Effects of floral traits and plant genetic composition on pollinator behavior

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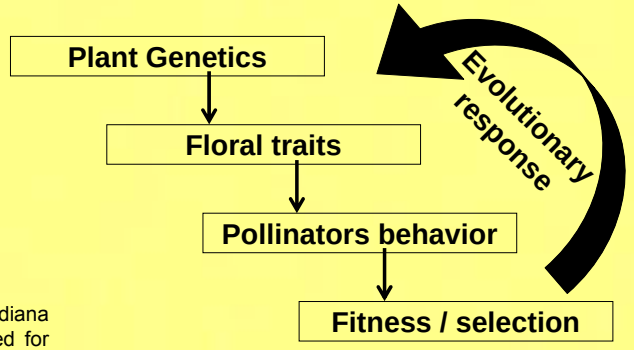

Figure 1 – Conceptual framework for studying indirect effect of plant genetics on pollinators behavior and floral evolution.

Introduction

Pollinator preferences are shaped by a suite of co-adapted floral traits. The genetic basis of a floral trait and its variation has an important role in understanding pollinator-mediated selection and the evolutionary response of that trait to selection. Surprisingly, studies integrating plant genetics with pollinator behavior have been rare in pollination ecology.

In this study we used recombinant inbred lines (RILs) of the common sunflower, *Helianthus annuus* L. and its conspecific crop relative, to test the indirect effect of plant genetics underlying floral traits on pollinator behavior.

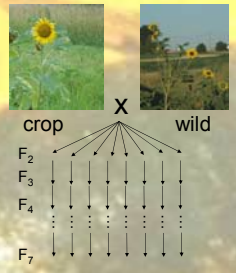

Figure 2 – Development of crop x wild sunflowers recombinant inbred lines (RILs) used in this study.

Methods

149 RILs were planted in 2005 at Indiana University. Morphological traits were scored for the primary flowering head and insect visitors were observed in 10-minute intervals. All achenes (seeds) of the primary flowering head were counted. Genetic composition of floral traits was scored by summarizing the weighted effect of floral traits QTL (from Baack et al., 2008. Mol. Ecol.). Path analysis and structural equation modeling were used to explore the direct and indirect effects of floral traits QTL on pollinator behavior and seed-set.

Figure 3 – Phenotypic variation of crop x wild RILs.

Results

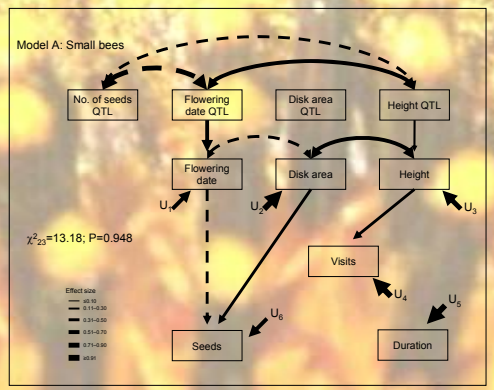

Figure 4 – Path model for the effect of QTL and floral traits on seed set and pollinators behavior (**Model A**) for small bees.

Table 1 – Structural equation modeling results for two models with six visitor types. Hypothetical models that do not deviate significantly from the observed covariance matrix are in bold. **Model A**: Full model (QTL→ floral traits→ pollinators behavior → fitness); **Model B**: Nested model without fitness (QTL→ floral traits→ pollinators behavior)

Model	Visitor type	χ^2	DF	Sig.
A	Large bees	44.91	23	P=0.004
	Medium-size bees	55.86	23	P<0.001
	Small bees	**13.18**	**23**	**P=0.948**
	Halictus spp.	56.87	23	P<0.001
	Non-bee insects	**30.65**	**23**	**P=0.132**
	Beetles	48.35	23	P=0.002
B	Large bees	25.76	14	P=0.028
	Medium-size bees	41.00	14	P<0.001
	Small bees	**5.28**	**14**	**P=0.971**
	Halictus spp.	36.13	14	P<0.001
	Non-bee insects	**17.10**	**14**	**P=0.251**
	Beetles	35.63	14	P=0.001

Main results and Conclusions

For two pollinator types, namely, small bees and non-bee insects, the genetic composition of the plant affected their behavior through floral traits. For the other pollinator types, we found an indirect path of that effect, although the full model connecting plant genetics with pollinator behavior and fitness was not validated by structural equation model analysis. Fitness was not affected by pollinator behavior in any of the models. Nested models without fitness showed similar results.

Overall, we found support for the hypothesis of an indirect effect of plant genetic composition on pollinator behavior. Nonetheless, this effect was different among different types of visitors, and no evolutionary response (in terms of fitness) could be identified. Future approaches will explicitly model linkage/pleiotropy for floral traits and its effect on pollinator behavior and fitness.

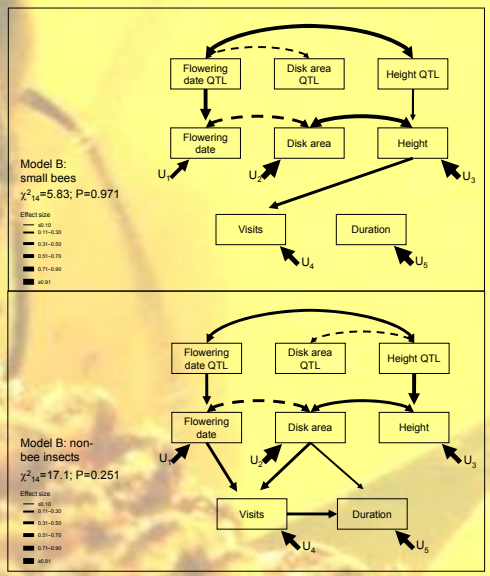

Figure 5 – Path model for the effect of QTL and floral traits on pollinators behavior (**Model B**) for small bees and non-bee insects.

Acknowledgements

A. Richardson, S. Barnes, N. Jones and J. Williams helped in field and lab work, J. Fox, R. Irwin, N. Lazar and R. Mitchell provided valuable comments and/or advised with the statistical analyses. The work was done in the lab of L. Rieseberg at Indiana University. Y. S. was supported by a BARD-Vaadia post-doctoral fellowship.