

Facing herbivory as you grow up: the ontogeny of resistance in plants

Karina Boege and Robert J. Marquis



Presentation by: Ashley Bouck, Devin Creek, Paul Footen, and Pete Sullivan

Robert J. Marquis



1. Has a Ph.D. from the University of Iowa
2. Professor at the University of Missouri-St. Louis in the Biology Department
3. Has over 25 publications on plant herbivory
4. Pursues research in plant herbivory because herbivores are, many times, considered pests on commercially important crops, and they have many direct effects on management and conservation issues.

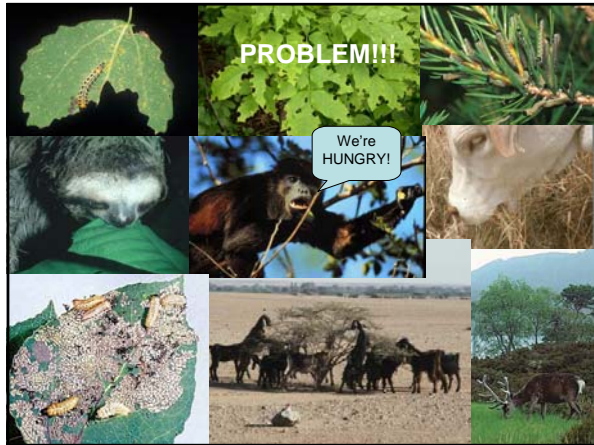
<http://www.umsl.edu/~biology/faculty/marquis.html>

Karina Boege



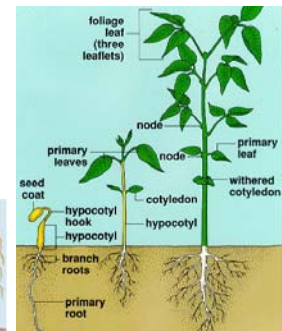
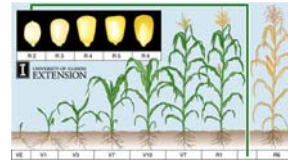
1. Bachelor of Science degree in Biology at the Universidad Nacional Autónoma de México, Ph.D. program at University of Missouri-St. Louis, Research internship at the University of California
2. Originally from Mexico and returning to Mexico to help with natural resource problems and get people together who can help, including conservation biologists, social scientists, economists and political scientists.

<http://icte.umsl.edu/scholarships/compton.html#Boege>



The Question?

- Will resistance to herbivores change during the plants development?
- Past theories on plant and herbivore interaction have focused on one ontogenetic stage.
- How will this affect the current plant defense theories?



Life stages of a plant

The Aim of the Study

- Clarify why development at the whole-plant level is necessary for a comprehensive plant defense theory
- Predict how resistance traits change as plants develop, based on resource allocation theory
- Describe what is known to date about ontogenetic variation in plant defense, escape and tolerance, and how herbivores respond to such variation (Boege and Marquis 2005)



Why study ontological changes in plant defense?

↳ **Ontogeny:** Course of development of an organism

- Resistance to herbivores is likely to change **during plant development**
 - Current experiments are largely confined to a **single ontogenic stage**
- Changes will occur in a **non-linear fashion**
 - **Amount and type** of resistance changes according to **impacts from herbivory**
 - Demographic priorities: **establishment, growth, reproduction**
 - **Resource allocation** constraints
- Role of ontogeny should be incorporated in **plant defense theory**



Antler rub



Tastes good!

Plant Ontogeny and Resource Allocation

- Resource allocation theories assume that plants have a limited pool of resources.
- The resources allocated to one function or structure cannot be used by another.
- This promotes tradeoffs that determine resource allocation constraint.
- Therefore, it is likely that resource allocation to herbivory defense will vary with ontogeny



Changes in defense and tolerance during plant ontogeny

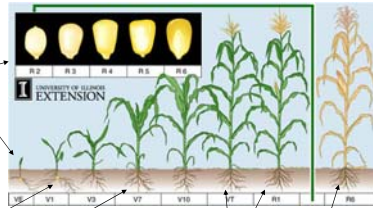
Cotyledon Stage: stored resources in cotyledons and seed reserves

Seedling: Large root:shoot ratio, plants need to produce more photosynthetic area; not enough resource for resistance

Sapling: root:shoot ratio decreases plants acquire more resources to store and use for resistance

Pre-reproductive/reproductive: Mature stage is reached, resistance can be decreased or maintained, depending on the reproductive strategy of the plant

Over mature/senile: reduced photosynthetic activity and hormone production; water stress, and loss of vigor



Defense: Direct Himalayan blackberry *Rubus discolor* The plant we love to hate

1. History

2. Problems



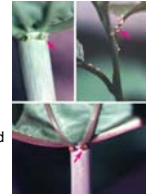
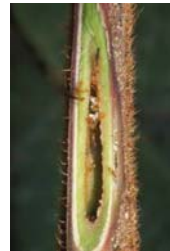
3. Benefits

4. People

Defense: Indirect

Prunus emarginata

- Traits that allow predator and parasitoid foraging
- Food rewards like extra floral nectaries and chemical cues
- Plants can provide housing and food for ants that protect them from herbivores.



Mechanisms of Herbivore resistance: Tolerance

Tolerance: Ability of plant to maintain fitness through growth and reproduction after sustaining herbivore damage.

Resource allocation: Beetle oviposition. *Acer sp.*

Compensatory growth: Bark damage from beaver browsing. *Populus trichocarpa*

Meristem activation: Lateral meristem growth. *Sequoiadendron giganteum*

Increased photosynthesis: *Abies amabilis*



Escapement:

After the loss of shoots due to browsing, the presence of dormant buds allow trees to grow above the browse line

Spruces have to produce enough shoots to survive multiple browse attacks before they are above the browse line.

Browsing by black-tailed deer.



Picea sitchensis



Where to go from here?

- Further experiments should be conducted over multiple ontogenetic stages.
- Understanding how plant ontogeny plays a role in the selective impacts of herbivores on plant traits, can play a significant part in developing a more comprehensive plant defense theory.
- Could be applied in environment-related fields, such as agriculture and forestry.
- Could also be used to develop a more-efficient use of pesticides in agriculture, if it was applied in the critical stages of the plants growth.

Thanks!!
That was good!



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Any Questions?

