Meta-analysis reveals intraspecific variation in herbivores for plant-mediated interactions


Link to publication

Citation for published version (APA):
Meta-analysis reveals intraspecific variation for plant-mediated interactions in herbivores

INTRODUCTION

When herbivores attack a plant, they induce changes in plant traits, which affect other herbivores on the same plant. Such ‘plant-mediated interactions’ among herbivores are important drivers of community dynamics (Sham et al. 2014).

Selection among herbivores can produce intraspecific variation for plant-mediated interactions with other herbivores. However, few studies assess this variability. What we did here, using plant-mediated interactions between two spider mite species on tomato host plants. We ask:

I. What extent do the spider mites Tetranychus evansi and Tetranychus urticae affect the performance of other spider mites through plant-mediated effects?

II. What factors contribute to variation in the strength of the interaction?

STUDY SYSTEM & EXPERIMENTS

Step 1: Infest with T. evansi, T. urticae or no mites for 2 - 7 days
Step 2: remove mites, eggs and web with a fine brush
Step 3: cut leaf discs from damaged tissue, place new adult females on each leaf disc individually, and assess oviposition rate over 2 - 5 days

Materials & Methods

We found 38 datasets where intact tomato plants were infested with either T. evansi or T. urticae (Step 1), and oviposition rates of other T. evansi or T. urticae populations were measured on the same leaflet (Step 3). For each dataset we calculated the standardized mean difference in oviposition rates per plant of adult females between:

A. T. evansi-infested plants and clean control plants
B. T. urticae-infested plants and clean control plants

We used these effect sizes (std mean difference) as input for random-effects meta-analysis.

RESULTS

T. evansi had positive effects on the performance of other mites, and T. urticae affected them negatively. Both interactions showed strong variability.

A. T. evansi-infested plants vs. clean control plants

B. T. urticae-infested plants vs. clean control plants

Discussion

The reduction in effect size over time can be explained by loss of function due to selection against plant defense induction and suppression in lab cultures, or due to mutation accumulation as a result of random genetic processes.

This case of ‘inadvertent selection’ in lab cultures demonstrates intraspecific variation in herbivores for plant-mediated effects on other herbivores, and suggests a change in heritable variation for these interactions over time.

Summary

Plant-mediated interactions among herbivores are important drivers of community dynamics, but we lack insight into variation among herbivores for these interactions.

A meta-analysis of datasets investigating plant-mediated interactions between herbivorous Tetranychus urticae and Tetranychus evansi spider mites infesting Solanum lycopersicum tomato plants showed that T. urticae had negative effects on the performance of other spider mite populations, whereas T. evansi affected them positively.

In both interactions effect sizes varied strongly, with 18 - 29% variation explained by the time populations had been cultured. Long lab culturing produced smaller effect sizes.

Literature cited


This case of ‘inadvertent selection’ in lab cultures demonstrates intraspecific variation in herbivores for plant-mediated effects on other herbivores, and suggests a change in heritable variation for these interactions over time.

Effect size decreased as populations had been cultured in the lab for longer periods, explaining 18 - 29% of the variation among datasets. The remaining variation was not explained.

Effect size decreased as populations had been cultured in the lab for longer periods, explaining 18 - 29% of the variation among datasets. The remaining variation was not explained.

A. T. evansi-infested plants vs. controls

B. T. urticae-infested plants vs. controls

Effect size (standardized mean difference)

Time in culture (estimated number of generations)

Solid lines indicate model predictions, shaded areas delineate 95% confidence intervals, and circles indicate observed effect size estimates.

Step 2: remove mites, eggs and web with a fine brush
Step 3: cut leaf discs from damaged tissue, place new adult females on each leaf disc individually, and assess oviposition rate over 2 - 5 days

Materials & Methods

We found 38 datasets where intact tomato plants were infested with either T. evansi or T. urticae (Step 1), and oviposition rates of other T. evansi or T. urticae populations were measured on the same leaflet (Step 3). For each dataset we calculated the standardized mean difference in oviposition rates per plant of adult females between:

A. T. evansi-infested plants and clean control plants
B. T. urticae-infested plants and clean control plants

We used these effect sizes (std mean difference) as input for random-effects meta-analysis.

Effect size decreased as populations had been cultured in the lab for longer periods, explaining 18 - 29% of the variation among datasets. The remaining variation was not explained.

A. T. evansi-infested plants vs. controls

B. T. urticae-infested plants vs. controls

Effect size (standardized mean difference)

Time in culture (estimated number of generations)

Solid lines indicate model predictions, shaded areas delineate 95% confidence intervals, and circles indicate observed effect size estimates.

Discussion

The reduction in effect size over time can be explained by loss of function due to selection against plant defense induction and suppression in lab cultures, or due to mutation accumulation as a result of random genetic processes.

This case of ‘inadvertent selection’ in lab cultures demonstrates intraspecific variation in herbivores for plant-mediated effects on other herbivores, and suggests a change in heritable variation for these interactions over time.

Effect size decreased as populations had been cultured in the lab for longer periods, explaining 18 - 29% of the variation among datasets. The remaining variation was not explained.

A. T. evansi-infested plants vs. controls

B. T. urticae-infested plants vs. controls

Effect size (standardized mean difference)

Time in culture (estimated number of generations)

Solid lines indicate model predictions, shaded areas delineate 95% confidence intervals, and circles indicate observed effect size estimates.