Conservation biological control in IPM systems: simplicity vs. complexity

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Preserves or refuges have long been used to maintain fauna and flora that could not exist otherwise. Recent interest among U.S. urban centers to promote wildlife, especially migratory waterfowl, has resulted in an upsurge in wetland restoration projects across the nation. Conservation biological control has a similar goal: the promotion of arthropods that benefit the biological control of serious agricultural pests. Although this practice existed over 1700 years ago in China, only recently has western culture placed value in this approach. Modern agriculture has done much to greatly simplify its environment and the process of controlling pest problems. Landscapes that were formerly a patchwork of farms, forests, and hedges have been replaced by vast monocultures. The replanting of annual crops in such areas disrupts populations of beneficial organisms in these fields. Although Integrated Pest Management was a response to single tactic insect control, short-term economic gain often dictates reliance on bouquets of pesticides rather than a combination of biological, cultural and insecticide control.

Conservation biological control often involves use of non-crop plants to promote or harbor natural enemies (Pickett & Bugg 1998, Landis et al. 2000). We believe one of the major limitations to understanding how natural enemies are affected by non-crop vegetation is knowing how they move or disperse within their environment: how different mixes of vegetation affect their movement between crops and surrounding vegetation. Recent advances in insect marking techniques have created new opportunities for studying insect movement. We were interested in learning if a natural enemy refuge, adjacent to field crops, could improve the biological control of silverleaf whitefly, a serious pest in the desert agricultural growing region of southern California. We marked indigenous parasitoids of silverleaf whitefly using the naturally occurring element, rubidium and studied how they moved from an overwintering refuge into small plots of either cantaloupe or cotton (Pickett et al., in prep.). Two questions were addressed: 1) will the aphelinids (Hymenoptera) *Eretmocerus eremicus* and *Encarsia* spp. move from strips of non-crop plants into an adjacent field of cantaloupe and cotton and 2) how much does the non-crop refuge contribute to the early season populations of whitefly parasitoids? Natural enemy refuges consisted of collards and sunflower. The location and proportion of trapped, marked parasitoids demonstrated that the refuges increased the numbers of *Eretmocerus eremicus* and *Encarsia spp.* in adjacent crops. Thirty-four to 100% of parasitoids caught in adjacent crops originated from these plants. However, the increased number of parasitoids resulting from the natural enemy refuge failed to increase biological control of silverleaf whitefly. The high number of whiteflies, relative to parasitoids produced in refuges during spring months, likely contributed to ineffective biological control.

Results from this study showed that a large portion of silverleaf whitefly specific parasitoids trapped in small plots of cantaloupe and cotton originated from adjacent refuges of collards and sunflower. However, the same plants produced far more of the pest than the beneficial insect. Other plants with lower affinities for the target pest, or harboring non-pest relatives would make better candidates for refuges.

References

Landis, D. A., Wratten, S. D., and Gurr, G. M. 2000. Habitat management to conserve natural enemies of arthropod pests in agriculture. Ann. Rev. Entomol. 45:175-201.

Pickett, C. H., and Bugg, R. L. (eds.). 1998. Enhancing Biological Control: Habitat Management to Promote Natural Enemies of Agricultural Pests. University of California Press, Berkeley. 422 pp.