Should I Eat or Should I Go?

Acridid Grasshoppers and Their Novel Host Plants: Implications for Biotic Resistance

Alina Avanesyan

Department of Entomology, University of Maryland, College Park, MD; alina@umd.edu

Summary

Novel, non-coevolved associations between introduced plants and native insect herbivores may lead to changes in trophic interactions in native communities, as well as to substantial economic problems. Although some studies in invasion ecology demonstrated that native herbivores can preferentially feed on introduced plants and therefore contribute to biotic resistance of native communities to plant invasions, the role of acridid grasshoppers as native generalist insect herbivores is largely overlooked. This systematic review aimed to identify patterns of grasshopper feeding preferences for native versus introduced plants and, consequently, the potential of grasshoppers to provide biotic resistance of native communities. The analysis has been conducted using 63 records of feeding preference trials for 28 North American grasshopper species retrieved from 2146 studies published during 1967-2017 *(Avanesyan 2018).*

Herbivory of native and exotic North-American prairie grasses by nymph *Melanoplus* grasshoppers

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Acridid grasshoppers are overlooked in the invasion studies

Herbivory of native and exotic North-American prairie grasses by nymph *Melanoplus* grasshoppers

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The authors used a very wide range of experimental conditions and measurements to assess grasshopper preferences

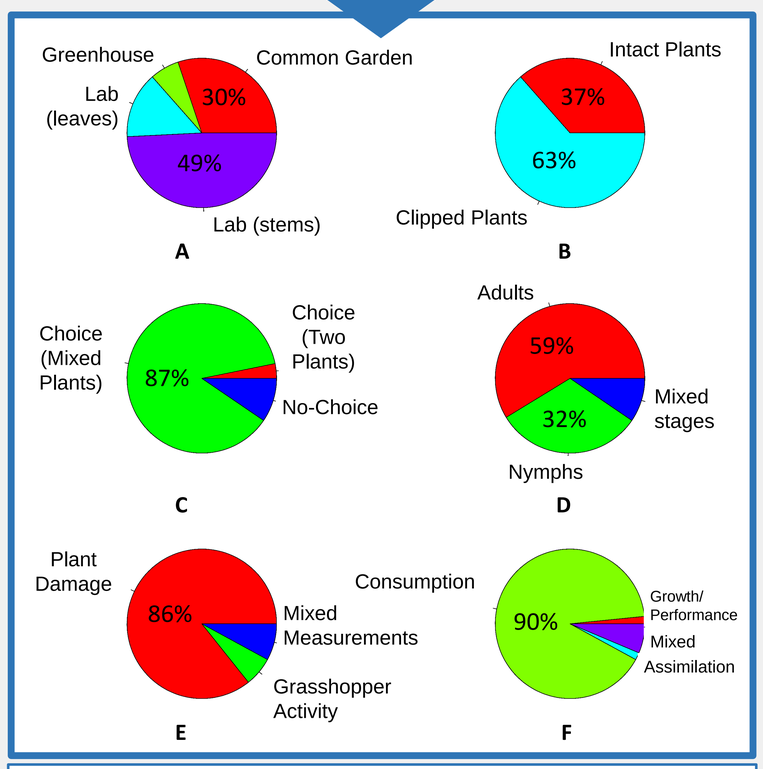


Figure 3. Percentage of studies that reported different experimental set-ups used to estimate grasshopper feeding preferences: **A** - types of the experimental environment used; **B** - type of plant material; **C** - type of a preference trial; **D** - grasshopper life stage used; **E** - general preference measurements; **F -** grasshopper activity measurements.

Results

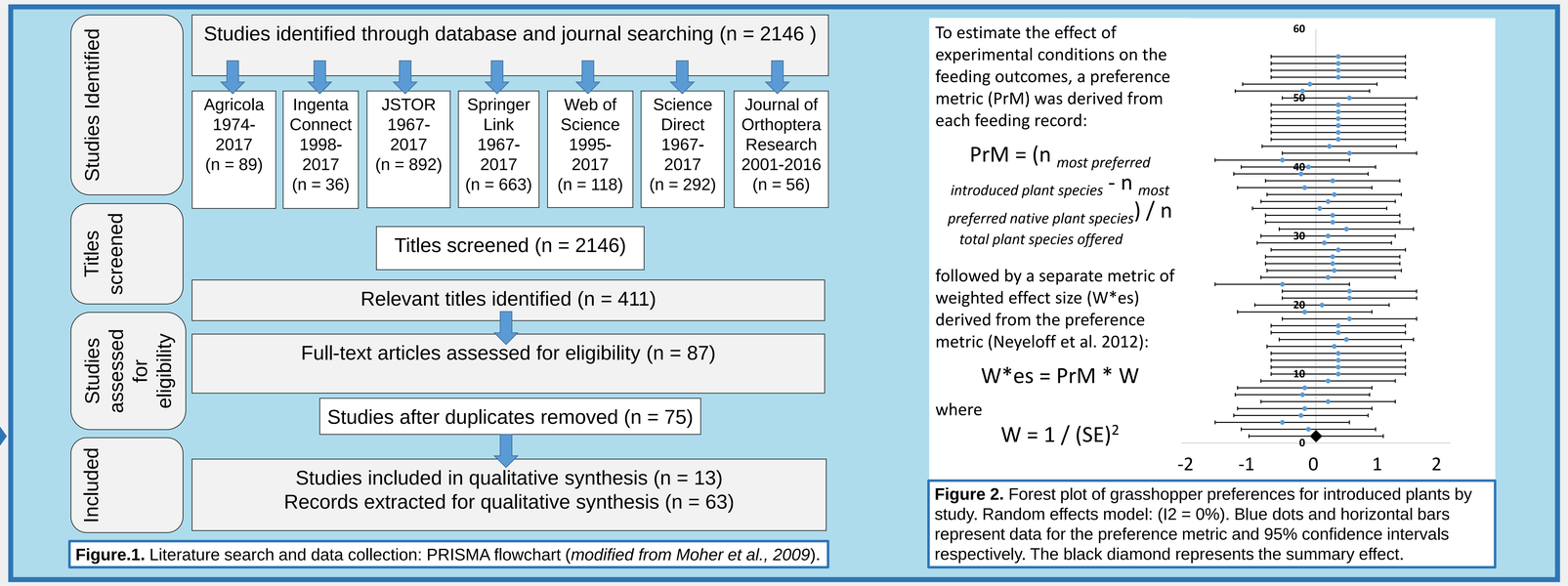


Figure.1. Literature search and data collection: PRISMA flowchart (*modified from Moher et al., 2009*).

To estimate the effect of experimental conditions on the feeding outcomes, a preference metric (PrM) was derived from each feeding record:

$$PrM = (n_{\text{most preferred introduced plant species}} - n_{\text{most preferred native plant species}}) / n_{\text{total plant species offered}}$$

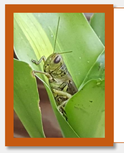
followed by a separate metric of weighted effect size (W*es) derived from the preference metric (Neyeloff et al. 2012):

$$W^*es = PrM * W$$

where

$$W = 1 / (SE)^2$$

Figure 2. Forest plot of grasshopper preferences for introduced plants by study. Random effects model: (I2 = 0%). Blue dots and horizontal bars represent data for the preference metric and 95% confidence intervals respectively. The black diamond represents the summary effect.



Acridid grasshoppers prefer to feed on introduced plants

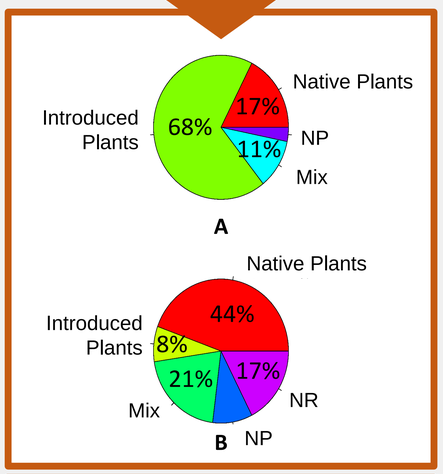
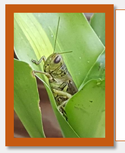


Figure 4. Percentage of studies that reported different outcomes of the feeding trials with acridid grasshoppers: **A** - most preferred plants; **B** - least preferred plants (NP: no preferences observed; NR: preferences not reported).



Acridid grasshoppers prefer to feed on introduced plants regardless the experimental conditions or plant material offered

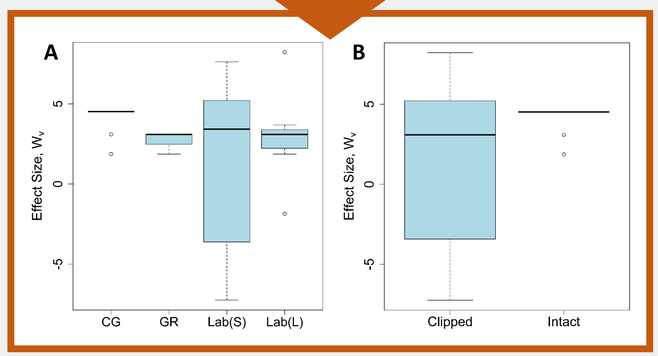


Figure 5. Mean effect sizes (with 95% confidence intervals) for studies conducting different feeding trials: **A** - studies using different experimental environment (CG: common garden; GR: greenhouse; Lab(S): laboratory, clipped stems; Lab(L): laboratory, clipped leaves); **B** - studies using different plant material (The Kruskal–Wallis test: $p > 0.05$).

Most of the preferred plants are highly invasive

Invasive potential of preferred introduced host plants:

- Twenty introduced plant species were reported as "the most preferred" and two plant species as "the second preferred" for grasshoppers
- Invasive ranks were determined, when available, for 13 plant species. Of these, 12 species showed high or middle I-rank
- Most grasshopper species were reported to have preferences for *Bromus inermis* and *Schedonorus arundinaceus*
- The highest number of U.S. National Parks (18) and states (25) where the plant species were reported as invasive was seen for *Sorghum halepense*

Main Findings

- More studies on grasshopper preferences on introduced vs. native plants are needed
- Acridid grasshoppers prefer to feed on introduced plants and might contribute to biotic resistance of native communities to plant invasions
- Researchers use different experimental designs and measurements – however, these differences don't affect grasshopper feeding choice

Acknowledgments and References

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References:

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