Interações planta-ambiente/ herbívoros: aspectos econômicos e ecológicos

Déborah Yara A. C. dos Santos
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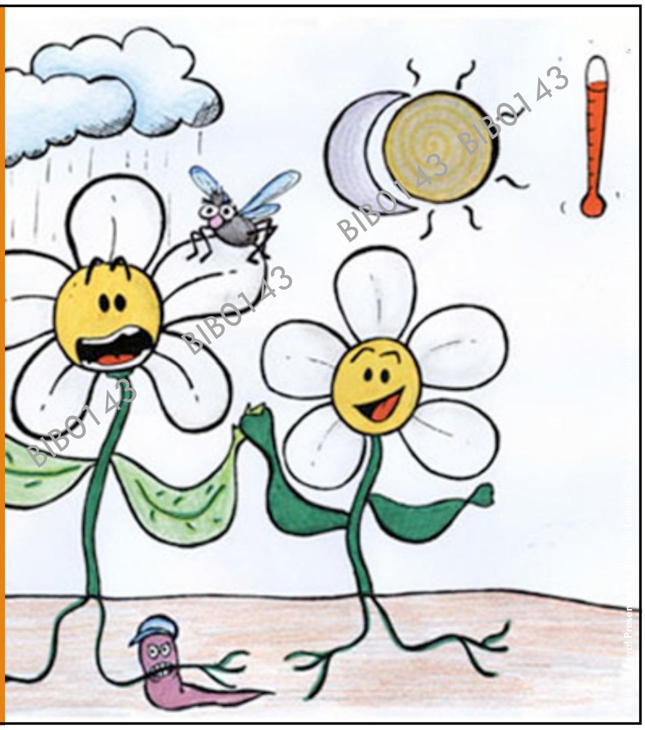
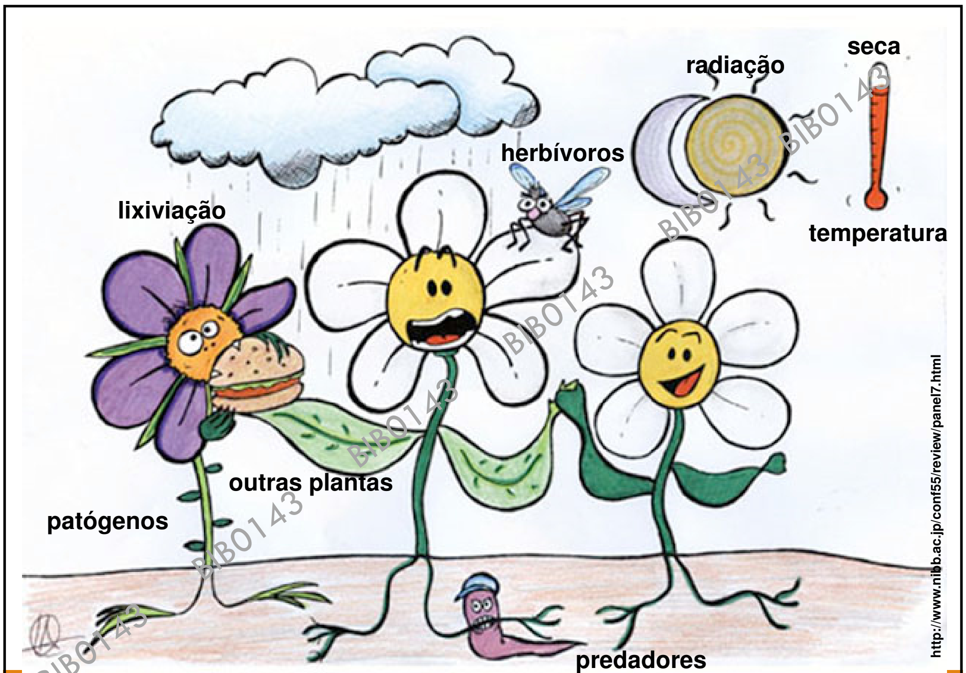
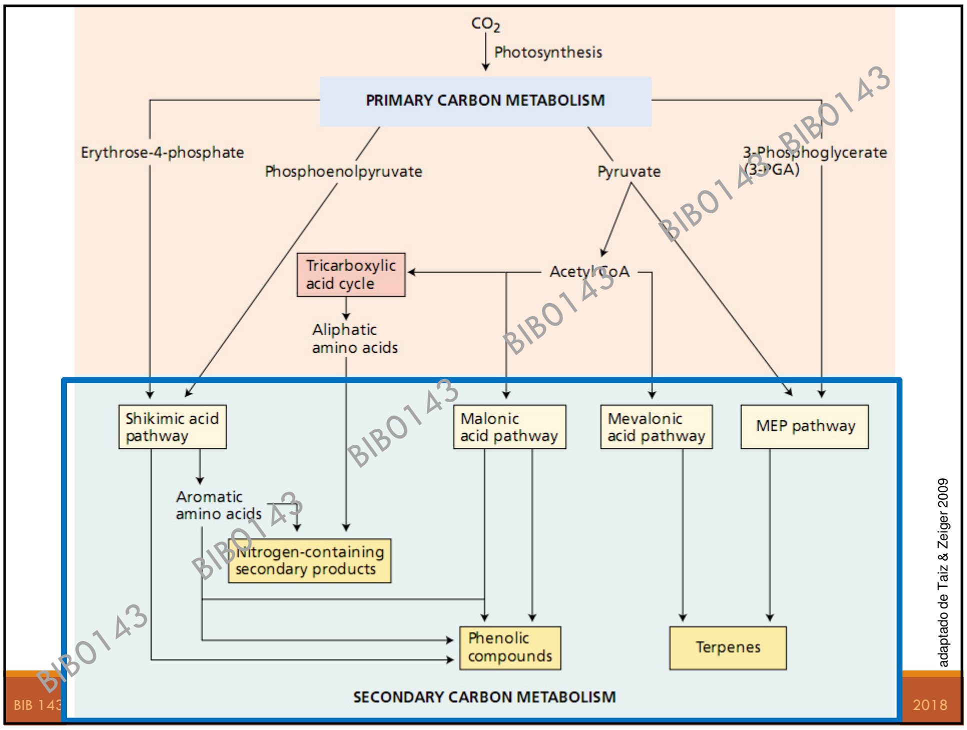
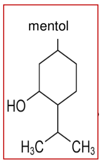
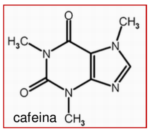




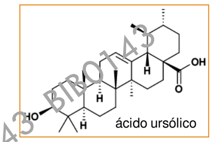


adaptado de Taiz & Zeiger 2009

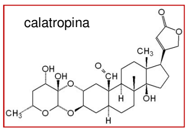




METABÓLITOS SECUNDÁRIOS



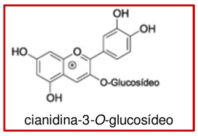
Promovem proteção contra herbívoros (insetos) como dissuasores alimentares, redutores de crescimento, toxinas, etc



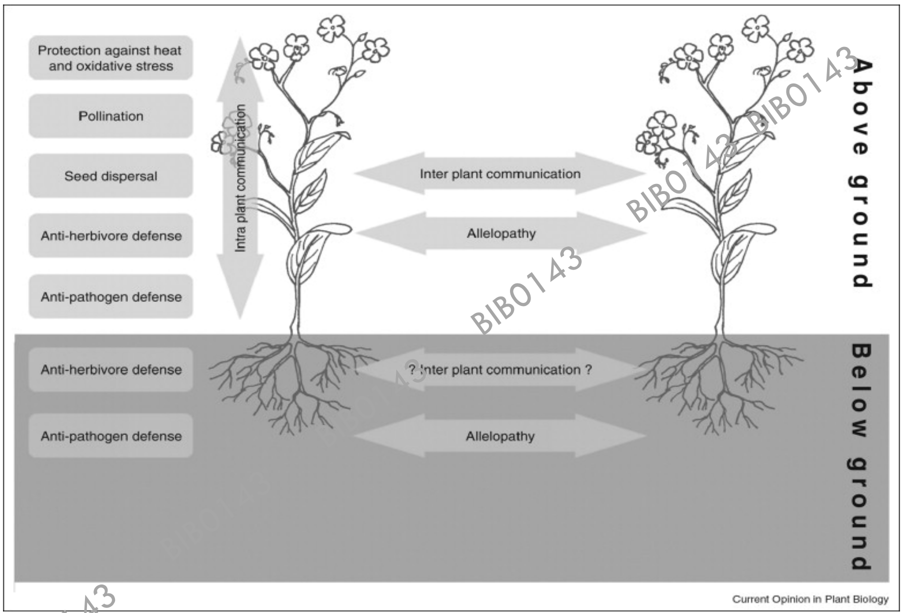
Interferência bioquímica com outras plantas - alelopatia

Proporciona proteção contra patógenos (fungos) - fitoalexinas

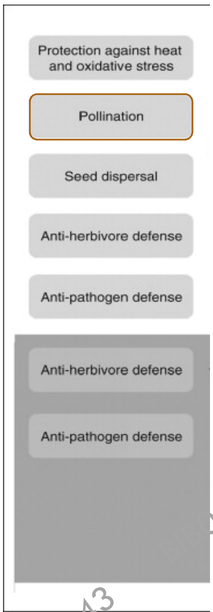
- Podem servir como sinalisadores para nodulação em leguminosas e para polinizadores



Metabólitos secundários são substâncias que NÃO participam dos processos de formação de protoplasto e geração de energia; são MEDIADORES em processos de interação das plantas com o ambiente; NÃO são UNIVERSAIS; apresentam ampla diversidade estrutural.



Sybille B. Unsicker , Grit Kunert , Jonathan Gershenzon. 2009. Protective perfumes: the role of vegetative volatiles in plant defense against herbivores. **Current Opinion in Plant Biology** 12(4): 479 – 485.



INTERAÇÕES COM FATORES BIÓTICOS

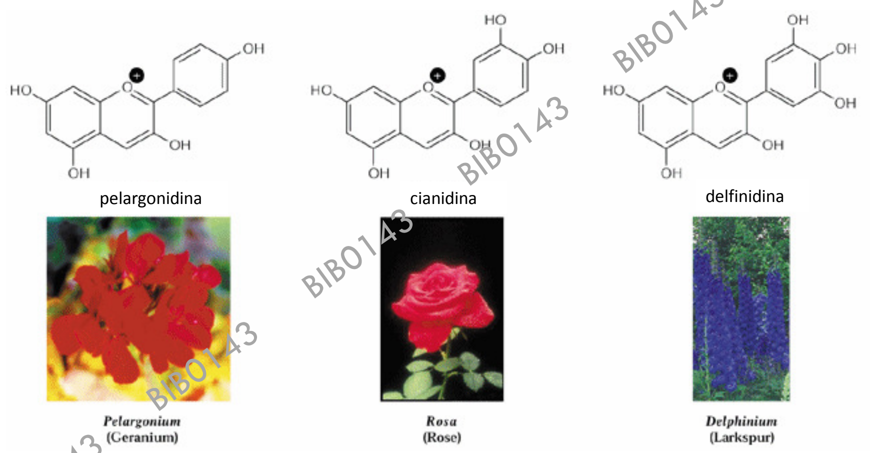
POLINIZAÇÃO

Sybille B. Unsicker , Grit Kunert , Jonathan Gershenzon. 2009. Protective perfumes: the role of vegetative volatiles in plant defense against herbivores. **Current Opinion in Plant Biology** 12(4): 479 – 485.

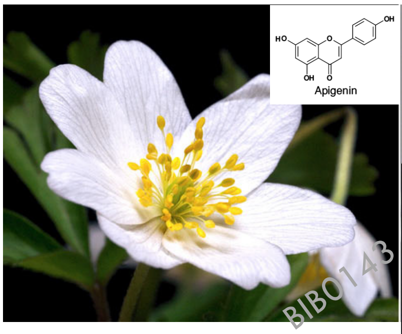
POLINIZAÇÃO

- ✓relação benéfica aos dois envolvidos: animal – néctar e pólen; planta – transferência do pólen;
- ✓a reprodução sexuada nas plantas envolve a polinização;
- ✓a polinização, em especial a cruzada, amplia e garante a variabilidade genética dos vegetais;
- ✓a relação entre o agente polinizador e a planta pode ser generalista ou especialista;
- ✓os agentes polinizadores mais abundantes em angiospermas são os insetos.

Como os metabólitos secundários estão envolvidos no processo de polinização?



visão humana



visão abelha

http://www.dailymail.co.uk/sciencetech/article-473897/A-bees-eye-view-How-insects-flowers-differently-us.html

Ecological Economics 71 (2011) 80–88

Contents lists available at SciVerse ScienceDirect

ELSEVIER

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

Valuing pollination services to agriculture

Rachael Winfree [a,*,1], Brian J. Gross [b,1], Claire Kremen [c]

[a] Department of Entomology, 93 Lipman Dr., Rutgers University, New Brunswick, NJ 08901, USA
[b] Food and Resource Economics, University of British Columbia, Vancouver, Canada, BC V6T1Z4
[c] Department of Environmental Science, Policy and Management, University of California, Berkeley, Berkeley, CA 94720, USA

https://en.wikipedia.org/wiki/Entomophily

A polinização por animais em culturas é um importante **serviço ecossistêmico**!

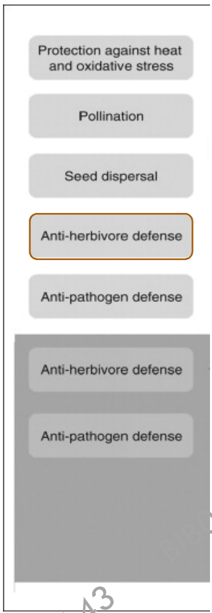
✓ Cerca de 35% da produção global de alimento depende de agente polinizador

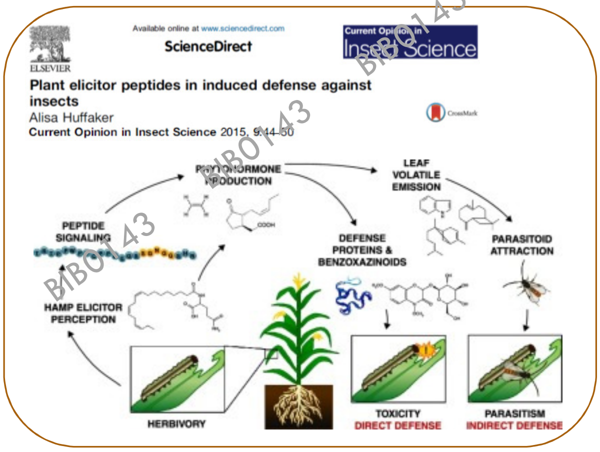
✓Abelhas (Hymenoptera: Apiformes) - *Apis mellifera* ☠

✓17.000 espécies de abelhas nativas: café, melão, tomate, canola, girassol

INTERAÇÕES COM FATORES BIÓTICOS

AÇÃO ANTI-HERBIVORIA





Sybille B. Unsicker , Grit Kunert , Jonathan Gershenzon. 2009. Protective perfumes: the role of vegetative volatiles in plant defense against herbivores. **Current Opinion in Plant Biology** 12(4): 479 – 485.

Identification of plant compounds that disrupt the insect juvenile hormone receptor complex

Seok-Hee Lee[a,1], Hyun-Woo Oh[b,1,2], Ying Fang[a], Saes-Byeol An[a], Doo-Sang Park[c], Hyuk-Hwan Song[d], Sei-Ryang Oh[d], Soo-Young Kim[e], Seonghyun Kim[f], Namjung Kim[f], Alexander S. Raikhel[g,2], Yeon Ho Je[a,h,2], and Sang Woon Shin[a,2]

[a]Department of Agricultural Biotechnology, College of Agriculture and Life Science, Seoul National University, Seoul 151-742, Republic of Korea; [b]Industrial Bio-Material Research Center, Korea Research Institute of Bioscience and Biotechnology, Daejeon 305-806, Republic of Korea; [c]Microbiological Resource Center, Korea Research Institute of Bioscience and Biotechnology, Daejeon 305-806, Republic of Korea; [d]Natural Medicine Research Center, Korea Research Institute of Bioscience and Biotechnology, Ochang 363-883, Republic of Korea; [e]National Institute of Biological Resources, Incheon 404-708, Republic of Korea; [f]Applied Entomology Division, National Academy of Agricultural Science, Rural Development Administration, Suwon 441-100, Republic of Korea; [g]Department of Entomology, University of California, Riverside, CA 92521; and [h]Research Institute for Agriculture and Life Sciences, Seoul National University, Seoul 151-742, Republic of Korea

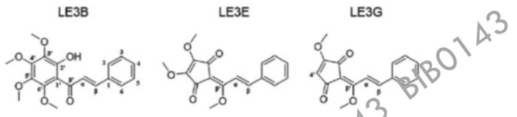
PNAS | February 10, 2015 | vol. 112 | no. 6 | 1733–1738

Significance

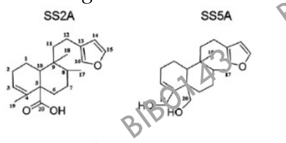
Juvenile hormone (JH) plays key roles in insect development, reproduction, and many other physiological functions. Because JH is specific to insects, it has been investigated for use as pest control. Although compounds that mimic the action of JH (JH analogues/agonists) are efficient, they have a limited scope of application. Development of potent compounds counteracting JH action (JH antagonists) would find a wider range of control applications. However, thus far, such JH antagonists have not been developed. Here, we report on the discovery of potent JH antagonists in plants, which represents an innate resistance mechanism of plants against insect herbivores. These newly discovered plant JH antagonist compounds could be used as the starting material for developing novel insecticides.

- ✓ Hormônio juvenil – papel fundamental no desenvolvimento e reprodução de insetos;
- ✓ Substâncias que atuem como antagonistas do hormônio juvenil dos insetos, aumentariam a eficiência no controle de pragas.

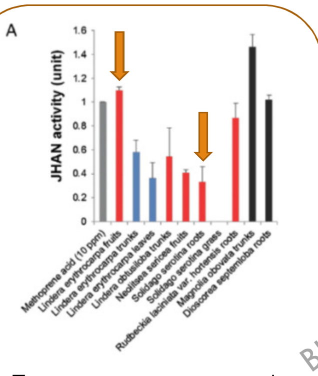
Lindera erythrocarpa – Lauraceae (frutos)



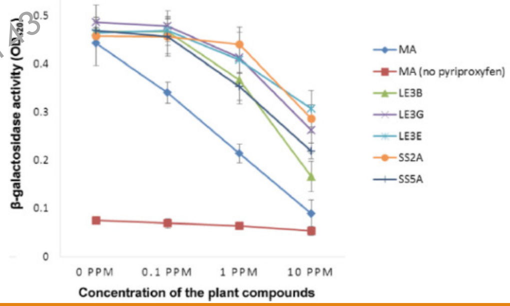
Solidago serotina – Asteraceae



Efeito das substâncias isoladas das plantas como inibidores do hormônio juvenil



Teste com os extratos de várias plantas na busca de maiores atividades inibidoras do hormônio juvenil



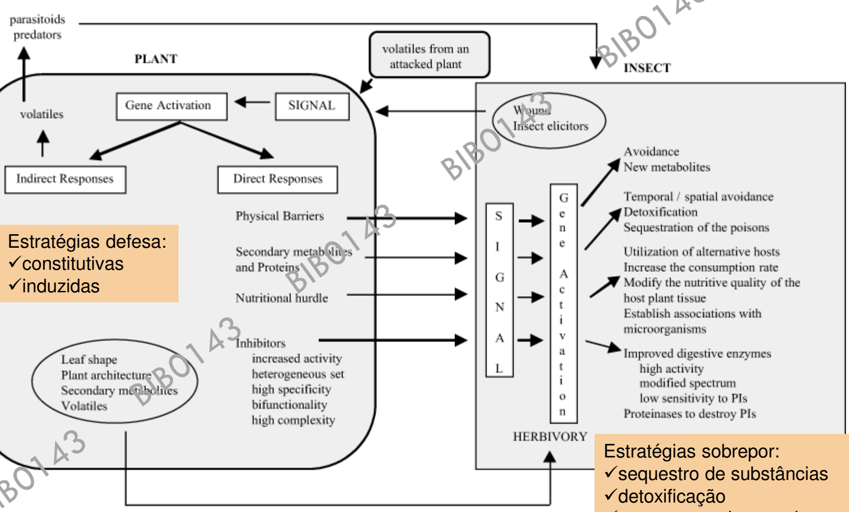
PNAS | February 10, 2015 | vol. 112 | no. 6 | 1733–1738

Braz. J. Plant Physiol., 14(2):71-81, 2002

MINIREVIEW

Plant-insect interactions: an evolutionary arms race between two distinct defense mechanisms

Marcia O. Mello and Marcio C. Silva-Filho*



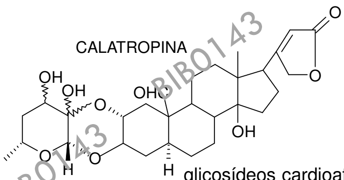
Estratégias defesa:
✓constitutivas
✓induzidas

Estratégias sobrepor:
✓sequestro de substâncias
✓detoxificação
✓assoc com microrganismos

Figure 1. Interactions between plants and insects.

Estratégias defesa nos insetos: sequestro de substâncias

monarca x *Asclepias* x pássaro

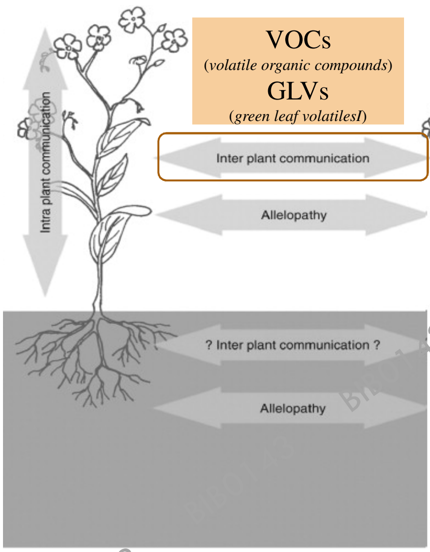


glicosídeos cardioativos

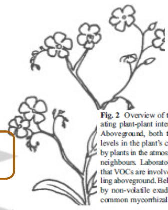
http://borboletasbr.blogspot.com.br/2016/02/lagartas-de-monarca-em-asclepias.html

INTERAÇÕES COM FATORES BIÓTICOS

VOCs
(volatile organic compounds)
GLVs
(green leaf volatilesI)



Sybille B Unsicker , Grit Kunert , Jonathan Gershenzon. 2009. Protective perfumes: volatiles in plant defense against herbivores. **Current Opinion in Plant Biology** 12(4

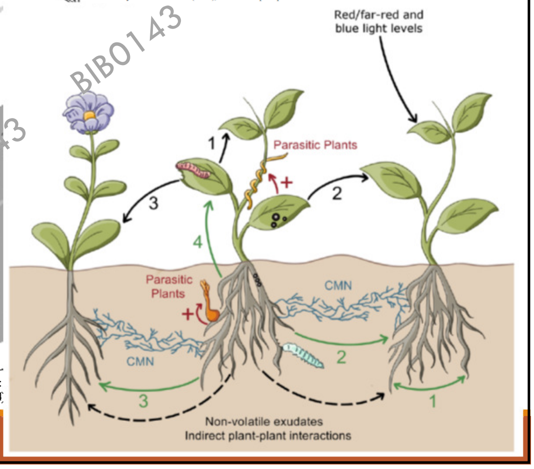


Root-emitted volatile organic compounds: can they mediate belowground plant-plant interactions?

Benjamin M. Delory · Pierre Delaplace · Marie-Laure Fauconnier · Patrick du Jardin

Plant Soil
DOI 10.1007/s11104-016-2823-3

Fig. 2 Overview of the known and potential mechanisms mediating plant-plant interactions above and below the soil surface. Aboveground, both the variations in red/far-red and blue light levels in the plant's canopy and the volatile compounds emitted by plants in the atmosphere enable plants to detect the presence of neighbours. Laboratory and field experiments have also shown that VOCs are involved in within-plant and between-plant signalling aboveground. Belowground, plant-plant interactions mediated by non-volatile exudates, the transport of compounds through common mycorrhizal networks (CMN), and indirect plant-plant interactions (alteration of soil chemistry, microbial populations and nutrient availability) have also been reported in the literature. The green arrows refer to plant-plant interactions mediated by root VOCs. 1, within-plant signalling (shoot-shoot or root-root); 2, intraspecific between-plant signalling (shoot-shoot or root-root); 3, interspecific between-plant signalling (shoot-shoot or root-root); 4, within-plant root-shoot signalling; +, attraction of parasitic plants; solid and labelled arrows, VOC emission (Drawing: Ir Carolina Levicek)



O INIMIGO DO MEU INIMIGO
É MEU ALIADO

Sabelis et al. 2001. The enemy of my enemy is my ally. **Science** 291: 2104-5

3. Voláteis inibem a oviposição pelo adulto de *Manduca*

2. Herbivoria induz liberação de voláteis que atrai inimigos naturais da lagarta

1. Plantas de tabaco predadas pela lagarta

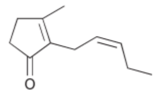
PLANT DEFENCES

Pesticide Outlook – June 2003

CIS-JASMONE SWITCHES ON PLANT DEFENCE AGAINST INSECTS

Toby Bruce, John Pickett and Lesley Smart from Rothamsted Research at Harpenden in the UK describe a volatile plant activator which could have an important part to play in plant defence mechanisms

***cis*-Jasmone**



Substâncias voláteis induzidas em plantas injuriadas:

1. Repelente de insetos fitófagos.
2. Defesa indireta – atração de predador ou parasita do fitófago.
3. Sinais entre plantas – indução de mecanismos de defesa em plantas vizinhas antes do ataque dos herbívoros.

Trigo (*Triticum aestivum*) x afídeo (*Sitobion avenae*) x parasitoide (*Aphidius ervi*)

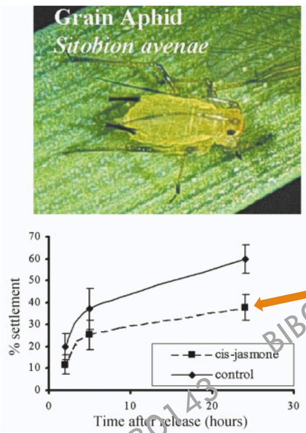


Figure 1 **Settlement of *S. avenae* in simulator bioassay**

Plantas tratadas com sinalizador são **menos** atrativas ao herbívoro e **mais** ao seu parasita

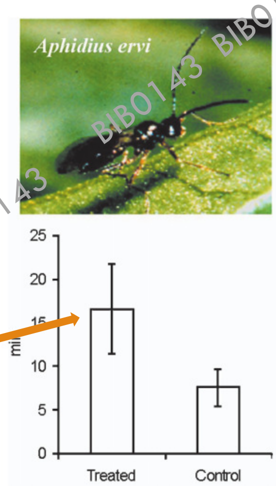


Figure 2 **Time spent foraging by *Aphidius ervi* on *cis*-jasmone and control wheat seedlings.**

Figure 3 **Field application of *cis*-jasmone**

Menor captura de afídeos em armadilhas de campo com plantas tratadas

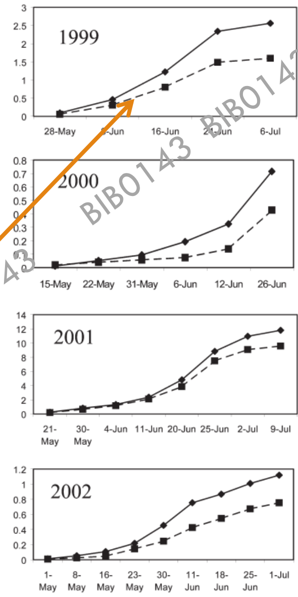
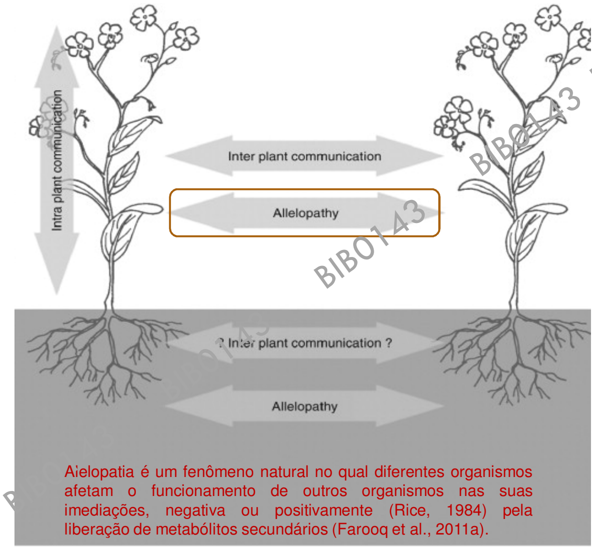


Figure 4 **Cumulative Cereal Aphid Counts in Field Plot Trials with *cis*-jasmone treatment 1999–2002 (control: ——: *cis*-jasmone: - - -)**

INTERAÇÕES COM FATORES BIÓTICOS



Aielopatia é um fenômeno natural no qual diferentes organismos afetam o funcionamento de outros organismos nas suas imediações, negativa ou positivamente (Rice, 1984) pela liberação de metabólitos secundários (Farooq et al., 2011a).

Sybille B Unsicker, Grit Kunert, Jonathan Gershenzon. 2009. Protective perfumes: the role of vegetative volatiles in plant defense against herbivores. **Current Opinion in Plant Biology** 12(4): 479 – 485.

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Int. J. Agric. Biol., Vol. 15, No. 6, 2013

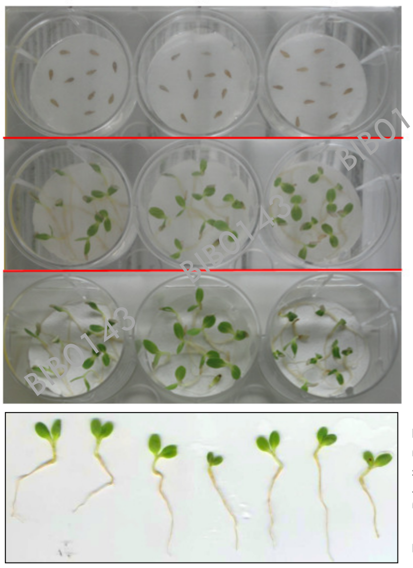
Review Article

Application of Allelopathy in Crop Production

Muhammad Farooq[1*], Ali Ahsan Bajwa[1], Sardar A. Cheema[1] and Zahid A. Cheema[1]
[1]*Allelopathy Laboratory, Department of Agronomy, University of Agriculture, Faisalabad-38040, Pakistan*
*For correspondence: farooqcp@gmail.com

Table 1: Weed control through allelopathic crop water extracts

Allelopathic extract	Crop	Weeds controlled	Weed control: Reduction in weed density (%)	Weed control: Reduction in dry weight (%)	Yield increase over control (%)	Reference
Sorghum	Wheat	*Fumaria indica, Phalaris minor, Rumex dentates, Chenopodium album*	21.6-44.2	35.4-49.0	11.0-20.0	Cheema and Khaliq (2000)
	Cotton	*Trianthema portulacastrum, Cynodon dactylon, Cyperus rotundus*	47.0	29.0-40.1	17.7-59.0	Cheema *et al.* (2002)
	Mungbean	*Cyperus rotundus, Chenopodium album, Convolvulus arvensis*	17.5-31.6	23.7-59.6	4.0-17.7	Cheema *et al.* (2001)
	Rice	*Echinochloa colonum, Cyperus rotundus, Cyperus iria*	-	40.4	12.5	Wazir *et al.* (2011)
Sunflower		*Avena fatua, Melilotus officinalis, Phalaris minor, Rumex obtusifolius*	10.6-33.6	2.2-16.5	1.6-10.7	Cheema *et al.* (2003), Naseem *et al.* (2010)
Sorghum + Sunflower Sorghum + Brassica Sorghum + Tobacco Sorghum + Sesame	Wheat	*Avena fatua, Phalaris minor*	-	10.0-62.0	18.55-62.0	Jamil *et al.* (2009)



Fotos: Priscila B. Torres

COMPOSIÇÃO QUÍMICA E ATIVIDADE ALELOPÁTICA DO ÓLEO ESSENCIAL DE EUCALIPTO

CHEMICAL COMPOSITION AND ALLELOPATHIC ACTIVITY OF THE EUCALYPTUS ESSENTIAL OIL

Marcelo Antonio TOMAZ[1]; Adilson Vidal COSTA[2]; Wagner Nunes RODRIGUES[3]; Patrícia Fontes PINHEIRO[2]; Luciana Alves PARREIRA[4]; Daniel RINALDO[2]; Vagner Tebaldi de QUEIROZ[2]

1. Professor, Doutor, Departamento de Produção Vegetal, Centro de Ciências Agrárias - CCA, Universidade Federal do Espírito Santo - UFES, Alegre, Espírito Santo, tomaz@cca.ufes.br; 2. Professor, Doutor, Departamento de Química e Física, CCA - UFES, Alegre, Espírito Santo; 3. Mestre, Doutorando em Produção Vegetal, CCA - UFES, Alegre, Espírito Santo; 4. Professora, Mestre, Departamento de Química e Física, CCA - UFES, Alegre, Espírito Santo.

Biosci. J., Uberlandia, v. 30, supplement 2, p. 47[illegible]483, Oct./14

Componente	%
α-pineno	0,80
β-pineno	0,18
p-cimeno	0,44
1,8-cineol	1,75
γ-terpineno	0,27
linalol	0,35
iso-isopulegol	10,20
citronelal	**64,92**
neo-isopulegol	0,58
β-citronelol	8,25
Acetato de α-terpenila	6,74
Acetato de citronelila	3,21

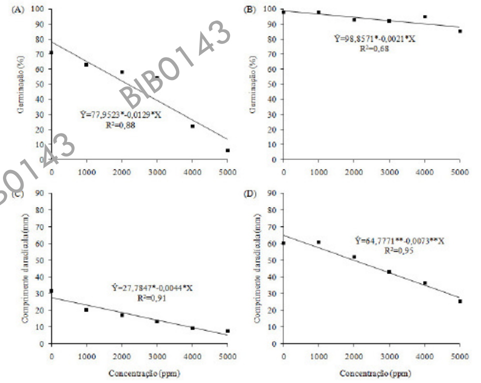


Figura 1. Germinação de sorgo (A) e pepino (B), e comprimento da radícula de sorgo (C) e pepino (D), em função do aumento da concentração do óleo essencial de *E. citriodora*.

Algal Research 32 (2018) 142–149

Contents lists available at ScienceDirect

ELSEVIER Algal Research

journal homepage: www.elsevier.com/locate/algal

Effects of extracts and isolated molecules of two species of *Gracilaria* (Gracilariales, Rhodophyta) on early growth of lettuce

Priscila Torres[a,*], Paula Novaes[a], Luciana Garcia Ferreira[b], Janaína Pires Santos[c], Ester Mazepa[b], Maria Eugênia R. Duarte[b], Miguel D. Noseda[b], Fungyi Chow[c], Deborah Y.A.C. dos Santos[a]

alga
↓
extratos de diferentes polaridades
↓
bioensaios
↓
extrato aquoso
↓
polissacarídeos (ficocoloides)

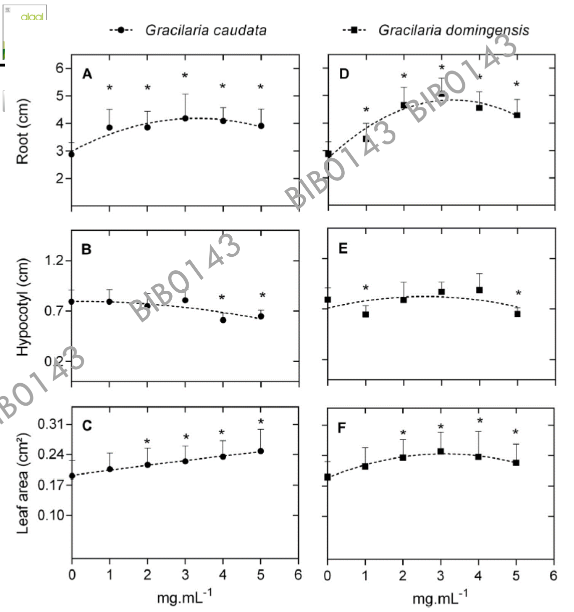
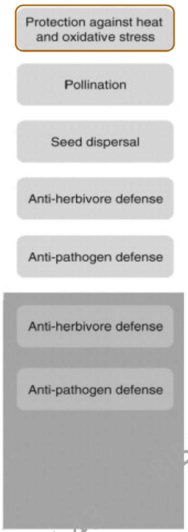


Fig. 2. Initial growth of *Lactuca sativa* under aqueous extracts of *Gracilaria caudata* and *Gracilaria domingensis*. A and D – root length, B and E – hypocotyl length, C and F – leaf area. Data correspond to means ± SD (n = 40). Asterisks (*) indicate significant difference from negative control (Kruskal-Wallis, Dunn; $p < 0.05$).

INTERAÇÕES COM FATORES ABIÓTICOS



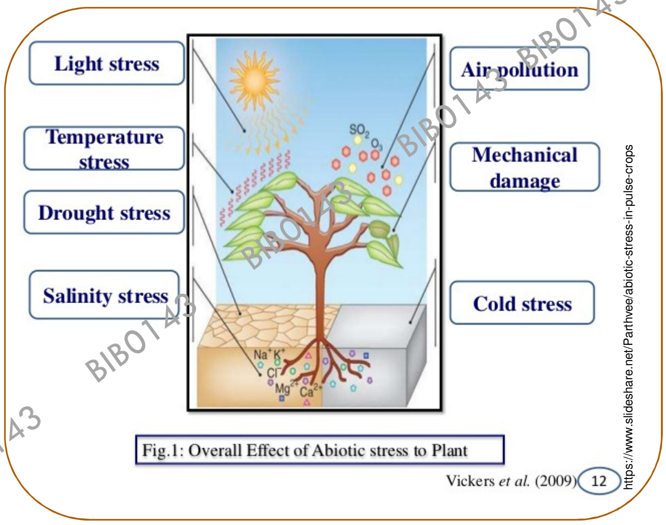
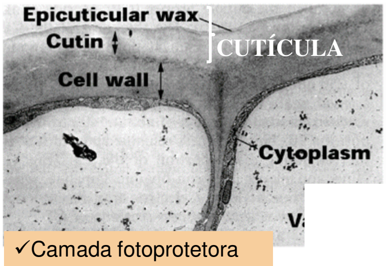


Fig.1: Overall Effect of Abiotic stress to Plant

Vickers *et al.* (2009) 12

https://www.slideshare.net/Parthvee/abiotic-stress-in-pulse-crops

Sybille B. Unsicker , Grit Kunert , Jonathan Gershenzon. 2009. Protective perfumes: the role of vegetative volatiles in plant defense against herbivores. **Current Opinion in Plant Biology** 12(4): 479 – 485.



Ceras cuticulares

- ✓Camada fotoprotetora
- ✓ Minimizar a adesão de resíduos nas superfícies das plantas
- ✓Limitar perda de água não estomática
- ✓ Mediação da interação das plantas com ambiente e herbívoros/patógenos
- ✓ Manutenção do correto desenvolvimento de vários órgãos

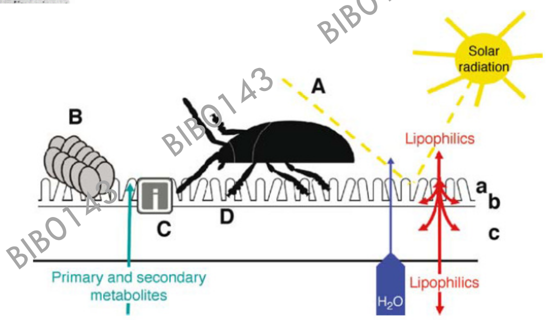
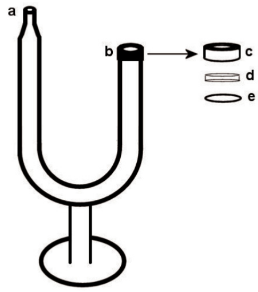


FIG. 4. Processes on the plant surface. (A) Reflectance, transmittance, and absorbance of solar radiation; (B) attachment of insect eggs (or spores of microorganisms, likewise); (C) physical and chemical cues used for host recognition by microorganisms and insects; (D) adhesion of insect legs and influences of surface characteristics on locomotion. Water and other metabolites diffuse in different degrees through the cuticular layer, formed by epicuticular wax crystals (a), the epicuticular wax film (b), and cutin and intracuticular waxes (c).

Müller, C. & Riederer, M. **J. Chemical Ecology** 31: 2621-51. (2005)

Hidrofobicidade da cutícula depende da composição relativa das frações de hidrocarbonetos, álcoois e aldeídos (mais relacionada com as ceras);



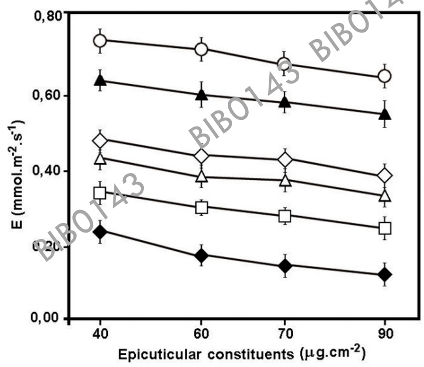


Fig. 3 – Evaporation rates (E) inWhatman paper discs impregnated with constituents separated fromfoliar epicuticularwaxes of species fromcaatinga and cerrado. Empty symbols correspond to triterpenoids. (○) ursolic acid, (▲) hentriacontan-16-one, (◇) lupeol, (△) lupeol + β-amyrin, (□) epifriedelinol, (◆)**n-alkanes**. Values correspond to means ± sd (n = 30), obtained at 25◦C and 65% relative humidity.

alcanos são mais eficientes que terpenoides como barreiras a perda de água

Oliveira & al. Epicuticular waxes from caatinga and cerrado species and their efficiency against water loss. Anais da Academia Brasileira de Ciências (2003) 75(4): 431-439

A composição de cada fração depende da espécie e afeta diretamente a condutância epidérmica e a estrutura da cera na superfície;

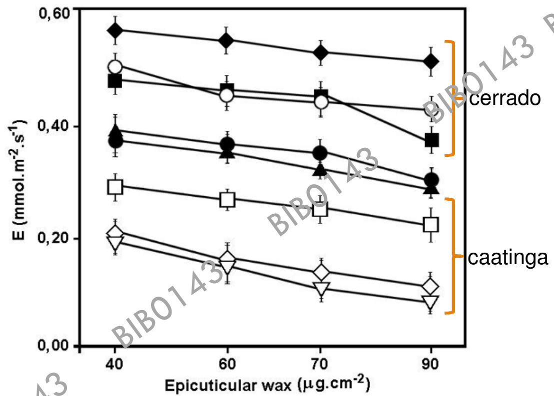


Fig. 2 – Evaporation rates (*E*) in Whatman paper discs impregnated with foliar epicuticular waxes of species from caatinga (empty symbols) and cerrado (full symbols). (○) *Aspidosperma pyrifolium*, (◇) *Capparis yco*, (□) *Maytenus rigida*, (▽) *Ziziphus joazeiro*, (■) *Aristolochia esperanzae*, (▲) *Didymopanax vinosum*, (●) *Strychnos pseudoquina*, (♦) *Tocoyena formosa*. Values correspond to means ± sd (n = 30), obtained at 25◦C and 65% relative humidity.

Increased Accumulation of Cuticular Wax and Expression of Lipid Transfer Protein in Response to Periodic Drying Events in Leaves of Tree Tobacco[1[W]]

Kimberly D. Cameron, Mark A. Teece, and Lawrence B. Smart*

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Plant Physiology, January 2006, Vol. 140, pp. 176–183

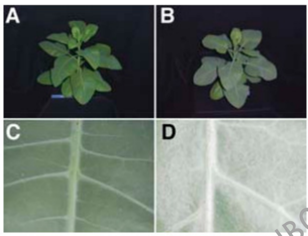


Figure 1. Tree tobacco plants exposed to periodic drying events. A, Well-watered plant. B, Plant exposed to three periodic drying events. C, Close-up of the adaxial surface of a fully expanded leaf from the plant in A. D, Close-up of the adaxial surface of a fully expanded leaf from the plant in B.

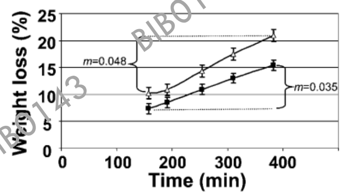


Figure 5. Rate of actual weight loss due to epidermal conductance from leaves excised from periodically dried (■) or well-watered (□) plants. Data represent one of three replicated experiments. Three leaves per plant from each of four well-watered and periodically dried plants were excised and immediately placed in a 30ºC incubator. Leaves were weighed after excision at approximately 150 min, 180 min, and at hourly increments thereafter. The percent of water loss was determined relative to the original leaf weight. Error bars indicate the mean SD across all time points. m 5 slope of the line.

Aumento na quantidade de cera nas plantas submetidas a seca

Aumento na tolerância a seca relacionado ao aumento de cera total

Pak. J. Agri. Sci., Vol. 54(1), 35-44; 2017
ISSN (Print) 0552-9034, ISSN (Online) 2076-0906
DOI: 10.21162/PAKJAS/17.5317
http://www.pakjas.com.pk

COMPARISON OF DIFFERENT FRUIT COATINGS TO ENHANCE THE SHELFLIFE OF KINNOW MANDARIN

SakeenaTul-Ain Haider[1,*], Saeed Ahmad[1], Ahmad Sattar Khan[1] and Shahzad, M.A. Basra[2]

[1]Institute of Horticultural Sciences, University of Agriculture Faisalabad, Pakistan; [2]Department of Agronomy, University of Agriculture Faisalabad, Pakistan.
*Corresponding Author's e-mail: sandhu100hassan@yahoo.com

http://clausennursery.com/citrus-trees/tangerine-trees/item/kinnow-mandarin

Citrus notabilis Lour. X *Citrus deliciosa* Tenora

2014 – 2015:

Pakistão exportou > 350 ton (US$ 284 milhões)

Perdas pós-colheita – 23 – 38%

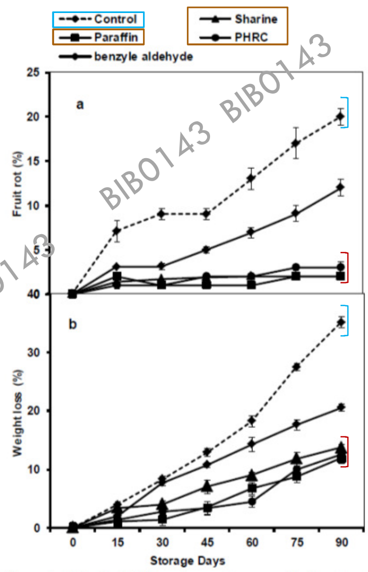


Figure 1. Effect of different wax types on fruit rot and weight loss (%) during storage.

Crop Protection 91 (2017) 57–65

Contents lists available at ScienceDirect

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

The interactions between surfactants and the epicuticular wax on soybean or weed leaves: Maximal crop protection with minimal wax solubilization

Tatiana Cardoso Damato [a], Letícia D.M. Carrasco [b], Ana Maria Carmona-Ribeiro [b], Ricardo Vagner Luiz [c], Roberta Godoy [c], Denise F.S. Petri [a, *]

Componentes isolados da cera não tem efeito antifúngico. Porém, não há crescimento de fungo sobre a superfície com cera recristalizada. Logo, a ornamentação é a barreira!

água + surfactantes | herbicida

água | CTAB 0,04% | SDS 0,25% | ESM20 0,008% | CF 0,2%

θa

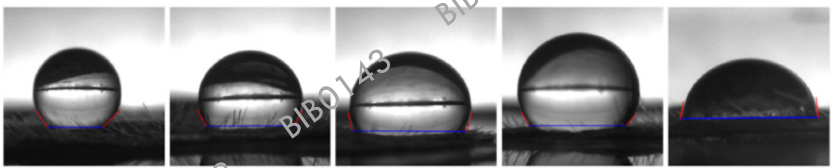


Fig. 5. Advancing (θa, upper row) and receding (θr lower row) contact angles determined for droplets of water, CTAB (0.04% v/v), SDS (0.25% v/v), ESM20 (0.008% v/v), and CF (0.2% v/v) on freshly harvest soybean leaves.

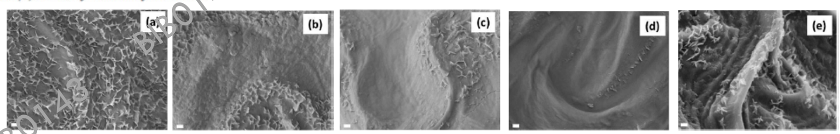
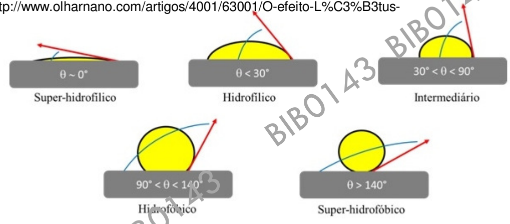


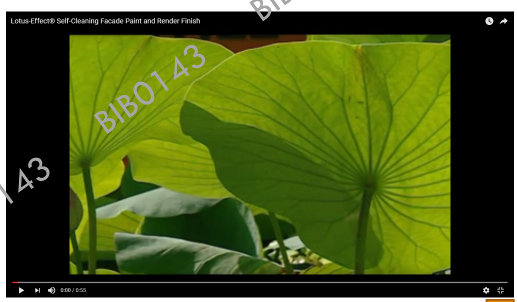
Fig. 7. SEM images obtained for freshly harvested soybean leaves (adaxial surfaces), which were in contact for 3 h with droplets of (a) MilliQ water, (b) CTAB (0.04% v/v), (c) SDS (0.25% v/v), (d) ESM20 (0.008% v/v), and (e) CF (0.2% v/v) until solvent evaporation, rinsed with water and allowed to dry in the air (see details in Fig. 4). The scale bar corresponds to 1 μm.

Efeito Lotus

Quanto menor o ângulo de contato da gota com a superfície, maior a possibilidade dessa superfície ficar molhada; relacionado com a impermeabilidade

http://www.olharnano.com/artigos/4001/63001/O-efeito-L%C3%B3tus-





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

Chemosphere 76 (2009) 1445–1450

Contents lists available at ScienceDirect

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere

ELSEVIER

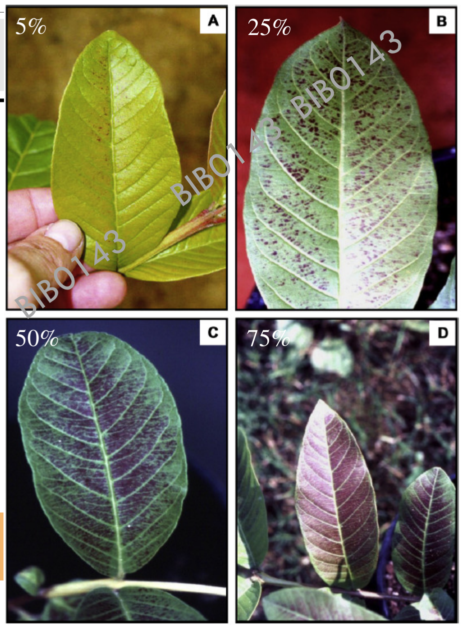
Anthocyanins and tannins in ozone-fumigated guava trees

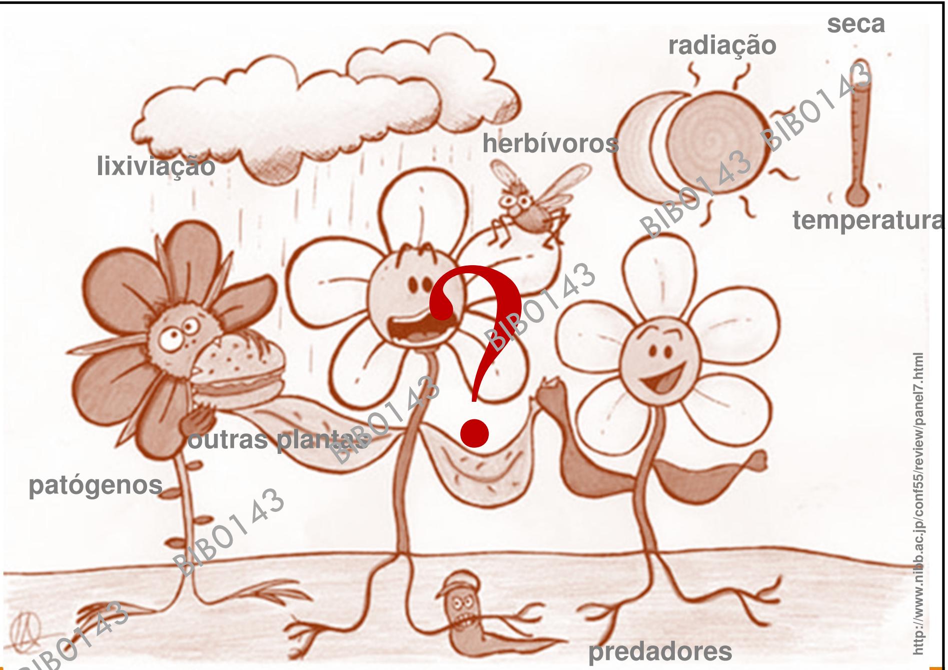
Fernanda Mendes de Rezende[a], Cláudia Maria Furlan[b,*]

Table 1
Mean percentages (±standard deviation) of anthocyanins and tannins on *Psidium guajava* 'Paluma' after 30 days of exposure to different fumigation treatments: CF – charcoal-filtered air; NF – ambient non-filtered air; NF + O_3 – ambient non-filtered air plus 40 ppb of O_3; $n = 10$; Values followed by # correspond to statistically different means when comparing to CF ($p < 0.05$).

Treatment	Anthocyanins	Tannins	
		Total	Condensed
CF	0.970 ± 0.4	0.136 ± 0.016	0.035 ± 0.006
NF	1.295 ± 0.7	0.160 ± 0.017#	0.051 ± 0.009#
NF + O_3	1.607 ± 0.6#	0.162 ± 0.014#	0.046 ± 0.006#

Correlação entre porcentagem de injúrias foliares e teor de antocianinas.





Modelo de desencadeamento de resposta em planta frente ao ataque de herbívoros e patógenos

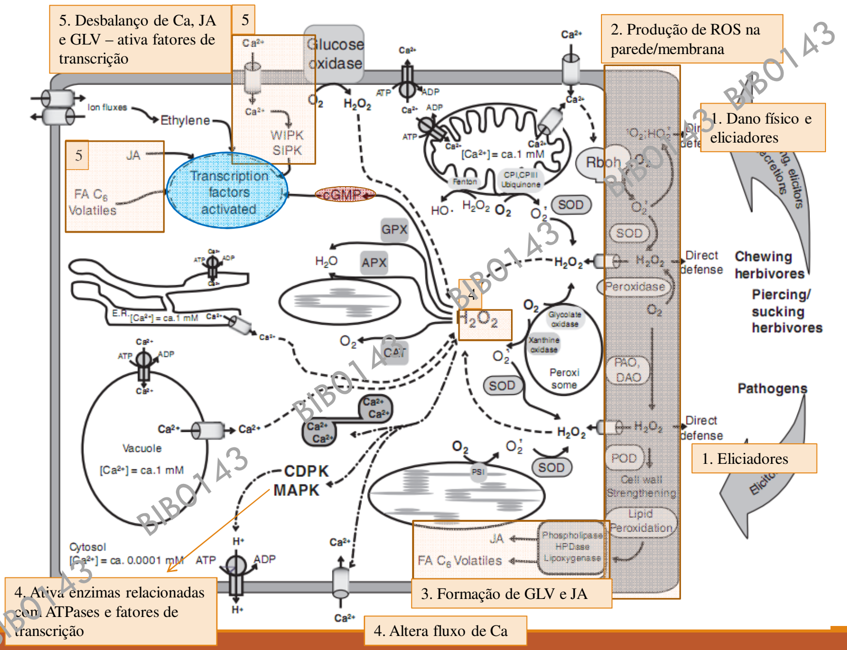
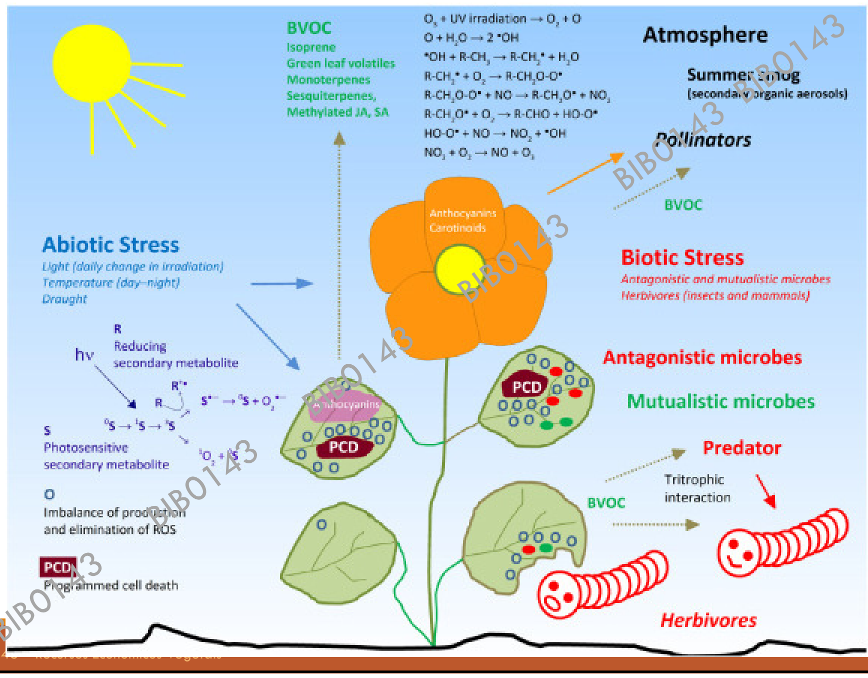


Figure 34 from David B Graves 2012 J. Phys. D: Appl. Phys. 45 263001



Environmental and Experimental Botany 114 (2015) 4–14

Contents lists available at ScienceDirect

Environmental and Experimental Botany

journal homepage: www.elsevier.com/locate/envexpbot

Signaling events in plants: Stress factors in combination change the picture

Christian M. Prasch*, Uwe Sonnewald

Biochemistry Division, Department of Biology, Friedrich-Alexander-University Erlangen-Nuernberg, 91058 Erlangen, Germany

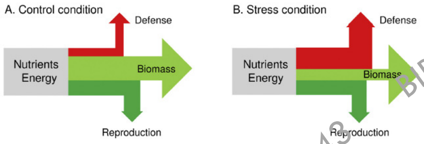


Fig. 1. Energy channeling is shifted from biomass production to defense programs. Under stress conditions nutrients and energy are redirected from biomass production towards defensive processes. Additionally reproduction is accelerated under adverse environmental conditions.

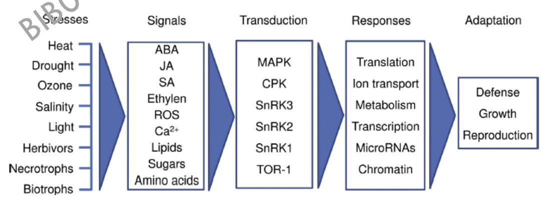


Fig. 2. Crucial events in the signal transduction pathway activated by several biotic and abiotic stress factors. The schematic diagram shows how different stress factors activate different signals, which themselves trigger signal transduction cascades. Different signaling events result in appropriate plant responses leading to adaption processes including defense, growth and reproduction. ABA (abscisic acid); ROS (reactive oxygen species); JA (jasmonic acid); SA (salicylic acid); Ca^{2+} (Calcium); MAPK (mitogen-activated protein kinase); CPK (Ca^{2+}-dependent protein kinases); SnRK (sucrose non-fermenting-1-related protein kinase); TOR-1 (target of rapamycin).

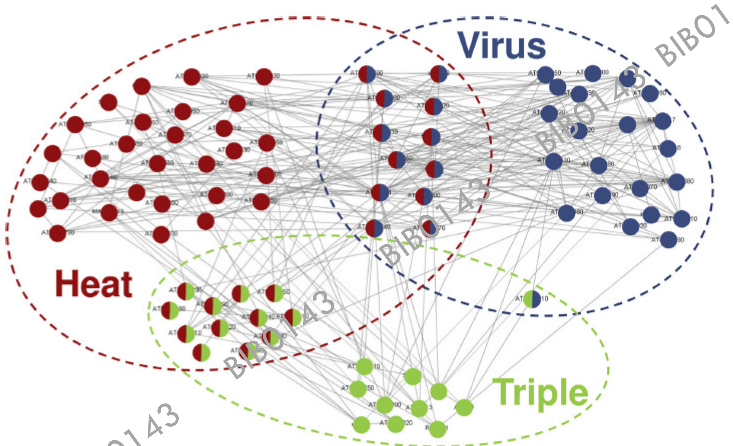


Fig. 3. Co-expression networks are changed under combination of stresses. A multifactorial test system, allowing simultaneous application of heat, drought, and virus stress revealed deactivation of defense responses under multifactorial stress, which in turn caused higher susceptibility to virus infection (Prasch and Sonnewald, 2013). As further transcriptome analysis showed clear changes in signaling genes, co-expression analysis of signaling genes under single and combined stress conditions have been conducted. The picture illustrates significantly regulated signaling genes within the heat, virus and triple stress network visualized by the ARANET Web tool (www.functionalnet.org/aranet/). These observations suggested that abiotic stress factors in combination with virus stress repress virus-specific networks. Gene identities are given in the supplemental Table S5 provided by Prasch and Sonnewald (2013).

Research Article

Pest Manag Sci 2012; 68: 935–940

SCI

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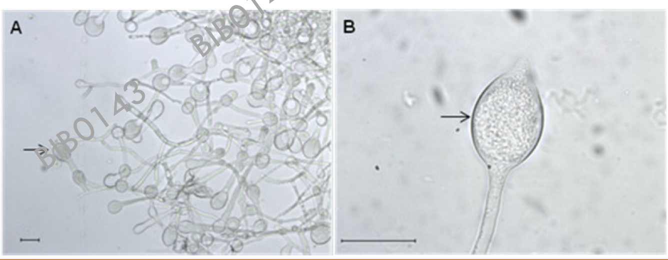
(wileyonlinelibrary.com) DOI 10.1002/ps.3254

Influence of caffeine on the survival of leaf-cutting ants *Atta sexdens rubropilosa* and *in vitro* growth of their mutualistic fungus

Carlos H Miyashira,[a] Daniel G Tanigushi,[a] Adriana M Gugliotta[b] and Déborah YAC Santos[a]*

Atta sexdens rubropilosa Forel

Leucoagaricus gongylophorus (Möller) Singer



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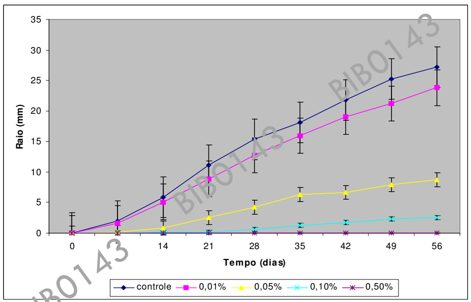

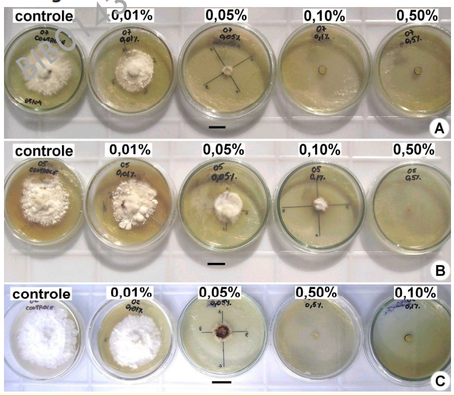

NPC Natural Product Communications

2011
Vol. 6
No. 8
1189 - 1192

Influence of Viral Infection on Essential Oil Composition of *Ocimum basilicum* (Lamiaceae)

Alice Nagai[a], Lígia M.L. Duarte[b] and Déborah Y.A.C. Santos[c,*]

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[b]*Biological Institute, Research Center of Plant Sanity, Laboratory of Plant Virology, Av. Cons. Rodrigues Alves, 1252, São Paulo-SP, Brazil, 04014-002*
[c]*University of São Paulo, Institute of Bioscience, Department of Botany, R. do Matão, 277. São Paulo-SP, Brazil, 05508-090*

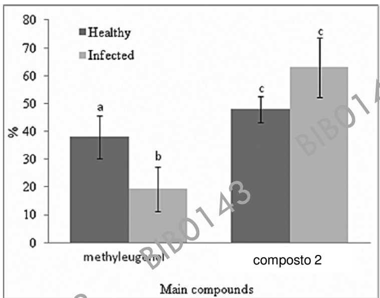


Figure 1: Mean and standard deviation of the main compounds detected in healthy and infected plants of *Ocimum basilicum* cv. Genovese. Different letters mean significant differences ($p \leq 0.05$).

Braz. J. Bot (2016) 39(1):131–137
DOI 10.1007/s40415-015-0225-z

CrossMark

Biological activities of Annonaceae species extracts from Cerrado

Paula Novaes[1] · Priscila Bezerra Torres[1] · Déborah Yara Alves Cursino dos Santos[1]

Annona coriacea

Annona crassiflora

Duguetia furfuraceae

Xylopia aromatica

Extratos etanólicos brutos, frações e substâncias isoladas

Fitotoxicidade (alface, tomate, cebola, infestantes)

Artêmia

Antimicrobiano (bactérias, fungos)

ISOLAMENTO BIOMONITORADO

Xylopia aromatica

Annona coriacea

Tomate – *Solanum lycopersicum*

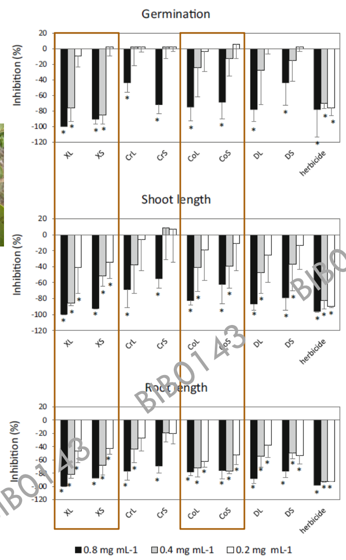


Fig. 3 Inhibition percentage of germination, shoot and root length of tomato at initial growth using leaf (*L*) and stem (*S*) extracts of *Xylopia aromatica* (*X*), *Annona crassiflora* (*Cr*), *Annona coriacea* (*Co*), and *Duguetia furfuracea* (*D*) and herbicide glyphosate in relation to negative control. *Asterisks* indicate significant difference from negative control ($P < 0.05$)

Cebola – *Allium cepa*

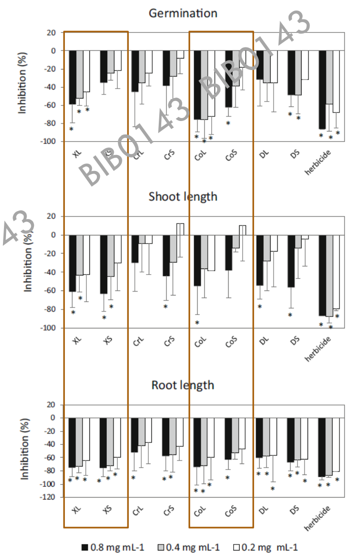
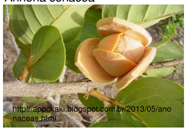


Fig. 4 Inhibition percentage of germination, shoot and root length of onion at initial growth using leaf (*L*) and stem (*S*) extracts of *Xylopia aromatica* (*X*), *Annona crassiflora* (Cr), *Annona coriacea* (*Co*), and *Duguetia furfuracea* (*D*) and herbicide glyphosate in relation to negative control. *Asterisks* indicate significant difference from negative control ($P < 0.05$)

Braquiária – *Urochloa decumbens*

Xylopia aromatica

Annona coriacea



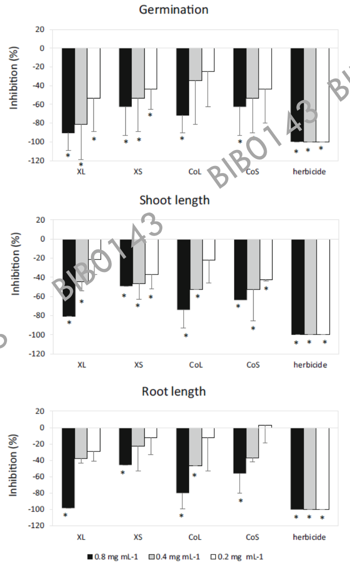


Fig. 5 Inhibition percentage of germination, shoot and root length of *Urochloa decumbens* at initial growth using leaf (*L*) and stem (*S*) extracts of *Xylopia aromatica* (*X*), *Annona coriacea* (*Co*) and herbicide glyphosate a in relation to negative control. *Asterisks* indicate significant difference from negative control ($P < 0.05$)