ABSTRACT

RAPID ADAPTATION OF FLORAL PHENOTYPES IN WEEDY RADISH,

R.R. RAPHANISTRUM

By

Amanda Charbonneau

Agricultural weeds cause billions of dollars' worth of damage worldwide as well as reducing yields, however we often know very little about where they came from, or how they adapt to farming techniques. Agricultural fields are human created environments quite unlike anything in nature and are relatively harsh environments that can exert strong selective pressures. Yearly tilling, for example, likely selects for plants that both quickly reproduce, and can survive in disturbed soils. While some plants with generalist phenotypes might be well suited for thriving in these conditions, others, like Raphanus raphanistrum ssp. raphanistrum (weedy radish), have likely evolved to become weeds. To better understand how these agricultural weeds evolve, I have phenotypically and genotypically characterized weedy R.r. raphanistrum and it's close relatives.

In chapters one and two, I show that weedy R.r. raphanistrum is most closely related to native populations of R.r. raphanistrum, but that these two ecotypes have very different flowering phenotypes. Weedy R.r. raphanistrum flowers in approximately thirty days, while the native plants take fifty to one hundred and fifty days to flower. This demonstrates a likely adaptation to agriculture, and in chapter two I find several loci that may contribute to these phenotypic differences. In chapter three, I analyze differential expression patterns in two selection lines derived from weedy R.r. raphanistrum, to determine genes that underlie differences in floral morphology. These genes should contribute to differences in anther exsertion, which in turn controls how pollen is dispersed onto pollinators.

Together, these studies answer basic questions about how evolution works on a short time scale and provide insights into the adaptations of one of the world's most damaging agricultural weeds. More broadly, these studies demonstrate that weedy radish is a good system for studying rapid evolution in response to both natural and artificial selection and lay the groundwork for

future work. In particular, chapters one and two will be useful for broad comparisons across agricultural weeds to determine whether weeds use similar strategies for invading croplands, which would tell us not only about the repeatability of evolution, but also be potentially useful in reducing agricultural losses due to weeds.