CROP-WILD HYBRIDIZATION AND THE RATE OF EVOLUTION IN WEEDS. Lesley. G. Campbell, Allison A. Snow, and Patricia M. Sweeney, Post-doctoral fellow, Department of Plant Sciences and Landscape Architecture, University of Maryland, College Park, MD, 20742,
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When species hybridize their offspring routinely suffer from reduced fertility and poorly adapted phenotypes. Consequently, it seems unlikely that these plants could be successful weeds. Reflecting this belief, risk assessments of crop-wild hybrids often dismiss the potential for crop gene flow to produce 'superweeds'. However, in the absence of empirical evidence, the evolutionary potential of early-generation hybrids remains hypothetical. Here, we explore the potential for *rapid* evolution in crop-weed hybrids and its consequences for crop allele introgression. Using hybrids of a cosmopolitan weed (*Raphanus raphanistrum*) and its cultivated relative (*R. sativus*), we compared the ability of hybrid and wild lineages to respond to artificial selection for early flowering and large size at reproduction, two life-history strategies which characterize weedy species. *Raphanus raphanistrum* grows a rosette with a thin, fibrous taproot, bolts within a few weeks after germination and produces yellow flowers soon after. On the other hand, crop breeding has emphasized delayed bolting with white flowers in *R. sativus* in order to produce the edible, enlarged roots (Snow and Campbell, 2005). Early flowering may be adaptive for weedy radishes because growing seasons for weeds are often curtailed by tilling schedules, herbivores, frost, and other causes of mortality or severe stress. The evolutionary potential to evolve earlier flowering may be more important for hybrid radishes given that hybrid fecundity, relative to wilds, may be limited by delayed flowering, a trait inherited from their cultivated parent and by low pollen fertility due to a reciprocal translocation that affects chromosome pairing (Snow et al. 2001; Campbell and Snow, in prep.). When hybridization occurs between species with such diverse life histories, the individual offspring will be phenotypically variable. Populations created with this initial diversity should have the opportunity to evolve along diverse trajectories with respect to life history. If crop-wild hybrids can evolve quickly from maladaptive intermediates to adaptive phenotypes, they may be more difficult to control. Large size in annual weeds is often correlated with rapid growth rates. In weedy radish, leaf length is correlated with high flower and seed production, suggesting that plants with rapid growth rates would also be highly fecund. If large size is adaptive, this may facilitate the introgression of additional adaptive quantitative traits into weed populations.

In wild and hybrid lineages, four generations of selection were performed to determine whether these traits exhibited a response to selection (i.e., were heritable) and the relative magnitude of their response across wild and hybrid lineages. Hybrid lineages exhibited a greater response to selection for early flowering suggesting its heritability is greater in hybrid lineages versus wild lineages. Early-generation hybrids had longer leaves than wild plants and they maintained this length difference after selection for longer leaves. This suggests that polygenic traits, such as size, inherited from domestic relatives may easily introgress into weed populations. Four generations of selection also resulted in the correlated evolution of hybrid flower petal color and hybrid pollen fertility. Large hybrid lineages exhibited higher than expected frequencies of plants with white petals, a crop-specific, simply inherited trait. Therefore, selection for a polygenic crop-specific trait accelerated the introgression of an additional crop-specific trait. Further, pollen fertility of early-flowering hybrid lineages was similar to that of wild lineages, and at least 12% higher than hybrid control lineages. Therefore, selection for earlier flowering in hybrid lineages led to rapid evolution of fertility, a key component limiting hybrid fitness. Despite selection for the early-flowering, wild phenotype, hybrid lineages maintained high frequencies of the crop-derived trait, white flower color, confirming persistent introgression. The persistence of

white flower color and increase in pollen fertility after experimental manipulation of the selection environment may explain some results from our long-term studies in crop allele introgression (Snow et al., in prep; Campbell et al., 2006)

Both wild and hybrid lineages apparently possess substantial additive genetic variation for size at reproduction. Nevertheless, hybrid lineages evolved more rapidly under selection for age at reproduction and exhibited more extreme phenotypes under selection for large size at reproduction than their weedy parents. We suggest that hybrids have the potential to rapidly respond to newly invaded environments and may become more invasive weeds than their wild progenitors.

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