Assessing the role of *Yucca* seed saponin content in pollinator moth specialization

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Introduction

What causes two codependent species to diversify into many codependent species pairs? Yucca moths and yucca plants are obligate partners. Female moths lay eggs into yucca flowers' pistils and then actively pollinate the flowers to ensure there are seeds for the larvae to feed on (Figure 1). The yucca gets fertilized and only loses a small portion of its seeds.

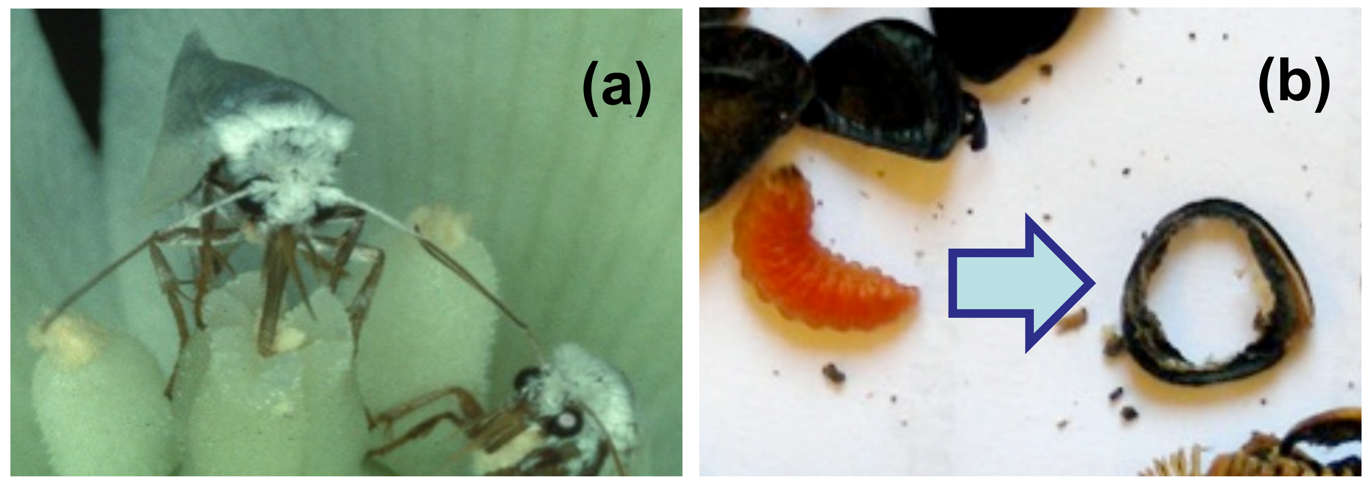

Figure 1. (a) Yucca moths pollinating and laying eggs. (b) A larva and the hole it left behind in the seed.

Yucca moth species are extremely specialized to one or a few yucca host species. A recent study suggests the inability of larvae to develop on seeds of non-natal hosts may be more important than pollination ability in determining diversification.[1] Because yucca seeds contain a large percentage of saponins that have anti-herbivore properties,[2,3,4] I compared saponin content among many yucca species to determine its relationship to host specialization by the moths.

Methods

Using a published protocol[5], I extracted saponins from 15 individual plants from a population of *Y. pallida* and 3 samples from 13 other *Yucca* species (Figure 2).[5] The saponins were measured as a percentage of total dry seed mass and compared within a population, among species, and among phylogenetic groups.[6] ANOVA and Mann-Whitney *U* tests were used to analyze the data before and after arcsine transformation of percentages.

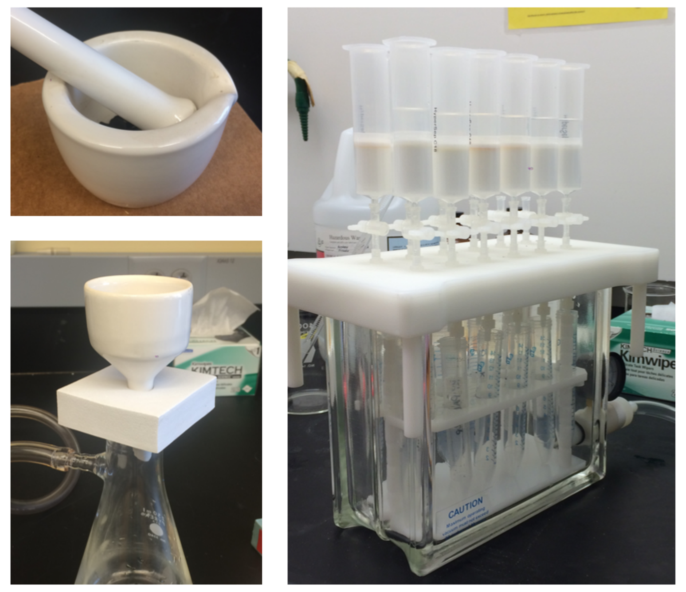

Figure 2. Procedure involves grinding seeds and multiple washes with ethanol, methanol, and hexane.

Purpose

1. **Are there differences in saponin content among *Yucca* species?**
2. **Do the differences have a strong phylogenetic component?**

Results

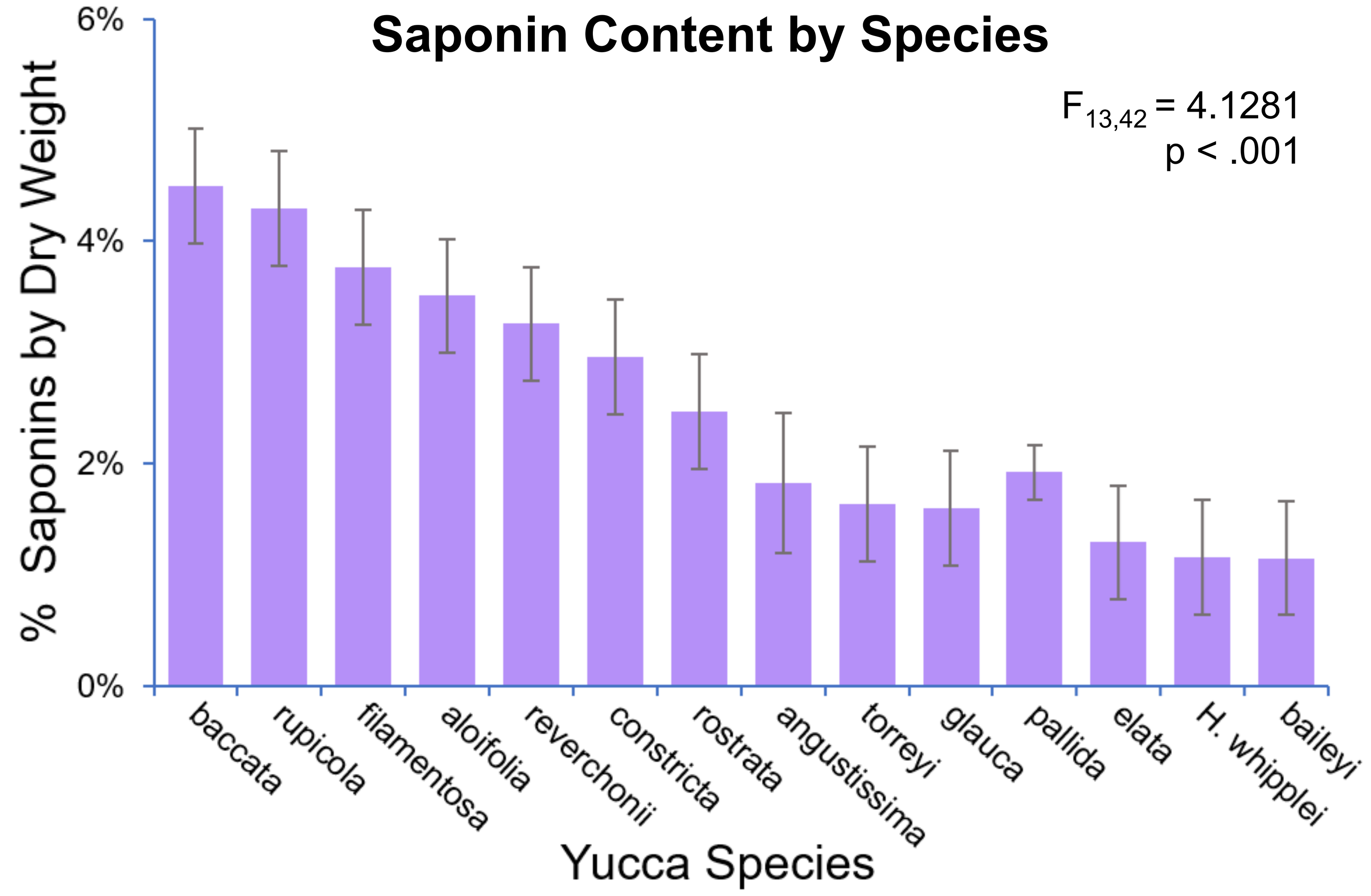

Figure 3. Average saponin content of seeds among *Yucca* species.

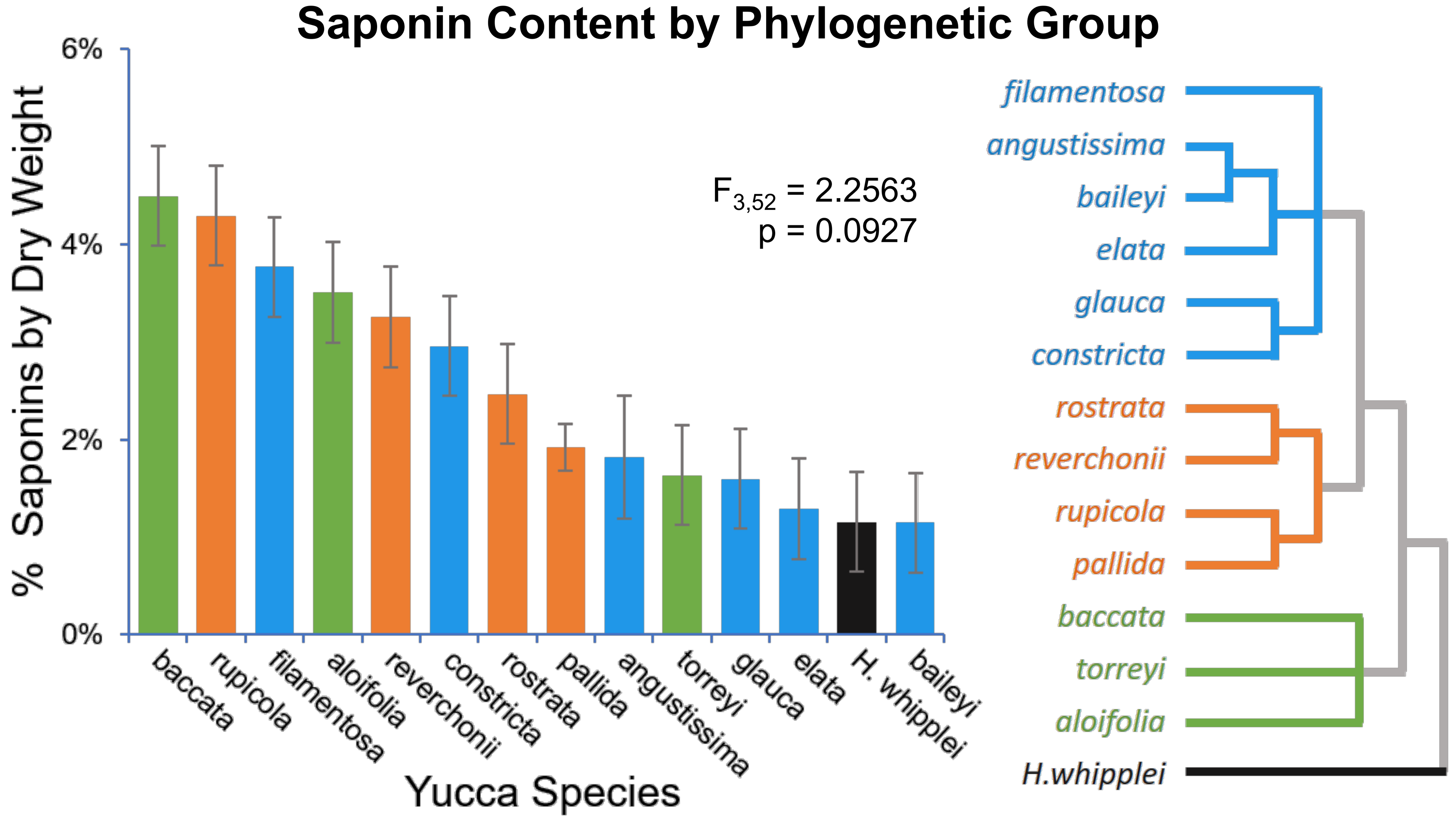

Figure 4. Comparisons among phylogenetic groups. Bars with the same color represent phylogenetic relatedness based on the depicted phylogeny.

Conclusions

1. Within a species, saponin content was fairly consistent. There was significant variation in saponin content among species, with more than a fourfold difference between the extremes.
2. Closely related species do not have similar levels of saponin content and there was no pattern with respect to phylogenetic relationships.

In a previous study,[1] *T. yuccasella* (a species of yucca moth) on *Y. filamentosa,* was unable to survive as larvae in *Y. pallida* despite the plant being a host for the moth species in another geographic area. *Yucca filamentosa* contained twofold more saponins than *Y. pallida*, suggesting that content may not be important.

- ❖ Saponin composition rather than overall content may be more important. Analysis of the saponins in each species is the next step.
- ❖ Larval survival may be tested directly by transferring species of larvae onto seed stacks of different *Yucca* species.

References

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