

Should I Eat or Should I Go?

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

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Abstract



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 of 63 records of feeding preference trials for 28 North American grasshopper species (retrieved from 2146 studies published during 1967-2017) has demonstrated a preference of grasshoppers for introduced host plants, and identified 12 preferred introduced plants with high or middle invasive ranks. A significant effect of the life stage ($p < 0.001$), but not experimental environment, plant material and measurements, on grasshopper preferences for introduced plants was also detected. Overall results suggest a potential for acridid grasshoppers to contribute to biotic resistance of native communities. (Avanesyan 2018; under review)

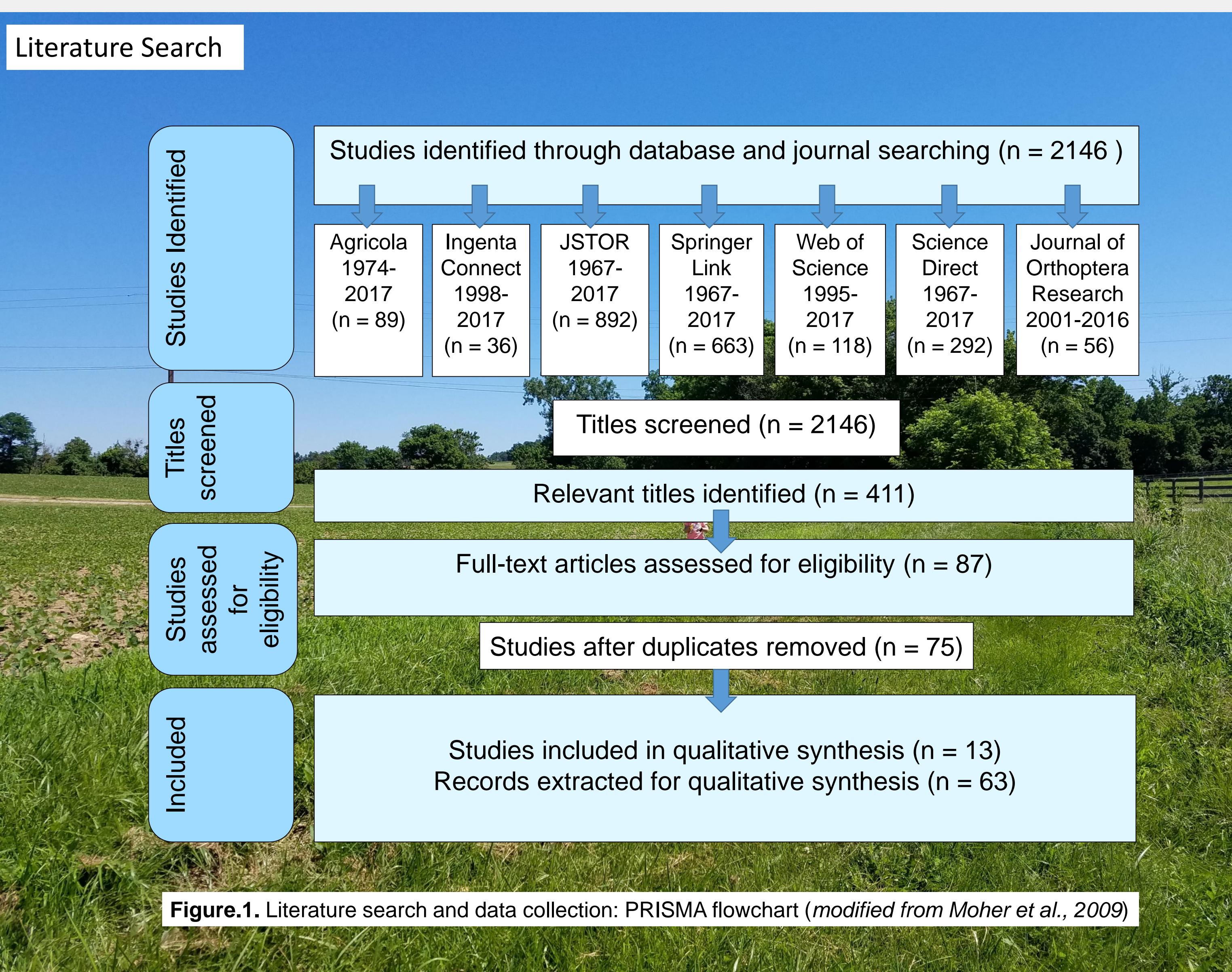
Objectives

1. To identify patterns of grasshopper feeding preferences for native vs. introduced plants
2. To examine the invasive potential of introduced host plants preferred by grasshoppers
3. To assess the effect of experimental conditions on grasshopper feeding choice

To be included in the analysis, a study had to:

- ✓ Use at least one plant which is native to North America and one plant which is exotic to North America
- ✓ Report grasshopper preference for either each plant species or for a group of native plants versus exotic plants
- ✓ Report grasshopper preference for plant species growing at the same environmental conditions
- ✓ Report grasshopper preference rather than acceptance of different plants
- ✓ Use "direct" grasshopper feeding trials on different plant species

Methods



Results and Discussion

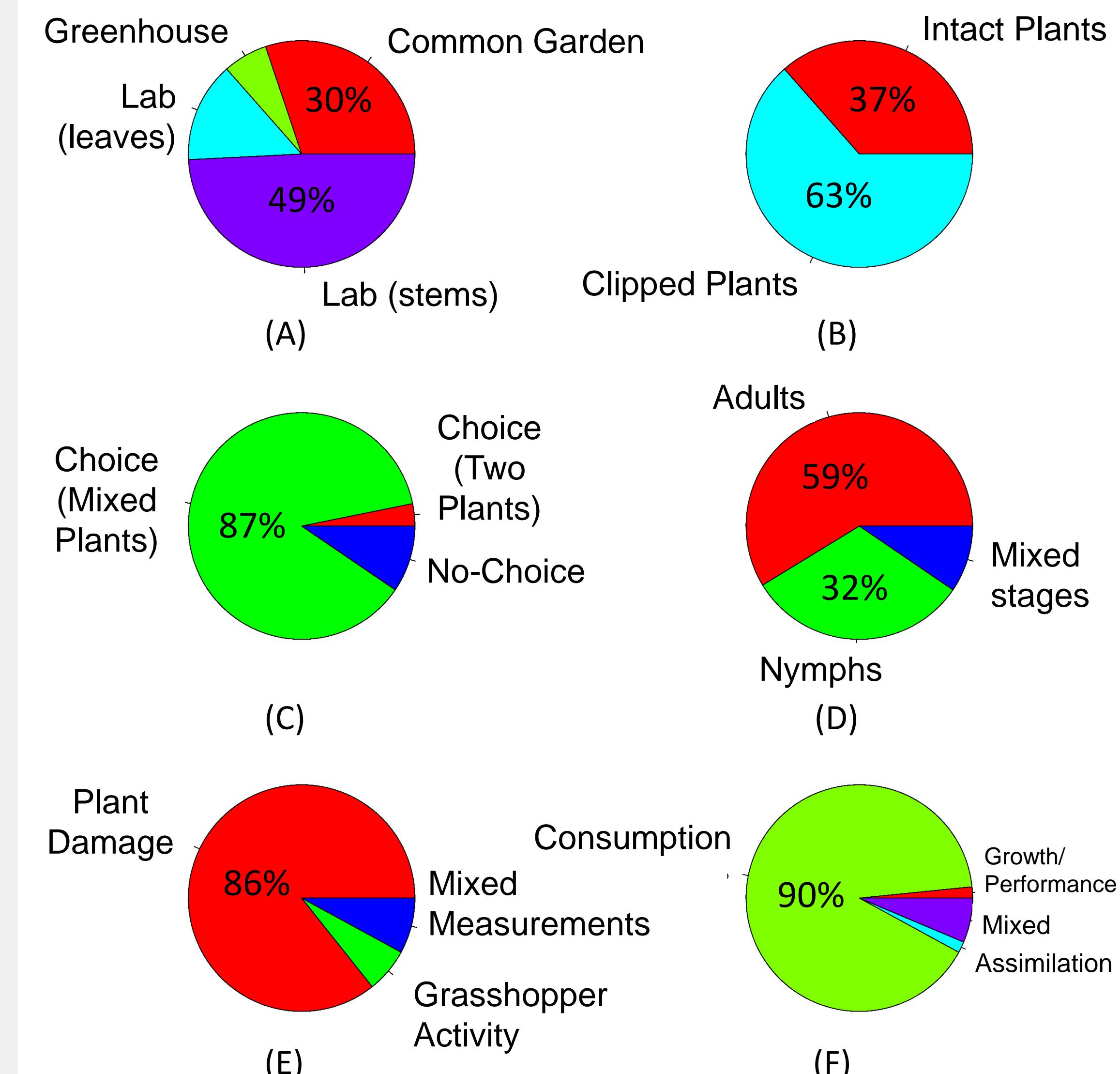


Figure 3. Percentage of studies that reported different experimental set-ups used to estimate grasshopper feeding preferences: (a) types of the experimental environment used; (b) type of plant material; (c) type of a preference trial; (d) grasshopper life stage used; (e) general preference measurements; and (f) grasshopper activity measurements

Results and Discussion

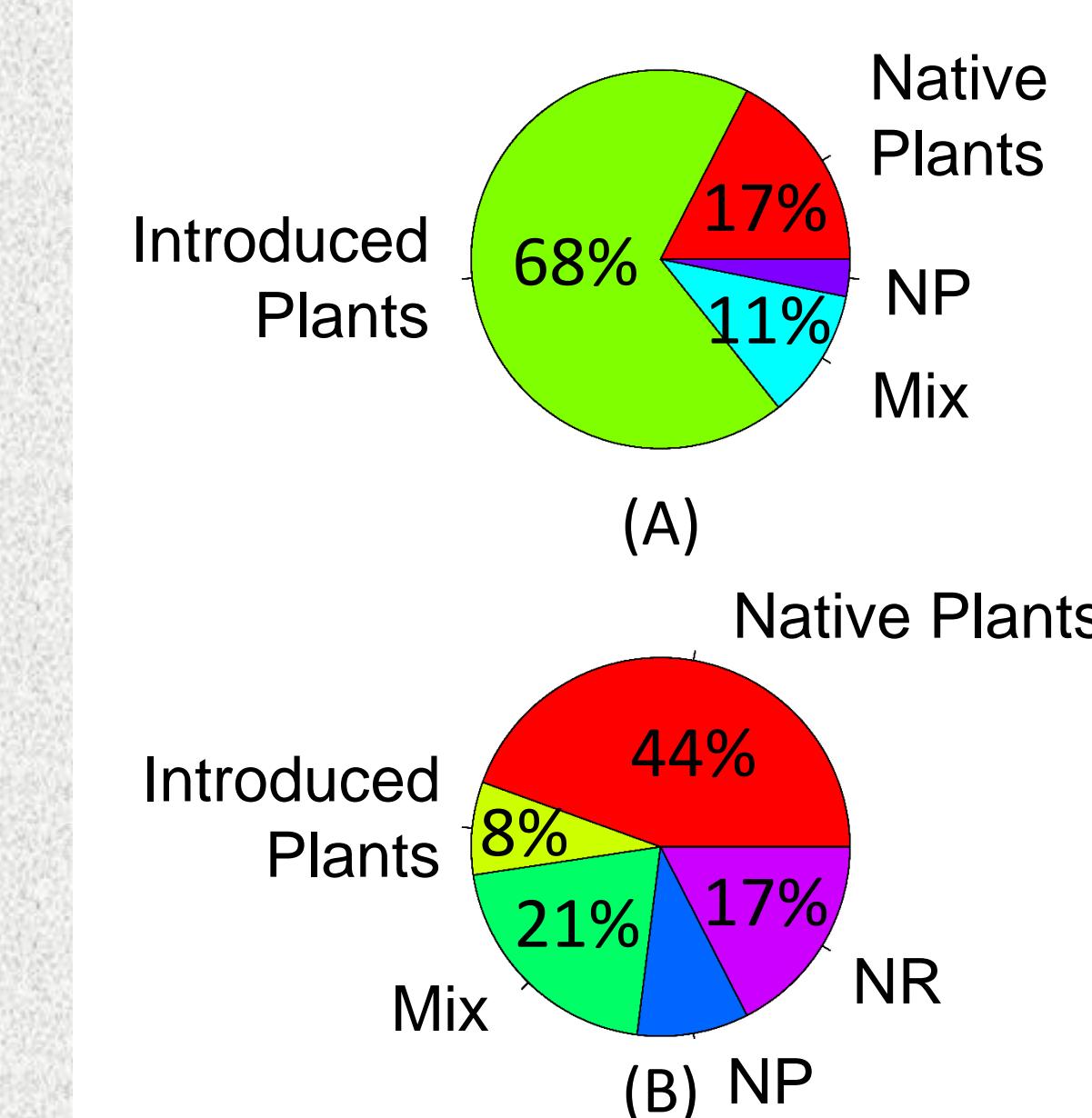
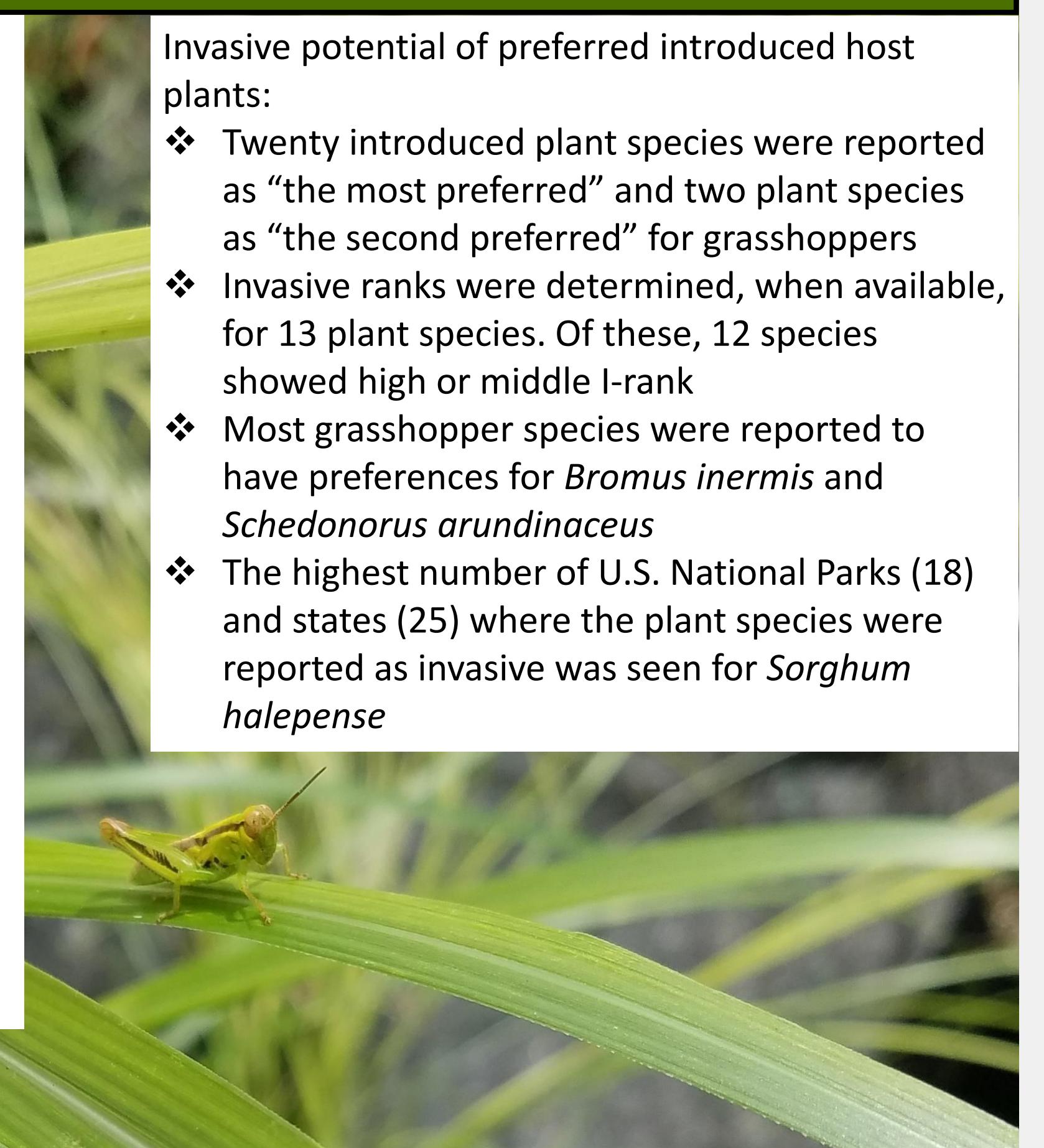


Figure 4. Percentage of studies that reported different outcomes of the feeding trials with acridid grasshoppers: (a) most preferred plants; (b) least preferred plants (NP: no preferences observed; NR: preferences not reported).



- 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*

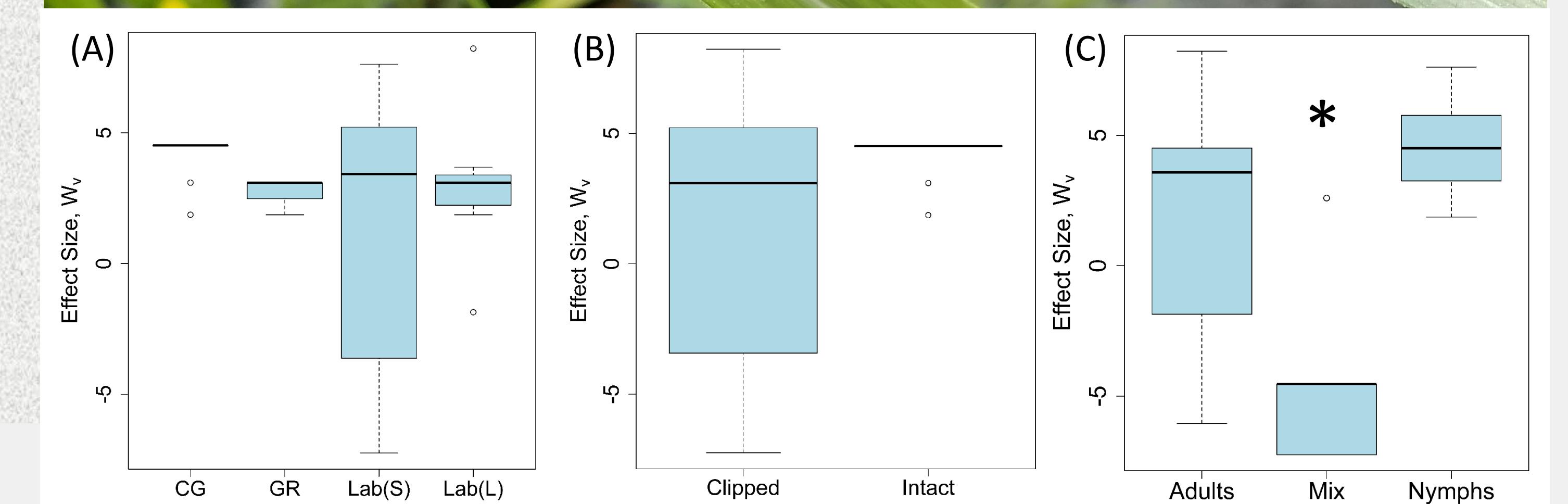


Figure 5. Mean effect sizes (with 95% confidence intervals) for studies conducting different feeding trials: (a) studies using different experimental environment (CG: common garden; GR: greenhouse; Lab(S): laboratory, clipped stems; Lab(L): laboratory, clipped leaves); (b) studies using different plant material; (c) studies using different grasshopper life stage. *The Kruskal-Wallis test: $\chi^2 = 13.96$, d.f. = 2, $p < 0.001$



Potential implications of the results for biotic resistance:

- The majority of studies demonstrated a preference of grasshoppers for introduced host plants → grasshoppers may potentially suppress invasive plant populations
- There was no tendency for native host plants to be among least preferred
- About 50% of preferred introduced plants have a middle or high invasive rank

Methodological recommendations:

- Using a combination of choice and no-choice feeding trials
- Using grasshopper activity measurements in feeding trials
- Using standardized measurements of grasshopper feeding preferences

Suggested future directions:

- Acridid grasshoppers as a study object in plant invasion ecology
- Combined effect of the plant origin and other factors on grasshopper feeding choice
- Time since introduction and plant resistance

References and Acknowledgments

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