

Summary

During their life time, plants become victims of attacks by several pathogens and herbivores. The intriguing defense responses of plants that are induced by such biotic agents have been the topic of much research conducted during the last few decades. Herbivore damage, the external biotic factor that is under consideration in this thesis, necessitates multiple defense strategies in plants out of which two will be addressed here.

Which countermeasures would a plant can take when its interior direct defense against refuge-seeking or refuge-inducing herbivores fails or when the predatory mites, part of the plant's battery of indirect defenses, cannot get access to the herbivores' feeding sites? Answering this question is the overall objective of the studies reported in this thesis. I hypothesized that the plants change their morphology in response to damage by herbivores and in turn, these morphological changes act so as to promote access of the natural enemies to the herbivores in their refuge. In the first part of this thesis, I studied a system consisting of the fruit of the coconut palm (*Cocos nucifera* L.), the coconut mite (*Aceria guerreronis* Keifer, Acari: Eriophyidae) and the predatory mite (*Neoseiulus baraki* Athias-Henriot, Acari: Phytoseiidae). For this tritrophic system, I showed that in response to herbivore damage, the distance between the perianth and the surface of the coconut fruit is increased and that these changes suffice to give predatory mites access to the space under the perianth (Chapter 2). When this phenomenon was simulated in the laboratory by artificially increasing the perianth-fruit distance, it was observed that the predatory mites enter the space under the perianth of the coconut fruit even without the presence of coconut mites, their cues or herbivore-induced plant cues (Chapter 3). It is still not clear how the morphological changes are initiated in the nuts. Probably the changes in the plant chem-

SUMMARY

istry after the herbivore damage contribute to the changes in the morphological changes. As shown by Lesna *et al.* (2004), tulip bulbs infested by the dry bulb mite, *A. tulipae* Keifer, release the plant hormone ethylene and this in turn triggers morphological changes in the bulb. Possibly, this mechanism is also responsible for what happens to coconuts after infestation by coconut mites, but this remains to be investigated. Whether the infested coconuts also release herbivore-induced volatile (HIPV), that attract predatory mites, was tested in olfactometer experiments, but the results were bordering significance.

In the second part of this thesis, I used the tritrophic system involving tulip bulbs to test whether the morphological response is associated with the release of herbivore-induced plant volatiles (HIPV) and how these two responses are coordinated. I hypothesized that ethylene not only mediates the morphological response to herbivory, but also the production of HIPV. It was found that when damaged by dry bulb mites, tulip bulbs emit volatile chemicals that are attractive to the predatory mite, *N. cucumeris* Oudemans (Chapter 4). While it is known that ethylene induces morphological changes in tulip bulbs, I show in addition that bulbs infested by dry bulb mites, as well as uninfested bulbs previously exposed to ethylene alone, are induced to release HIPV and thereby attract the predatory mites. Gas Chromatography-TOF-Mass Spectrometry analysis of the volatiles from tulip bulbs showed that the predatory mites are attracted to the tulip bulbs when tuliposides are not too high and benzoates are produced. Since tuliposides are known to be toxic to fungi and arthropods, I suggested that the presence of benzoates overrules the effect of tuliposides.

Reference

- Lesna I., Conijn C.G.M. and Sabelis M.W. (2004). From biological control to biological insight: rust-mite induced change in bulb morphology, a new mode of indirect plant defense? *Phytophaga* 14: 1-7.