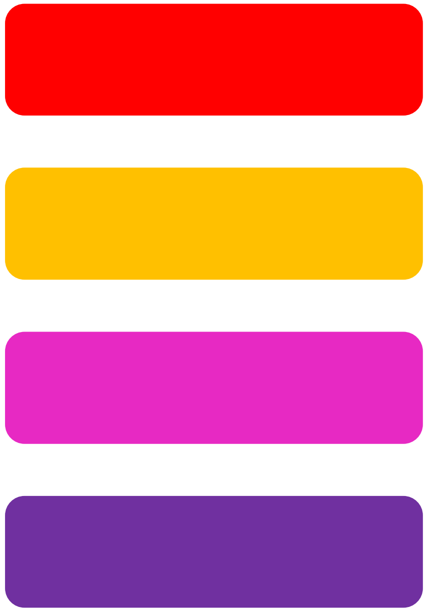


Willmer 2011

Cor



Betalains



Willmer 2011

Compostos voláteis

Alifáticos

Aromáticos (benzenóides)

Terpenóides

Compostos nitrogenados

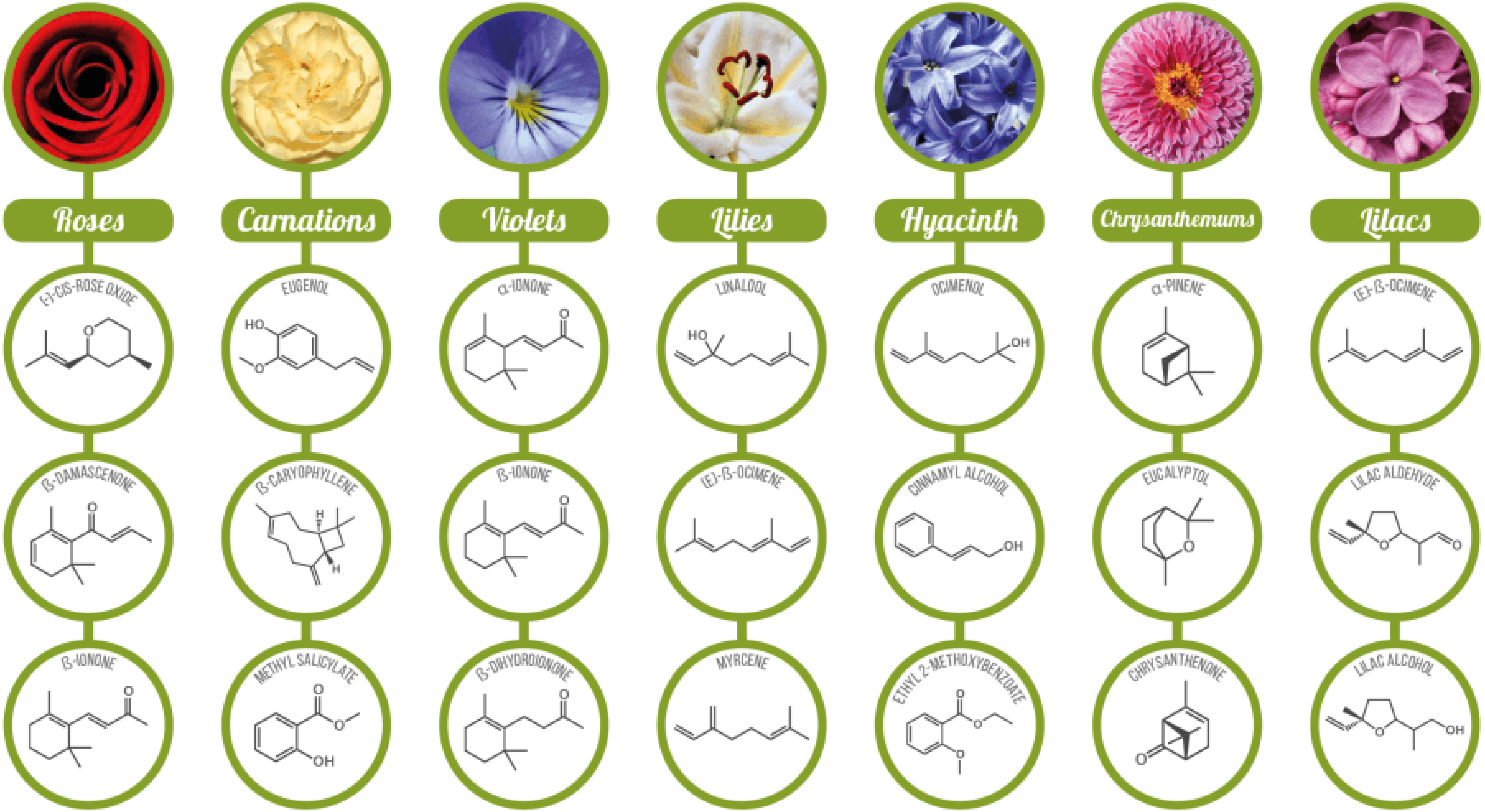
Compostos de enxofre

etc

Willmer 2011

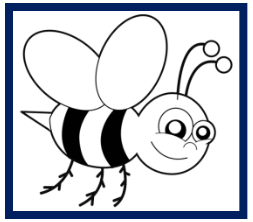
AROMA COMPOUNDS IN COMMON FLOWERS

A wide range of compounds contribute to the scents of flowers. This graphic looks at a selection of major contributors for a number of common flowers. Note that volatile aroma compounds can vary significantly between species; this graphic represents a broad overview of common components, and is by no means definitive!




COGNIÇÃ0

COGNIÇÃ0



percepção

aprendizado

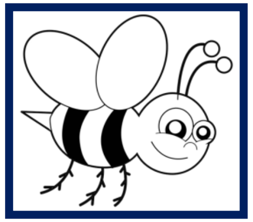
memória

atenção

preferências

Brito *et al.* 2014

COGNIÇÃ0



percepção

aprendizado

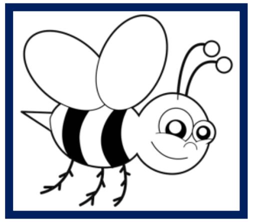
memória

atenção

preferências

Brito *et al.* 2014

COGNIÇÃ0



audição

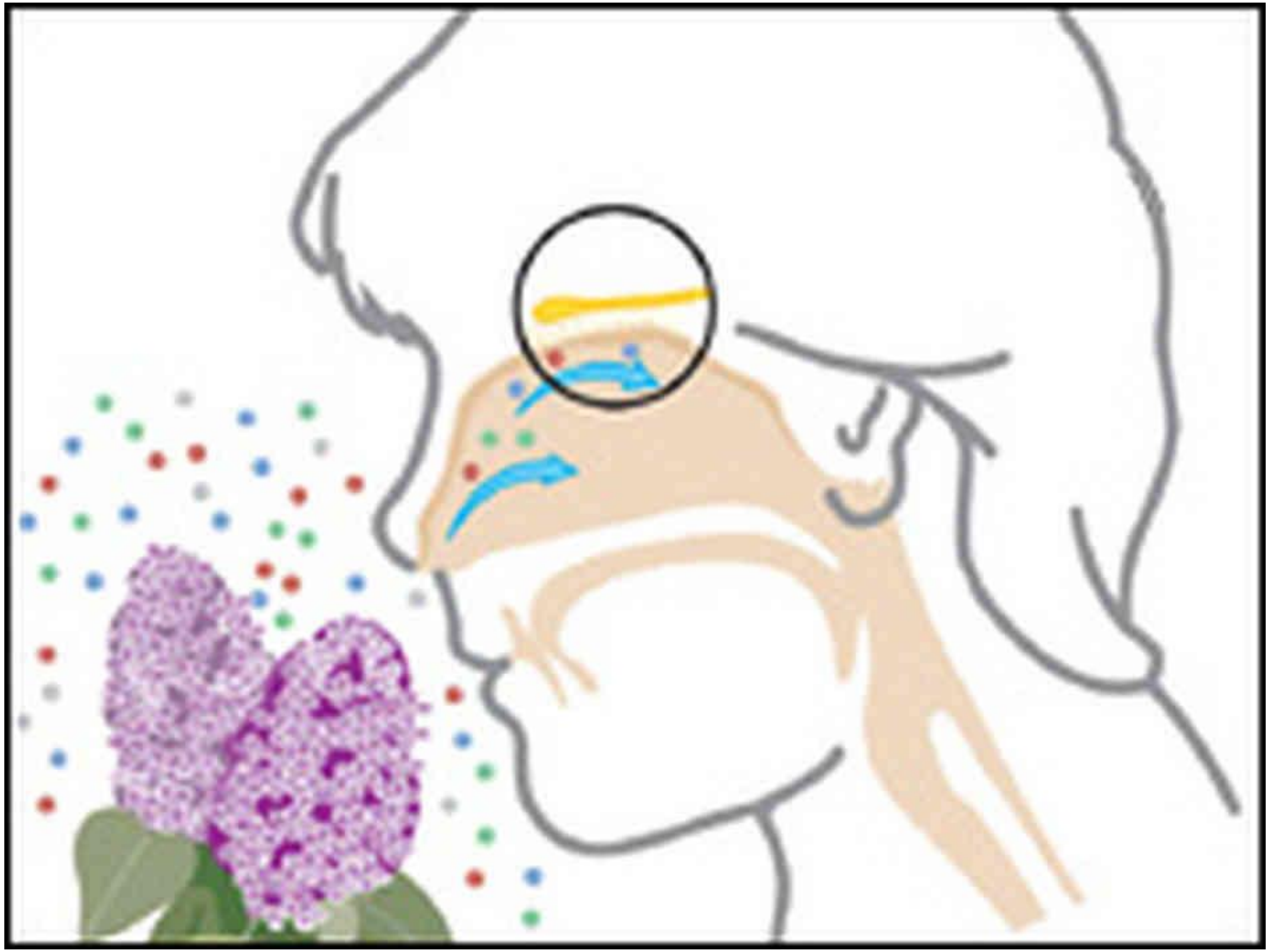
toque

olfato

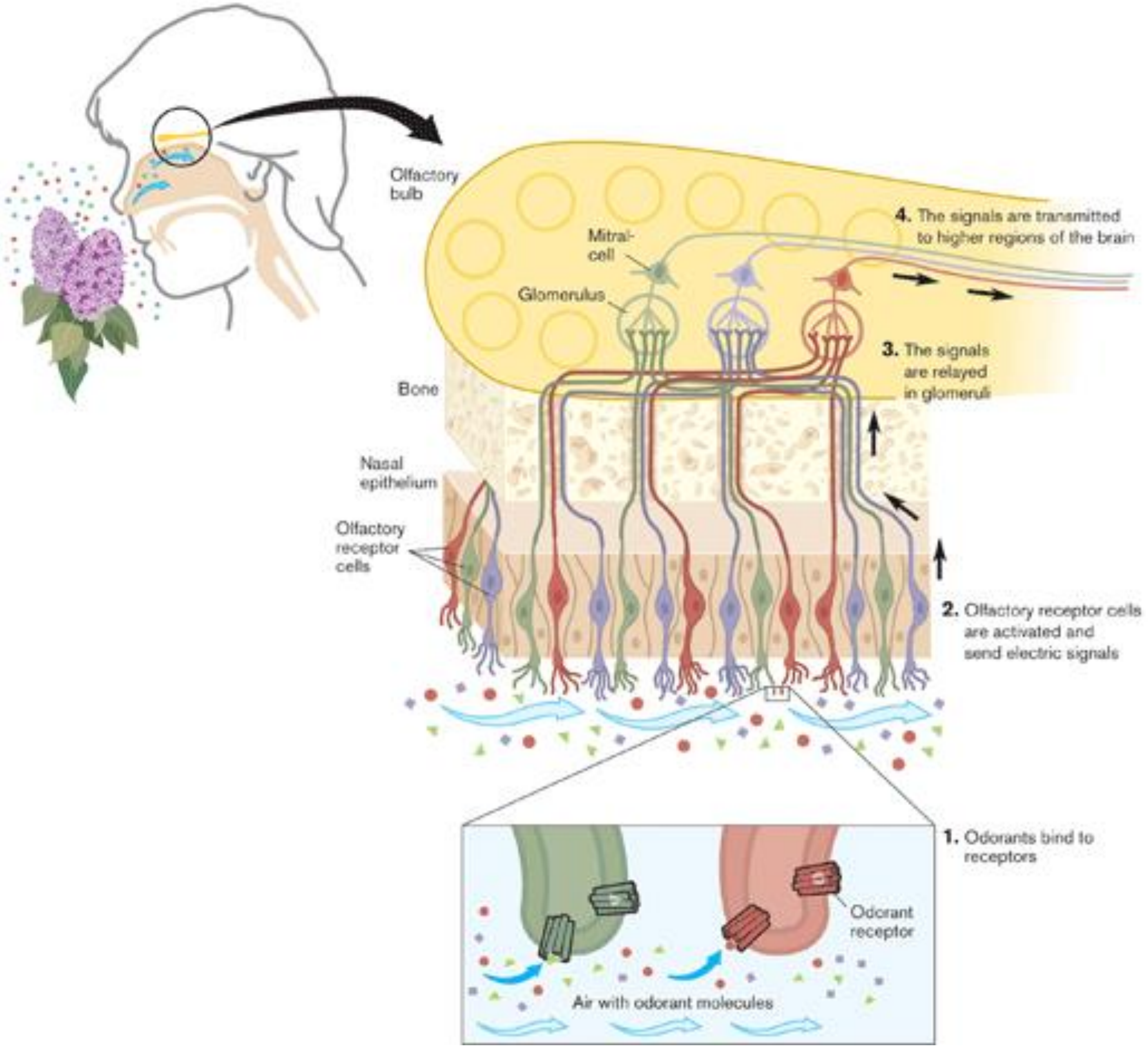
gustação

visão

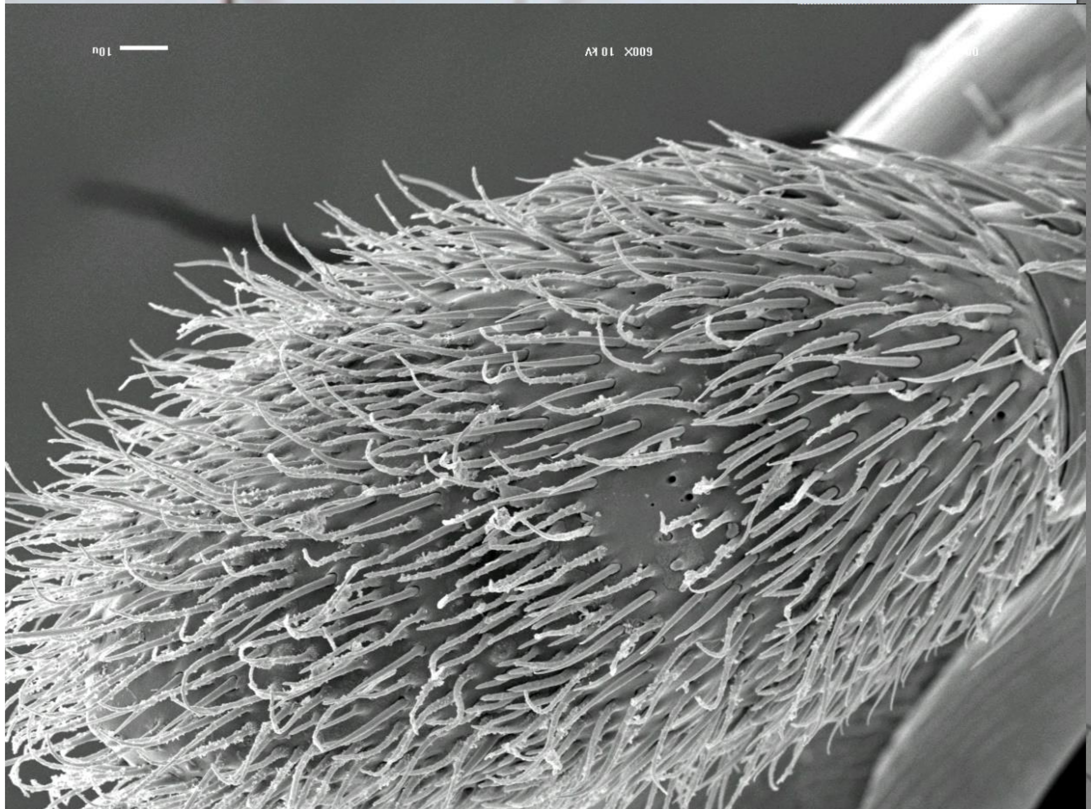
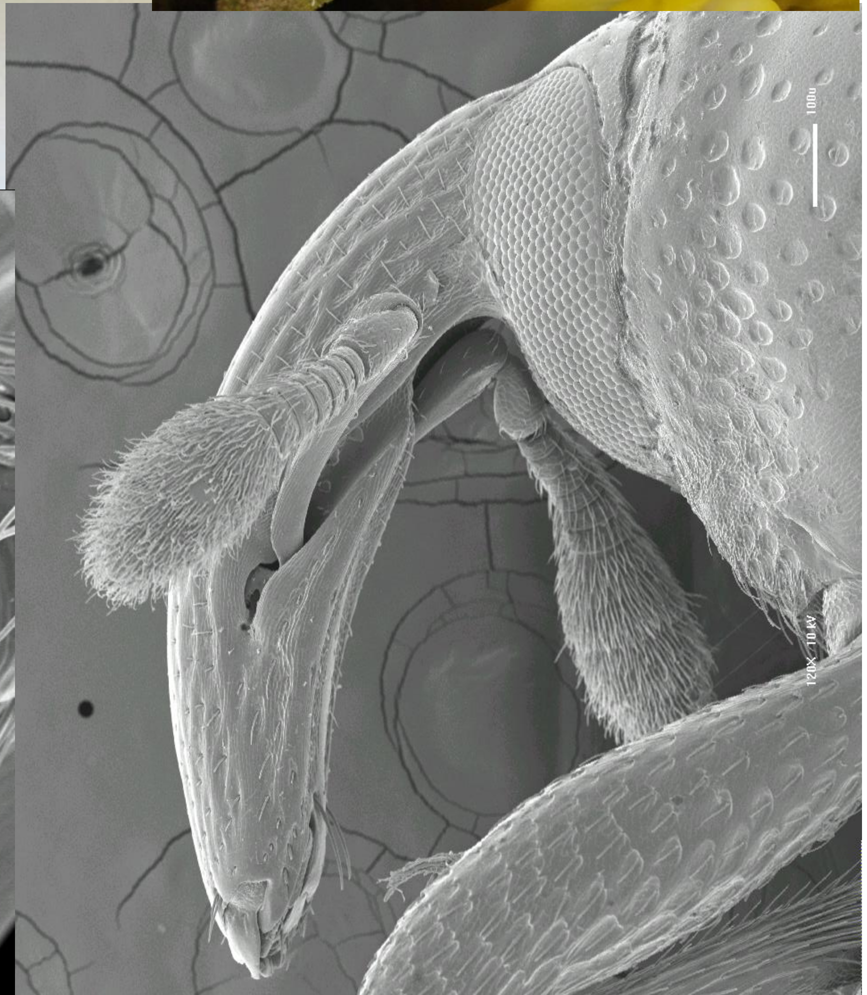
Brito *et al.* 2014



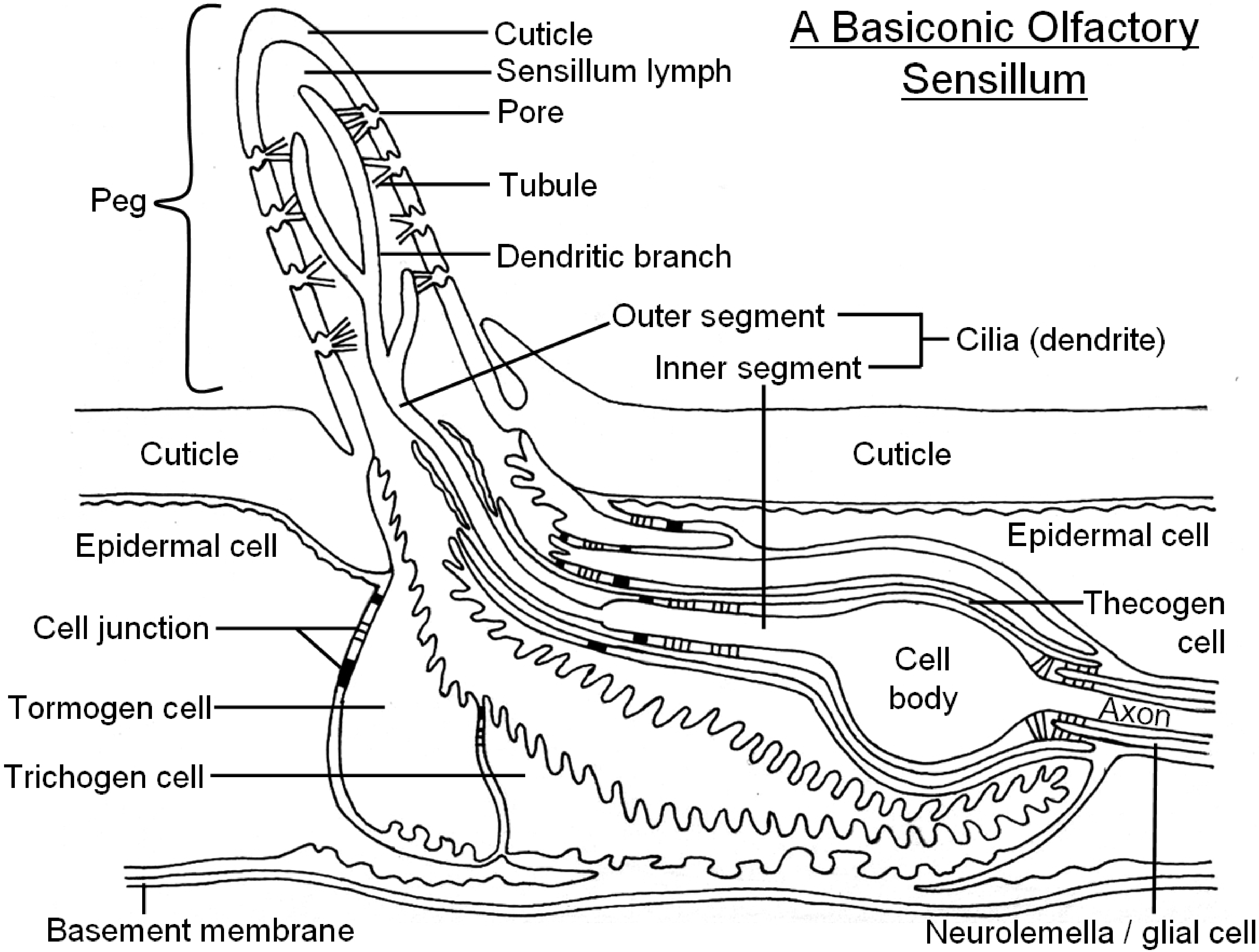
Odorant Receptors and the Organization of the Olfactory System





A Basiconic Olfactory Sensillum



New Phytologist

Research

The betrayed thief – the extraordinary strategy of *Aristolochia rotunda* to deceive its pollinators

Birgit Oelschlägel[1], Matthias Nuss[2], Michael von Tschirnhaus[3], Claudia Pätzold[1], Christoph Neinhuis[1], Stefan Dötterl[4,5] and Stefan Wanke[1]

[1]Institut für Botanik, Technische Universität Dresden, Zellescher Weg 20b, 01062 Dresden, Germany; [2]Senckenberg Naturhistorische Sammlungen Dresden & Museum für Tierkunde, Königsbrücker Landstraße 159, 01109 Dresden, Germany; [3]Fakultät Biologie, Universität Bielefeld, Postfach 100 131, 33501 Bielefeld, Germany; [4]Lehrstuhl für Pflanzensystematik, Universität Bayreuth, Universitätsstraße 30, 95447 Bayreuth, Germany; [5]Current address: Organismische Biologie, Universität Salzburg, Hellbrunnerstr. 34, 5020 Salzburg, Austria

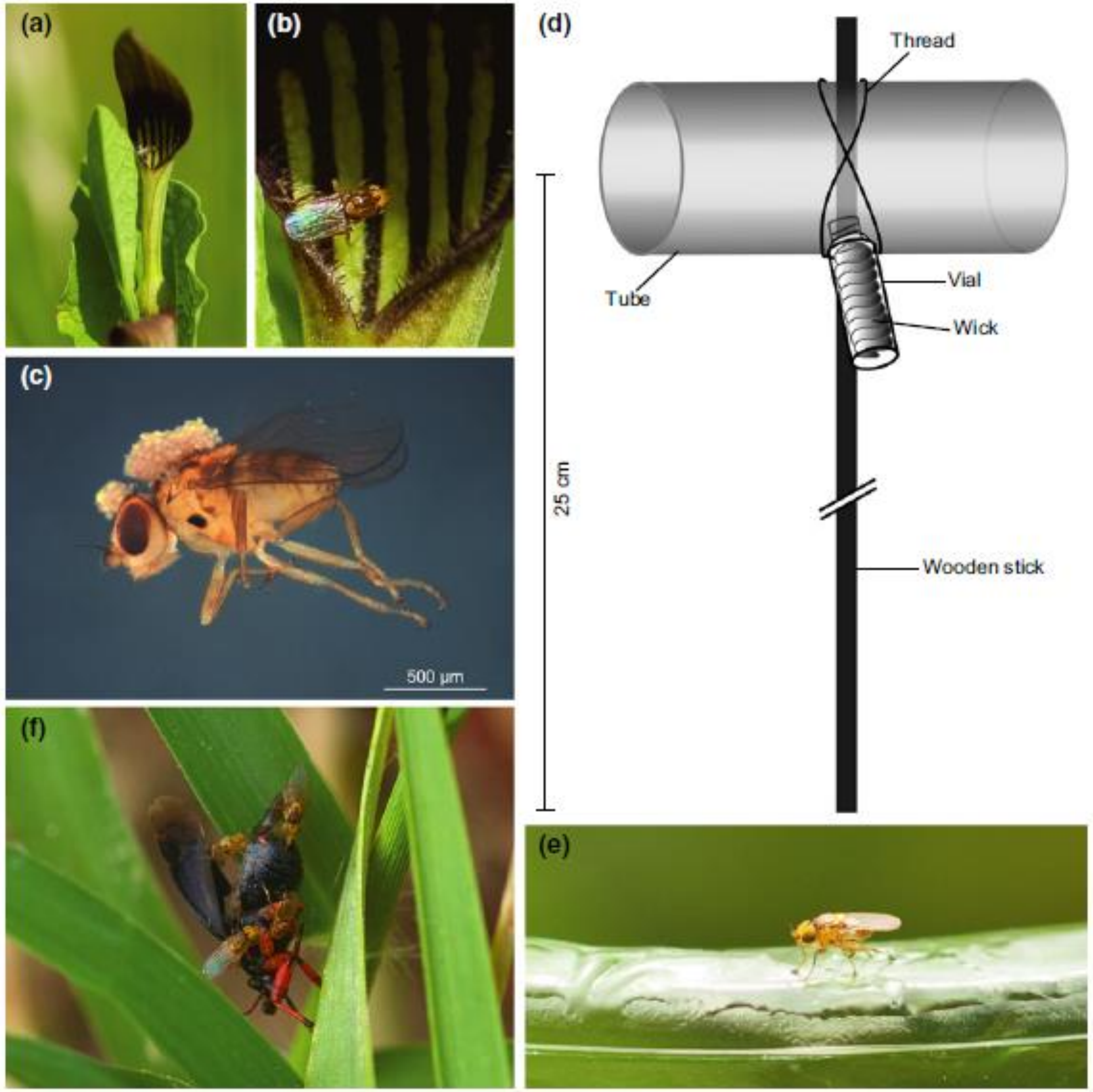


Fig. 1 Actors involved in the newly discovered mimicry system and bioassay setup. (a) Flower of *Aristolochia rotunda* with a *Trachysiphonella ruficeps* individual at the margin of the flower tube. (b) Magnification of panel (a). (c) *T. ruficeps* pollinator collected from an *A. rotunda* flower in the female stage, carrying *Aristolochia* pollen on the head and thorax. (d) Flytrap used for bioassays. (e) *T. ruficeps* pollinator sticking to insect glue of a trap loaded with Mix 'Aristolochia-Miridae'. (f) *T. ruficeps* individuals on a freshly killed *Capsus ater*. The fly in the upper part of the picture is feeding on *C. ater* secretions.

Table 1 *Aristolochia rotunda* components eliciting antennal responses in *Trachysiphonella ruficeps* and their presence in freshly killed Heteroptera (Miridae, Lygaeidae)

		Miridae		Lygaeidae	
	*Aristolochia rotunda** ($n = 7$)	*Capsus ater* ($n = 3$)	*Notostira elongata* ($n = 1$)	*Peritrechus gracilicornis* ($n = 2$)	*Xanthochilus quadratus* ($n = 1$)
Total amount of scent trapped per flower per true bug (ng (20 min)$^{-1}$)	Median (min–max) 153.6 (113.1–282.4)	Min–max 281.1–759.5	177.7	Min–max 214.4–228.2	918.4
Aliphatic esters					
Hexyl isobutyrate**	+	+	–	–	–
(*Z*)-3-Hexenyl butyrate**	+	+	+	–	–
(*E*)-3-Hexenyl butyrate	+	+	–	–	–
Hexyl butyrate	++++	++++	+	+	+
(*E*)-2-Hexenyl butyrate	++++	+++	+++	+	+
Hexyl 2-methylbutyrate	+++	–	–	–	–
Heptyl butyrate**	+	+	–	–	–
Hexyl hexanoate	+++	+	+	–	–
(*E*)-2-Hexenyl hexanoate	+++	+	++++	–	–
Octyl butyrate	++	+	–	–	–
Decyl acetate	+	–	–	–	–
(*E*)-2-Hexenyl (*E*)-2-hexenoate	+	–	–	–	–
Decyl butyrate	+	–	–	–	–
Aliphatic alcohols					
(*Z*)-3-Hexen-1-ol + (*E*)-2-Hexen-1-ol + hexanol	++	–	–	–	–
Aliphatic hydrocarbons					
Undecane	++++	–	–	–	–
Tridecane	++++	–	–	–	–
Pentadecane	++++	–	–	–	–
Unknowns (seven substances pooled)	+++	–	–	–	–

Sample size (n), median, minimum (min), and maximum (max) total absolute amounts of scent trapped. Relative amounts of single components are provided as: –, not detected; +, ≤0.5%; ++, 0.6–1.0%; +++, 1.1–5.0%; ++++, >5.1%. Within a component class, substances are ordered based on retention time on a ZB-5 column. A list of all components found in *A. rotunda* and the heteropterans is available in Table S2.

*Relative amounts are based on all seven samples, while absolute amounts are based only on five thereof (see Table S2).

***T. ruficeps* responded to a synthetic sample only.

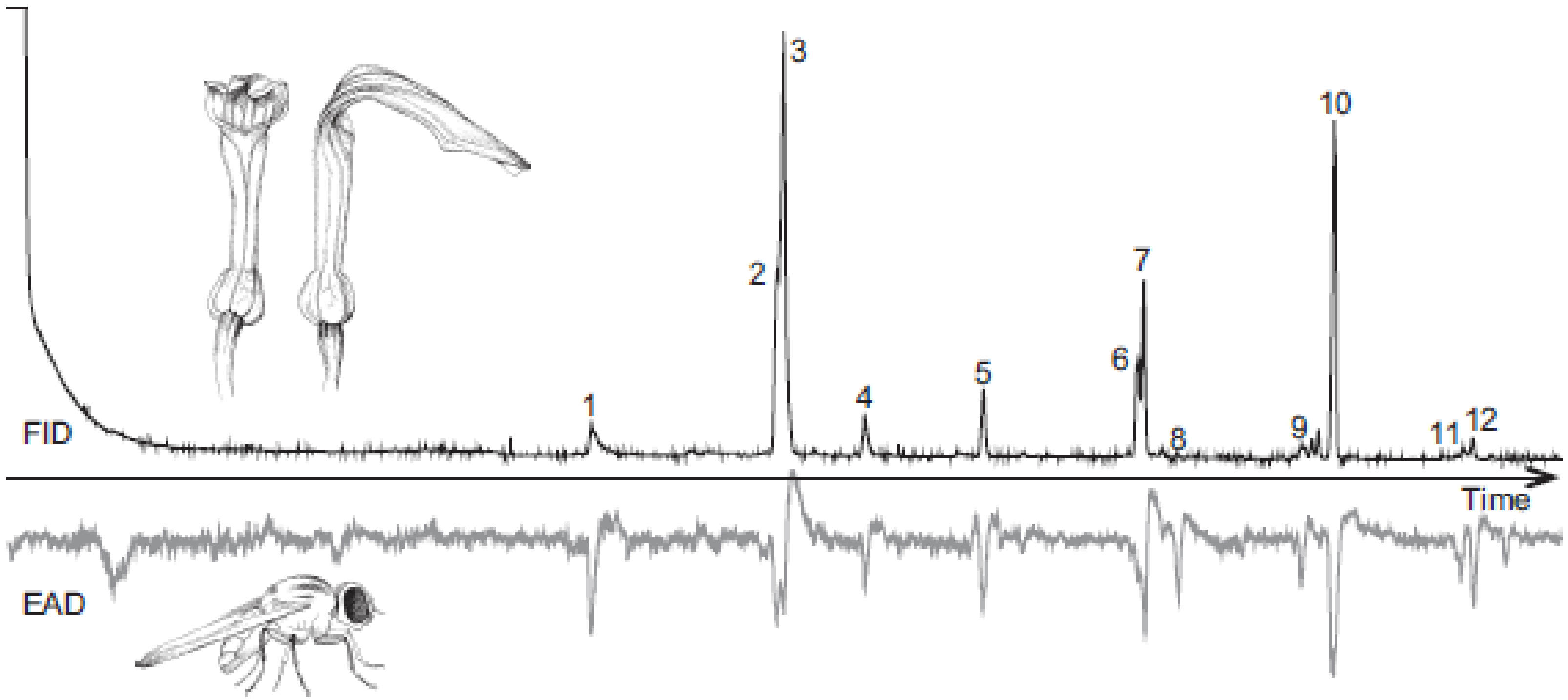


Fig. 2 *Aristolochia rotunda* flower scent components are physiologically active in *Trachysiphonella ruficeps*. The black track represents the flower scent chromatogram (FID) of *A. rotunda*, and the gray track the respective electroantennogram (EAD) of *T. ruficeps*. Twenty-six components (see Table 1) consistently elicited a response in the antennae of female flies used for the measurements, of which the ones that elicited the strongest responses are indicated: 1, undecane; 2, hexyl butyrate; 3, (*E*)-2-hexenyl butyrate; 4, hexyl 2-methylbutyrate; 5, tridecane; 6, hexyl hexanoate; 7, (*E*)-2-hexenyl hexanoate + octyl butyrate; 8, decyl acetate; 9, unknown aliphatic hydrocarbon; 10, pentadecane; 11, unknown aliphatic; 12, decyl butyrate.

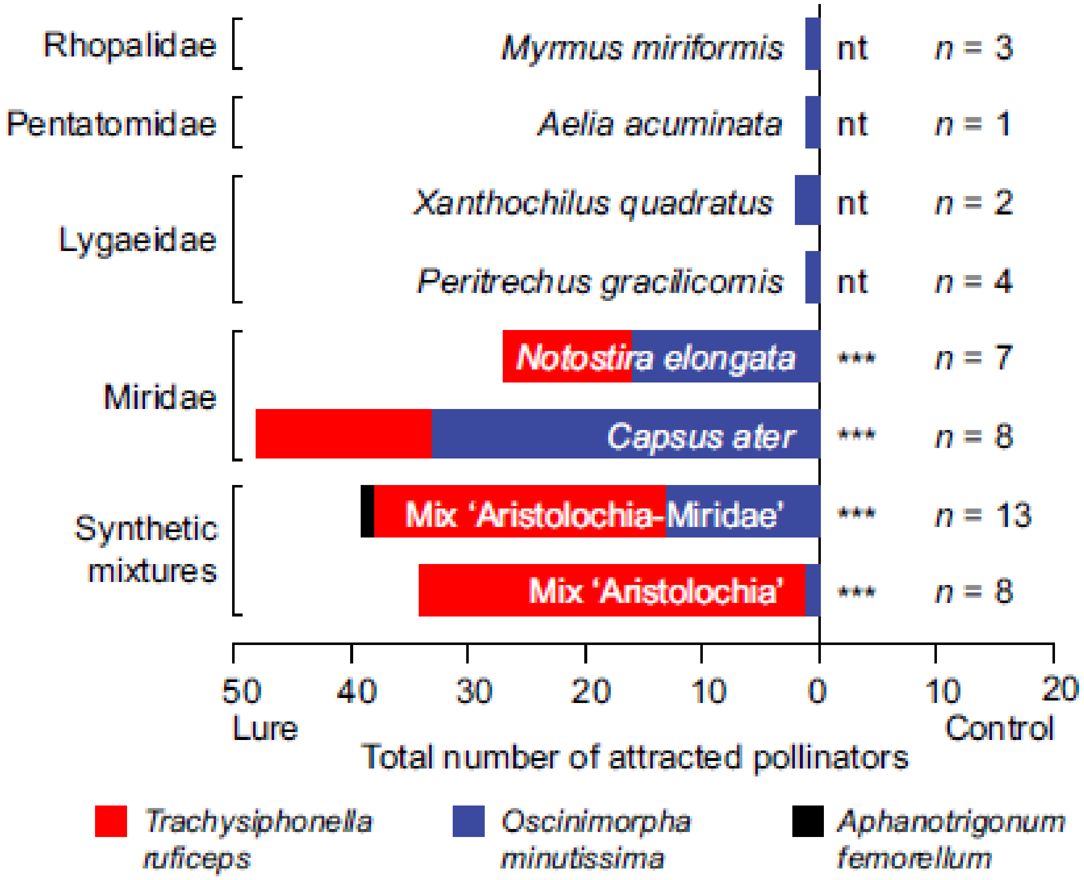
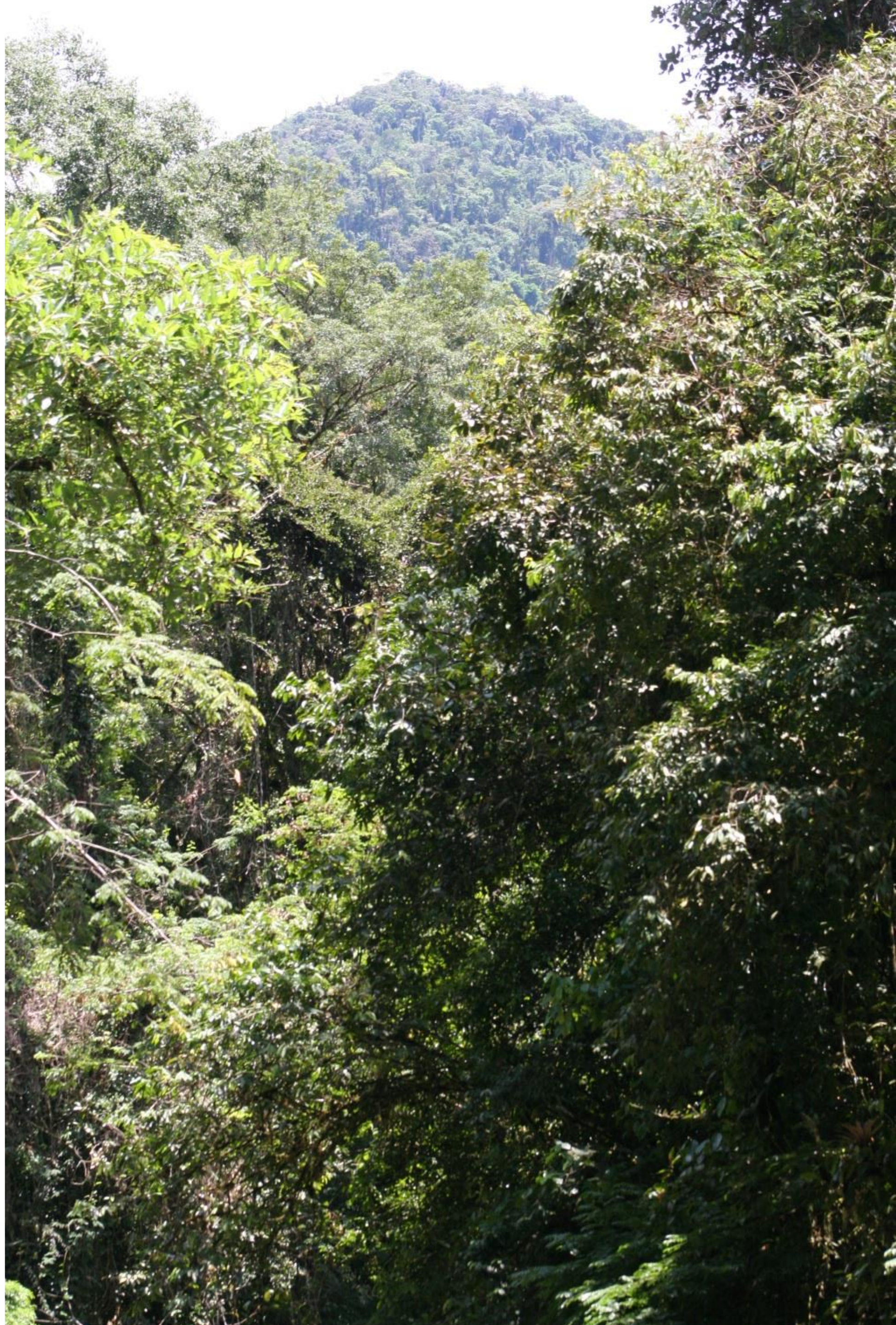


Fig. 3 Behavioral response of pollinators to synthetic volatile mixtures and freshly killed true bugs. Two-choice bioassays (*n*, number of replicates) performed in the field testing a bait (synthetic mixtures or freshly killed true bugs) against a negative control (acetone for synthetic scent mixtures and the blank trapping devices for heteropterans). In all bioassays, there was no response to a negative control. The main pollinator of *Aristolochia rotunda*, *Trachysiphonella ruficeps*, only responded to synthetic mixtures and Miridae spp. but not to individuals of the other heteropteran families. The sex ratios of the flies are given in Tables S5 and S6. Exact binomial tests were performed (scent vs control) when applicable: ***, $P \leq 0.001$; nt, not tested, owing to the small number of attracted flies.

Problemas em se comunicar em uma floresta tropical...



- Quais os visitantes florais e polinizadores?

- Qual o sistema reprodutivo da planta?

- Qual o comportamento dos polinizadores?

- Qual o papel dos voláteis florais na comunicação planta-visitantes florais?

- Quais os compostos químicos envolvidos na comunicação entre planta e visitantes florais?

- Que visitantes florais são atraídos pelos compostos voláteis?

Registro dos polinizadores: observações focais

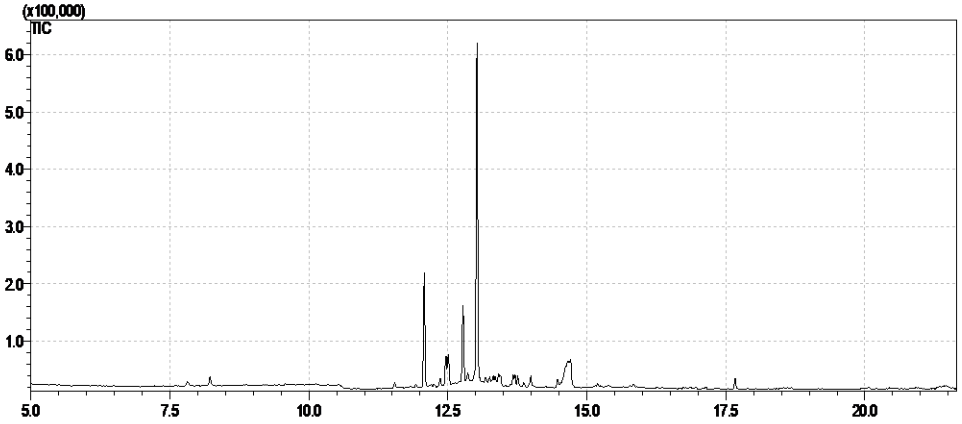
Determinação do sistema reprodutivo: polinizações controladas

- Emasculação
- Ensacamento
- Autopolinização manual
- Polinização cruzada manual
- Controle em condições naturais

Coleta e análise inicial dos voláteis florais: MEFS (SPME) e CG-EM

- Plantas em casa de vegetação
- Micro-Extração em Fase Sólida (MEFS)
- Separação por Cromatografia Gasosa (CG)
- Identificação por Espectrometria de Massas (EM)
- Obtenção de cromatogramas
- Cálculo dos tempos relativos de retenção.

Coleta e análise inicial dos voláteis florais: MEFS (SPME) e GC-MS



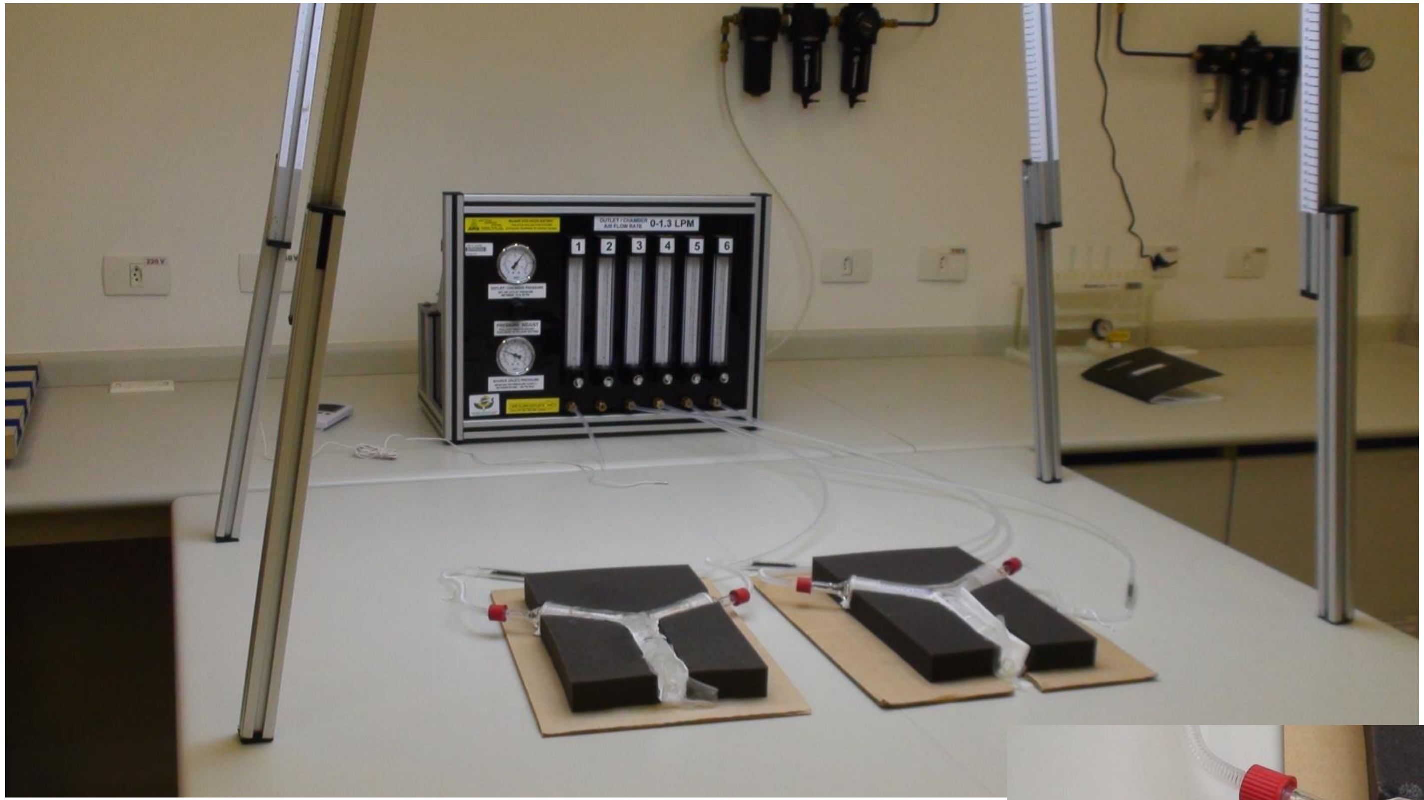
Análises químicas

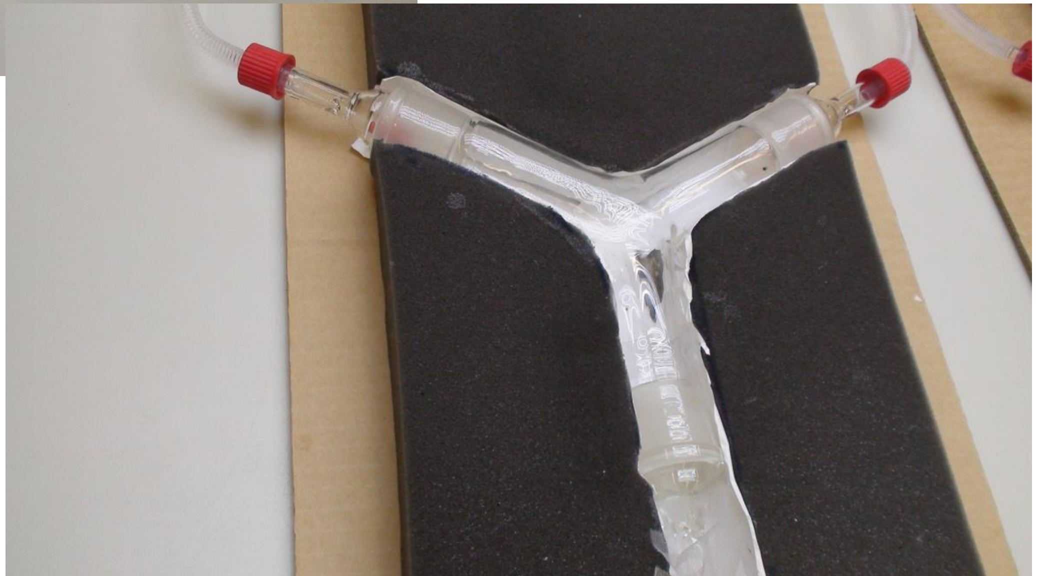
- Busca em bases de dados *online*
- Investigação da função dos voláteis encontrados
- Verificação da ocorrência destes voláteis em outros organismos


FEEDBACK
THE PHEROBASE
DATABASE OF PHEROMONES AND SEMIOCHEMICALS
Existing Users Log In
Username
Password
REMEMBER ME
Log In
Forgot password?
Register here!
Email Activation Link
HOME
ABOUT
GUIDE
AUTHOR
HI – TECH PRODUCTS
TOOLS
ADVERTIZE
CONTRIBUTE
Thousands of Floral Compounds that Mediate Pollinator Attraction to Flowers
START EXPLORE THE DATABASE OR SIMPLY SEARCH
SEARCH
Submit an image

Bioensaios

Bioensaios





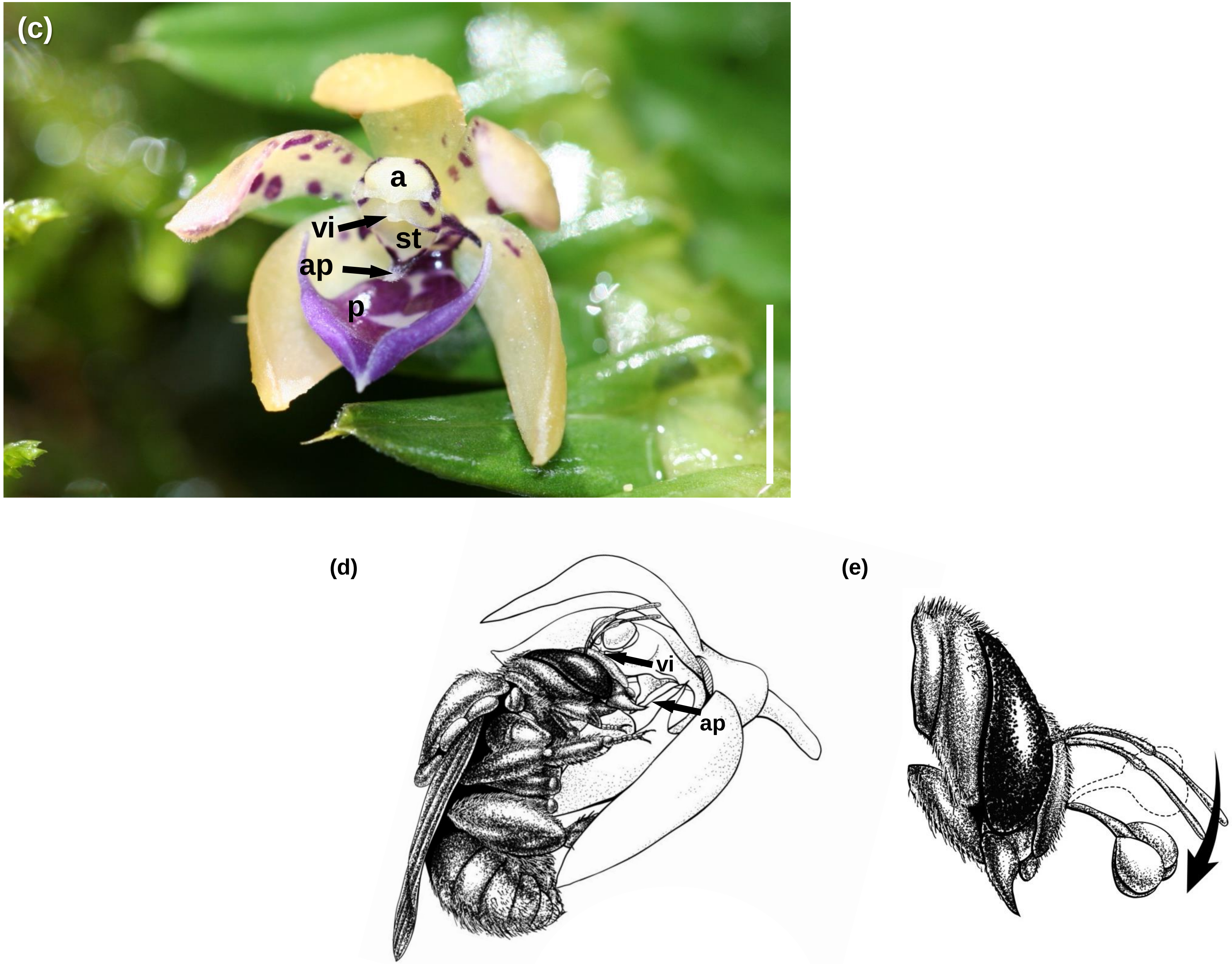
Sistema Reprodutivo

- Totalmente auto-incompatível

Experiment	Fruit set %	Fruits/total	*n*
Hand cross-pollination	45.45	15/33	18
Hand self-pollination	0	0/24	16
Spontaneous self-pollination	0	0/32	7
Natural pollination	5.6	7/125	26
Weevil pollination	0	0/25	23

Visitantes florais e polinizadores

Visitantes florais e polinizadores



(c)
a
vi
st
ap
p
(d)
vi
ap
(e)

- Autoincompatibilidade e polinização por machos Euglossini

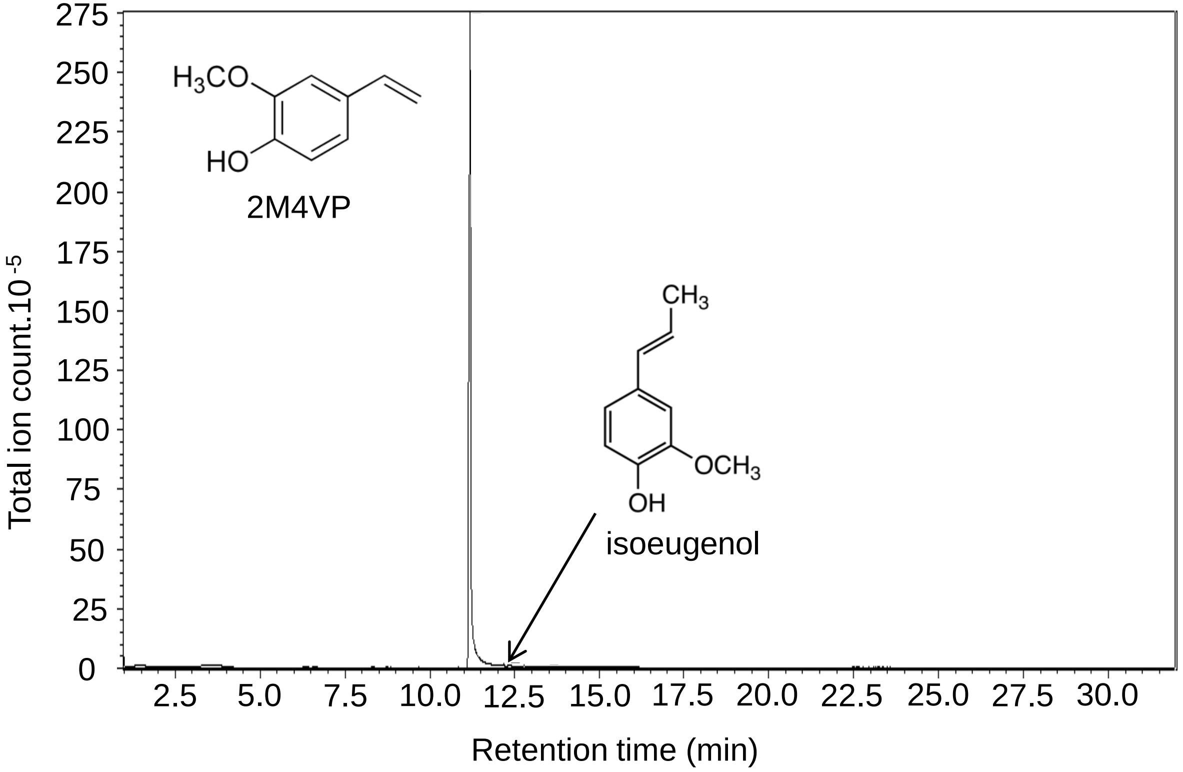
- *Montella* sp. nova poliniza mas não há frutos

Voláteis florais

Table 2 Relative amounts (%) of compounds in headspace fractions of flowers of *Dichaea pendula* plants investigated where detectable VOC amounts were collected, 17 individuals from a total of 25 plants sampled from a population (– indicates not detected compounds)

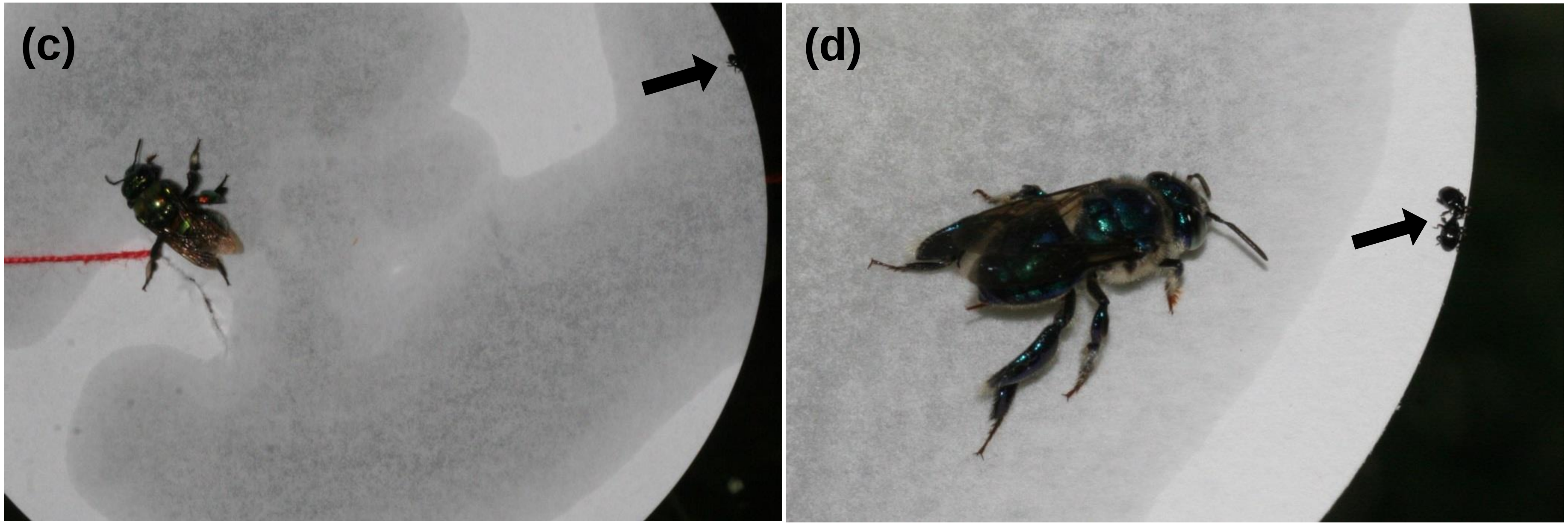
Sample			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
VOC	RI	CAS																	
2-Methoxy-4-vinylphenol	1328	7786-61-0	99.47	99.29	–	–	99.44	100	–	100	100	100	100	100	100	100	–	100	100
4-Hydroxy-3-methylacetophenone	1367	876-02-8	–	–	100	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Thujopsene	1375	470-40-6	–	–	–	–	–	–	41.4	–	–	–	–	–	–	–	–	–	–
3,7-Dimethylnonane	1379	17302-32-8	–	–	–	1.65	–	–	–	–	–	–	–	–	–	–	–	–	–
α-Bourbonene	1397	5208-58-2	–	–	–	–	–	–	2.08	–	–	–	–	–	–	–	–	–	–
No id	1400		0.14	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tetradecane	1400	629-59-4	–	–	–	–	0.56	–	–	–	–	–	–	–	–	–	–	–	–
Dodecane	1407	112-40-3	–	–	–	5.05	–	–	–	–	–	–	–	–	–	–	–	–	–
Isoeugenol	1411	97-54-1	0.24	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Trans-α-bergamotene	1411	13474-59-4	–	–	–	–	–	–	8.26	–	–	–	–	–	–	–	–	–	–
Sativene	1463	3650-28	–	–	–	–	–	–	30.23	–	–	–	–	–	–	–	–	–	–
2,6,11-Trimethyldodecane	1464	31297-82-2	–	–	–	1.61	–	–	–	–	–	–	–	–	–	–	–	–	–
α-Himachalene	1494	3853-83-6	–	–	–	–	–	–	10.78	–	–	–	–	–	–	–	–	–	–
No id	1501		0.15	0.21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
α-Chamigrene	1521	19912-83-5	–	–	–	–	–	–	2.81	–	–	–	–	–	–	–	–	–	–
3-Methylheptadecane	1773	6418-44-6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.5	–	–
Octadecane	1803	593-45-3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	99.5	–	–
Squalene	2832	111-02-4	–	–	–	91.69	–	–	–	–	–	–	–	–	–	–	–	–	–

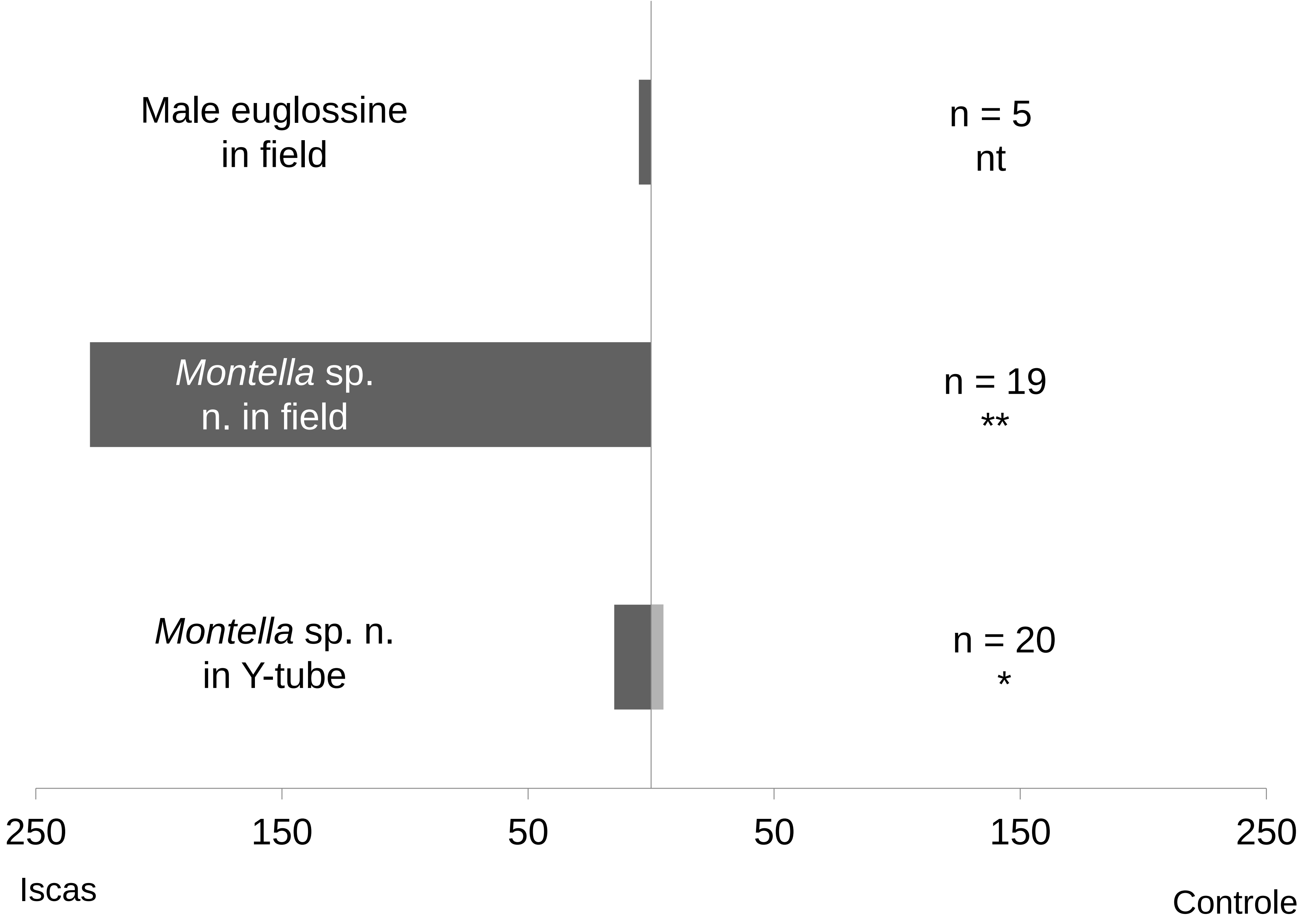
Compounds that could be detected but not identified are named no id. Compounds are listed according to Kovats retention index (RI). Chemical abstracts service (*CAS*) registry numbers and literature Kovats retention index (*RI*) are also provided



Total ion count.10 -5
275
250
225
200
175
150
125
100
75
50
25
0
H3CO
HO
2M4VP
CH3
OCH3
OH
isoeugenol
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
30.0
Retention time (min)

Bioensaios



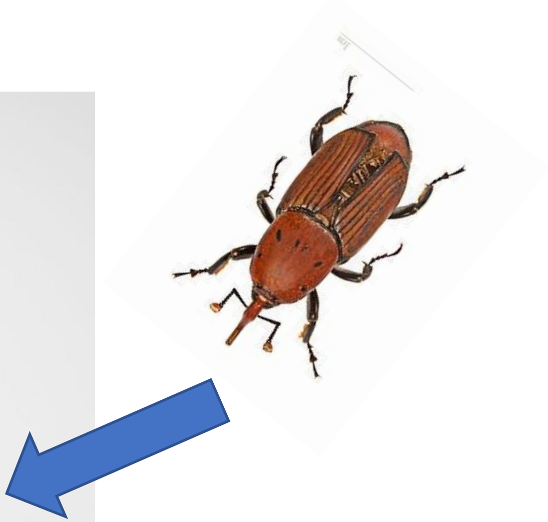


Male euglossine in field
n = 5
nt
Montella sp. n. in field
n = 19
**
Montella sp. n. in Y-tube
n = 20
*
250
150
50
50
150
250
Iscas
Controle

Papel ecológico do 2M4VP

- Nunca antes encontrado em flores
- Kairomônio: atrai broca do coqueiro, outro Curculionidae, para sua hospedeira.

http://en.wikipedia.org/wiki/



Oecologia (2016) 182:933–946
DOI 10.1007/s00442-016-3703-5

HIGHLIGHTED STUDENT RESEARCH

The dilemma of being a fragrant flower: the major floral volatile attracts pollinators and florivores in the euglossine-pollinated orchid *Dichaea pendula*

Carlos E. P. Nunes[1] · Maria Fernanda G. V. Peñaflor[2] · José Maurício S. Bento[2] · Marcos José Salvador[3] · Marlies Sazima[3]

Pressões seletivas conflitantes na emissão de voláteis!

Ecology, 93(2), 2012, pp. 430–435

Advertising to the enemy: enhanced floral fragrance increases beetle attraction and reduces plant reproduction

NINA THEIS[1] AND LYNN S. ADLER

Department of Plant, Soil and Insect Science, 102 Fernald Hall, 270 Stockbridge Road, University of Massachusetts, Amherst, Massachusetts 01003 USA

Abstract. Many organisms face challenges in avoiding predation while searching for mates. For plants, emitting floral fragrances to advertise reproductive structures could increase the attraction of detrimental insects along with pollinators. Very few studies have

ECOLOGY LETTERS

Ecology Letters, (2013) **16**: 299–306 doi: 10.1111/ele.12038

LETTER

Petunia flowers solve the defence/apparency dilemma of pollinator attraction by deploying complex floral blends

Danny Kessler,[1] Celia Diezel,[1] David G. Clark[2] Thomas A. Colquhoun[2] and Ian T. Baldwin[1]*

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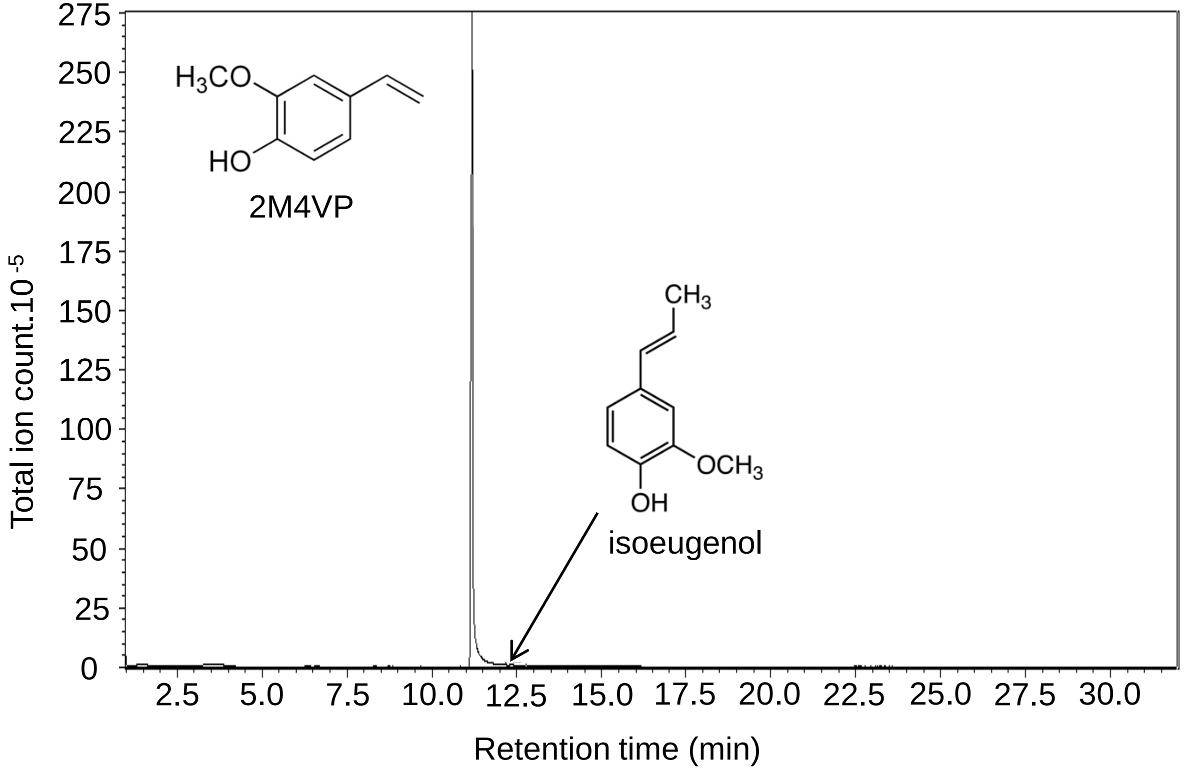
[2]*Environmental Horticulture Department, University of Florida, 1525 Fifield Hall, Gainesville, FL, 32611, USA*

**Correspondence: E-mail: baldwin@ice.mpg.de*

Isoeugenol



275
250
225
200
175
150
125
100
75
50
25
0
Total ion count.10 -5
H3CO
HO
2M4VP
CH3
OCH3
OH
isoeugenol
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
30.0
Retention time (min)

Conclusões

- Um volátil, interações mutualísticas e antagonísticas

- Escassez de polinizadores e outras pressões que não a florivoria podem ser a maior restrição à reprodução da planta.

- Atração de polinizadores e promoção da polinização cruzada teriam sido mais importantes na ecologia evolutiva das flores de *Dichaea pendula*.

PLOS | ONE

RESEARCH ARTICLE

Why Do Floral Perfumes Become Different? Region-Specific Selection on Floral Scent in a Terrestrial Orchid

Karin Gross, Mimi Sun, Florian P. Schiestl*

Institute of Systematic Botany, University of Zurich, Zollikerstrasse 107, CH-8008, Zurich, Switzerland

* florian.schiestl@systbot.uzh.ch

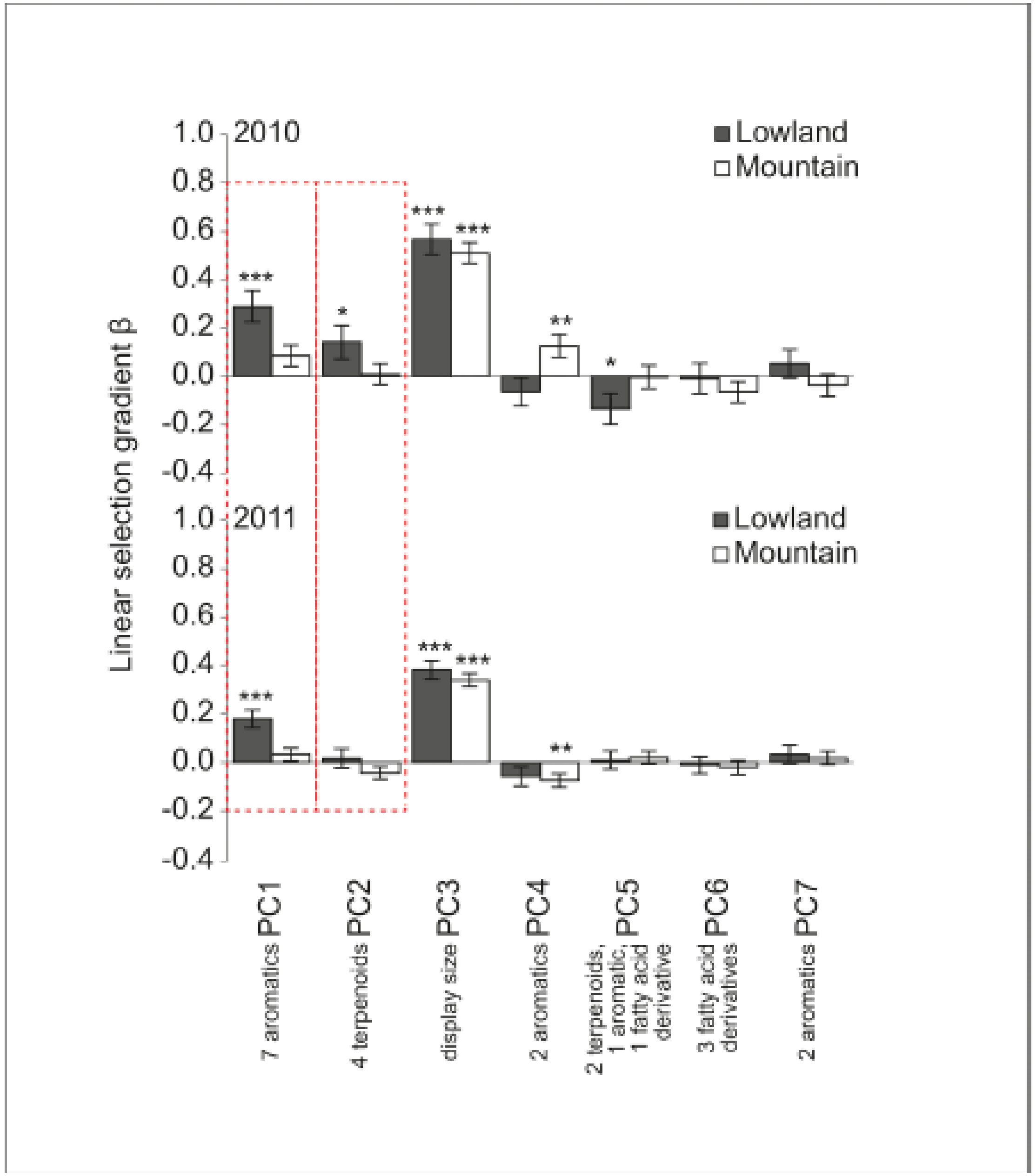


Fig 1. Linear selection gradients β ± SE for principal components (PCs) in the lowland and mountain regions in *Gymnadenia odoratissima*. Two floral scent PCs (PC1 and PC2, marked with red dotted quadrangles) show consistent spatial differences in selection indicated by significant differences between regions but not between years (see Table 1 for details). The x-axis legend gives a short summary of the floral signals loading primarily on each PC (for details, see S3 Table). Significances of linear selection gradients are indicated above the bars: $***P < 0.001$, $**P < 0.01$, $*P < 0.05$. Sample sizes are 2010: $n_{lowland} = 253$ (three populations), $n_{mountain} = 212$ (three populations); 2011: $n_{lowland} = 312$ (four populations), $n_{mountain} = 251$ (three populations).

Brand et al. BMC Evolutionary Biology (2015) 15:176
DOI 10.1186/s12862-015-0451-9

BMC Evolutionary Biology

RESEARCH ARTICLE Open Access

Rapid evolution of chemosensory receptor genes in a pair of sibling species of orchid bees (Apidae: Euglossini)

Philipp Brand[1,2*], Santiago R. Ramírez[2], Florian Leese[1,4], J. Javier G. Quezada-Euan[3], Ralph Tollrian[1] and Thomas Eltz[1]

Review

Pollinator-mediated evolution of floral signals

Florian P. Schiestl[1] **and Steven D. Johnson**[2]

[1] Institute of Systematic Botany, University of Zurich, Zollikerstrasse 107, CH-8008 Zürich, Switzerland
[2] School of Life Sciences, University of KwaZulu-Natal, P. Bag X01, Scottsville, Pietermaritzburg 3209, South Africa

Coevolução??

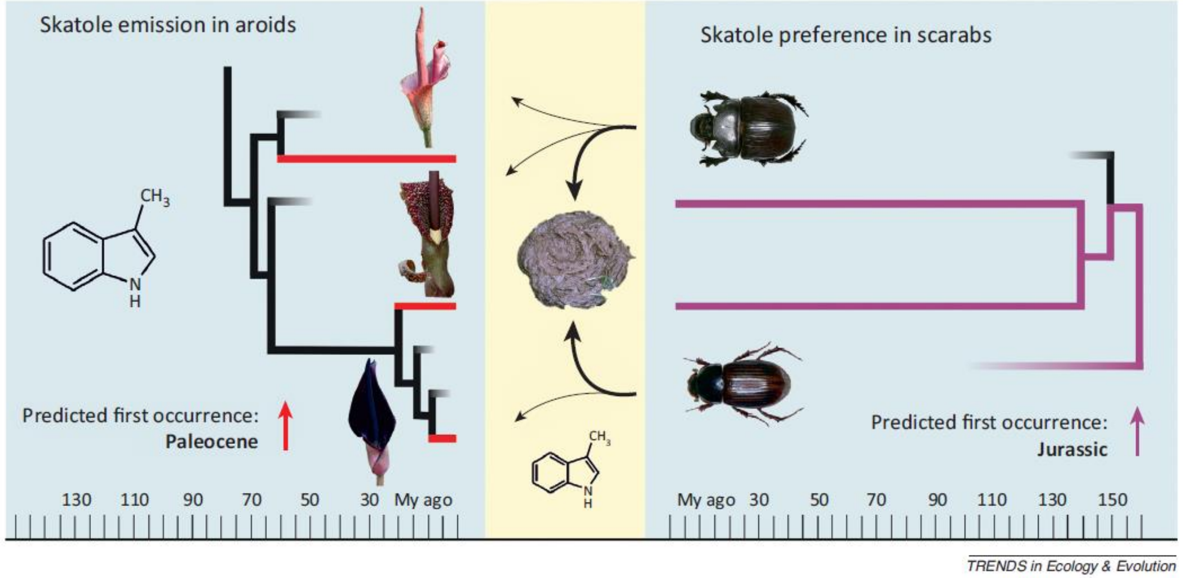


Figure I. The emission of skatole in mimetic Araceae has evolved through pre-existing bias. The three aroid genera *Amorphophallus*[a], *Sauromatum*[a], and *Arum*[b] (from top to bottom in the left panel) comprise species with skatole emission (red branches in left phylogeny) that mimic dung and thereby attract coprophagous insects as pollinators. Skatole emission is a key signal in this floral mimicry, because it is usually emitted from dung and attracts dung beetles. The right panel shows a reconstruction of preference for skatole (purple branches in phylogeny) in scarab beetles. The figure shows species of the genera *Heliocopris*[c] (top) and *Aphodius*[c] (bottom) that pollinate dung-mimicking aroids in *Amorphophallus*, *Sauromatum*, and *Arum*, respectively. Dated phylogenies suggest that preferences for skatole in the beetles evolved at least 150 Mya, whereas the emission of skatole in aroids evolved comparatively recently, approximately 60 Mya [19]. Picture credits: [a]Alex Bernhard, [b]Seán O'Hara, [c]Udo Schmidt.

Implicaria em codivergência

Convergência??

Floral convergence leading to pollination syndromes

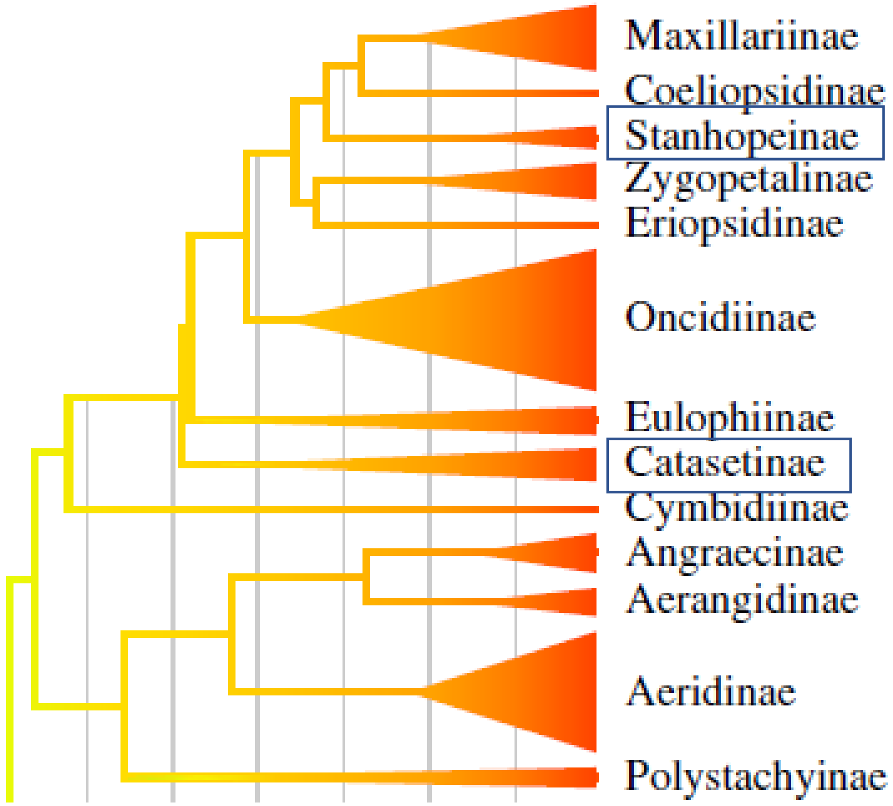
Unrelated plants pollinated by the same pollinators tend to exhibit convergence in their floral traits, including advertizing signals [56]. These macroevolutionary associations between particular signals and pollinators (Figure 1) are usually based on qualitative measures of flower color and scent according to human perception. Nevertheless, an increasing number of quantitative studies show good support for signal convergence [1,57,58]. Convergent floral syndromes can be useful for generating hypotheses about traits under pollinator-mediated selection. For example, bat-pollinated plants show convergence in emission of sulfur-containing compounds [59]. Bats have been shown to be attracted to some of the compounds, providing an explanation for their evolution [60].

Catasetum cernuum and *Gongora bufonia*

What would these two orchid species have in common?


A
B
C
D
E
F
G

Not so closely related Epidendroids



Givnish *et al.* 2015

Hetherington-Rauth & Ramírez 2015

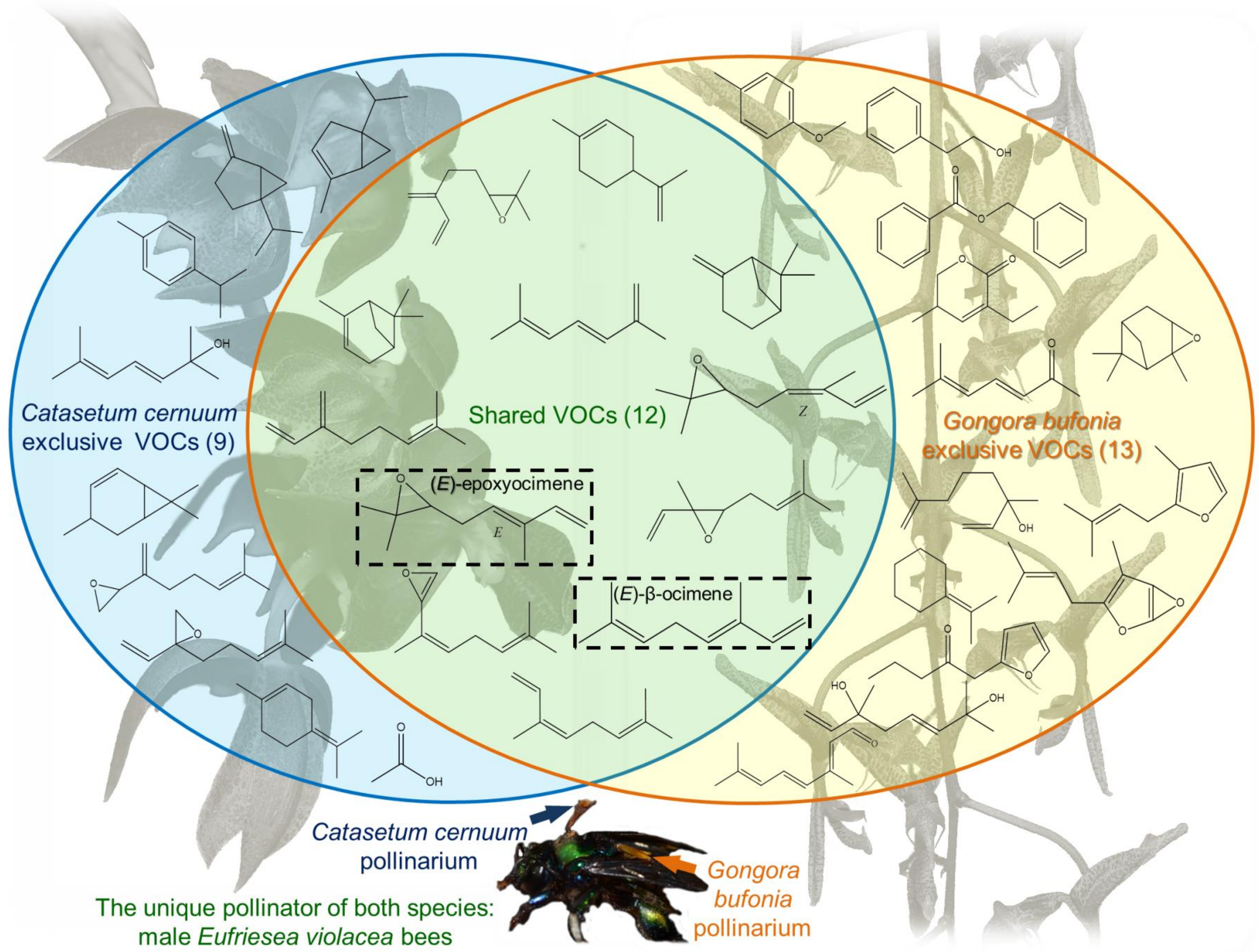
Mais de 80 horas de observação
Diferentes pesquisadores em diferentes reservas de Mata Atlântica

Só um
polinizador

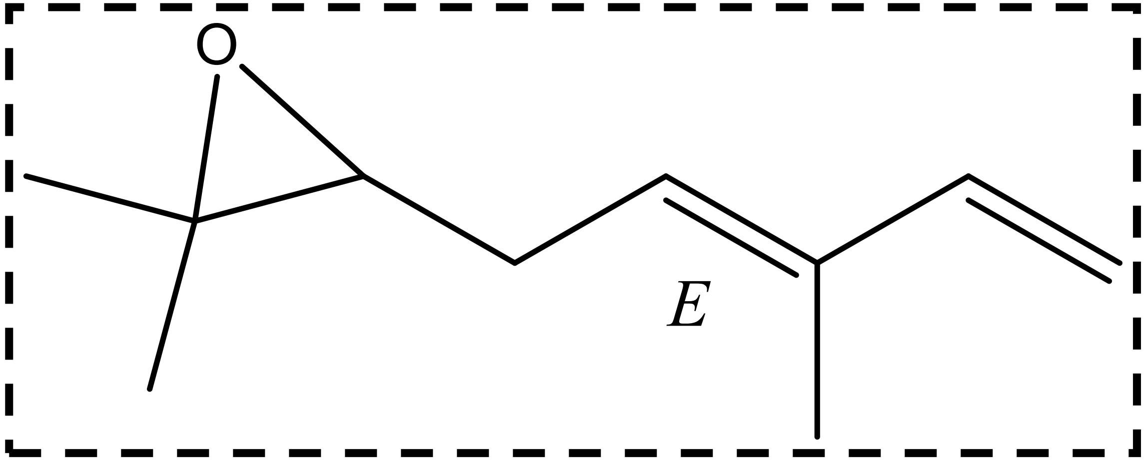
Machos de
Eufriesea violacea


Mais detalhes em Adachi et al.
2015, Botany.

Compartilham muitos compostos, mas com buquês diferentes

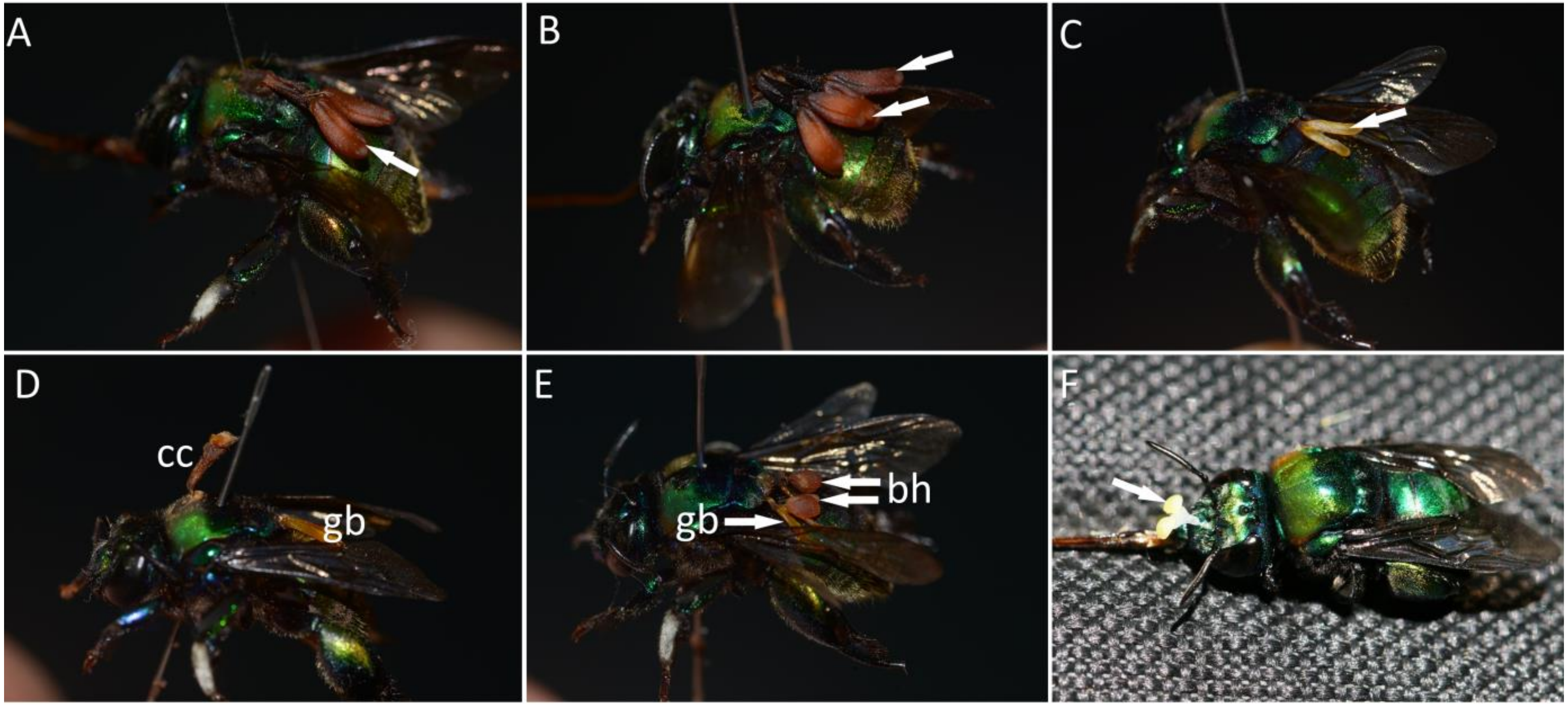


MRPP, A = 0.21, d_{obs} = 24.05, d_{exp} = 30.49, *p* = 0.09; ANOSIM, R = 0.8, *p* = 0.17



Ambas emitem *(e)*-epoxyocimene

... outras orquídeas também usam *Eufriesea violacea*, mas sem exclusividade



Com tantas espécies de Euglossini, por que só *Eufriesea violacea*?

Images A-E by Prof. Dr. Emerson Riccardo Pansarin

Jogo da imitação?

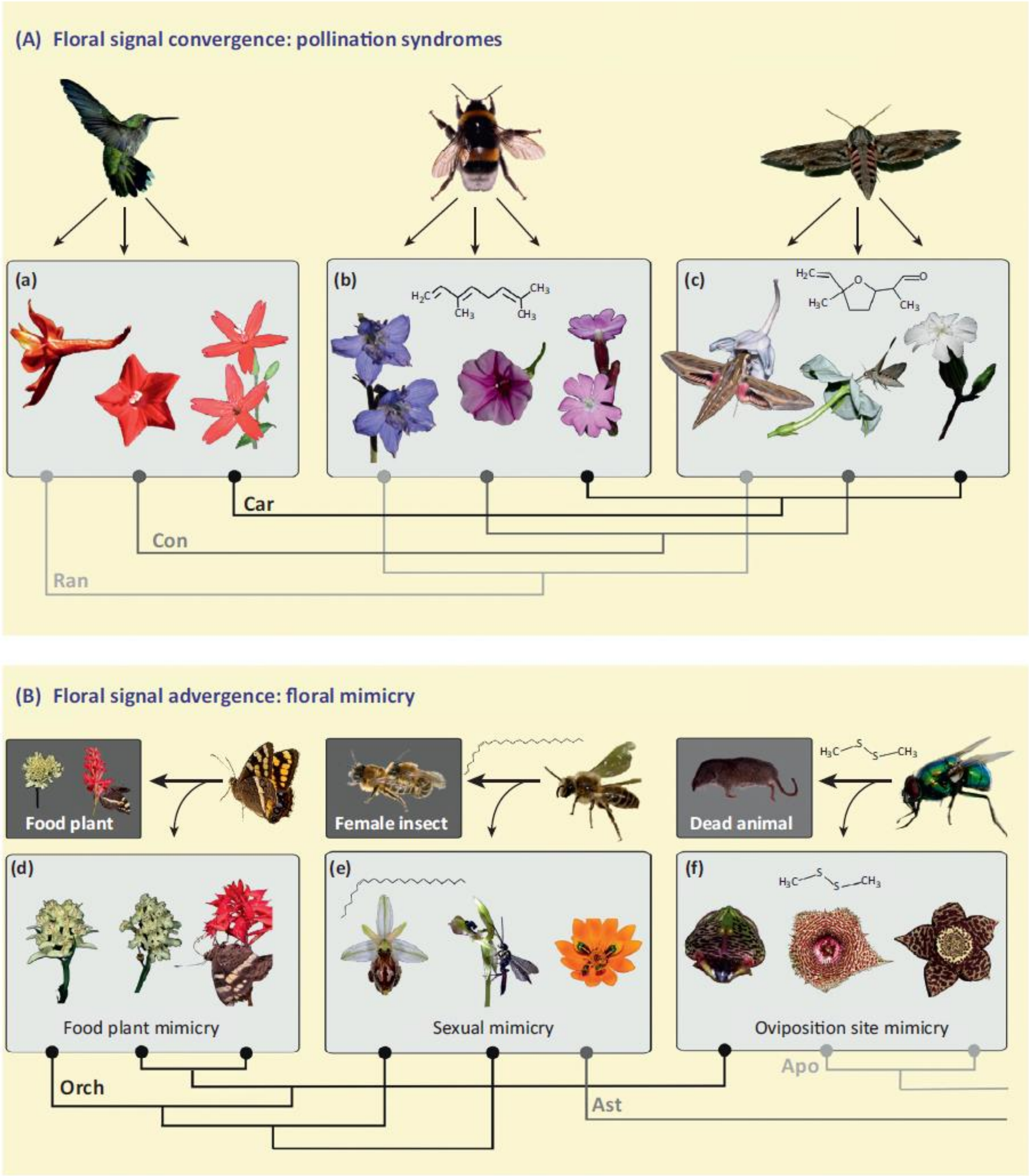
Duas espécies de orquídeas teriam resolvido o problema de atrair um mesmo polinizador da mesma forma?

Review

Pollinator-mediated evolution of floral signals

Florian P. Schiestl[1] and Steven D. Johnson[2]

[1] Institute of Systematic Botany, University of Zurich, Zollikerstrasse 107, CH-8008 Zürich, Switzerland
[2] School of Life Sciences, University of KwaZulu-Natal, P. Bag X01, Scottsville, Pietermaritzburg 3209, South Africa

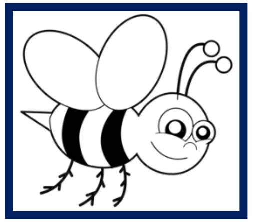

(A) Floral signal convergence: pollination syndromes
(a)
(b)
(c)
Car
Con
Ran
(B) Floral signal advergence: floral mimicry
Food plant
Female insect
Dead animal
(d)
(e)
(f)
Food plant mimicry
Sexual mimicry
Oviposition site mimicry
Orch
Apo
Ast

Advergência ou mimetismo?

Floral advergence leading to mimicry

Mimicry is the similarity of one organism (the mimic) to another (the model) that enhances the mimic's fitness through its effect on the behavior of a third party, the operator. Because the mimic evolves to resemble a model, but the model is not necessarily shaped by the mimic, this is a form of advergent evolution [69]. In floral mimicry, the operator is a pollinator and the models can be the flowers of rewarding plants [70], or even oviposition sites [71] or female insects [43,72] (Figure 1). Mimicry is most effective when behavioral responses to the signals of models are essential for the survival or reproduction of certain pollinators.

COGNIÇÃO



audição

tato

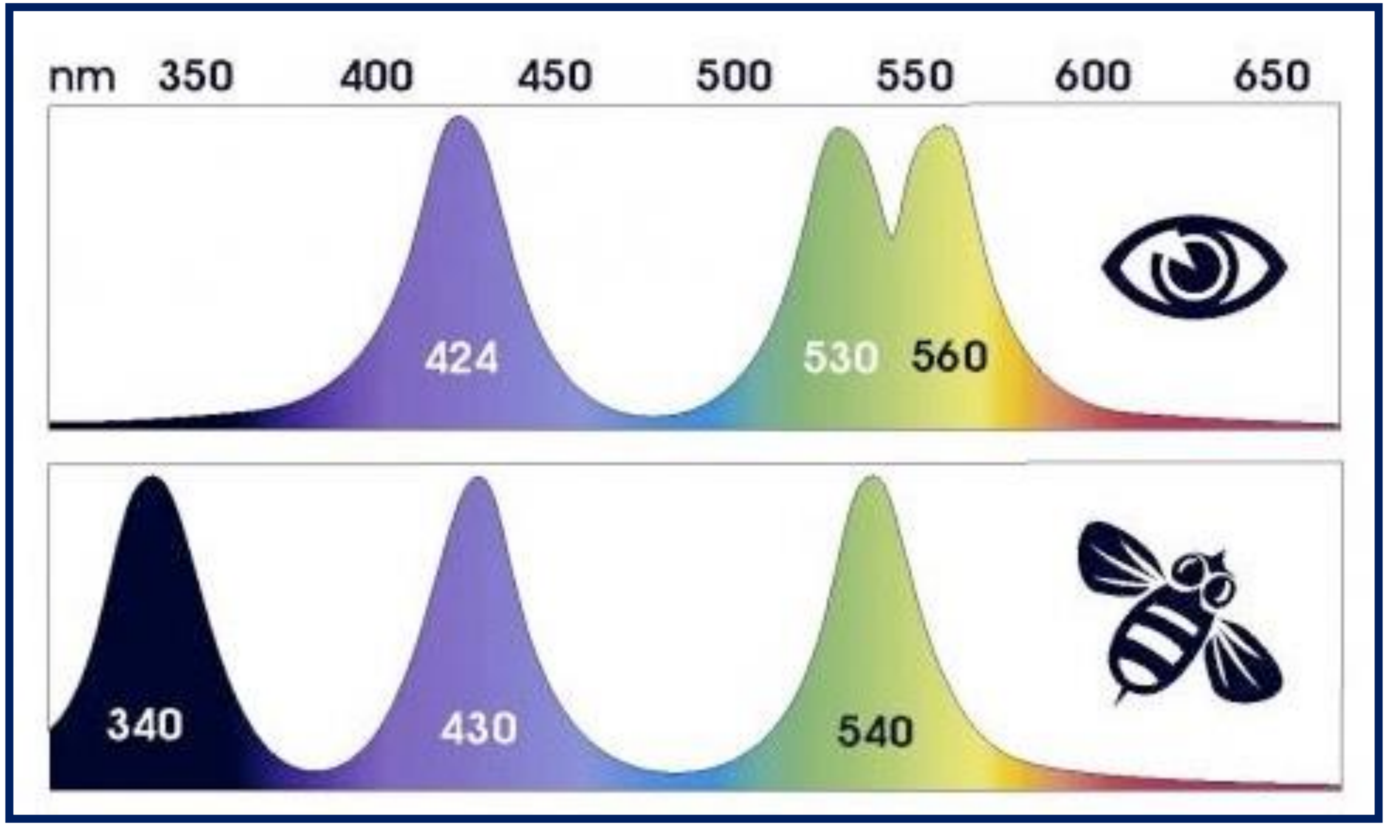
olfato

gustação

visão

Brito *et al.* 2014

Visão

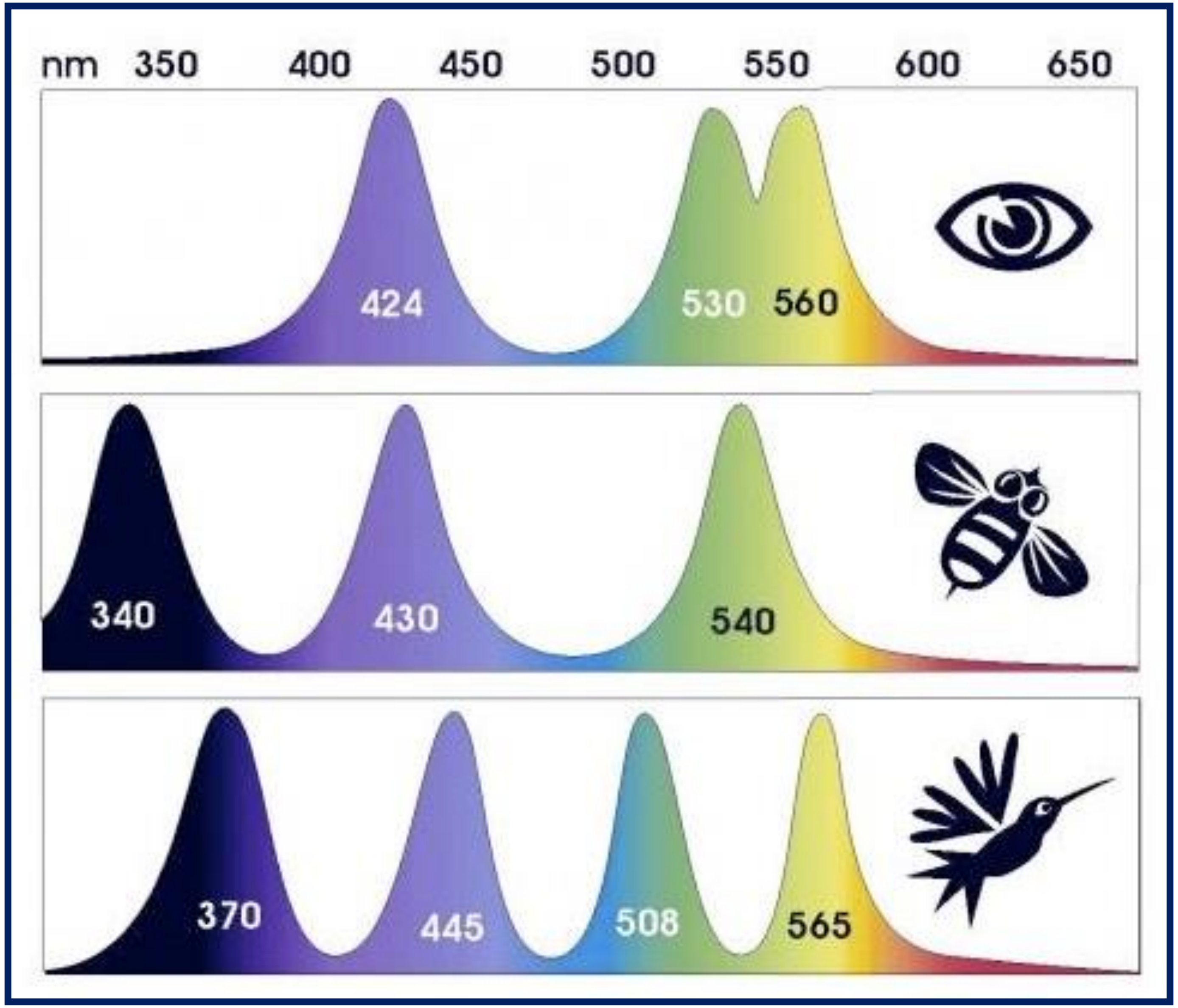


Visão

Visão

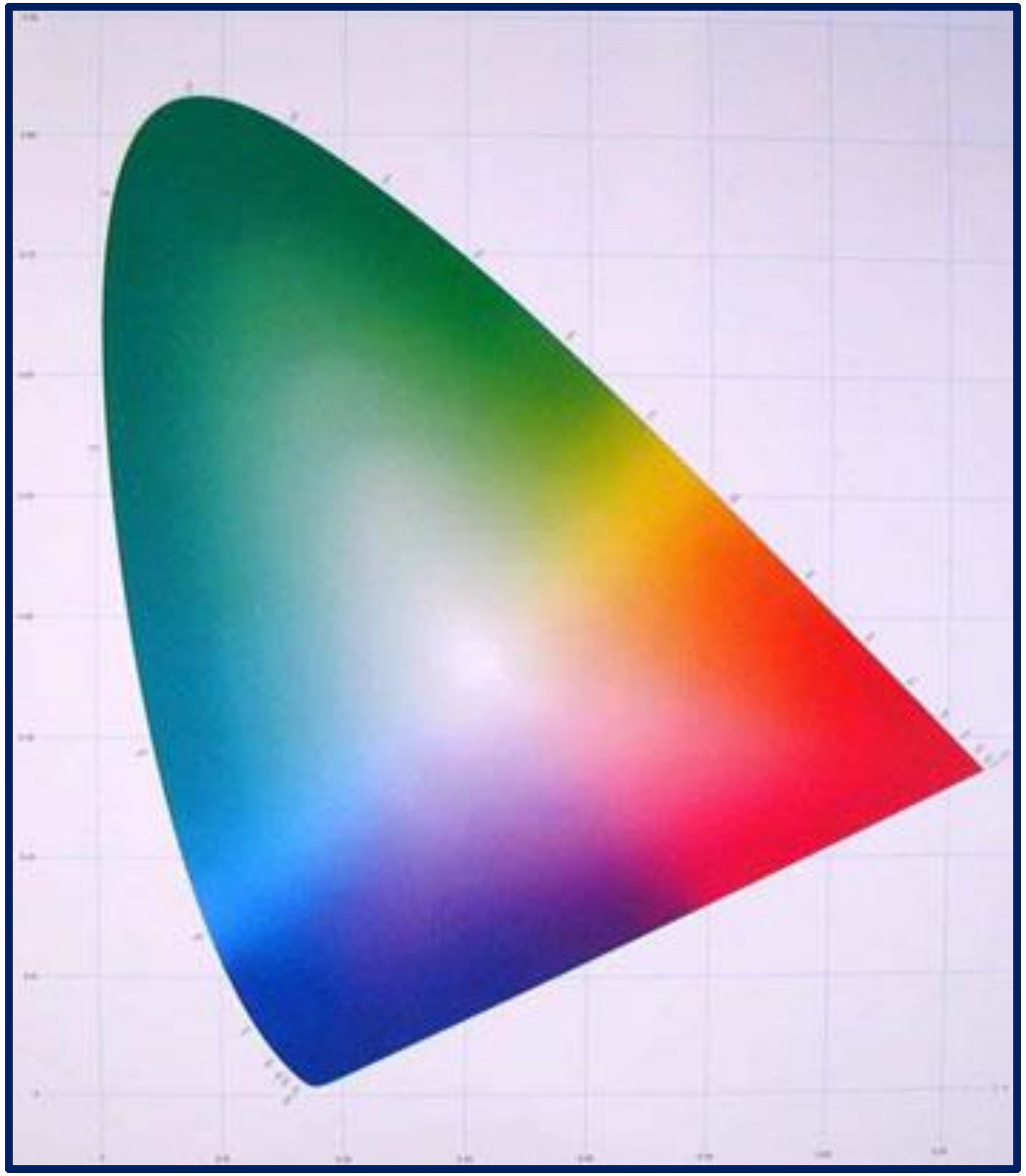
Visão

Vision

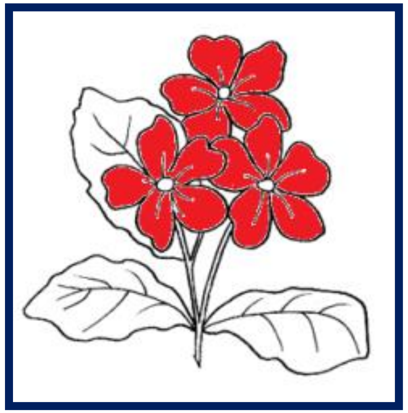


nm
350
400
450
500
550
600
650
424
530
560
340
430
540
370
445
508
565

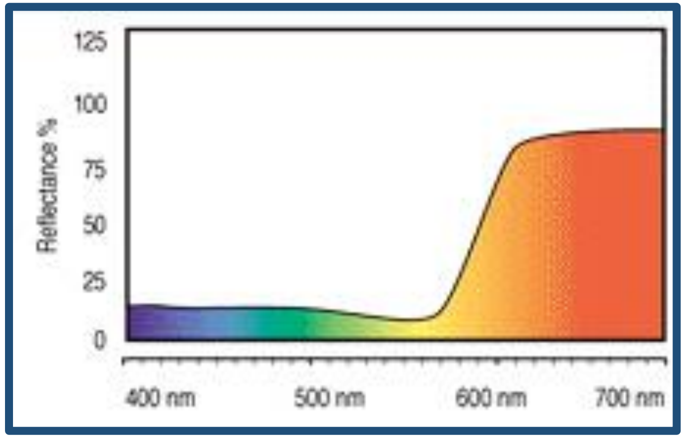
Visão



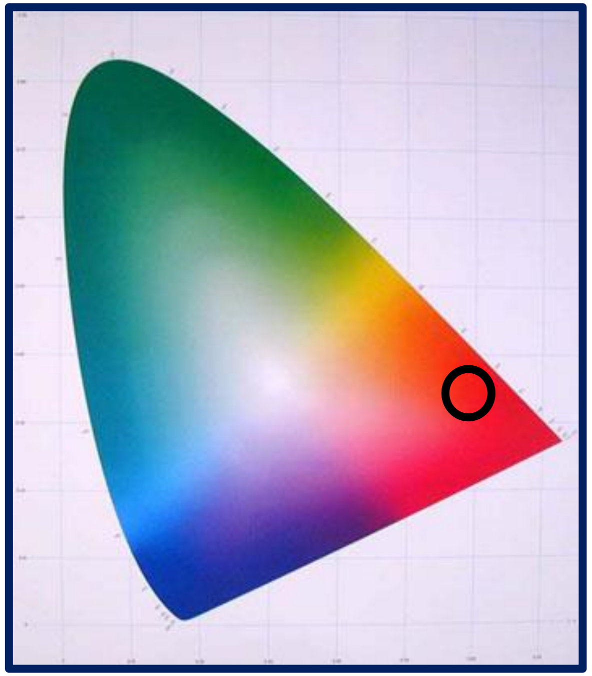
Visão



flor

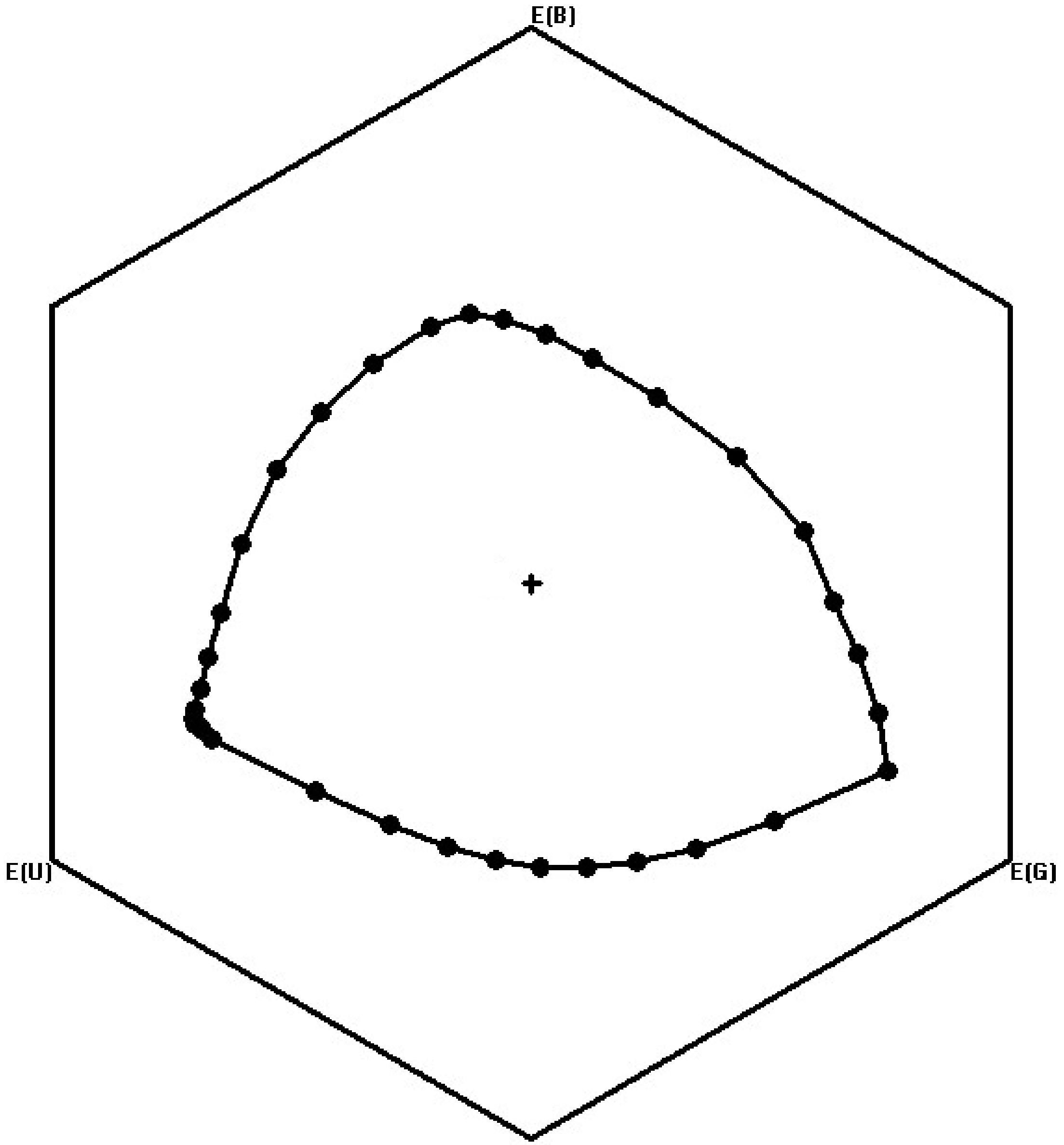


curva de reflectância

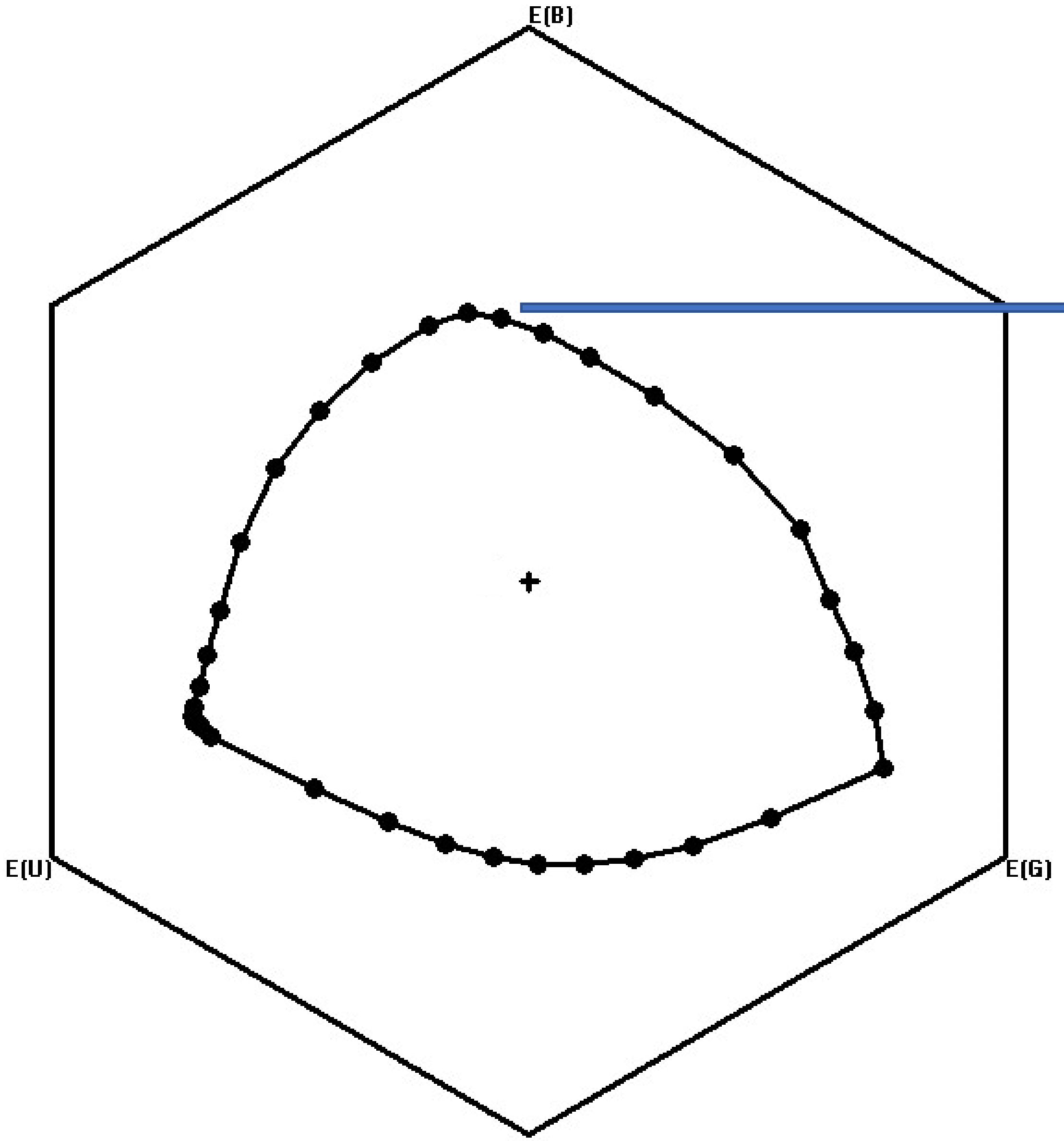


locus de cor

Visão

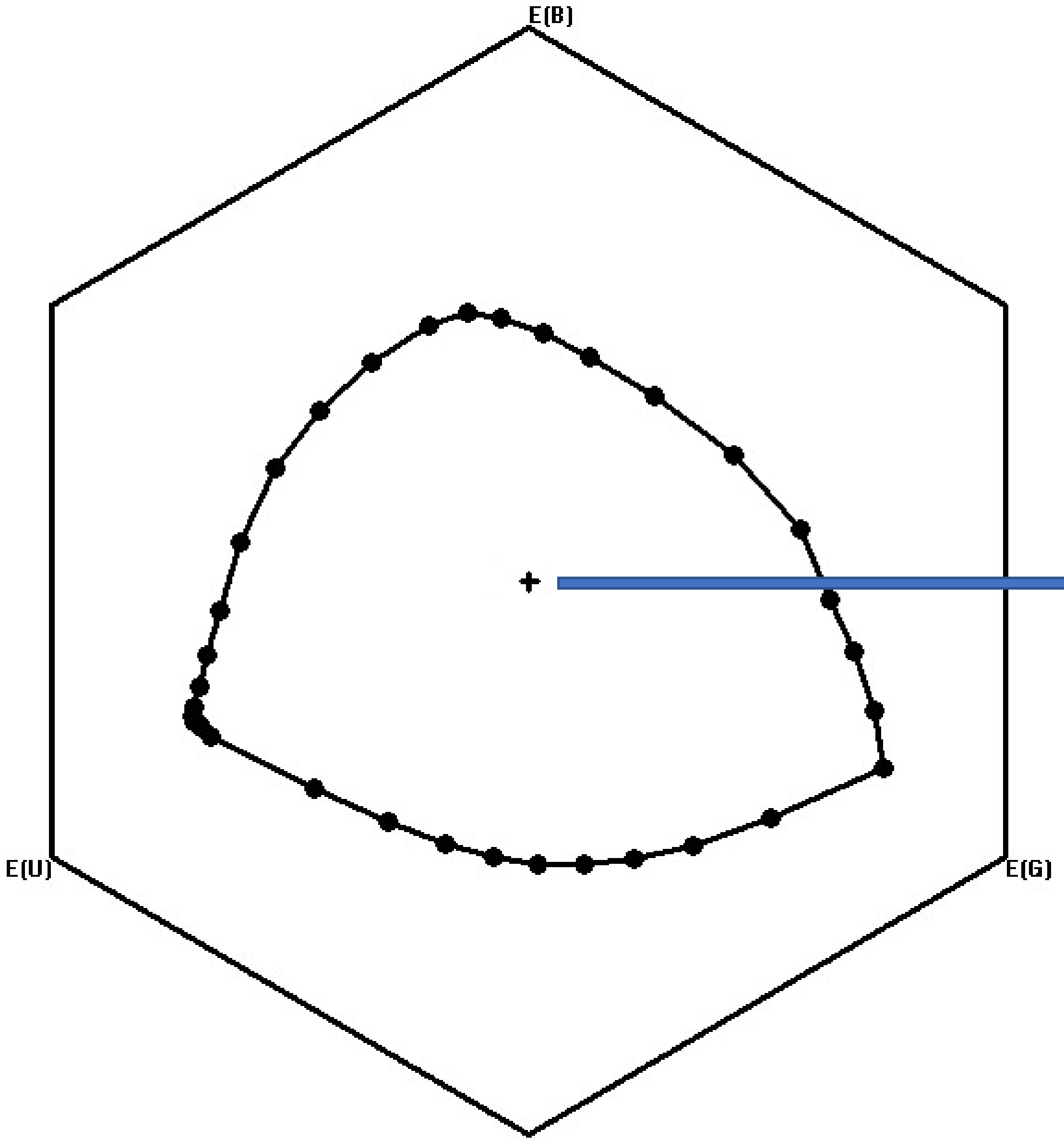


Visão



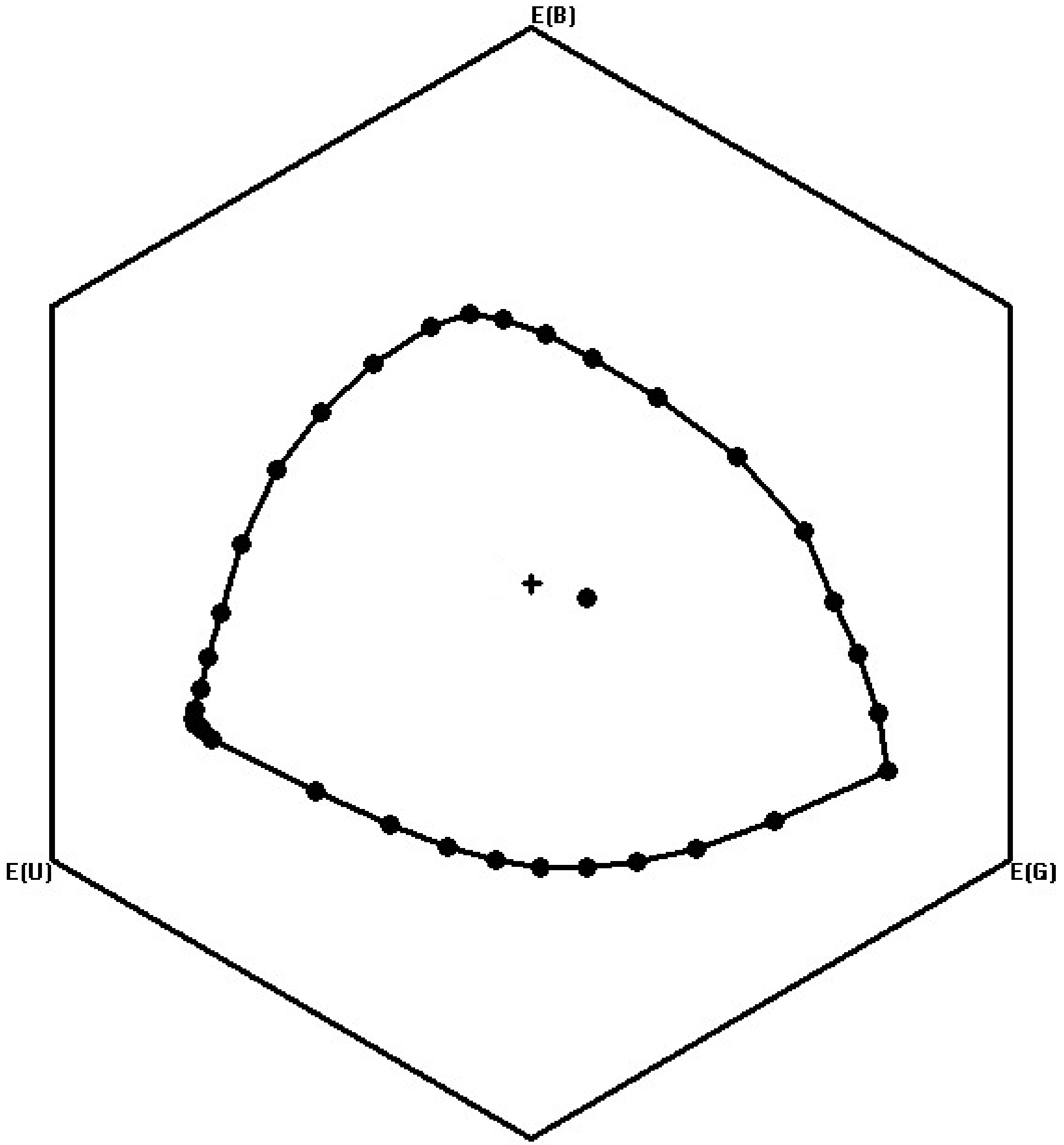
Excitação máxima

Visão



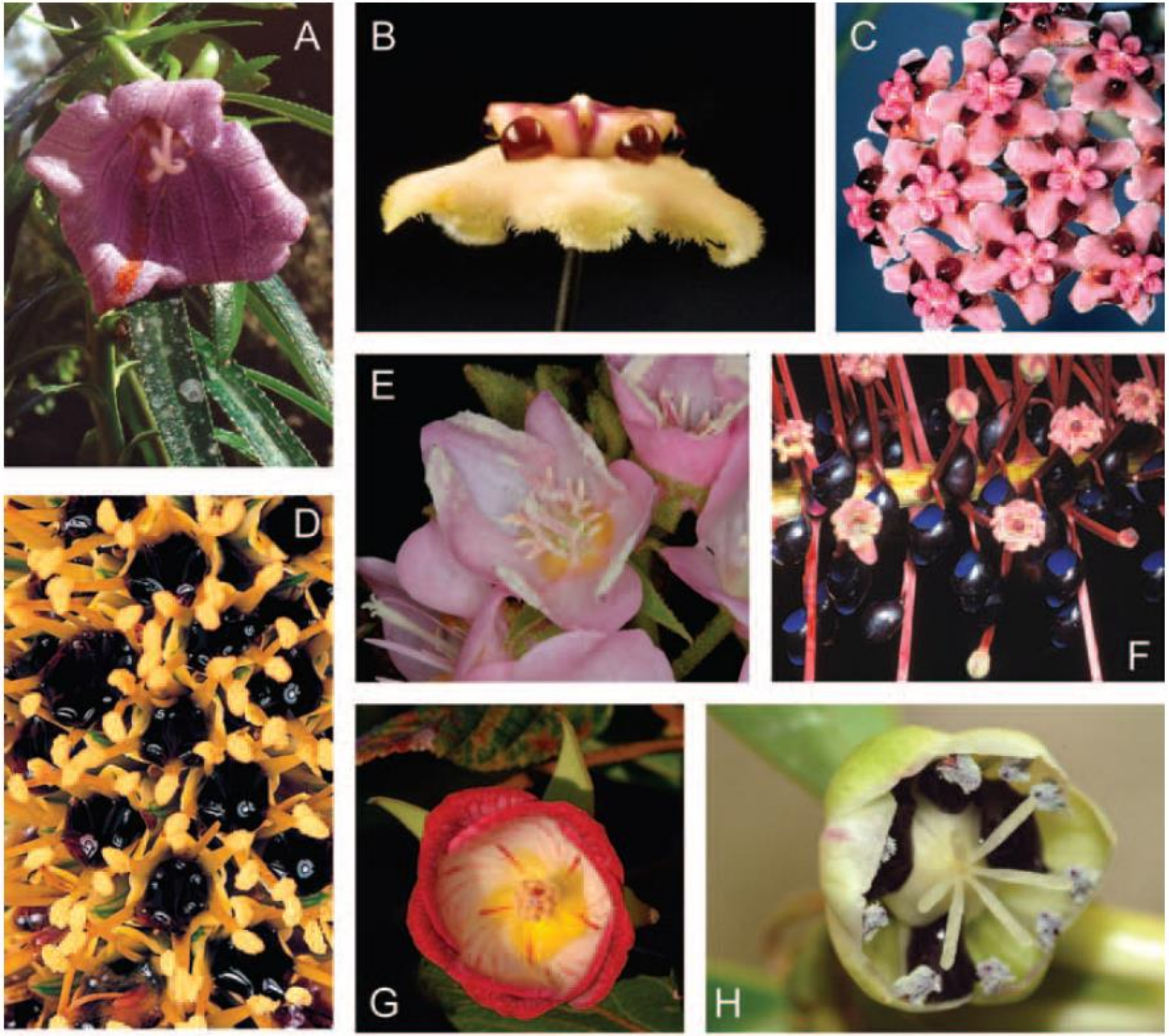
acromática
(verde)

Visão

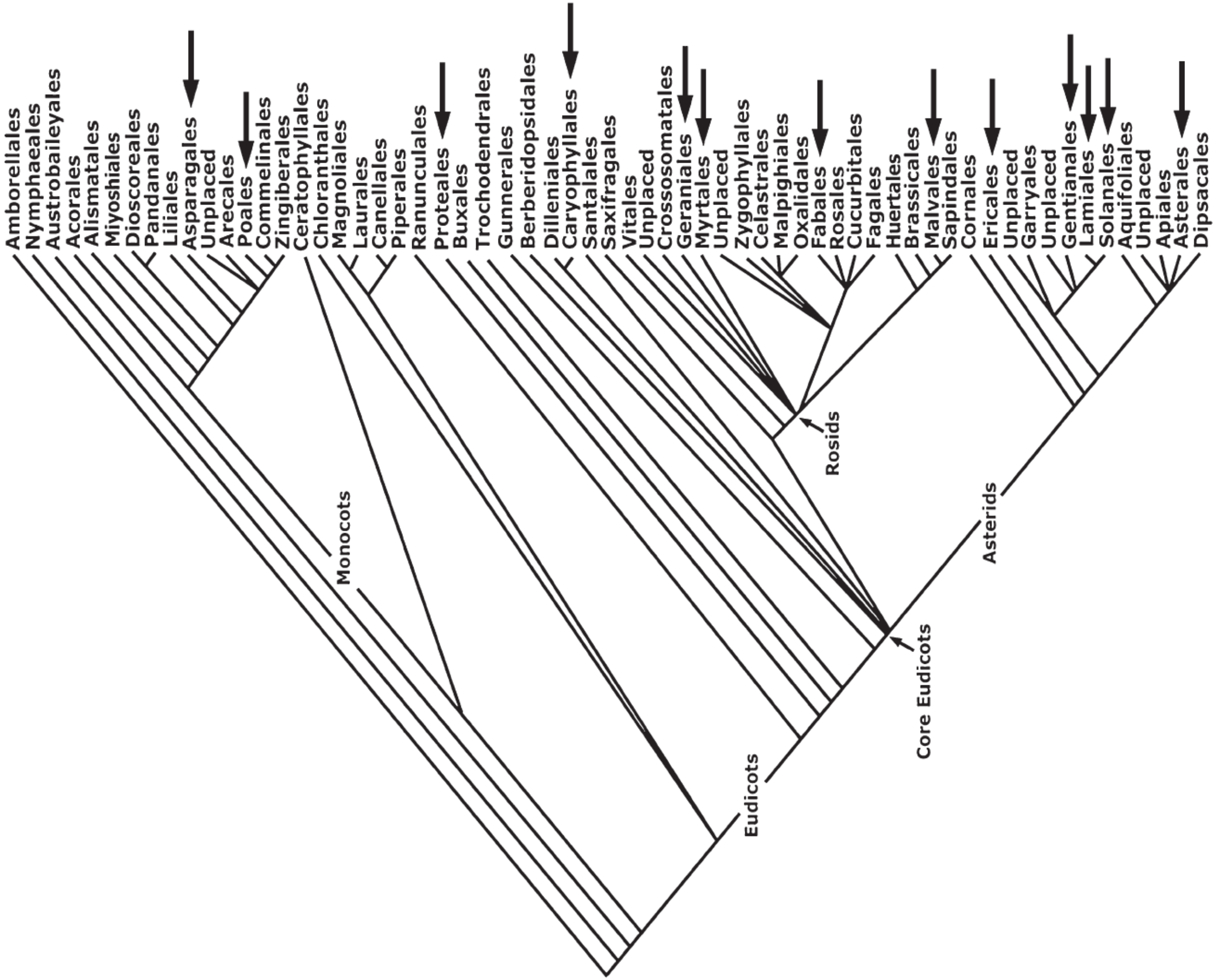


Pureza espectral

Contraste de verde


A
B
C
D
E
F
G
H


I
J
K
L
M
N
O
P
Q
R



At least 15 times independently!!!

Hansen et al. 2007

Bixa orellana

Honestidade na comunicação

Sinalização honesta → Quantidade de recurso informada diretamente pelo sinal

Armbruster *pers. comm.*


Calypso bulbosa

Honestidade na comunicação

Sinalização desonesta → **Sinalização sem recurso**

Armbruster *pers. comm.*

Honestidade na comunicação

Flores sem recurso

Florescimento adiantado

Se aproveitam dos polinizadores "inocentes"

Se aproveitam de preferências inatas

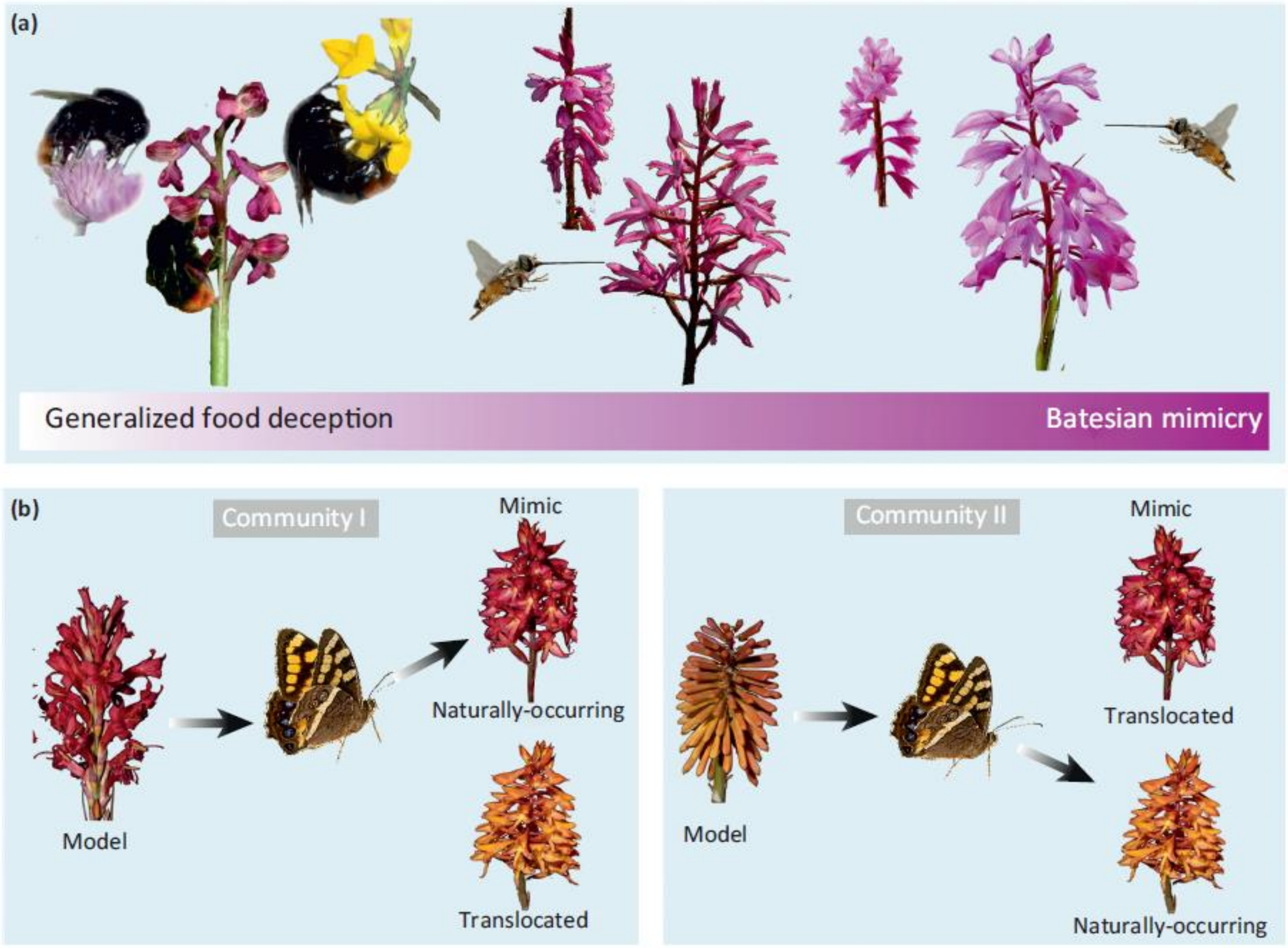
Honestidade na comunicação

Sinalização desonesta

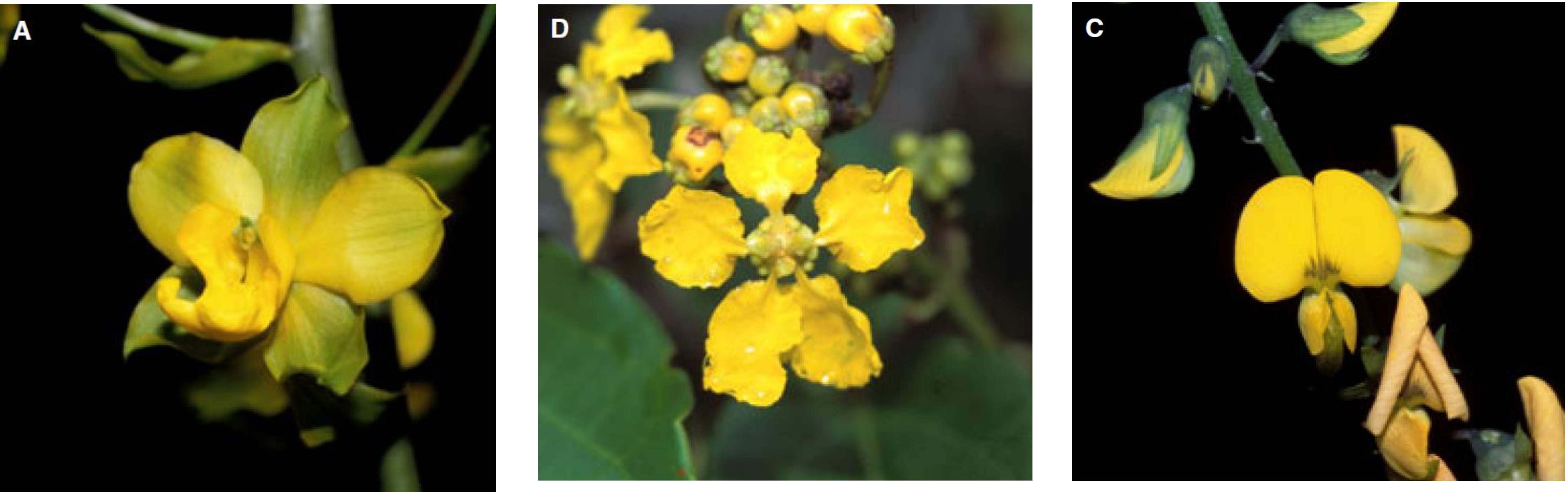
Flores sem recurso

Flores miméticas

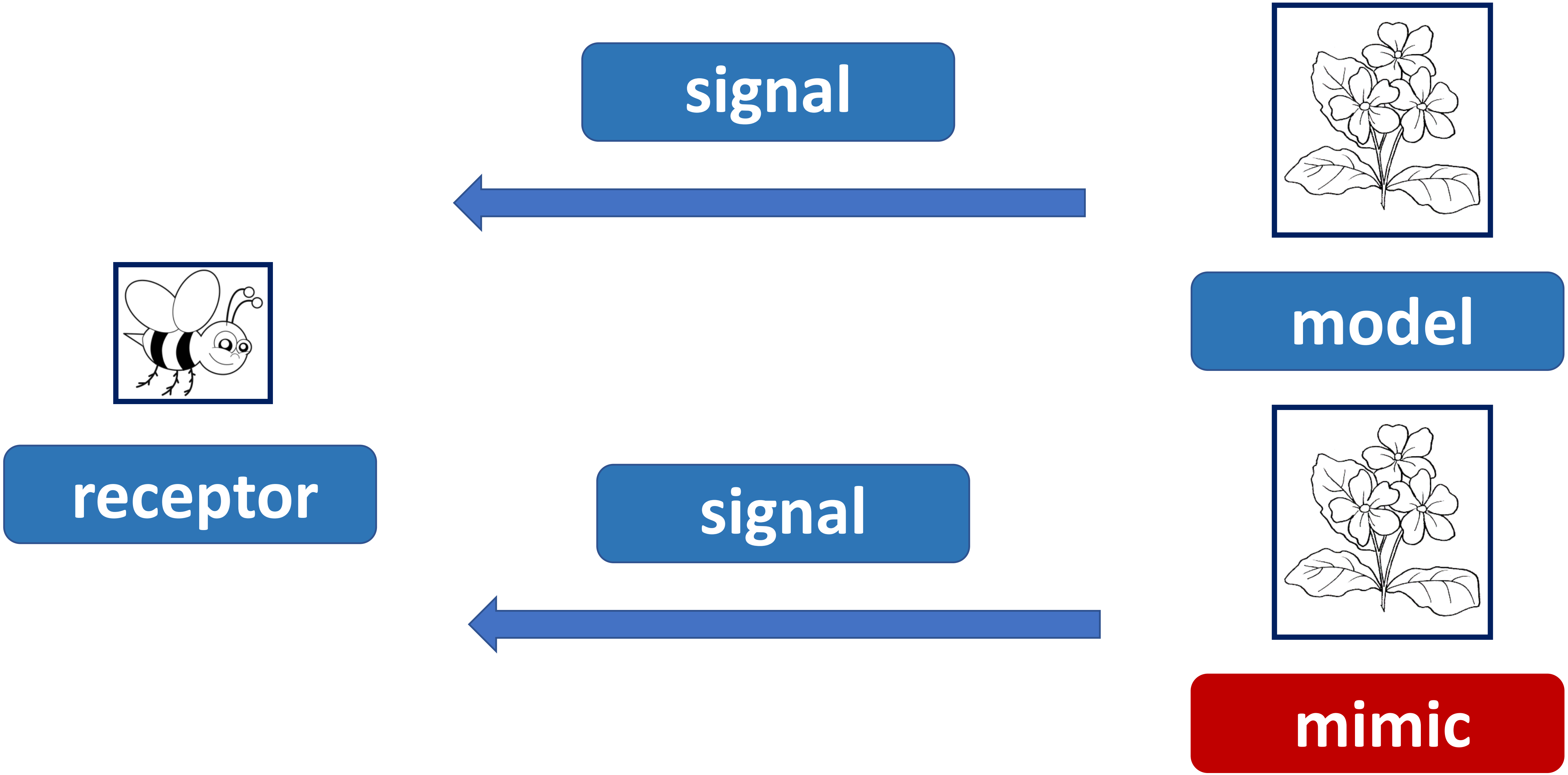
Polinização por pseudocópula



TRENDS in Ecology & Evolution


A
D
C

Honestidade na comunicação



Honestidade na comunicação

Predições sobre o mimetismo

Semelhança dos atributos florais

Sobreposição no espaço, no tempo e no nicho

Sucesso reprodutivo mais alto na presença do modelo

Roy & Widmer 1999

Honestidade na comunicação

Sinalização desonesta

Flores sem recurso

Flores miméticas

Polinização por pseudocópula

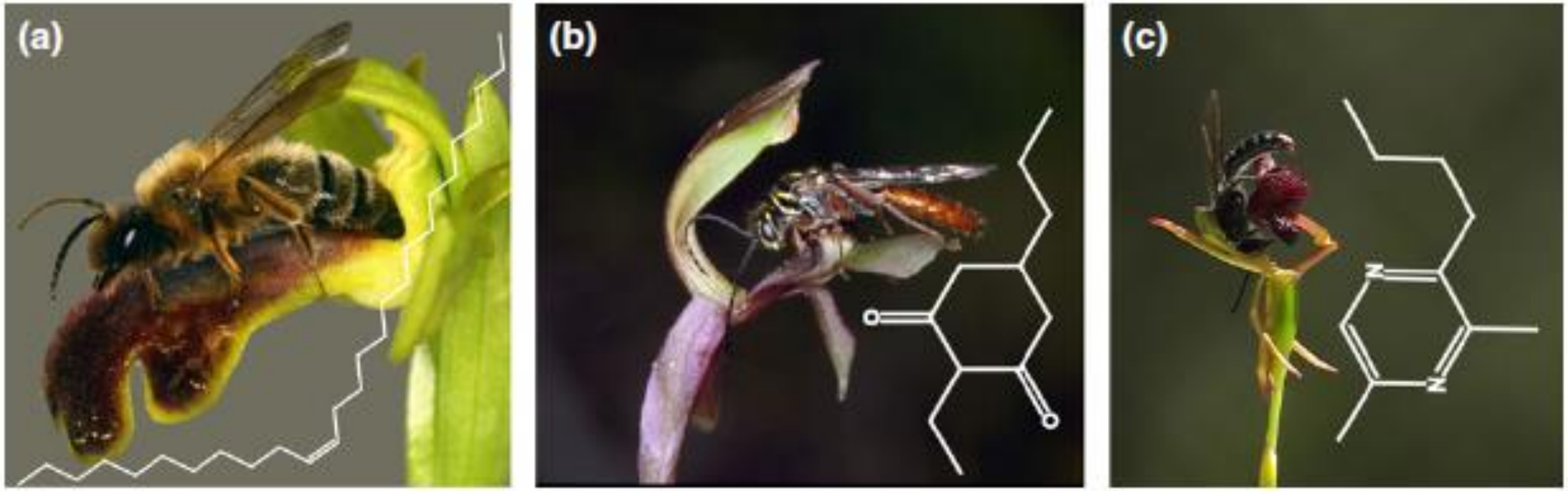
Ophrys sp.

***Ophrys* sp.**

Drakaea sp.

Commentary

The role of preadaptations or evolutionary novelties for the evolution of sexually deceptive orchids



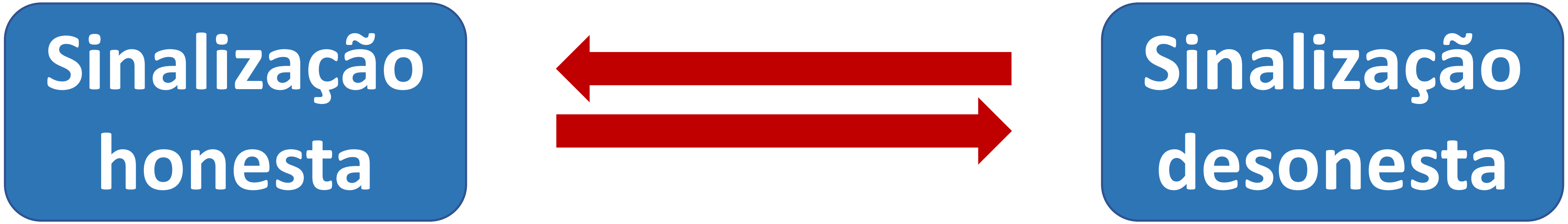
Ayasse & Dottërl 2014

Honestidade na comunicação

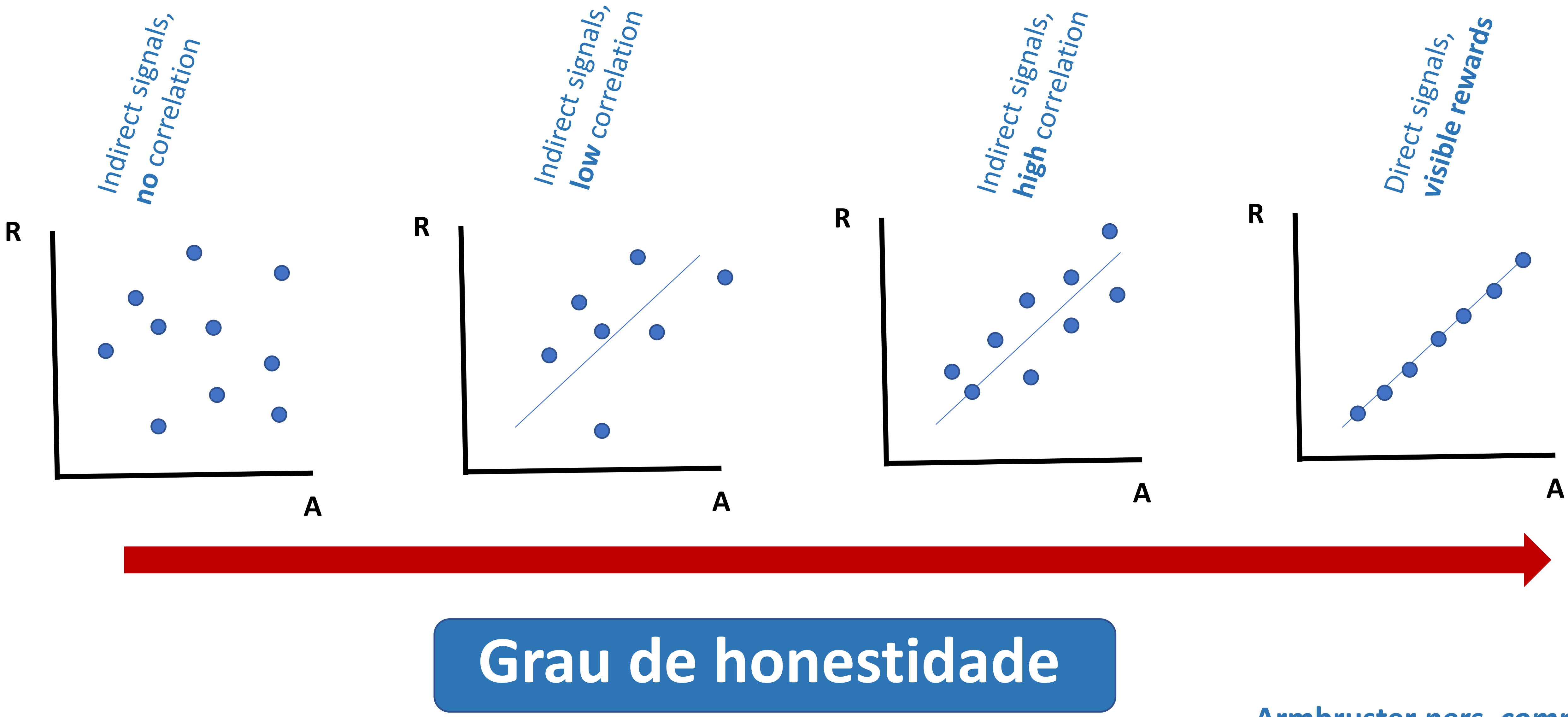
Sinalização honesta

Sinalização desonesta

Honestidade na sinalização



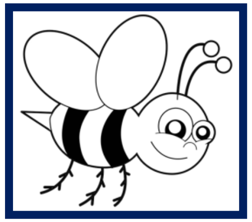
Honestidade na comunicação

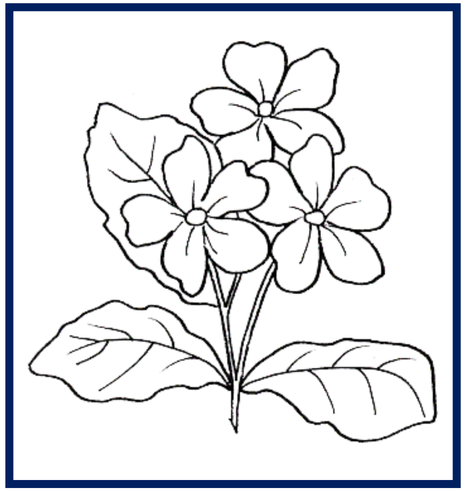


Armbruster *pers. comm.*

Comunicação Inseto -> Planta

sinal



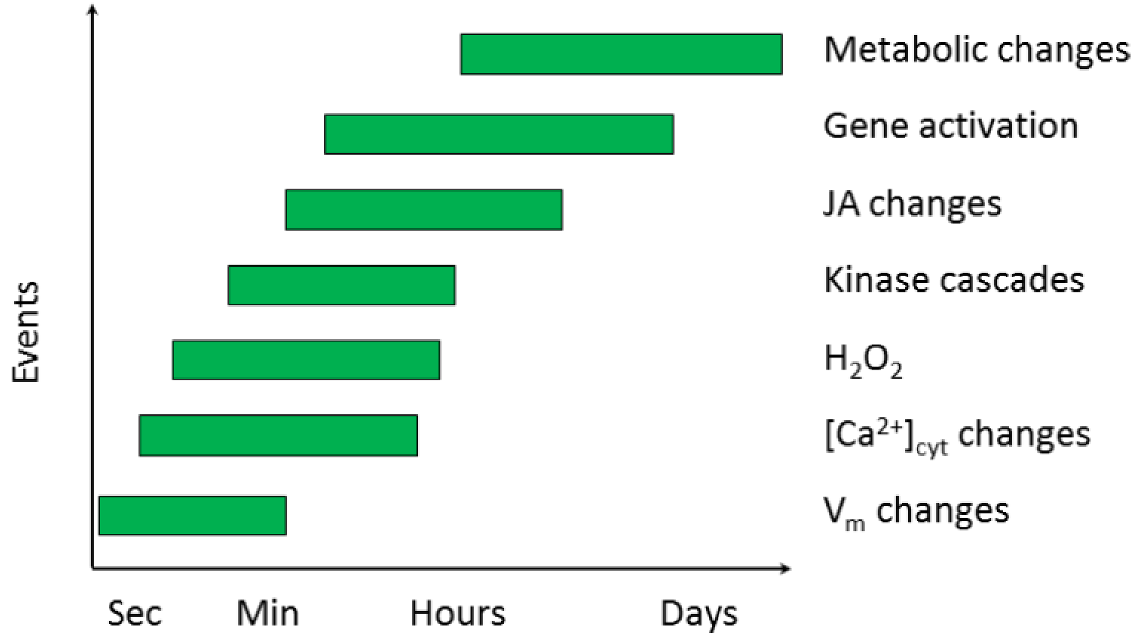


emissor

receptor

Percepção química das plantas

Figure 3. Events in plants after feeding by insect herbivores. Changes in the transmembrane potential (V_m) appear immediately upon herbivory damage and are tightly followed by changes in the intracellular Ca^{2+} concentration and generation of H_2O_2. Kinases and the phytohormone jasmonic acid (JA) are detectable within minutes. After roughly 1 h, gene activation followed by metabolic changes is seen (Adapted from [44]).



Fürstenberg-Hägg J, Zagrobelny M, Bak S. 2013Int J Mol Sci. 14(5):10242-97.

Eletromagnetismo

REPORT

Detection and Learning of Floral Electric Fields by Bumblebees

Dominic Clarke[*], Heather Whitney[*], Gregory Sutton, Daniel Robert[†]

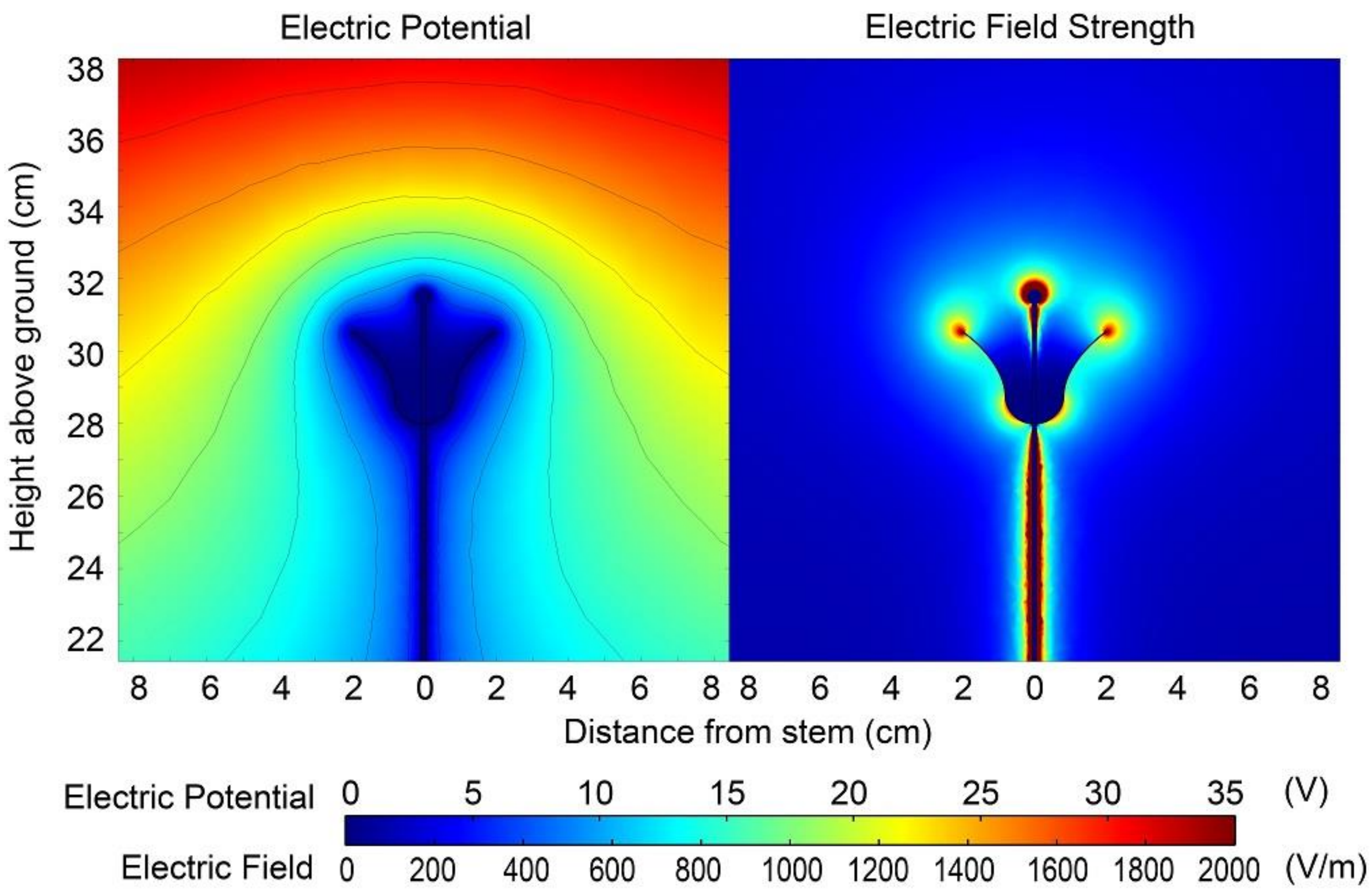
+ Author Affiliations

↵†Corresponding author. E-mail: d.robert@bristol.ac.uk

↵* These authors contributed equally to this work.

Science 05 Apr 2013:
Vol. 340, Issue 6128, pp. 66-69
DOI: 10.1126/science.1230883

https://www.youtube.com/watch?v=zfP0_5fwSN0


Electric Potential
Electric Field Strength
Height above ground (cm)
38
36
34
32
30
28
26
24
22
8 6 4 2 0 2 4 6 8
8 6 4 2 0 2 4 6 8
Distance from stem (cm)
Electric Potential 0 5 10 15 20 25 30 35 (V)
Electric Field 0 200 400 600 800 1000 1200 1400 1600 1800 2000 (V/m)

REPORT

Caffeine in Floral Nectar Enhances a Pollinator's Memory of Reward

G. A. Wright[1,*], D. D. Baker[2], M. J. Palmer[3], D. Stabler[1,2], J. A. Mustard[4], E. F. Power[1,2], A. M. Borland[2], P. C. Stevenson[5,6]

+ Author Affiliations

[*]To whom correspondence should be addressed. E-mail: jeri.wright@ncl.ac.uk

Science 08 Mar 2013:
Vol. 339, Issue 6124, pp. 1202-1204
DOI: 10.1126/science.1228806

Vibrações...

ECOLOGY LETTERS

Ecology Letters, (2019) **22**: 1483–1492 doi: 10.1111/ele.13331

LETTER

Flowers respond to pollinator sound within minutes by increasing nectar sugar concentration

Marine Veits,[1†] Itzhak Khait,[1†] Uri Obolski,[1] Eyal Zinger,[1] Arjan Boonman,[2] Aya Goldshtein,[2] Kfir Saban,[1] Rya Seltzer,[2] Udi Ben-Dor,[1] Paz Estlein,[1] Areej Kabat,[1] Dor Peretz,[1] Ittai Ratzersdorfer,[1] Slava Krylov,[3] Daniel Chamovitz,[1] Yuval Sapir,[1§] Yossi Yovel,[2§] and Lilach Hadany[1*§]

Abstract

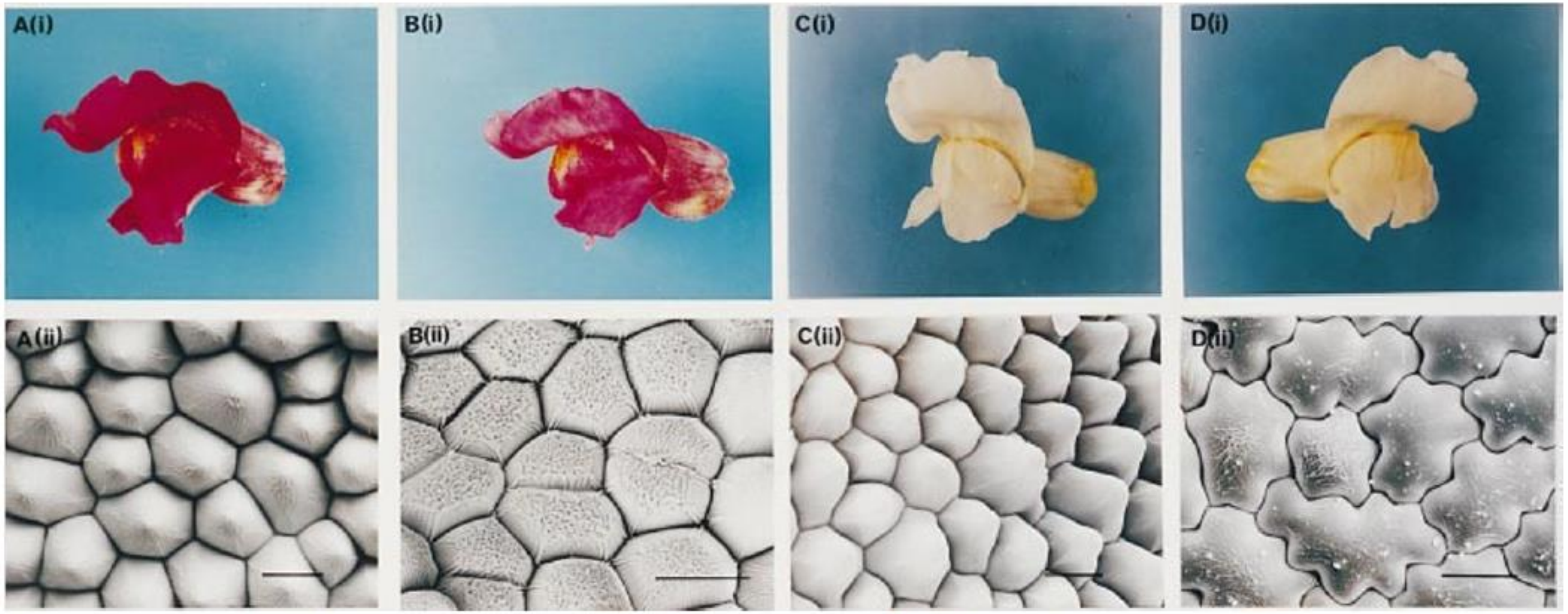
Can plants sense natural airborne sounds and respond to them rapidly? We show that *Oenothera drummondii* flowers, exposed to playback sound of a flying bee or to synthetic sound signals at similar frequencies, produce sweeter nectar within 3 min, potentially increasing the chances of cross pollination. We found that the flowers vibrated mechanically in response to these sounds, suggesting a plausible mechanism where the flower serves as an auditory sensory organ. Both the vibration and the nectar response were frequency-specific: the flowers responded and vibrated to pollinator sounds, but not to higher frequency sound. Our results document for the first time that plants can rapidly respond to pollinator sounds in an ecologically relevant way. Potential implications include plant resource allocation, the evolution of flower shape and the evolution of pollinators sound. Finally, our results suggest that plants may be affected by other sounds as well, including anthropogenic ones.

Tato: preferências por certas texturas

The role of petal cell shape and pigmentation in pollination success in *Antirrhinum majus*

BEVERLEY J. GLOVER* & CATHIE MARTIN

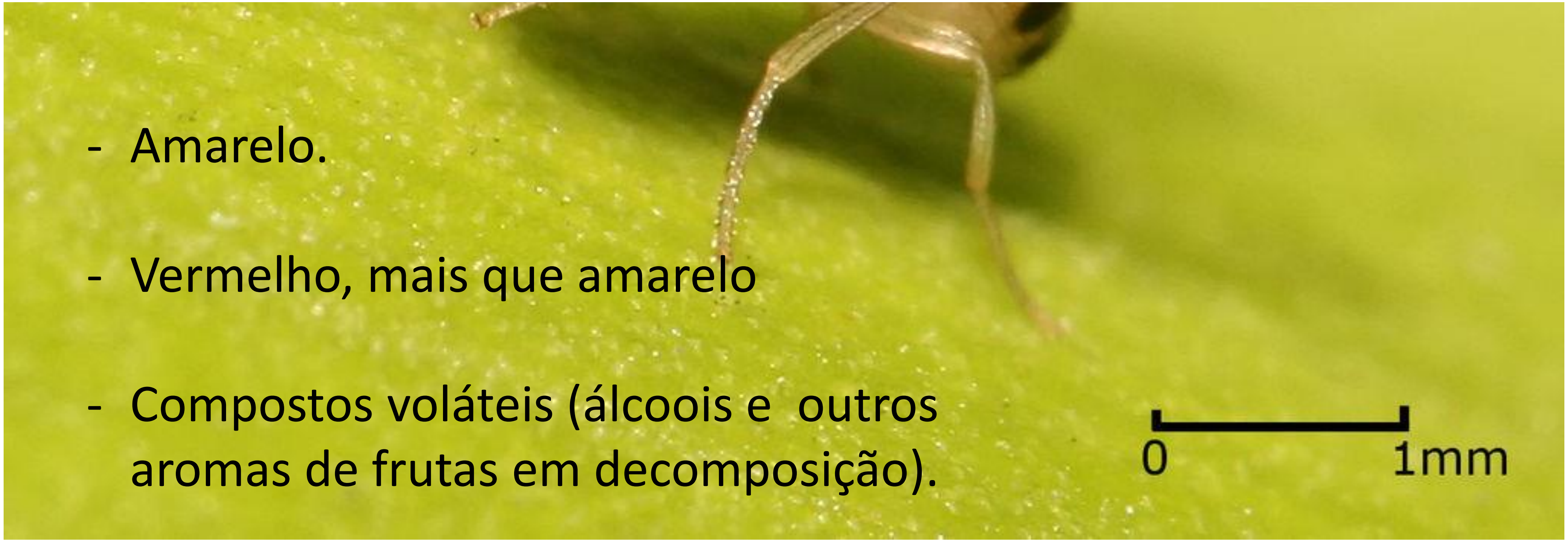
Department of Genetics, John Innes Centre for Plant Science Research, Norwich Research Park, Norwich NR4 7UH, UK



Integrando diferentes canais sensoriais

Trapping *Drosophila repleta* (Diptera: Drosophilidae) using Color and Volatiles

Author(s): B. A. Hottel, J. L. Spencer and S. T. Ratcliffe
Source: Florida Entomologist, 98(1):272-275.
Published By: Florida Entomological Society
DOI: http://dx.doi.org/10.1653/024.098.0144
URL: http://www.bioone.org/doi/full/10.1653/024.098.0144



- Amarelo.
- Vermelho, mais que amarelo
- Compostos voláteis (álcoois e outros aromas de frutas em decomposição).


Masdevalia infracta

Questões para reflexão

Importante: conhecer sistema cognitivo de cada inseto para entender os sinais que percebem das plantas

Quais as causas e consequências ecológico-evolutivas de sinais desonestos em sistemas mutualísticos e antagonísticos?


Obrigado!
cepnunes@gmail.com