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Success of sexual reproduction in a specialized nursery pollination mutualism

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Success of sexual reproduction in a specialized nursery pollination mutualism

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Introduction

- We studied the yucca-yucca moth pollination mutualism that evolved 40 MYA.
- It is a nursery pollination mutualism where host plants depend on their specialized nursery pollinator for seed production, which is the host plant's measure of fitness.
- Nursery pollinators lay eggs in the flowers they pollinate, and the pollinator's larvae depend on the produced seeds for food.
- Some yucca moth species lay eggs in developing fruits and do not pollinate flowers. Non-pollinating yucca moth's larvae also depend on yucca seeds for food.
- This system has other seed-eating larvae that reduce seeds that are important for the fitness of both host plants and pollinator larvae.

Methods

- We collected 58 full-grown fruit pods from 6 yucca flowering stalks in July 2014 at the Kingsley Dam, Lake Ogallala, Keith County, NE.
- We counted yucca moth larvae, and other seed-eating larvae emerging from fruits. Yucca moth larvae from pollinating and non-pollinating yucca moths could not be distinguished. Therefore, the number of yucca moth larvae is an overestimate of the pollinator's larvae.
- We measured the length of the fruit from the base to the tip of the remnant style as a measure of fruit size.
- We also quantified the number of total, fertile black, infertile white, damaged by larvae, and intact seeds in each fruit.
- We used Generalized Linear Mixed-Effects models with Poisson distribution, and inflorescence identity as a random effect. Fixed effects were number of yucca moth larvae, number of other seed-eating larvae and fruit length.

Results

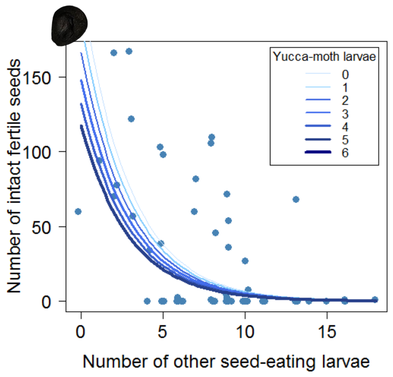


Figure 1.
Increase in number of yucca moth and other seed-eating larvae significantly decreased number of intact fertile seeds. (p-values of slopes <0.0001)

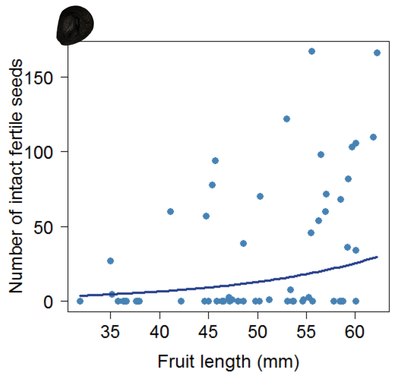


Figure 2.
Larger fruits had higher number of intact fertile seeds. (p-value of slope <0.0001)

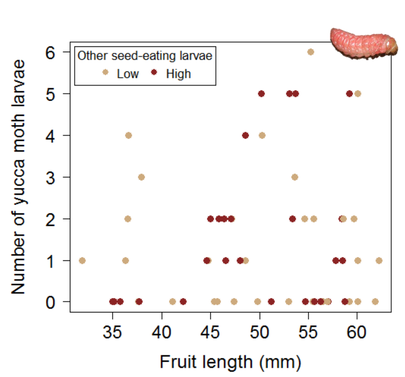
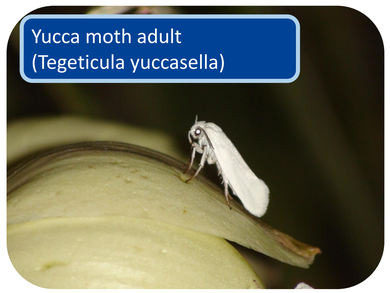
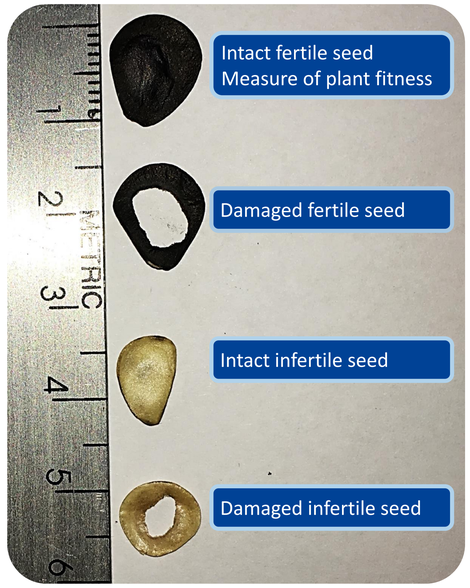


Figure 3.
Fruit size and other seed-eating larvae did not explain the number of yucca moth larvae emerging from fruits. (p-values of slopes >0.8)

Hypotheses

1. Number of fertile intact seeds will decrease with increase in pollinating and other seed-eating larvae because larvae predate on seeds.
2. Plants will invest higher resources in fruits with higher fertile intact seeds because growing larger seeds will increase the seed's probability of survival.
3. Higher number of yucca moth larvae will emerge from fruits with larger fruit size and fewer other seed-eating larvae because yucca moth larvae will have higher number of seeds to eat and less competition.





Conclusion

- Results support hypotheses for host plant fitness (Hypotheses 1 & 2).
- Seed predation by larvae decrease host plant fitness.
- The short distance between lines in Figure 1 indicate that yucca moth larvae are a lower cost to host plant fitness than other seed-eating larvae.
- Plants allocate higher resources to fruits with higher seeds.
- Hypothesis 3 is not supported by our results because pollinators may have evolved to lay fewer eggs per flower to minimize resource limitation and competition with other larvae.

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