

Interaction of native and invasive grasses with a generalist herbivore insect

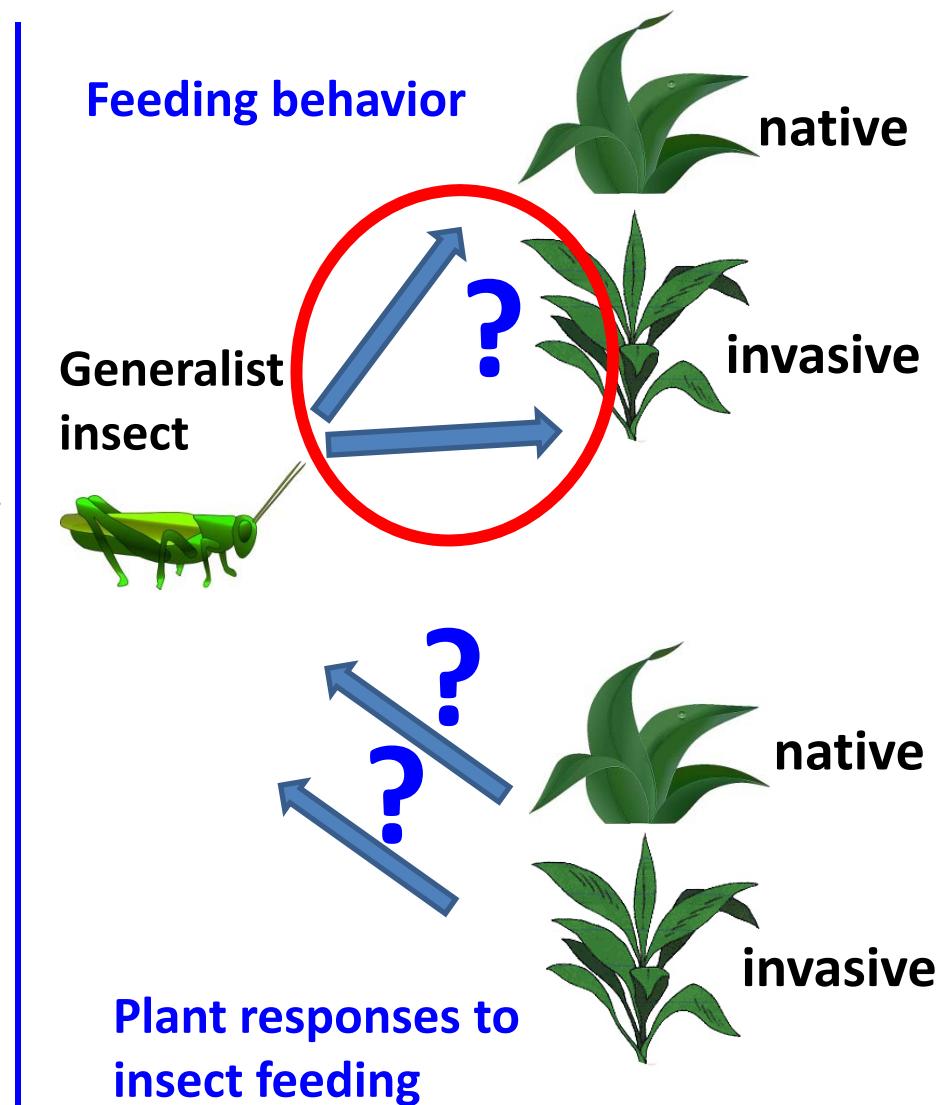
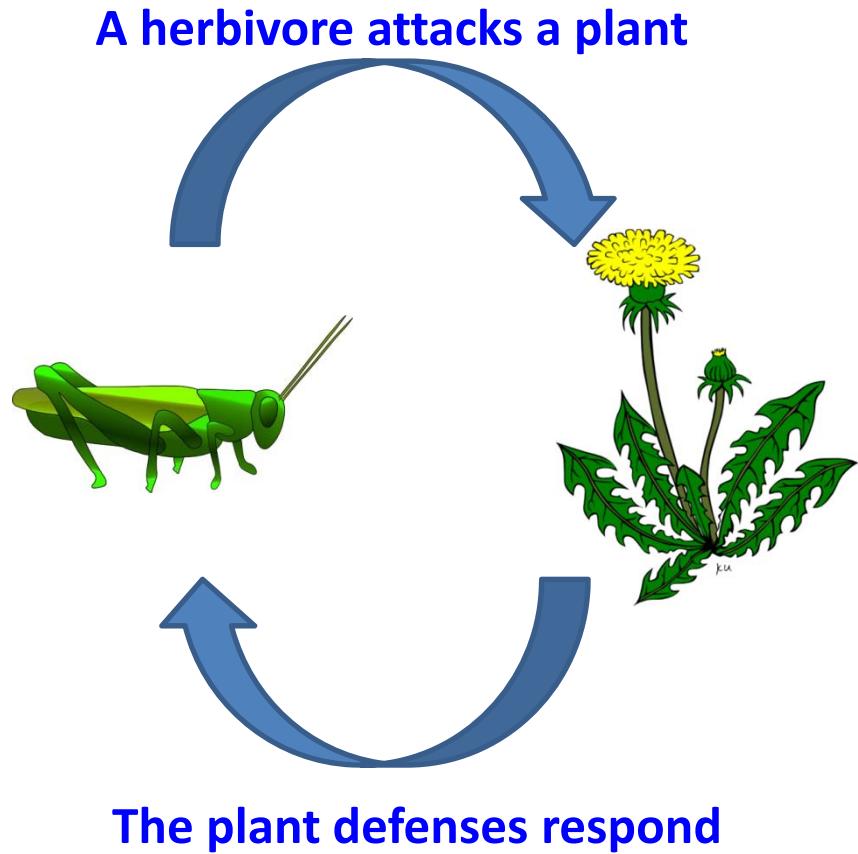
Alina Avanesyan and Theresa Culley

Department of Biological Sciences, University of Cincinnati



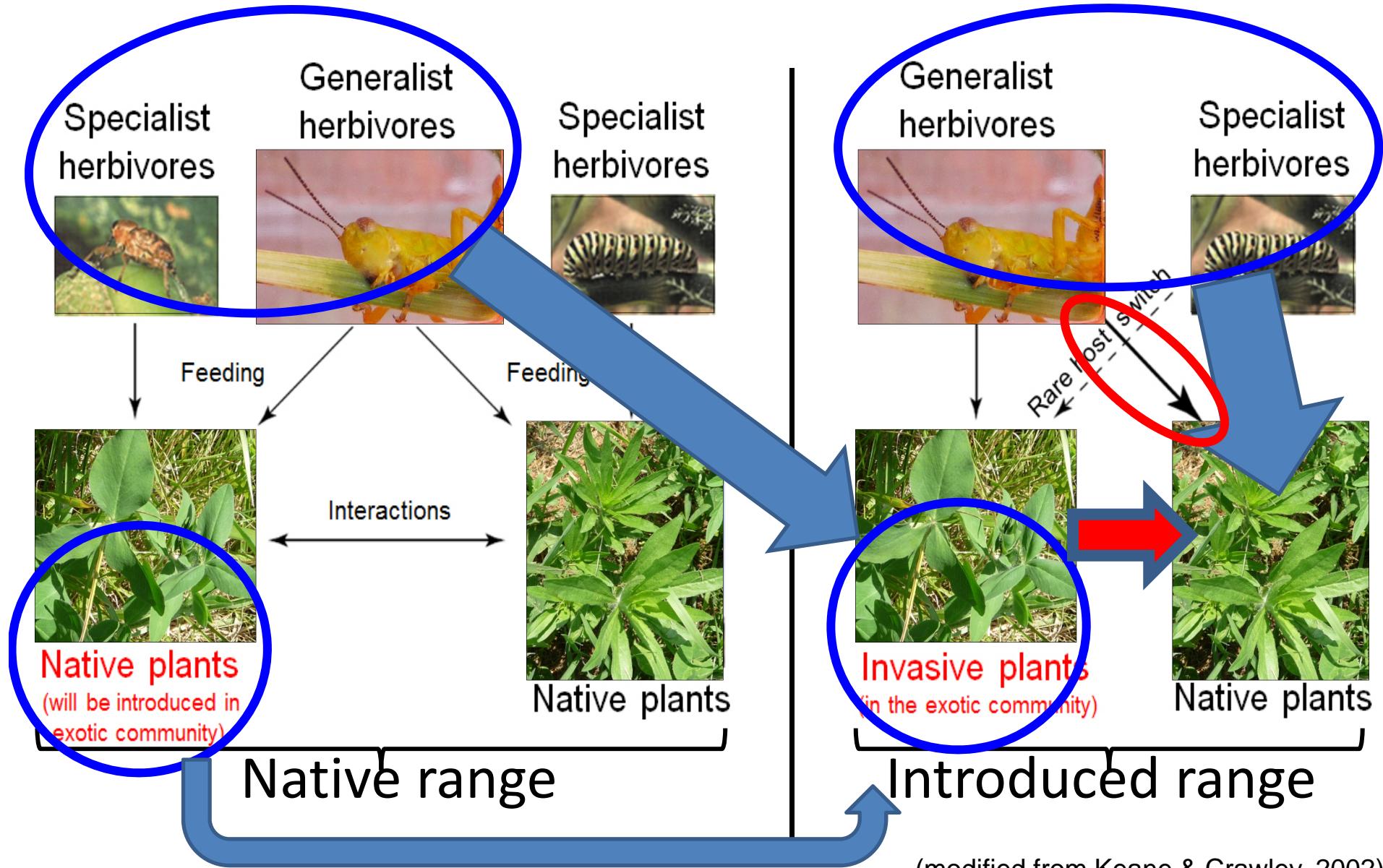
<http://ptygmatic.wordpress.com/category/insects/>

The interaction between plants and insect herbivores



Enemy Release Hypothesis

(Darwin 1859, Williams 1954, Elton 1958, Gillett 1962)



Main question

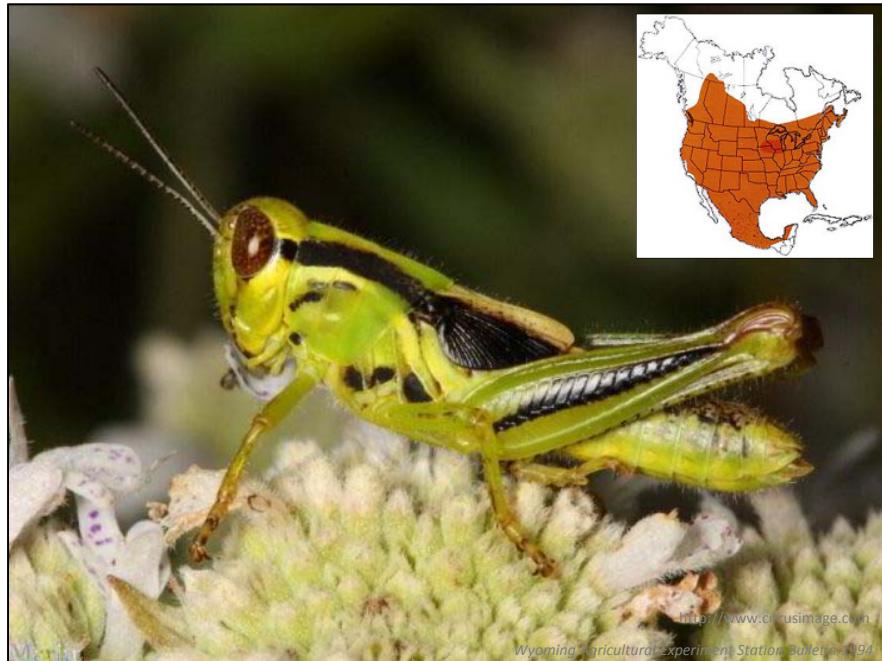
Do invasive grasses receive less leaf damage from generalist herbivores than native grasses?

- Generalist grasshoppers feed on a wide variety of plants
- They often switch between plants
- They prefer new food

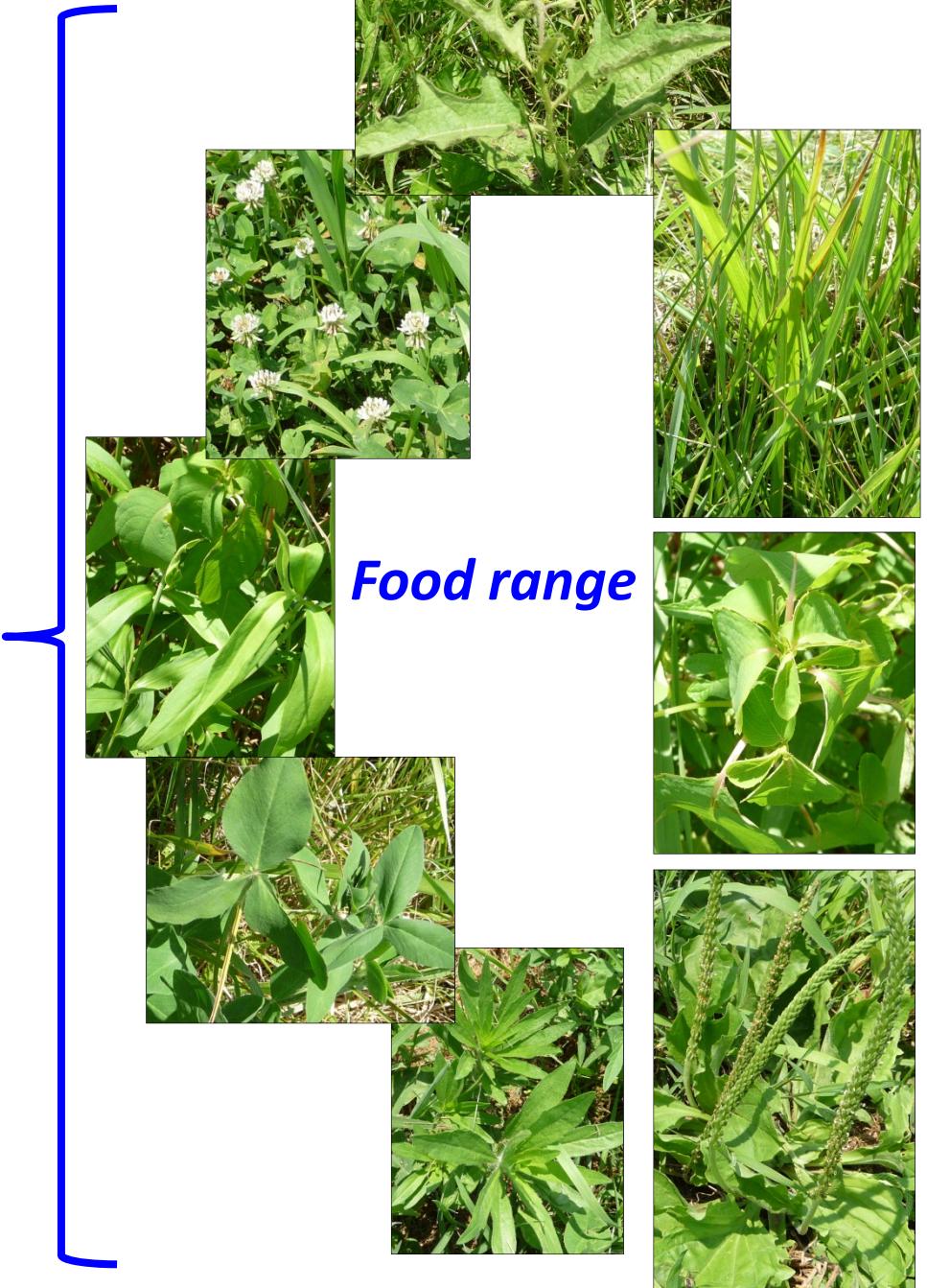
Main hypothesis

Invasive grasses will receive more leaf damage from native *Melanoplus* grasshoppers than native grasses

Study Organisms

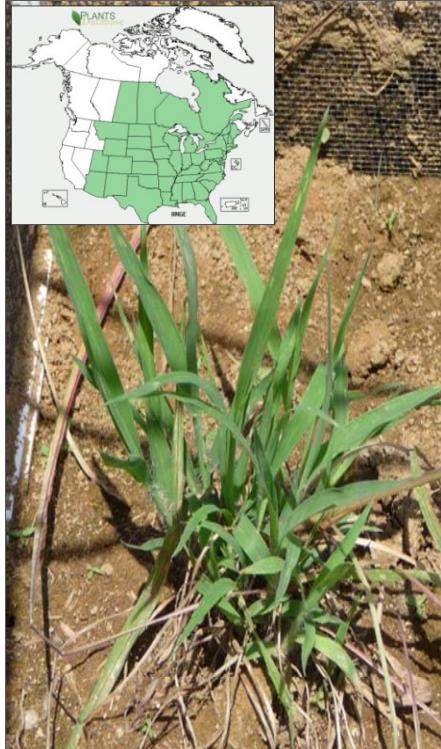


Melanoplus spp.
(Orthoptera: Acrididae)
grasshopper nymph

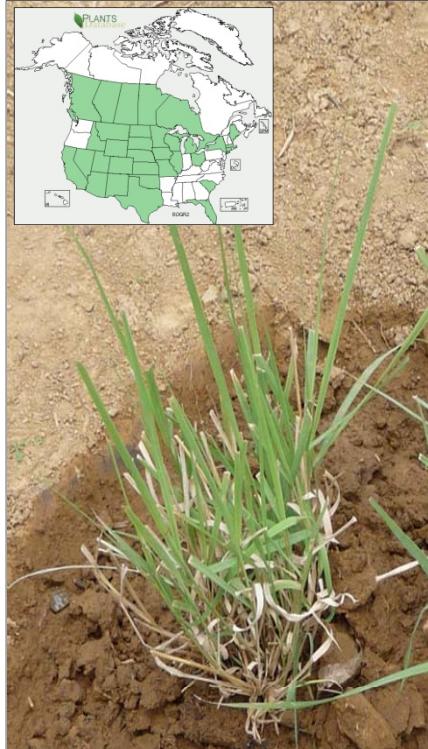


Summer 2012

Study Organisms (cont.)



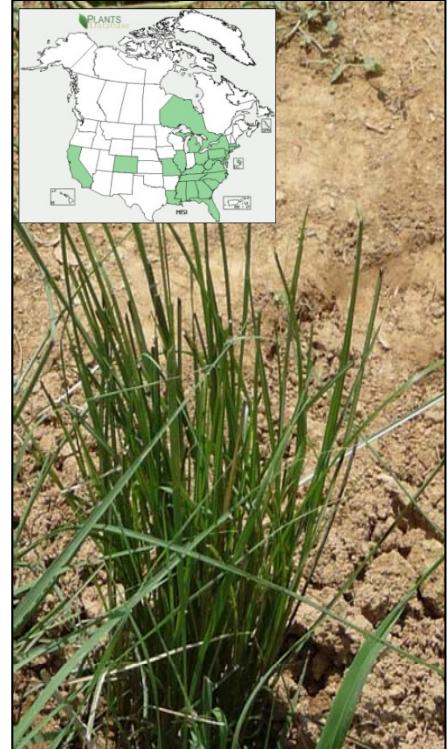
*Andropogon
Gerardii*
Big Bluestem



*Bouteloua
Curtipendula*
Sideoats Grama



*Miscanthus
sinensis
'Zebrinus'*
Zebra Grass



*Miscanthus
sinensis
'Gracillimus'*
Maiden Grass

Native grasses

Family: Poaceae

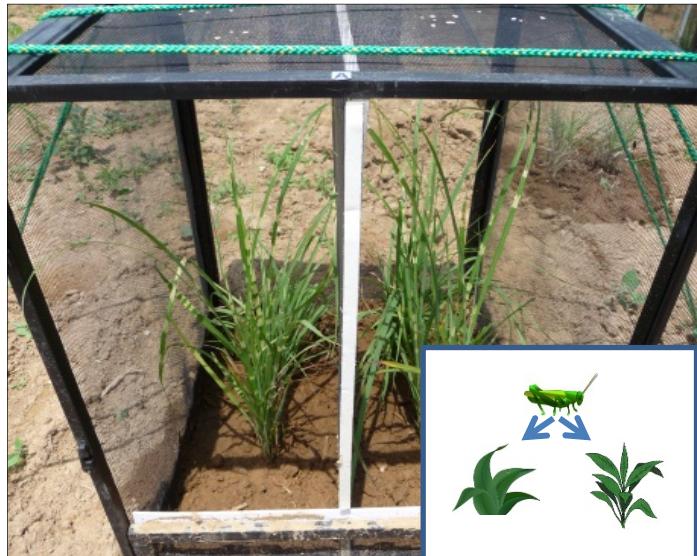
Invasive grasses

Western Maryland Research and Education Center



Choice feeding experiments

Plants



Leaves



Main hypothesis

Invasive grasses will receive more leaf damage from native *Melanoplus* grasshoppers than native grasses

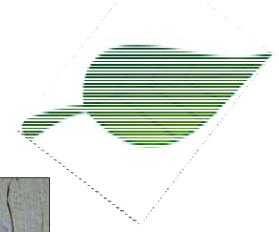


Research questions

1. Does leaf damage from grasshoppers differ between native and invasive plants?
2. Does food consumption of grasshoppers differ on leaves from native and invasive plants?



Measurements



Leaf damage: Volume of the grazed portion [$\text{length} \times \text{width} \times \text{depth of "scars"}$, cm³]

Frequency of grazing:

[number of scars per plant]

[number of scars/number of leaves]



Leaf consumption: [leaf tissue offered – leaf tissue not eaten, g]

Proportion of leaves consumed:
[leaf consumption/leaf tissue offered]
[(length of leaf offered-length of leaf remained)/length of leaf offered]

Field experiments with plants



*Andropogon
gerardii*



*Miscanthus sinensis
'Zebrinus'*

Native/invasive
plant pairs



*Bouteloua
curtipendula*



*Miscanthus sinensis
'Gracillimus'*

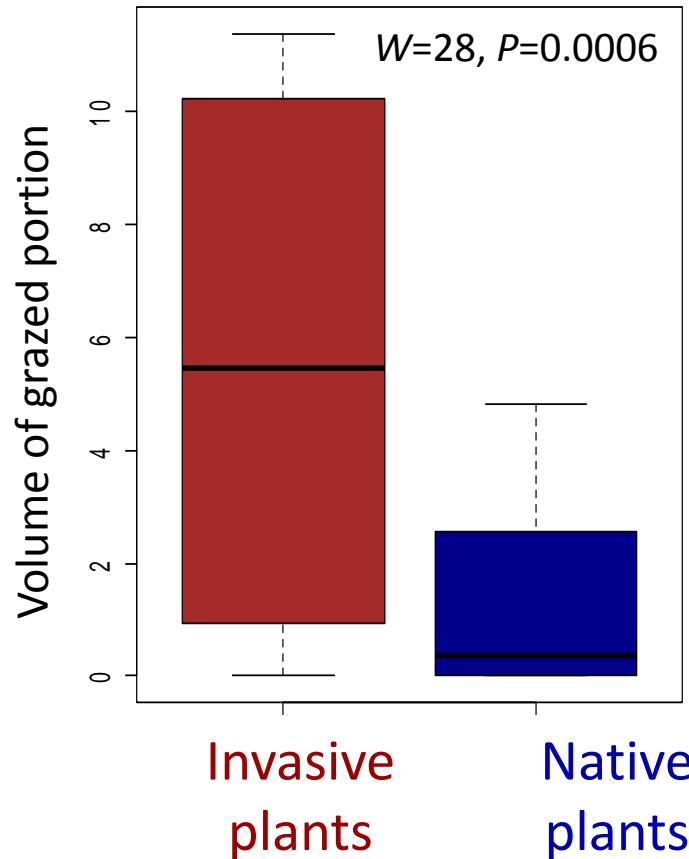


5 days

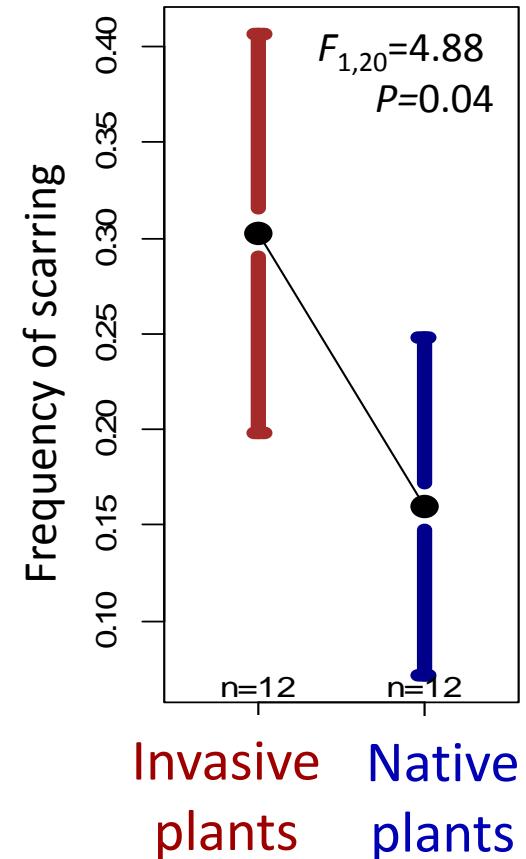
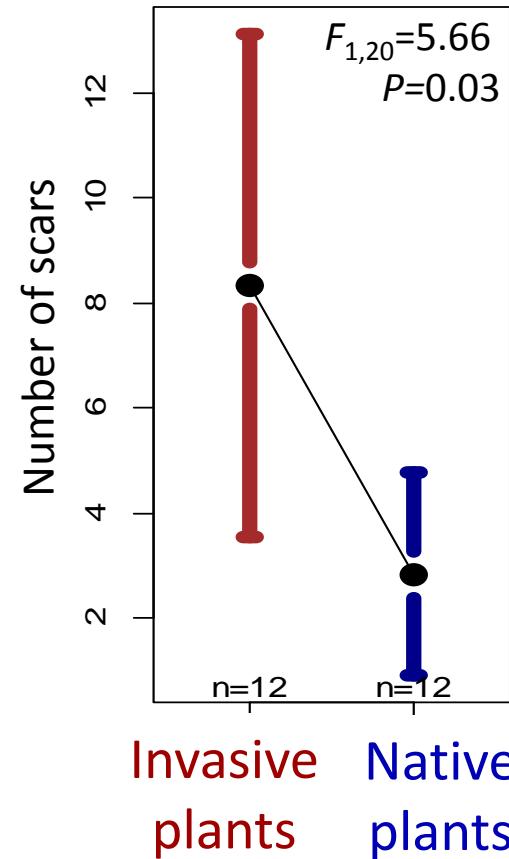


Results: Field experiments

Leaf damage



Frequency of grazing



Both leaf damage and frequency of grazing of grasshoppers were greater on invasive plants.

Experiments with leaves



*Andropogon
gerardii*



*Miscanthus sinensis
'Zebrinus'*

Native/invasive
plant pairs



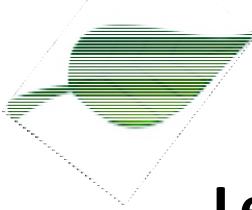
*Bouteloua
curtipendula*



*Miscanthus sinensis
'Gracillimus'*

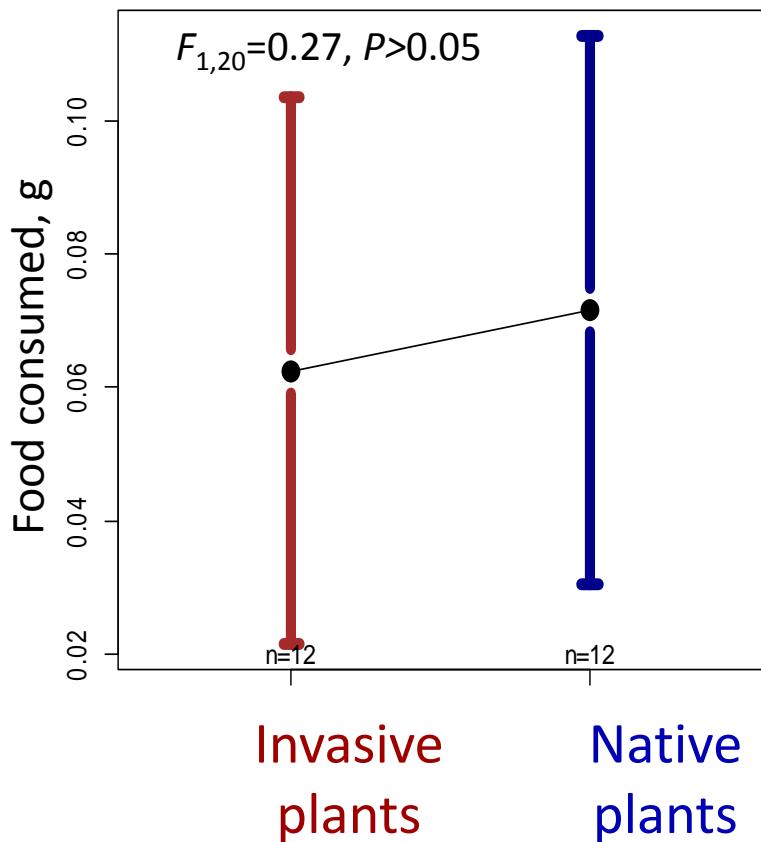


5 hours

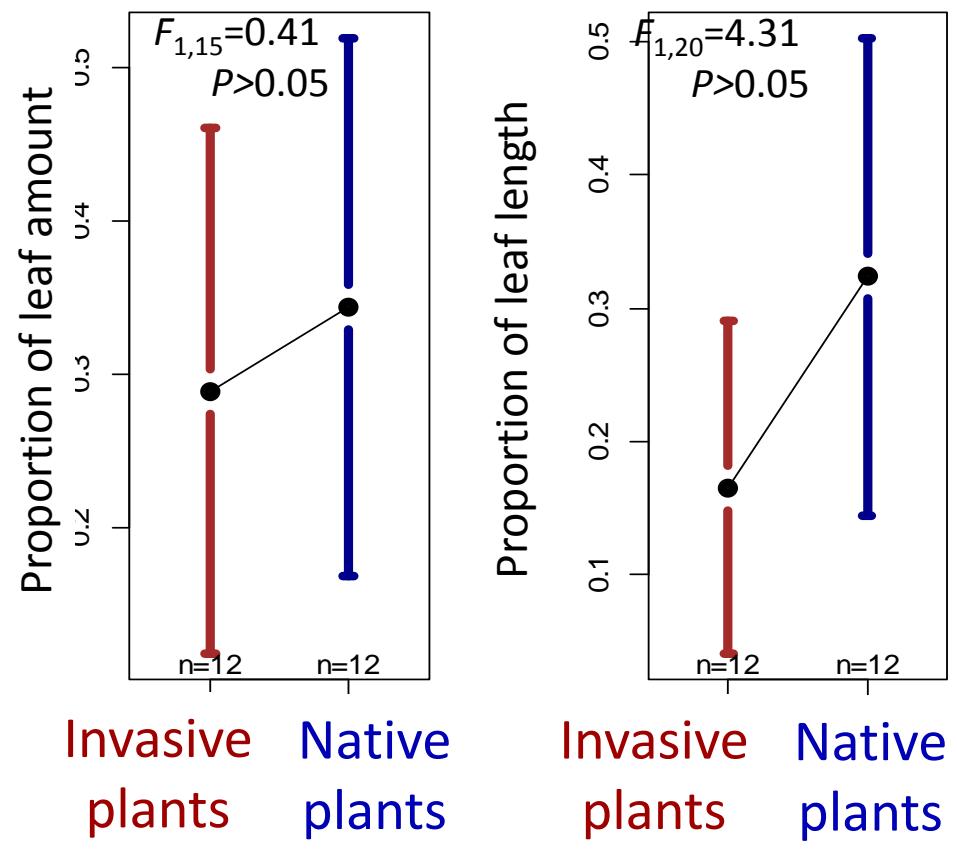


Results: Experiments with leaves

Leaf consumption



Proportion of leaves consumed



Both leaf consumption and proportion of leaves consumed by grasshoppers did not differ significantly between native and invasive plants.

Summer 2013

Study Organisms



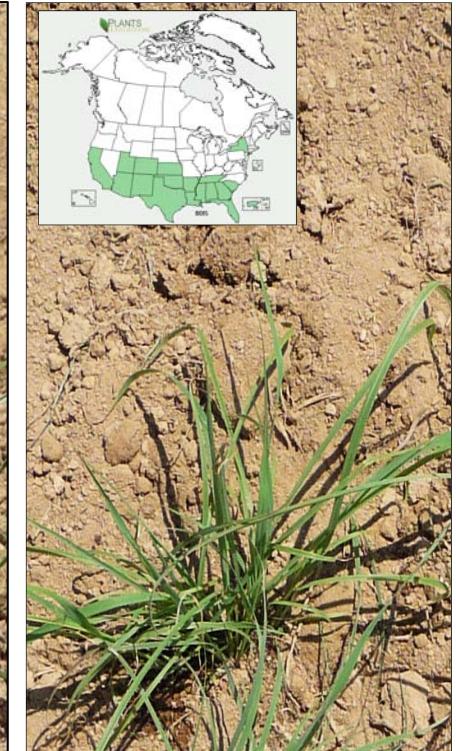
*Andropogon
Gerardii*
Big Bluestem



*Bouteloua
Curtipendula*
Side oats Grama



*Miscanthus
sinensis*
Chinese Silver
Grass



*Bothriochloa
ischaemum*
Yellow Bluestem

Native grasses

Family: Poaceae

Invasive grasses

Study Sites

**Western Maryland
Research and Education
Center (MD)**



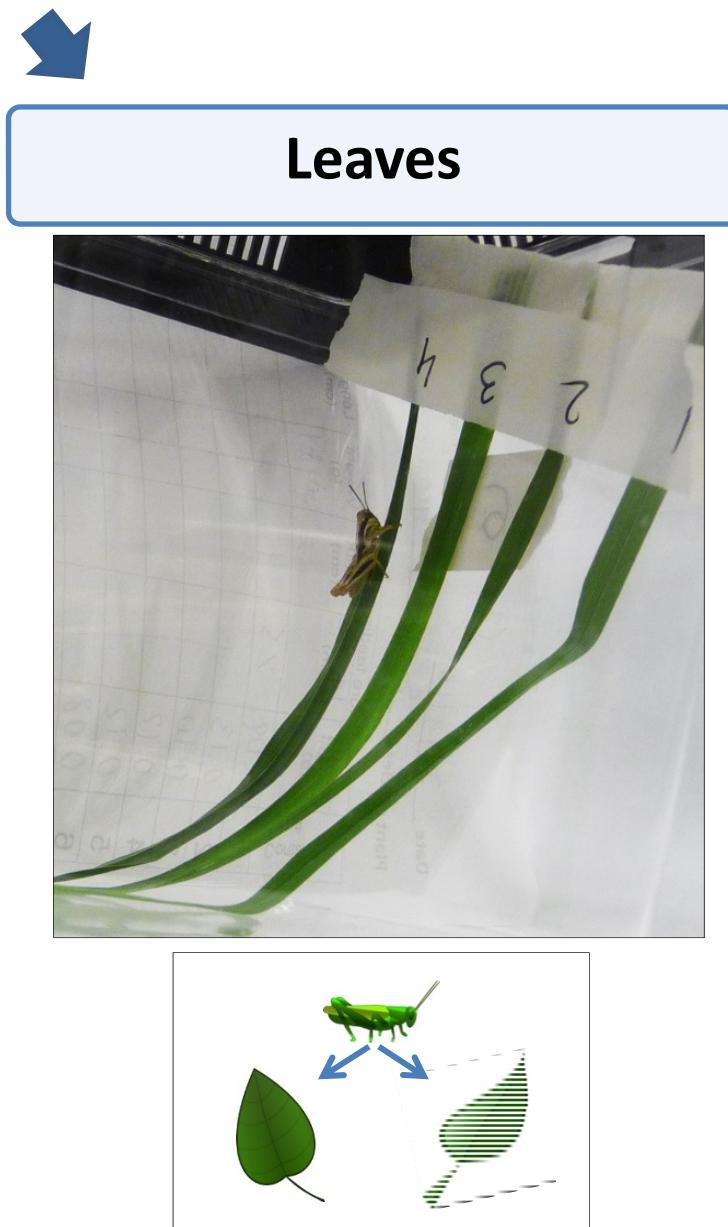
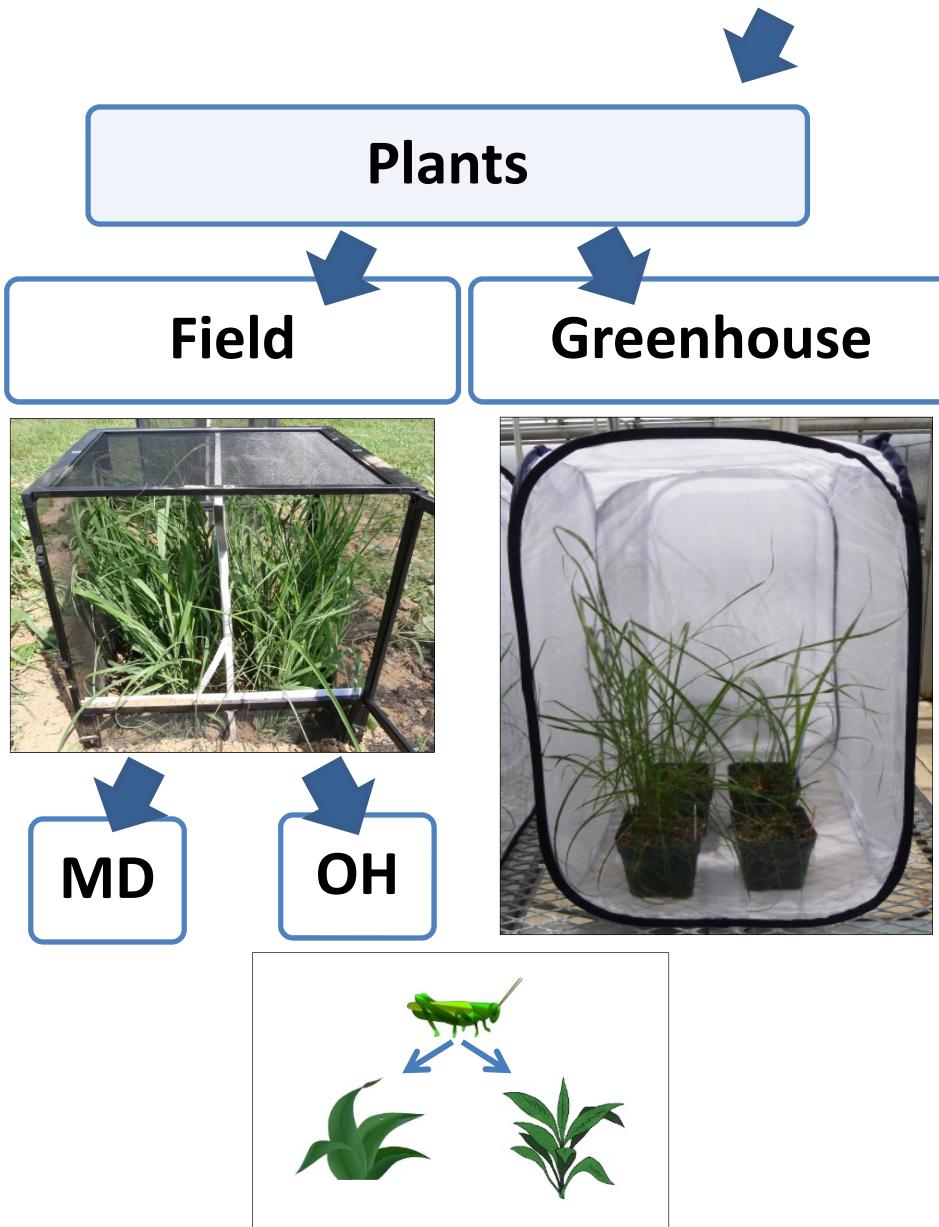
**Cincinnati Center
for Field Studies (OH)**



**University of Cincinnati
Greenhouse (OH)**



Choice feeding experiments





Additional Measurements

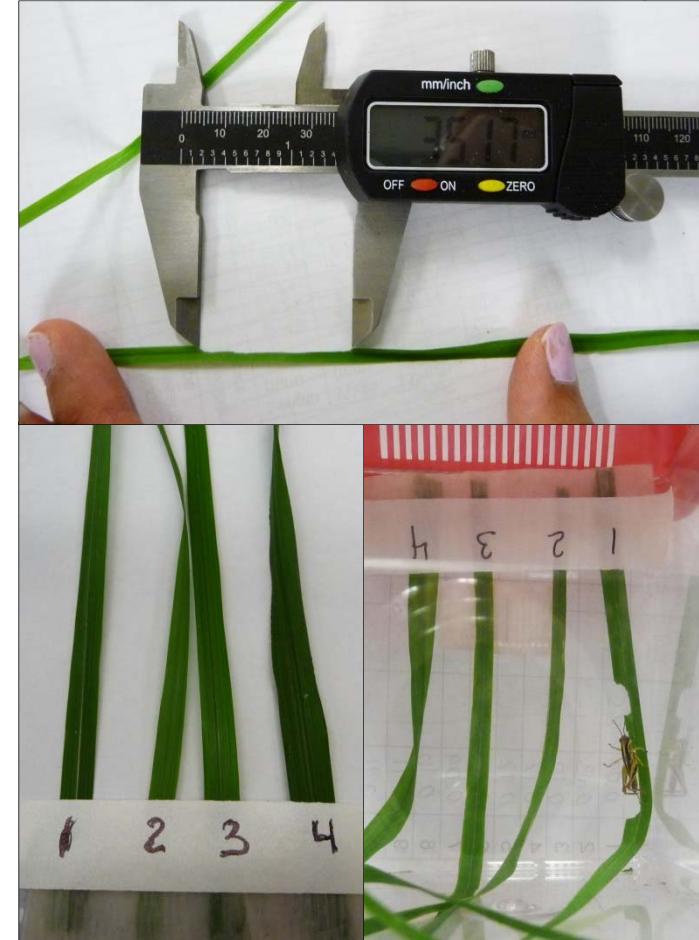


Average volume of the grazed portion:

[total volume of the grazed portion/number of scars]

Portion of damaged leaves: [number of damaged leaves/number of leaves]

Portion of a plant utilized for grazing:
[height of the highest scar - height of the lowest scar/height of the plant]

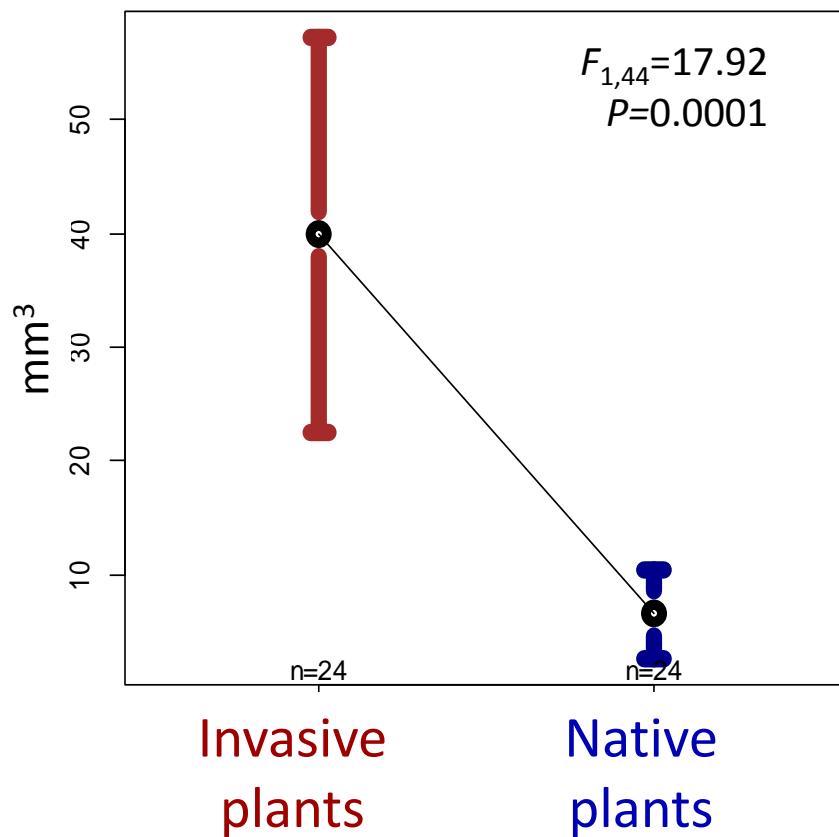


Volume of the grazed portion: [length × width × depth of “scars”, cm³]

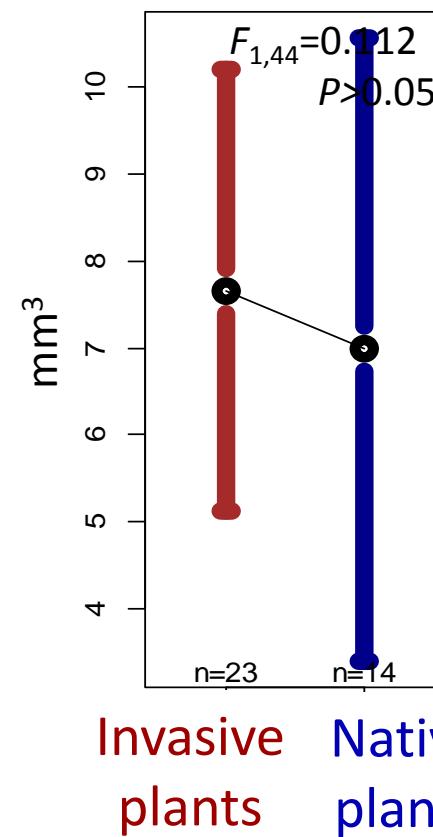


Results: Field experiments (MD)

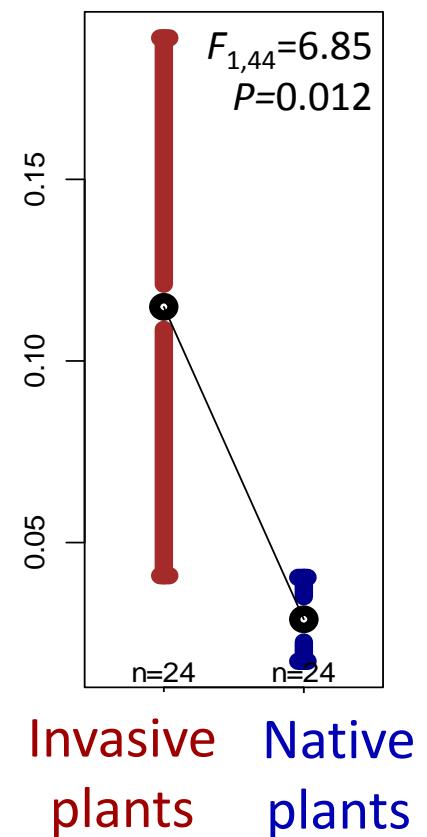
Total volume of grazed portion



Average volume of grazed portion



Portion of damaged leaves

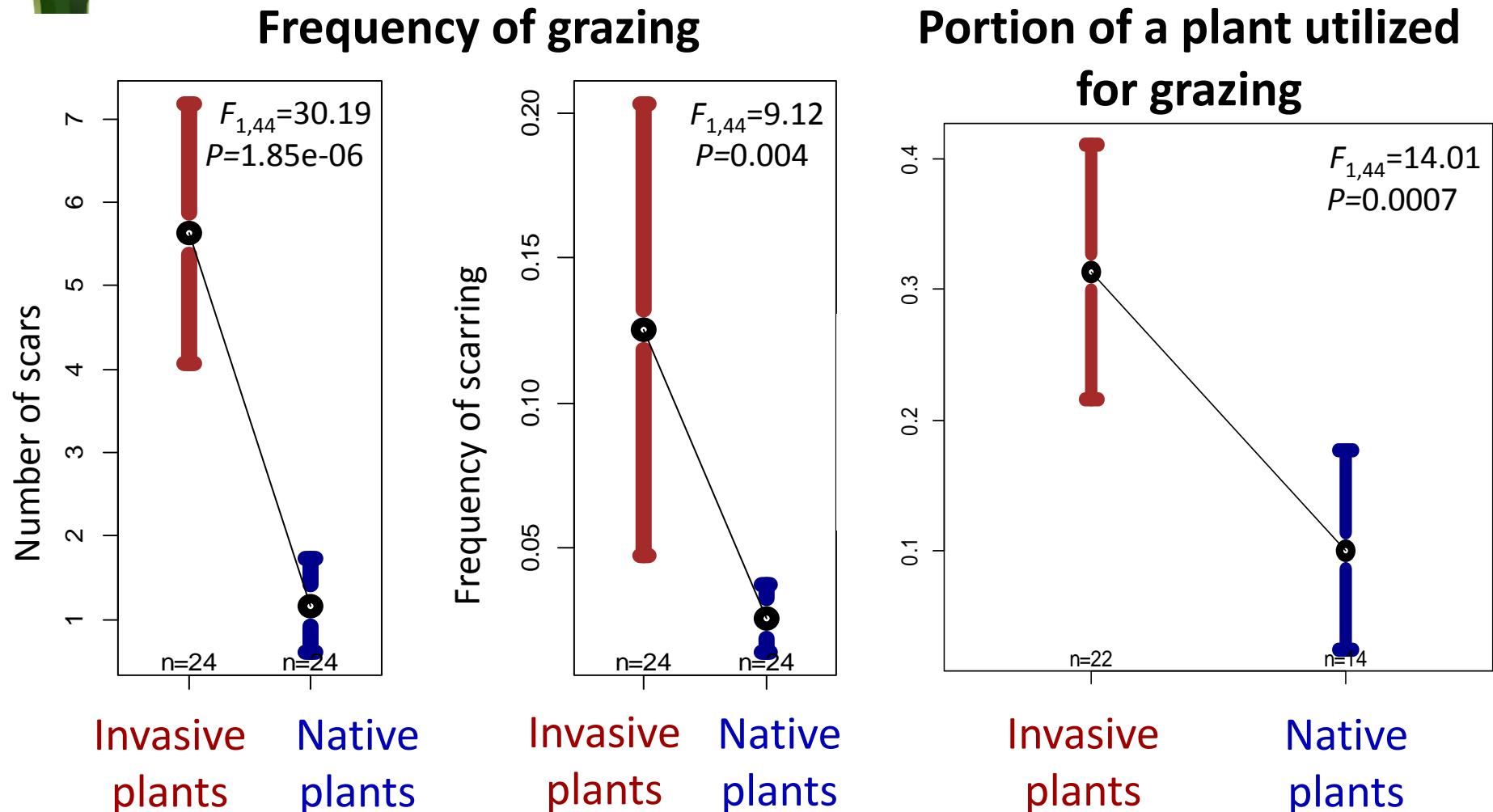


Both total volume of grazed portion and portion of damaged leaves were greater in invasive plants.

Average volume of grazed portion did not differ significantly between native and invasive plants.



Results: Field experiments (MD, cont.)

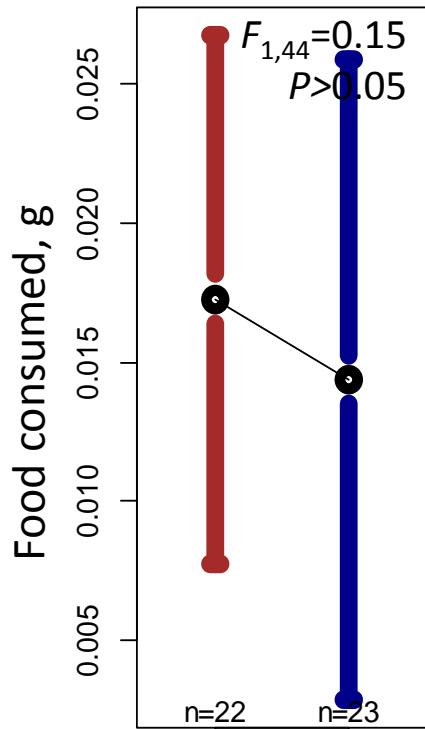


Both frequency of grazing and portion of a plant utilized for grazing by grasshoppers were greater in invasive plants.

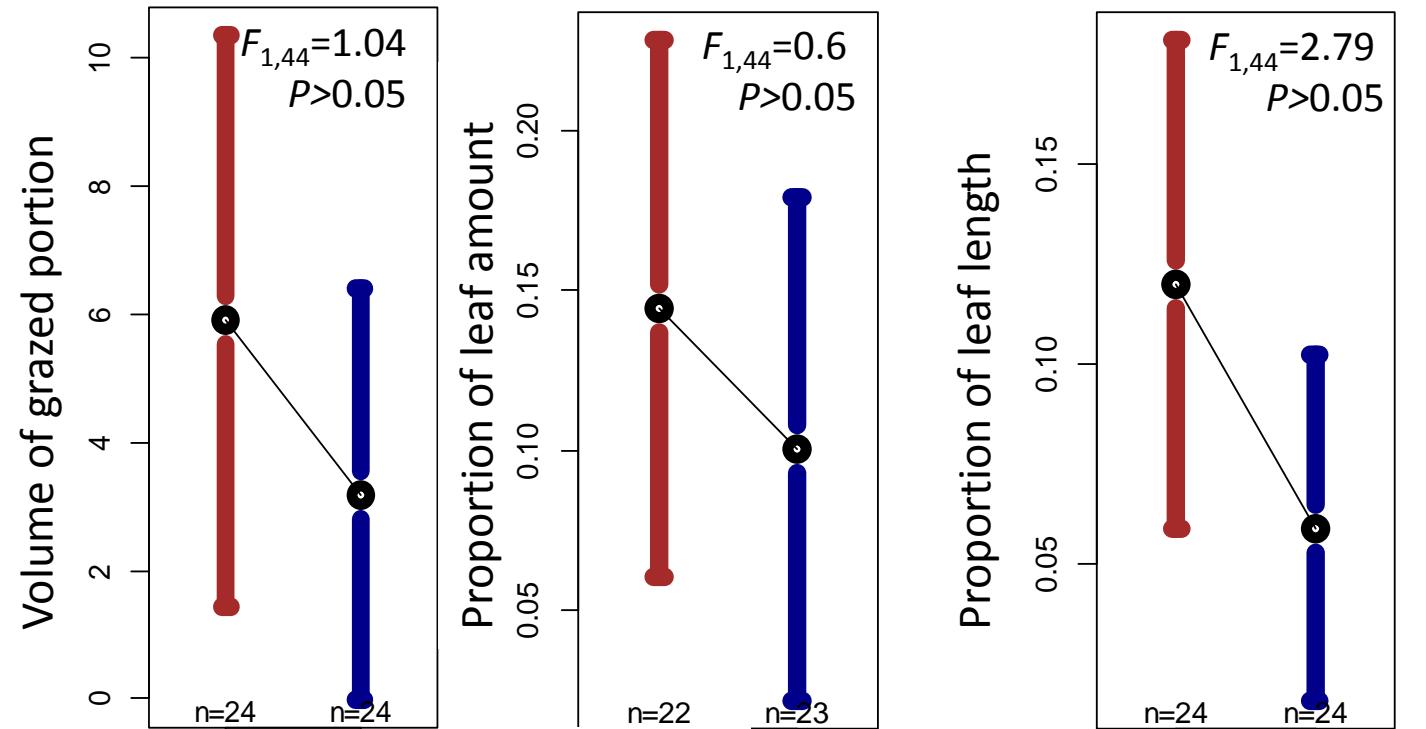


Results: Experiments with leaves

Leaf consumption



Proportion of leaves consumed



Both leaf consumption and proportion of leaves consumed by grasshoppers did not differ significantly between native and invasive plants.

Conclusions

Main hypothesis: Invasive grasses will receive more leaf damage from native *Melanoplus* grasshoppers than native grasses. The hypothesis was supported in the experiments with intact plants but was not supported in the experiments with leaves.

Possible explanations:

- Differences in grasshopper feeding under natural (intact plants) and artificial (leaves) conditions
- Decreasing in resistance of plant leaves after they have been clipped

Significance to the field of study



Impact of generalist insects on invasive and native plants are still uncertain

Effective pest control strategies in order to preserve biodiversity in native communities.

The choice of grasshoppers: agricultural importance
(Hewitt & Onsager, 1983)

Convenient plant-insect model (may be used and extended in future studies)



Thank you!



University of Cincinnati:

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Angelo Randaci
Roger Ruff
Dr. George Uetz



University of Maryland:

Tim Ellis
Dr. William Lamp

Wieman Wendel Benedict Award 2011, 2012, 2013.
University of Cincinnati

