

Martin Heil – Curriculum vitae

Departamento de Ingeniería Genética,
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Personal information

Born 5.5.1968 in Hanau, Hessen, Germany
Parents: Heinz Werner Heil and Karin Ilse Carla Heil

Research Interests

Indirect plant defence
Costs of induced resistance of plants to pathogens
Mutualistic and antagonistic interactions among different trophic levels
Evolutionary stability of mutualism
Plant-plant communication

Professional experience

Since April 2007	Researcher and Lecturer at CINVESTAV (Centro de Investigación y de Estudios Avancados) in Irapuato, Guanajuato, México Position: Investigador 3C, SNI III
Oct. 2004 - Aug 2007	Head of Dept. (Professor C4) of General Botany – Plant Ecology and Director of the Botanical Garden of University Duisburg-Essen, Germany
Dec. 2001 – Sept. 2004:	Head of a junior group at the Max-Planck-Institute for Chemical Ecology (Dept. of Bioorganic Chemistry) in Jena, Germany
Jan 2000 – Nov. 2001	Postdoctoral Fellowship at CEFCE-CNRS, Montpellier, France
Jan 1998 – Dec. 1999	Postdoctoral Fellowship at University of Würzburg, Germany

Education

- May 2003 **Habilitation in Ecology** at University of Würzburg, Germany.
Thesis on „Costs of plant defences as a concept to understand the evolution of genetic variability and phenotypic plasticity in defence traits”
Public lecture on “Molecular ecology – chances, risks and limits“
- Dec. 1997 **Ph.D. in Ecology** at University of Würzburg, Germany
Doctoral thesis on „Quantitative cost-benefit analysis in various ant-plant mutualisms in the genus *Macaranga*”.
Graded “*summa cum laude*”
Honors: The doctoral thesis won the annual price for the best thesis by the „Unterfränkische Gedenkjahresstiftung für die Wissenschaft“
- March 1993 **Diploma (equivalent to Masters) in Geobotany** at University of Würzburg, Germany
Diploma thesis on “Differentiations and dynamics in the greenland vegetation of the Hafenlohrtal (Spessart, Germany)”.
- 1987 – 1993 **Studies in Biology and Philosophy** at University of Würzburg, Germany

Languages

German (mother tongue),
English (fluent in conversation, writing and reading),
Spanish (adequate conversation, writing and reading),
French (beginner’s level)

Current working group

Postdoc

María Escalante-Perez (May 2011-May2012) Genetic control of extrafloral nectar secretion

PhD. Students

Quintana-Rodríguez, Elizabeth (started Sept. 2009) Mecanismos fisiológicos y ecológicos asociados con la resistencia de frijol común (*Phaseolus vulgaris*) contra patógenos e insectos [Physiological and ecological mechanisms in the resistance of common bean (*Phaseolus vulgaris*) to pathogens and herbivores]

Orona -Tamayo, Domancar (started February 2010) Proteomic investigation of *Acacia* food bodies and extrafloral nectaries.

Angeles-Lopez, Yesenia Ithaí (started March 2010), Papel de volátiles inducidos por virus en la atracción del vector del virus, la mosquita blanca (*Bemisia spec.*) [Role of virus-induced volatiles in attracting the vector, whitefly (*Bemisia spec.*)]

Navarro-Meléndez, Ariana L. (started September 01, 2010) The role of endophytic fungi in the anti-herbivore resistance of Lima bean (*Phaseolus lunatus*)

Razo-Belmán, María del Rosario (started Sept 01, 2011) Reciprocal adaptations optimizing the exchange of rewards and services in the *Acacia-Pseudomyrmex* mutualism

Technical assistant

Rosa Maria Adame-Álvarez. Enzymatic assays, DNA and mRNA extraction, plant cultivation, help with field work

Jaime Mendiola Soto. Cultivation of bacteria and endophytic fungi, taking care of greenhouse plants.

Personal assistant and graphic designer

Sergio Alejandro Barajas Barron. Design of illustrations and web page, personal assistant, enzymatic assays, help with field work

Field assistant

Juan Carlos Silva Bueno. Help with plant cultivation and field experiments

Contributions to the scientific community

Referee for international journals

- 1998** Acta Oecologica
- 2000** Annals of Botany, Functional Ecology (2x), Biological Systematics and Evolution
- 2001** Journal of Ecology, Ecology, Basic and Applied Ecology, Functional Ecology, Journal of Chemical Ecology (2x), Oecologia
- 2002** Functional Ecology, Acta Oecologica, Ecoscience
Book chapter for "Plant-provided food and plant-carnivore interactions", Cambridge
- 2003** Trends in Plant Science, Functional Ecology, Journal of Tropical Ecology, Oikos, Physiologia Plantarum
- 2004** Acta Oecologica, Oecologia, Journal of Tropical Ecology, Journal of Phytopathology Ecological Applications
- 2005** Oecologia, Naturwissenschaften, Physiological and Molecular Plant Pathology, Pesticide Biochemistry and Physiology, Oikos, Journal of Chemical Ecology, Ecology Letters, Canadian Journal of Botany, Ecology Letters (2x), Journal of Tropical Ecology
- 2006** Acta Oecologica (2x), Biology Letters (3x), Canadian Journal of Botany, Ecology Letters, Functional Ecology, Journal of Ecology, Journal of Chemical Ecology (2x), Journal of Tropical Ecology, New Phytologist (2x), Oecologia, Oikos, Plant, Cell & Environment, Plant Journal, Proceedings of the Royal Society of London B, Tree Physiology
- 2007** Am Naturalist, Ann Bot (2x), Behav Ecol Sociobiol (2x), Ecology (2x), Ecol Entomol, Ecol Lett (2x), Ecol Research, Entomol Exp Applic, Environ Pollution, Eur J Plant Pathol, Evol Ecol, J Appl Entomol (4x), J Chem Ecol (2x), J Ins Physiol, J Plant Interactions, Oecologia, Naturwissenschaften (2x), New Phytol (3x), Plant Journal, Plant Physiol, Plant Science, Proc Natl Acad Sci USA, Proc Roy Soc London B (3x), Scientia Agricola, Science (2x)
- 2008** Acta Oecol, Ann Bot, Behav Ecol Sociobiol, Evol Ecol, Biol Control, Biol Reviews (2x), Biotropica, Curr Biol, Ecology (2x), Ecol Lett, Ecol Research, Entomol Exp Appl, Evol Ecol, Funct Ecol (2x), J Ecol (2x), J Exp Botany, J Trop Ecol, Mol Ecol, Myrmecological News, Naturwissenschaften (2x), New Phytol (3x), Oikos, Plant Cell & Environ, Plant Journal, Plant Physiol (2x), Plant & Soil, Proc Natl Acad Sci USA, Proc Roy Soc London B, Trends Plant Sci
- 2009** Acta Oecol, Austr J Botany, Asian Myrmecol, Basic Appl Ecol (2x), Behav Ecol Sociobiol, Biol Invasions, BMC Plant Biology, Eur J Plant Pathol, Ecology, Field Crops Research, J Agric Sci (2x), J Anim Ecol, J Chem Ecol (2x), J Exp Bot, J Phytopathol, J Plant Growth Regulation (2x), J Trop Ecol, Nature Chem Biol (2x), Naturwissenschaften, New Phytol (3x), Oikos, Physiol Mol Plant Pathol, Plant J, Plant Physiol (2x), Plant & Soil, PLoS ONE, Progress in Bot, Trends Plant Sci (2x)

- 2010** Am J Bot, Ann Bot, Biology Lett, BMC Plant Biology, Chemoecology (2x), Communic Integrat Biol, Ecol Entomol, Ecology, Funct Ecol (2x), J Chem Ecol (3x), J Plant Physiol (2x), J Trop Ecol, Naturwissenschaften, Oecologia, Plant Biol (2x), Phytochemistry (2x), PLoS ONE (2x), Popul Ecol (2x), Proc Roy Soc Lond B, Symbioses, Trends Plant Sci
- 2011** Adv Mol Ecol, Afric J Biotechnol, Am Naturalist (2x), Animal Behav, Ann Botany (3x), Biol Lett, Biotropica (2x), Ecol Lett, J Chem Ecol (2x), J Integrat Plant Biol, J Trop Ecol, Mol Ecol, Mol Plant-Microbe Interact, Oikos, Plant Cell & Environ, Plant Physiol (4x), PLoS ONE (3x), Plant J, Plant Physiol, Proc Natl Acad Sci USA, Proc Roy Soc Lond B, Science, Trends Plant Sci (2x)
- 2012** Ann Bot, Austral Ecol, Biol Lett (2x), J Chem Ecol, Nature, Proc. Natl Acad Sci USA, Proc Roy Soc Lond B, Plant Cell Environ, Plant J, Science

Councillor of Scientific Society

08/2008 – 08/2012: Councillor of the *International Society of Chemical Ecology*

Memberships in editorial boards

since 01/2005: Member of the editorial board of *Journal of Ecology*

since 01/2007: Member of the editorial board of *The Plant Pathology Journal*

since 09/2007: Member of the editorial board of *Communicative and Integrative Biology*

since 01/2011: Member of the advisory editorial board of *Trends in Plant Science*

since 05/2011: Member of the editorial board of *Frontiers in Plant-Microbe Interactions*

since 10/2011: Member of the editorial board of *PLoS ONE*

since 01/2012: Member of the editorial board of *Journal of Chemical Ecology*

Referee for grants/applications

Since 2001 five proposals reviewed for „Netherlands Organisation for Scientific Research“ Dept. „Earth and Life Sciences“.

2007 review for a proposal submitted to British Ecological Society

- review for a proposal submitted to U.S. National Science Foundation (NSF)

2008 review for a proposal submitted to the DFG (German Research Foundation)

- evaluation of the three final candidates for a professorship ‘Chemical Ecology’, University of Bielefeld, Germany.

- review for a proposal submitted to U.S. National Science Foundation (NSF)

2009 review for two proposals submitted to the DFG (German Research Foundation)

- review for one project proposal and four student grants submitted to the CONACyT (Consejo Nacional de Ciencia y Tecnología de México)
- review for a proposal submitted to U.S. National Science Foundation (NSF)
- Comments on the application of a candidate for tenure and promotion to Associate Professor, University of Minnesota, Duluth, MN, USA

2010 review for two proposals submitted to the DFG (German Research Foundation)

- review for one proposal submitted to the ISF (Israel Science Foundation)
- review for two proposals of the CONACyT (Consejo Nacional de Ciencia y Tecnología de México)
- Comments on the application of a candidate for tenure and promotion to Associate Professor, Cornell University, Ithaca, NY, USA

2011 review for a proposal submitted to U.S. National Science Foundation (NSF)

2012 review for a proposal submitted to U.S. National Science Foundation (NSF)

- review for a proposal submitted to the DFG (German Research Foundation)

Committee member for foreign PhD theses

March 2008: Megha Shenoy, Bangalore, India

May 2008: Sarah Gomez, Nijmegen, The Netherlands

May 2008: Rieta Gols, Wageningen, The Netherlands

Teaching

Practical field courses for graduate students (6-8 weeks of field research):

- W. Scholtz (1997) On the effect of food body production on structure and development of ant colonies in *Macaranga*.
- B. Baumann (1998) Effects of abiotic and biotic site factors on secretion of extrafloral nectar by *Macaranga tanarius*.
- A. Brunschweiler (1998) The importance of scale insects as a third partner in the mutualisms among *Crematogaster* ants and the myrmecophytes, *Macaranga triloba* und *M. hypoleuca*.
- A. Muth (1999) Site preferences of myrmecophytic and myrmecophilic *Macaranga* species.

Licenciatura students (graduated, México)

- E. Mendoza (2008) "Evaluación de las estrategias de defensa indirecta del frijol lima (*Phaseolus lunatus*) y frijol común (*Phaseolus vulgaris*)" Tesis de Licenciatura, Universidad del Mar, Puerto Escondido, Oax., Mex.

Master students (graduated)

- P. Menke (1996) Food body production by ant-plants of the genus *Macaranga* (Euphorbiaceae). University of Frankfurt/Main.
- G. Eck (2001) Anti-herbivore protection in ant-plants of the genus *Macaranga*: chemical and biological strategies. University of Würzburg.
- D. Feil (2002) Relations among soil nutrient content, size of ant colony, and anti-herbivore protection, in the ant plant, *Macaranga bancana*. University of Würzburg.
- S. Greiner (2004) Rapid evolution of inducibility of the secretion of extrafloral nectar by Mexican *Acacia* species. University of Würzburg/MPI for Chemical Ecology Jena
- S. Mantheij (2004) Phylogenetic analysis of Central American Ant-Acacias using ITS sequences. University of Jena/MPI for Chemical Ecology Jena.
- L. Clement (2005) Biology of the parasitic ant *Pseudomyrmex gracilis*. University of Jena/MPI for Chemical Ecology Jena.
- J. Sickinger (2006) Floristic and biogeographic investigations in the two valleys Rumbachtal and Forstbachtal: implications for conservational strategies. University of Duisburg-Essen
- S. Kautz (2006) Invertase activity and molecular phylogeny of plant-inhabiting *Pseudomyrmex* ants. Thesis in English. University of Duisburg-Essen.
- M. Hermes (2006) Responses of herbivorous beetles to herbivore-induced plant volatiles of Lima bean, *Phaseolus lunatus*. University of Duisburg-Essen.
- S. Köppen (2006) How do herbivores localise ant-free *Acacia*-ant plants? Olfactory strategies to select enemy-free space. Thesis in English. University of Duisburg-Essen.
- J. Preuß (2007) Release of volatiles and secretion of extrafloral nectar by *Pteridium aquilinum* – an induced defence? University of Duisburg-Essen.
- A. Ellwanger (2007) Inhibition of root nodule development in Soybean by chemical induction of plant resistance to pathogens. University of Duisburg-Essen.

- O. Cordoba-Campos (2011) Inducción de defensa directa e indirecta en plantas de frijol (*Phaseolus vulgaris* L. y *Phaseolus coccineus* L.) y su relación con la domesticación. CINVESTAV – Irapuato.
- M.d.R Razo-Belmán (2011) Remote-sensing for partner finding: Plant volatiles allow founding plant-ant queens to judge on host identity and quality. CINVESTAV – Irapuato.
- P. S. Girón-Calva (2011) Volatile concentration and exposure time affect the induction of a phenotypic resistance response in airborne plant-plant signaling. CINVESTAV – Irapuato.

PhD. Students (graduated)

- C. Kost (2006) Herbivore-induced indirect plant defences of Lima bean (*Phaseolus lunatus*, Fabaceae). Thesis in English. University of Jena/MPI for Chemical Ecology Jena.
- N. Wirtz (2006) Phylogeny and phylogeography of antarctic and bipolar lichens of the genus *Usnea*, *Neuropogon*. University of Duisburg-Essen.
- S. Eilmus (2009) Diversität und Funktionen der mit der Ameisengattung *Pseudomyrmex* (Lund, 1831) assoziierten Bakterien (Diversity and functions of bacteria associated with the ant-plant genus *Pseudomyrmex* [Lund, 1831]).
- S. Kautz (2009) Behavioural and biochemical adaptations in food use and genetic colony structure of obligate ant-plants of the genus *Pseudomyrmex*.
- M. González-Teuber (2009) The chemical ecology of extrafloral nectar of myrmecophytic and non-myrmecophytic *Acacia* species

Courses taught include Seminars on “Biology and Epistemology”, “Chemical Ecology”, “Chemical ecology of plant-animal interactions”, “Scientific Writing”, “Theory of Science”, “Epistemology”, practical courses on “Plant Determination”, “Animal Determination”, “Microscopy for Beginners”, and lectures on “General Botany”, “Biology of Crop Plants”, “Evolution”, “Biodiversity”, “Tropical Ecology”

Publications

1. Heil, M. (1995) Differenzierungen und Dynamik in der Grünlandvegetation des Hafenlohrhals (Spessart): Nutzung als dominierender Standortfaktor. (Differentiations and dynamics in the greenland vegetation of the Hafenlohrhals (Spessart, Germany). Land use as dominant site factor). **Tuexenia** **15**: 295-327
2. Heil, M., Fiala, B., Linsenmair, K.E., Zotz, G., Menke, P. & Maschwitz, U. (1997) Food body production in *Macaranga triloba* (Euphorbiaceae): a plant investment in anti-herbivore defence via symbiotic ant partners. **J. Ecol** **85**: 847-861
3. Heil, M., Fiala, B., Kaiser, W. & Linsenmair, K.E. (1998) Chemical contents of *Macaranga* food bodies: adaptations to their role in ant attraction and nutrition. **Funct. Ecol.** **12**: 117-122
4. Heil, M. (1999) Systemic acquired resistance: available information and open ecological questions. **J. Ecol.** **87**: 341-346
5. Heil, M., Fiala, B., Boller, T. & Linsenmair, K.E. (1999) Reduced chitinase activities in ant plants of the genus *Macaranga*. **Naturwissenschaften** **86**: 146-149
6. Heil, M (2000) Different strategies for studying ecological aspects of systemic acquired resistance (SAR). **J. Ecol.** **88**: 707-708
7. Heil, M., Fiala, B., Baumann, B. & Linsenmair, K.E. (2000) Temporal, spatial and biotic variation in extrafloral nectar secretion by *Macaranga tanarius*. **Funct. Ecol.** **14**: 749-757
8. Heil, M., Hilpert, A., Kaiser, W. & Linsenmair, K.E (2000) Reduced growth and seed set following chemical induction of pathogen defence: does systemic acquired resistance (SAR) incur allocation costs? **J. Ecol.** **88**: 645-654
9. Heil, M., Staehelin, C. & McKey D. (2000) Low chitinase activity in *Acacia* myrmecophytes: a potential trade-off between biotic and chemical defences? **Naturwissenschaften** **87**: 555-558
10. Heil, M. (2001) The ecological concept of costs of induced systemic resistance (ISR) **Eur. J. Plant Pathol.** **107**: 137-146
11. Heil, M. (2001) Induced systemic resistance (ISR) against pathogens – a promising field for ecological research. **Perspect. Plant Ecol. Evol. Syst.** **4**: 65-79
12. Heil, M., Koch, T., Hilpert, A., Fiala, B., Boland, W. & Linsenmair, K.E. (2001) Extrafloral nectar production of the ant-associated plant, *Macaranga tanarius*, is an induced, indirect, defensive response elicited by jasmonic acid. **Proc. Natl. Acad. Sci. USA** **98**: 1083-1088

13. Heil, M., Fiala, B., Maschwitz, U. & Linsenmair, K.E. (2001) On benefits of indirect defence: short- and long-term studies of antiherbivore protection via mutualistic ants. **Oecologia 126**: 395-403
14. Heil, M., Hilpert, A., Fiala, B., Linsenmair, KE (2001) Nutrient availability and indirect (biotic) defence in a Malaysian ant-plant. **Oecologia 126**: 404-408
15. Linsenmair, K.E., Heil, M., Kaiser, W.M., Fiala, B., Koch, T. & Boland, W. (2001) Adaptations to biotic and abiotic stress: *Macaranga*-ant plants optimise investment in biotic defence. **J. Exp. Bot. 52**: 2057-2065
16. Heil, M. (2002) Ecological costs of induced resistance. **Curr. Opin. Plant Biol. 5**: 345-350
17. Heil, M. & Baldwin, I. (2002) Fitness costs of induced resistance: emerging experimental support for a slippery concept. **Trends Plant Sci. 7**: 61-67
18. Heil, M. & Bostock, R. (2002) Induced systemic resistance (ISR) against pathogens in the context of induced plant defences. **Ann. Bot. 89**: 503-512
19. Heil, M., Hilpert, A., Fiala, B., bin Hashim, R., Strohm, E., Zotz, G. & Linsenmair, K.E. (2002) Nutrient allocation of *Macaranga triloba* ant plants to growth, photosynthesis, and indirect defence. **Funct. Ecol. 16**: 475-483
20. Heil, M., Delsinne, T., Hilpert, A., Schürkens, S., Andary, C., Linsenmair, K.E., Sousa, M.S. & McKey, D. (2002) Reduced chemical defence in ant-plants? A critical re-evaluation of a widely accepted hypothesis. **Oikos 99**: 457-468
21. Heil, M., Baumann, B., Andary, C., Linsenmair, K.E., McKey, D. (2002) Extraction and quantification of “condensed tannins“ as valuable measure of plant anti-herbivore defence? Revisiting an old problem. **Naturwissenschaften 89**: 519-524
22. Heil, M. & McKey, D. (2003) Protective ant-plant interactions as model systems in ecological and evolutionary research. **Annu. Rev. Ecol. Evol. Syst. 34**, 425-453
23. Heil, M. (2004) Induction of two indirect defences benefits Lima bean (*Phaseolus lunatus*) in nature. **J. Ecol. 92**, 527-536
24. Heil, M. (2004) Direct defense or ecological costs?? Responses of herbivorous beetles to volatiles released by wild Lima bean (*Phaseolus lunatus*). **J. Chem. Ecol. 30**, 1289-1295
25. Heil, M., Greiner, S., Meimberg, H., Krüger, R., Heubl, G., Noyer, J.-L., Linsenmair, K.E. & Boland, W. (2004) Evolutionary change from induced to constitutive expression of an indirect plant resistance. **Nature 430**, 205-208

26. Heil, M., Hilpert, A., Krüger, R. & Linsenmair, K.E. (2004) Competition among visitors to extrafloral nectaries as a source of ecological costs of an indirect defence. **J. Trop. Ecol.** **20**, 201-208
27. Heil, M., Feil, D., Hilpert, A. & Linsenmair, K.E. (2004) Spatio-temporal patterns in indirect defence of a South-East Asian ant-plant support the optimal defence hypothesis. **J. Trop. Ecol.** **20**, 573-580
28. Heil, M., Baumann, B., Krüger, R. & Linsenmair, K.E. (2004) Main nutrient compounds in food bodies of Mexican *Acacia* ant-plants. **Chemoecol.** **14**, 45-52
29. Dietrich, R., Ploß, K. & Heil, M. (2004) Constitutive and induced resistance to pathogens in *Arabidopsis thaliana* depend on nitrogen supply. **Plant Cell Environ.** **27**, 896-906
30. Kost, C. & Heil, M. (2005) Increased availability of extrafloral nectar reduces herbivory in Lima bean plants (*Phaseolus lunatus*). **Basic Appl. Ecol.** **6**, 237-248
31. Dietrich, R., Ploss, K., & Heil, M. (2005) Growth responses and fitness costs after induction of pathogen resistance depend on environmental conditions. **Plant Cell Environ.** **28**, 211-222
32. Heil, M., Büchler, R. & Boland, M. (2005) Quantification of invertase activity in ants under field conditions. **J. Chem. Ecol.** **31**, 431-437
33. Heil, M., Rattke, J., Boland, W. (2005) Post-secretory hydrolysis of nectar sucrose and specialization in ant/plant mutualism. **Science** **308** (5721), 560-563
34. Kost, C. & Heil, M. (2006) Herbivore-induced plant volatiles induce an indirect defence in neighbouring plants. **J. Ecol.** **94**, 619-628
35. Ballhorn, D.J., Heil, M. & Lieberei, R. (2006) Phenotypic plasticity of cyanogenesis in lima bean *Phaseolus lunatus* - activity and activation of β -glucosidase. **J. Chem. Ecol.** **32**: 261-275.
36. Heil, M. & Kost, C. (2006) Priming of indirect defences. **Ecol. Lett.** **9**: 813-817.
37. Heil, M. & Ploss, K (2006) Induced resistance enzymes in wild plants – do ‘early birds’ escape from pathogen attack? **Naturwissenschaften** **93**: 455-460.
38. Heil, M. & Silva Bueno, J.C. (2007) Within-plant signalling by volatiles leads to induction and priming of an indirect plant defence in nature. **Proc. Natl. Acad. Sci. USA** **104**: 5467-5472.
39. Heil, M. & Silva Bueno, J.C. (2007) Herbivore-induced volatiles as rapid signals in systemic plant responses. **Plant Signal. Behav.** **2**, 191-193

40. Walters, D. & Heil, M. (2007) Costs and trade-offs associated with induced resistance. **Physiol. Mol. Plant Pathol.** **71**, 3-17
41. Ballhorn, D., Heil, M., Pietrowski, A., Lieberei, R. (2007) Quantitative effects of cyanogenesis on an adapted herbivore. **J. Chem. Ecol.** **33**, 2195-2208
42. Kost, C. & Heil, M. (2008) The defensive role of volatile emission and extrafloral nectar secretion for Lima bean in nature. **J Chem. Ecol.** **34**, 2-13
43. Clement, L., Köppen, S.C.W., Brand, W.A., & Heil, M. (2008) Strategies of a parasite of the ant-*Acacia* mutualism. **Behav. Ecol. Sociobiol.** **62**, 953-962.
44. Heil, M. (2008) Indirect defence via tritrophic interactions. **New Phytologist** **178**, 41-61
45. Heil, M. (2008) Ants and plants – a world of interactions. **Trends Ecol. Evol.** **23**, 253-254. (invited book review).
46. Heil, M., Lion, U. & Boland, W. (2008) Defence-inducing volatiles – in search for the active motif. **J. Chem. Ecol.** **34**, 601-604
47. Heil, M. & Ton, J. (2008) Long-distance signalling in plant defence. **Trends Plant Sci.** **13**, 264-272
48. Heil, M. (2008) Rico-Gray, V. & Oliveira, P.S. 2007: The ecology and evolution of ant-plant interactions. **Myrmecol. News** **11**: 78 (invited book review).
49. Ballhorn D.J., Kautz S., Lion U. & Heil, M. (2008) Trade-offs between direct and indirect defences of lima bean (*Phaseolus lunatus*). **J. Ecol** **96.**, 971-980
50. Radhika, V., Kost, S., Bartram, S., Heil, M. & Boland, W. (2008) Testing the optimal defence hypothesis for two indirect defences: secretion of extrafloral nectar and emission of volatile organic compounds. **Planta** **228**, 449-457
51. Ballhorn, D.J., Schiwy, S., Jensen, M. & Heil, M. (2008) Quantitative variability of direct chemical defense in primary and secondary leaves of lima bean (*Phaseolus lunatus*) and consequences for a natural herbivore. **J Chem Ecol** **34**, 1298-1301
52. Ballhorn, D.J., Kautz, S., Lion, U. & Heil, M. (2008) Qualitative variability of lima bean's VOC bouquets and its putative consequences on plant-plant communication **Plant Signal. Behav.** **3**, 1005-1007
53. Kautz, S., Lumbsch, T.H., Ward, P.S. & Heil, M. (2009) How to prevent cheating: digestive specialization ties mutualistic plant-ants to their ant-plant partners. **Evolution** **63**, 839-853

54. Kautz, S., Schmid, V.S., Trindl, A., Heinze, J., Ballhorn, D.J. & Heil, M. (2009) Isolation and characterization of microsatellite loci in the plant-ant *Pseudomyrmex ferrugineus* (Formicidae: Pseudomyrmecinae) and cross-testing for two congeneric species. **Mol. Ecol. Resoures** **9**, 1016-1019
55. González-Teuber, M., Eilmus, S., Muck, A., Svatos, A. & Heil, M. (2009) Pathogenesis-related proteins protect extrafloral nectar from microbial infections. **Plant J.** **58**, 464–473
56. Heil, M. (2009) Book review for: Induced Plant Resistance to Herbivory. A. Schaller (Ed.) Springer, Berlin, Heidelberg (2008) 462 pp, ISBN: 978-1-4020-8181-1. **Bas. Appl. Ecol.** **10**, 583
57. González-Teuber, M. & Heil, M. (2009) The role of extrafloral nectar amino acids for the preferences of facultative and obligate ant mutualists. **J. Chem. Ecol.** **35**, 459-468
58. Heil, M. (2009) Damaged-self recognition in plant herbivore defence. **Trends Plant Sci.** **14**, 356-363
59. Ballhorn, D.J., Kautz S., Heil M. & Hegemann A.D. (2009) Cyanogenesis of wild lima bean (*Phaseolus lunatus* L.) is an efficient direct defence in nature. **PLoS ONE** **4**, e5450
60. Eilmus, S. & Heil, M. (2009) Bacterial associates of arboreal ants and their putative functions in an obligate ant-plant mutualism. **Appl. Environ. Microbiol.** **75**, 4324-4332
61. Heil, M. (2009) Plant Communication. In: ENCYCLOPEDIA OF LIFE SCIENCES. John Wiley & Sons, Ltd: Chichester <http://www.els.net/>Plant communication.
62. Ballhorn, D.J., Kautz S., Heil M. & Hegemann A.D. (2009) Analyzing plant defenses in nature. **Plant Signal. Behav.** **4 (8)**, 743-745
63. González-Teuber, M. & Heil, M. (2009) Nectar chemistry is tailored for both attraction of mutualists and protection from exploiters **Plant Signal. Behav.** **4 (9)**, 809-813
64. Heil, M., González-Teuber, M., Clement, L.W., Kautz, S., Verhaagh, M. & Silva Bueno, J.C. (2009) Divergent investment strategies of *Acacia* myrmecophytes and the coexistence of mutualists and exploiters. **Proc. Natl. Acad. Sci. USA** , **106 (43)**: 18091-18096
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67. Heil, M. & Karban, R. (2010) Explaining evolution of plant communication by airborne signals. **Trends Ecol. Evol** **25**, 137-144
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69. Kley, J., Heil, M., Muck, A., Svatoš, A. & Boland, W. (2010) Isolating intact chloroplasts from small *Arabidopsis* samples for proteomic studies. **Analyt. Biochem** **398**, 198-202
70. Heil, M. (2010) Plastic defence expression in plants. **Evol. Ecol.** **24**, 555-569.
71. González-Teuber, M., Pozo, M.-J., Muck, A., Svatos, A., Adame-Álvarez, R.M. & Heil M. (2010) Glucanases and chitinases as causal agents in the protection of *Acacia* extrafloral nectar from infestation by phytopathogens. **Plant Physiol.** **152**, 1705-1715
72. Yi, H.-S., Ryu, C.-M. & Heil, M. (2010) Sweet smells prepare plants for future stress: airborne induction of plant disease immunity. **Plant Signal. Behav.** **5**, 528-531
73. Heil, M. (2010) Resistance induction and priming by plant volatiles. **lobc/wprs** bulletin.
74. Cipollini, D. & Heil, M. (2010) Costs and benefits of induced resistance to herbivores and pathogens in plants. **CAB Rev.: Perspect. Agricult. Vet. Sci. Nutrit. Nat. Res.** **5**, No 005
75. Radhika, V., Kost, C., Boland, W. & Heil, M. (2010) The role of jasmonate signalling in floral nectar secretion. **PLoS ONE** **5**, e9265
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79. Radhika, V., Kost, C., Boland, W. & Heil, M. (2010) Towards elucidating the differential regulation of floral and extrafloral nectar secretion. **Plant Signal. Behav.** **5**(7) 924 - 926
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83. Heil, M. Editorial – (2011) Plant-mediated interactions among above- and below-ground communities at multiple trophic levels. **J. Ecol** **99** (1), 3-6
84. Kessler, A. & Heil, M (2011) The multiple faces of indirect defences and their agents of natural selection. **Funct Ecol** **25**, 348-357
85. Ballhorn, D.J., Kautz S., Jensen, M. Heil M. & Hegemann A.D. (2011) Genetic and environmental interactions determine plant defences against herbivores. **J. Ecol** **99** (1), 313-326
86. Heil, M. (2011) Nectar: generation, regulation and ecological functions. **Trends Plant Sci.** **16**, 191-200
87. Partida-Martínez, L.P.P. & Heil, M. (2011) The microbe-free plant: fact or artifact? **Frontiers Plant Sci** **2**, art. No. 100
88. Girón-Calva, P.S., Molina-Torres, J. & Heil, M. (2012) Volatile dose and exposure time impact perception in neighboring plants. **J Chem Ecol** **37**, 226-228
89. Heil, M., Ibarra-Laclette, E., Adame-Álvarez, R.M., Martínez, O., Ramirez-Chavez, E., Molina-Torres, J. & Herrera-Estrela, L. (2012) How plants sense wounds: Damaged-self recognition is based on plant-derived elicitors and induces octadecanoid signaling. **PLoS ONE** **7** (2), e30537
90. Barrett, L. & Heil, M. (2012) Unifying concepts and mechanisms in the specificity of plant-enemy interactions. **Trends Plant Sci** **17** (5) in press
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92. Heil, M. (2012) Damaged-self recognition as a general strategy for injury detection. **Plant Signal Behav** in press

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94. González-Teuber, M., Silva-BUeno, J.C., Heil, M. & Boland, W. (2012) Increased host investment in extrafloral nectar (EFN) improves the efficiency of a mutualistic defensive service. **J Ecol**, in press

Book

Heil, M. (1998) Quantitative Kosten-Nutzen-Analyse verschiedener Ameisen-Pflanzen-Assoziationen innerhalb der Gattung *Macaranga*. Wissenschaft & Technik Verlag, Berlin.

Book chapters

1. McKey, D., Gaume, L., Brouat, C., di Giusto, B., Pascal, L., Debout, G., Dalecky, A., Heil, M. (2005) The trophic structure of tropical ant-plant-herbivore interactions: community consequences and coevolutionary dynamics. pp 386-413 in: Burslem, D., Pinard, M., Hartley, S. (eds.) Biotic Interactions in the tropics: Their Role in the Maintenance of Species Diversity. Cambridge University Press
2. Heil, M. (2005) Plant protection by induced systemic resistance (ISR) - chances and potential risks. pp 1254-1275 In: Dris, R. (ed.) Crops: Growth, quality and biotechnology. WFL publisher, Helsinki.
3. Heil, M. (2007) Trade-offs associated with induced resistance. pp 157-177 In: Walters, D., Newton, C.A., Lyon, G.D. (eds) Induced Resistance for Plant Defence: a sustainable approach to crop protection. Blackwell, Oxford, U.K, 258 pp.
4. Heil, M. (2007) Indirect defence – recent developments and open questions. pp 360-395 In: Lüttke, U., Beyschlag, W., Murata, J. (eds.) Progress in Botany Vol. 69. Springer, Berlin. 479 pp.
5. Heil, M. (2009) Airborne induction and priming of defences. pp 137-152 In: Baluška, F. (ed.) Plant – Environment Interactions: From Sensory Plant Biology to Active Plant Behavior (Series: Signaling and Communication in Plants) Springer, Berlin. 308 pp.
6. Heil, M. & Walters, D. (2009) Ecological consequences of plant defence signalling. Chapter 15. pp 667-716 In: L.C. van Loon (ed.) 'Plant Innate Immunity', Elsevier, Amsterdam.

7. Heil, M. & Ton, J. (2010) Systemic resistance induction by vascular and airborne signalling pp. 279-306 In: Lüttke, U., Beyschlag, W., Murata, J. (eds.) Progress in Botany Vol. 71. Springer, Berlin.
8. Heil, M. (2010) Within-plant signalling by volatiles triggers systemic defences. pp. 99-112 In: F. Baluška & V. Ninkovic (eds.) Plant Communication from an Ecological Perspective. Springer, Berlin.
9. Mendoza, G. E. E. y Heil, M. (2011). Mecanismo de defensa indirecta de frijol lima *Phaseolus lunatus* y frijol común *Phaseolus vulgaris* contra herbívoros. In: Alternativas ecológicas contra plagas. Agricultura sostenible 7. C. Rodríguez-Hernández, J. F. López-Olguín. y A. Aragón-García (Eds.). 1ª edición. Colegio de Postgraduados y Benemérita Universidad Autónoma de Puebla. Montecillo, Texcoco, Estado de México, México. Pp. 3-17.
10. Escalante-Pérez, M. & Heil, M (2012) Nectar secretion: its ecological context and physiological regulation. Pp 187-220 In J. Vivanco & F. Balsuska (eds.) Secretions and Exsudates in Biological Systems. Springer, Berlin.
11. Escalante-Pérez, M. & Heil, M (in press) The production and protection of nectars. In Lüttge, U., Beyschlag, W. & Murate, J (eds.) Porgress in Botany Vol. 73

Talks and Posters at congresses

1. Heil, M., Fiala, B. & Linsenmair, K.E. (1997) Rentiert sich eine Ameisen-Schutzarmee? Quantitative Bilanzierung des Herbivorie-Schutzes bei *Macaranga*. 10. meeting of the German Society for Tropical Ecology (Deutsche Gesellschaft für Tropenökologie, GTÖ), 14.-16.2 1997, Leipzig.
2. Heil, M. Hilpert, A., Fiala, B. & Linsenmair, K.E. (1999) Herbivorenverteidigung, Ameisennahrung und Standortfaktoren: Hängen die Standortansprüche verschiedener *Macaranga*-Arten von ihrer Symbiose mit Ameisen ab? 12. meeting of the German Society for Tropical Ecology (Deutsche Gesellschaft für Tropenökologie, GTÖ), 17.-19.2.1999 Ulm. Meeting Abstracts: P26.
3. Heil, M. (1999) On the cost of plant defence against pathogens: hints from studies in wheat, bean, and tropical ant plants. International Society of Chemical Ecology, 16th annual meeting, 13.-17.11.1999 Marseille, France. Meeting Abstracts: P50
4. Heil, M. (2000a) SAR in the context of ecological questions and theories. Talk at 1st Internat. Symp. Induced resistance to plant diseases. 22.-27.2000, Corfu, Greece. Meeting Abstracts: P18.
5. Heil, M. (2000b) On the costs of chemically induced resistance against pathogens. Poster at 1st Internat. Symp. Induced resistance to plant diseases. 22.-27.5.2000, Corfu, Greece. Meeting Abstracts: P83.
6. Heil, M. (2001) Costs of induced resistance – what do we know and what can they explain? (Talk at 1st IOBC Conference on Induced resistance in plants against insects and diseases. 26.-28.4.2001, Wageningen, The Netherlands)
In Baldwin, I., Dicke, M., Haukioja, E., Mauch-Manie, B., Schmitt, A. (eds) Induced Resistance in Plants against Insects and Diseases. IOBC/wprs Bulletin 26: 89-94.
7. Heil, M., Koch, T., Hilpert, A., Fiala, B., Boland, W. & Linsenmair, K.E. (2001) Extrafloral nectar produced by *Macaranga tanarius* is an induced, indirect defence against herbivores. (Poster at 1st IOBC Conference on Induced resistance in plants against insects and diseases. 26.-28.4.2001, Wageningen, The Netherlands)
In Baldwin, I., Dicke, M., Haukioja, E., Mauch-Mani, B., Schmitt, A. (eds) Induced Resistance in Plants against Insects and Diseases. IOBC/wprs Bulletin 26: 177-182.
8. Heil, M. (2002a) Indirect defence by ant-plants – a successful strategy on secondary sites in the tropics. (Poster at GFÖ meeting 2002). In Verhandlungen der Gesellschaft für Ökologie Bd. 32: 281.
9. Heil, M. (2002b) Costs of induced resistance – new evidence for an old question (Talk at GFÖ meeting 2002). In Verhandlungen der Gesellschaft für Ökologie Bd. 32: 276.

10. Baumann, B., Heil, M. (2002) Indirect defence in lima bean – ontogenetic variation in volatile production of *Phaseolus lunatus*. (Poster at GFÖ meeting 2002). In Verhandlungen der Gesellschaft für Ökologie Bd. 32: 279.
11. Heil, M. (2002c) Indirect defence by ant-plants – regulatory processes in defensive ant-plants interactions. (Talk held at Botanikertagung 2002, Freiburg i. Brsg.)
12. Heil, M. (2004a) Responses of herbivorous beetles to volatiles released by wild Lima bean (*Phaseolus lunatus*) (Talk held at 12th Symposium on Insect-Plant relationships 2004, Berlin)
13. Heil, M. (2004b) Chemical composition of ant food produced by *Acacia* myrmecophytes (Talk held at Botanikertagung 2004, Braunschweig)
14. Heil, M. Ploss, K., Dietrich, R. (2004) Growth and fitness of *Arabidopsis* after chemical induction of pathogen resistance (Poster presented at Botanikertagung 2004, Braunschweig)
15. Kost, C. & Heil, M. (2004) Two induced indirect defences benefit lima bean plants in nature. (Poster presented at 12th Symposium on Insect-Plant relationships 2004, Berlin)
16. Heil, M. (2005a) Physiological and molecular adaptations stabilizing symbiotic ant-plant mutualisms. (Talk held at 21st Annual meeting of the International Society of Chemical Ecology, 2005, Washington DC, USA)
17. Kost, C. & Heil, M. (2005) Lima bean neighbourhood watch – herbivore-induced volatiles induce an indirect defence in neighbouring plants. (Poster presented at 21st Annual meeting of the International Society of Chemical Ecology, 2005, Washington DC, USA)
18. Heil, M. (2005b) Coevolutionary adaptations stabilizing obligate ant-plant mutualism. (Talk held at 90th Annual meeting of the Ecological Society of America (ESA), Montréal, Quebec, Canada).
19. Heil, M. (2006) Plant talk - but to whom? Talk held at 22nd Annual meeting of the International Society of Chemical Ecology, Barcelona, Spain
20. Heil, M., Silva Bueno, J.C. & Kost, C. (2007) Induction and priming of an indirect plant defence in nature. Talk held at congress on 'PR proteins and induced resistance against pathogens and insects' in Doorn, The Netherlands.
21. Heil, M. & Clement, L. (2007) Investment pays off - resource provisioning of myrmecophytic *Acacia* species to mutualistic and parasitic ants. Talk held on 2nd August at SIP 13 (13th Symposium on Insect-Plant Relationships) in Uppsala, Sweden.

22. Silva Bueno, J.C., Kost, C., Heil, M. (2007) Ecological and physiological functions of herbivore-induced volatiles in nature. Poster presented at SIP 13 (13th Symposium on Insect-Plant Relationships) in Uppsala, Sweden.
23. Heil, M. (2007) Lima bean: multiple interactions among direct and indirect defences. Invited talk held at 23rd ISCE Annual meeting of the International Society of Chemical Ecology. July 22nd-26th Jena, Germany.
24. Heil M. (2008) Plant-plant signalling by volatiles – mechanisms and evolutionary implications. Poster presented at the annual meeting of the American Society of Plant Biologists (ASPB) in Mérida, México.
25. Eilmus S. & Heil, M. (2008) The unexplored diversity of bacteria in arboreal ants of the genus *Pseudomyrmex* and their putative role in nitrogen fixation. Poster presented at 24th Annual meeting of the International Society of Chemical Ecology. August 17th – 22nd, State College, Pennsylvania, USA.
26. González-Teuber M. & Heil, M. (2008) Components of extrafloral nectar (EFN): functions in ant attraction and pathogen defence. Talk held at 25th Annual meeting of the International Society of Chemical Ecology. August 17th – 22nd, State College, Pennsylvania, USA.
27. Orona-Tamayo, D. & Heil, M. (2008) Análisis proteómico de granulos nutritivos para hormigas protectoras de *Acacia hindsii*. Poster presented at XXVII Congreso Nacional de la Sociedad Mexicana de Bioquímica. November 16th – 21st, Mérida, Yucatán, México.
28. Heil, M. & Adame-Álvarez, R.-M. (2009) Damaged self-recognition in plant anti-herbivore defence. Talk held at 25th Annual meeting of the International Society of Chemical Ecology. August 23th – 27th, University of Neuchâtel, Neuchâtel, Switzerland
29. Wielsch, N., Orona-Tamayo, D., Muck, A., Svatos, A. & Heil, M. (2011) Comprehensive proteomic analysis of *Acacia* food bodies. Poster presented at 44. Annual meeting of the German Association for Mass Spectrometry (DGMS). Feb 27th – March 2nd in Dortmund, Germany.
30. Razo-Belman, M.D.R. & Heil, M. (2011) Plant volatiles allow founding ant queens to judge on host identity and quality. Poster presented at 27th Annual meeting of the International Society of Chemical Ecology. July 24th – 28nd, Simon Fraser University, Burnaby, British Columbia, Canada
31. Orona-Tamayo, D. Wielsch, N. & Heil, M. (2011) Ant proteases and plant protease inhibitors create a lock-key system to protect *Acacia* food bodies from exploitation Talk presented at 27th Annual meeting of the International Society of Chemical Ecology. July 24th – 28nd, Simon Fraser University, Burnaby, British Columbia, Canada

32. Heil, M. , Bartram, S. & Eilmus, S. (2011) Does bacterial nitrogen fixation play a major role in the alimentionation of arboreal ants? Talk presented at 27th Annual meeting of the International Society of Chemical Ecology. July 24th – 28nd, Simon Frazer University, Burnaby, British Columbia, Canada
33. Razo-Belmán, M.d.R. & Heil, M. (2012) Honest signals in an ant-plant mutualism? Colony—founding plant-ant queens use plant volatiles to judge on host quality. Poster presented at Gordon Conference on Plant Volatiles 2012. Jan 29th – March 3rd in Ventura, CA, USA.
34. Quintana-Rodríguez, E. & Heil, M. (2012) Multiple roles of plant volatiles in the resistance of common bean to a fungal pathogen. Talk presented at Gordon Conference on Plant Volatiles 2012. Jan 29th – March 3rd in Ventura, CA, USA.
35. Heil, M. (2012) Thresholds in plant-plant signalling: distance, minimum concentration and exposure time. Poster presented at Gordon Conference on Plant Volatiles 2012. Jan 29th – March 3rd in Ventura, CA, USA.

Invited plenary talks at international congresses

1. Floral and extrafloral nectar - the same or not the same? Talk presented on 25th June 2007 at 9th International Pollination Symposium at Iowa State University, Ames, Iowa, USA
2. Induced indirect defences of plants against natural enemies. Talk presented on 11th July 2007 at KCIST-2007 International Symposium on Molecular Host-Parasite Interactions: New Horizon for Interface Biology. Jeju, S. Korea.
3. Lima bean: Multiple interactions among direct and indirect defences. Talk at 23rd Annual meeting of the International Society of Chemical Ecology. July 22nd - 26th 2007. Jena, Germany
4. Ecological and physiological roles of herbivore-induced plant volatiles. Talk held at Gordon Conference on Plant Volatiles. Oct. 12-17th 2007. Les Diablerets, Switzerland.
5. *Acacia* and *Pseudomyrmex*: Coevolutionary stabilisation of an obligate mutualism. Keynote lecture held at the biannual Workshop “Multitrophic interactions”, in Goettingen, Germany, from 6th to 7th March, 2008.
6. Parasites of a mutualism: strategies and phylogenetic histories in the *Acacia-Pseudomyrmex* system. Talk at 25th Annual meeting of the International Society of Chemical Ecology. 17th – 22nd August 2008, State College, Pennsylvania, USA.

7. Indirect defence achieved by facultative and obligate plant-carnivore mutualisms. Talk held at International workshop “Plant Interactions with the Environment”. 3rd – 5th September 2008, Neuchâtel, Switzerland
8. Plant resistance induced by airborne signalling. Talk held at 2008 KSPP International Symposium (Korean Society of Plant Pathology). 23rd-24th October 2008, Muju, Korea.
9. Chemical communication and coevolution in ant-plant mutualism. Talk held at International Symposium of the Fondation Jean-Marie Delwart on “Chemical communication within, among and around plants”, 7th-9th November 2008, Genval, Belgium.
10. Resistance induction and priming by plant volatiles. Talk held at IOBC meeting “*Induced Resistance in Plants against Insects and Diseases*”, 12-16th May 2009, Granada, Spain
11. Volatile organic compounds in the defense of lima bean against pests and pathogens. Talk held at “6a Reunion de Investigación en Productos Naturales y MEXBio” Oct 21-23 2009 Irapuato, México.
12. Tritrophic interactions and their potential in crop protection talk held at „XIII National Congress of Biochemistry and Plant Molecular Biology & 6th Symposium Mexico-USA“ Nov 9-13 2009, Guanajuato, México.
13. Damaged-self recognition elicits expression of indirect defenses. Talk held at „Gordon Research Conference on Plant-Herbivore Interactions“ Feb 21-26 2010, Galveston, TX, USA.
14. Reciprocal adaptations as a key factor in the stabilization of a defensive ant-plant mutualism. Talk held at “MBI Workshop on Coevolution and the Ecological Structure of Plant-Insect communities” April 4-7th 2011, Ohio State University, Columbus, OH, USA

Invited talks at institutes

1. Heil, M. (1999) What are the costs of systemic acquired resistance? SAR from an ecologist's point of view. Talk held on 25 March 1999 at the Botanical Institute (AG Prof. Boller), University of Basel, Switzerland.
2. Heil, M., Fiala, B., Rosli, H. & Linsenmair, K.E. (1999) Do the growing sites of different *Macaranga* species depend on their respective form of ant-plant mutualism? Poster presented at the Meeting at the Department of Zoology, University of Malaya, Kuala Lumpur, Malaysia (30 March 1999).
3. Heil, M. (2000) Ecological aspects of systemic acquired resistance (SAR) – findings and perspectives. Talk held at 1st. Postdoc conference, 26th-28th April 2000, John Innes Centre, Norwich, UK.

4. Heil, M. (2001) Kosten induzierter Pathogenabwehr: Ergebnisse aus dem Freiland und theoretische Hintergründe. (Costs of induced pathogen defence. Results from field studies and theoretical background). Talk held on 11.2.2001 at the Phytopathology Institute, University of Hohenheim, Stuttgart-Hohenheim, Germany
5. Heil, M. (2003a) Costs of induced resistance to pathogens – new empirical evidence for an evolutionary concept. Talk held on 23.7.2003 at the Max-Planck-Institute for Plant Breeding in Köln, Germany
6. Heil, M. (2003b) Defensas activadas e indirectas de las plantas - Estudios en sitios naturales en México. Talk held on 27.11.2003 at the Universidad del Mar in Puerto Escondido, Oaxaca, Mexico
7. Heil, M. (2005a) Comparative Approaches in Contemporary Ecology - Lessons from the Insect-Plant-Interface. Talk held at “Symposium on new directions in the study of plant-insect interactions” in Feb. 2005 at MPI of Chemical Ecology, Jena, Germany
8. Heil, M. (2005b) Indirect plant defences – costs and benefits. Talk held during symposium on “Above- and belowground interactions of plants” held in May 2005 at the Forschungszentrum Jülich, Jülich, Germany.
9. Heil, M. (2005c) How comparative approaches help to understand evolutionary processes. Talk held on 4.8.2005 in the group of Prof. Dr. P. Barbosa, University of Maryland, Maryland, USA.
10. Heil, M. (2005d) Defensas activadas e indirectas de las plantas - Costos y beneficios de diferentes estrategias. Talk held on 15.8.2005 at CINVESTAV – IPN, Irapuato, Guanajuato, México.
11. Heil, M. (2006a) Indirect defence - costs, consequences and co-occurring strategies. Talk held on 15.2.2006 in the group of Prof. Dr. R. Medina at Texas A & M University, College Station, TX, USA
12. Heil, M. (2006b) El costo de las relaciones permanentes: adaptaciones y gastos en las interacciones de las plantas con insectos y patógenos. Talk held on 3.2.2006 at CINVESTAV – IPN, Irapuato, Guanajuato, México.
13. Heil, M. (2006c) The difficult partnerships. Stability and specificity in defensive ant-plant interactions. Talk held on 11.12.2006 in the group of Dr. Ted Turlings, University of Neuchatel, Switzerland
14. Heil, M. (2006d) The difficult partnerships. Stability and specificity in defensive ant-plant interactions. Talk held on 13.13.2006 at the Institute of Ecology and Evolution, University of Lausanne, Switzerland.
15. Heil, M. (2007a) La comunicación difícil: Estabilidad y especificidad en interacciones defensivas entre plantas y hormigas. Talk held on 14.3.2007 at Universidad del Mar, Campus Puerto Escondido. Pto. Escondido, Oaxaca, México.

16. Heil, M. (2007b) Costs of defence. Talk held on 9th July in the group of Dr. Choong-Min Ryu, Systems Microbiology Research Center KRIBB, Daejeon, S. Korea.
17. Heil, M. (2008a) Indirect defences in facultative and obligate plant-carnivore mutualisms - field studies in México. Talk held on March 23th in the group of Prof. Dr. Marcel Dicke at the University of Wageningen, The Netherlands
18. Heil, M. (2008b) Indirect defences in facultative and obligate plant-carnivore mutualisms - field studies in México. Talk held on March 24th in the group of Prof. Dr. Corné Pieterse at the University of Utrecht, The Netherlands
19. Heil, M. (2008c) Plant volatiles carry both private and public messages - communication within and among lima beans. Talk held on March 27th in the group of Prof. Dr. Hans de Kroon at the University of Nijmegen, The Netherlands
20. Heil, M. (2009a) "Indirect defences in facultative and obligate plant-carnivore mutualisms - field studies in México" Talk held on January 12th in the group of Dr. Nathaniel Holland. Rice University, Houston, Tx., USA
21. Heil, M. (2009b) "Indirect defenses via facultative and obligate plant-carnivore mutualisms". Talk held on March 23rd in the Department of Ecology and Evolutionary Biology (co-hosted by the Department of Neurobiology and Behavior) at Cornell University in Ithaca, NY, USA
22. Heil, M. (2009c) "Defensa indirecta en interacciones planta-hormiga" Talk held on March 30th in the Centro de Estudios en Ecosistemas (CIECO) in Morelia, Michoacan, México.
23. Heil, M. (2009d) "Defensa indirecta de plantas por atracción de carnívoros". Talk held on September 22nd in the ECOSUR in Tapachula, Chiapas, México.
24. Heil, M. (2010a) „Indirect and induced plant resistances against herbivores and pathogens“. Talk held on March 31st in the Department of Botany I at University of Würzburg, Germany
25. Heil, M (2011a) Teamwork as a defence strategy: indirect and induced plant defences in nature. Talk held on January 12th At The bionzentrum of the University of Wien, Vienna, Austria
26. Heil, M. (2011b) Teamwork als Strategie pflanzlicher Verteidigung: indirekte und induzierte Verteidigung im natürlichen Ökosystem. Talk held on January 14th at University of Osnabrück, Osnabrück, Germany

27. Heil, M. (2011c) Induced and indirect defence strategies of plants in nature“ Talk held on Jan 21.th in The Botanisches Kolloquium, University of Bonn, Bonn, Germany
28. Heil, M. (2011d) Induced and indirect plant edfenecs in nature: teamwork as a defence strategy. Talk held on April 12th at Texas A&M University, College Station, Tx, USA
29. Heil, M. (2011e) Stabilizing a defensive mutualism: genetic, biochemical and phenotypical mechanisms.Talk held on Sept. 26th at Instituto de Biotecnología de la UNAM, Cuernavaca, Morelos, México

Grants and Fellowships

- Since 1.7.2011** **Project 147492 CONACyT-DFG Bilateral Cooperation “Elicitation of contrasting plant defenses against herbivores and pathogens”.** With Prof. Dr. Jonathan Gershenzon, MPI For Chemical Ecology, Jena, Germany, and Dr. Ken Oyama Nagakana, CIECO, Morelia. Mexican part: 107,200.00 Mexican Pesos for international travelling
- Since 1.04.2011** **Project 129678 del CONACyT “Reciprocal specializations of host plants and ant mutualists that stabilize the *Acacia-Pseudomyrmex* mutualism“**
Thermocycler, Material for gelelectrophoresis, portable freezer and consumables for field work, sequencing, enzymatic assays and congress participations. Overall volume 1,420,000.000 Mexican Pesos (120,000 US-\$) for three years.
- Since 1.04.2011** **Project 130656 del CONACyT “Physiological and genetic mechanisms in the establishment and maintenance of mutualisms of plants with different partners“**
Group project with Dr. Yoav Bashan (CIBNOR, La Paz) and Dra. Gabriela Olmedo (CINVESTAV Irapuato). One postdoc position for 18 month, consumables for sequencing, field work, publications etc. Overall volume 4,380,000.00 Mexican Pesos (360,000 US-\$)
- Since 1.10.2009** **Project SAGARPA–CONACyT 2009-109621 “Desarrollo de variedades de frijol de alto rendimiento, tolerantes a sequía y resistente a patógenos”** (“Development of common bean cultivars with high yield and resistance to drought and pathogens”)
Group project with an overall budget of 26.000.000 Mexican Pesos (ca.2.000.000 US-\$). Budget of the own sub-project: GC-MS equipped for headspace analysis, SPME and chemical as well as thermic ionisation (3.400.000 Mexican Pesos), funding for field work, congress participation and consumables at 600.000 Pesos for four years.
- Since 1.12.2007** **Project 160379 del CONACyT “Specificity and stabilising factors in defensive ant-plant mutualisms”**

Portable GC (Z-Nose), funds for travelling, consumables for field investigation and plant cultivation, consumables for laboratory studies on enzyme activities, quantification of volatile compounds (GC-columns) etc.

Overall volume 1.800.000 Mexican Pesos (180.000 US-\$) for equipment and consumables for three years.

1.10.2005-1.10.2009 DFG Project He 3169/4-2 “Coevolutionary stabilisation of specific mutualisms with special emphasis on ant-plant symbiosis”

2 positions for PhD students

One thermocycler for realtime-PCR, one plate-reader photometer.

Funds for material, travelling and field work (molecular phylogeny and physiological and behavioural adaptations of *Pseudomyrmex* ants, biodiversity of endosymbiotic bacteria of ants inhabiting *Acacia* as mutualists or parasites, nutrient fluxes between ant and plant, chemical adaptations of nectar, control of nectar secretion)

Overall volume ca. 470.000 € for three years.

1.3.2003 – 30.9.2005 DFG Project He 3169/3-1 “Evolution of the inducibility of an indirect defence trait in myrmecophilic and myrmecophytic *Acacia* species”

Funds for material and field work (field work in Mexico, enzymatic assays, chemical analytics, working with molecular markers and sequencing to establish a molecular phylogeny of *Acacia* species) for 18 months

Overall volume ca. 100.000 €

1.12.2001 – 30.9.2005 Emmy-Noether-grant (He 3169/2-1,2,3,4) “Ecological aspects of induced plant defence to pathogens and herbivores”

1 position for group leader, 2 positions for doctoral students, 1 for an assistant

Funds for student helpers in Germany and Mexico, material, travelling and field

work (field work in Malaysia und Mexico, enzymatic assays, chemical analytics etc.)

Equipment for the quantification of plant gas exchange.

Overall volume ca. 600.000 €

1.1.2000 – 30.11.2001 DFG Projects He 3169/1-1 to 1-4

Grant for studies over 23 months in Montpellier, France and field work in Malaysia and Mexico

Funds for local helpers in Mexico, for material, travelling and field work

Overall volume ca. 110.000 €

1.1.1998 – 31.12.1999 TP C8 of SFB 251

Own postdoc position for two years

Funds for material, travelling and field work in Malaysia, clima measuring
equipment

Overall volume ca. 90.000 €