# APPENDIX B
# HABITATS FOR BENEFICIAL INSECTS

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Beneficial insects such as predators and parasites are fundamentally important to preventing outbreaks of pest insect populations. Key tenets of insect pest management include:

- sustain natural enemies through the use of habitat manipulation
- avoid pests by using cultural practices
- when necessary, use rescue insecticide treatments or other practices that have minimal effect on beneficial insects to control the pests

Plant diversity in an agricultural setting generally adds stability to a system and helps encourage the presence of beneficial insects. There are different options for providing plant diversity depending on whether the main crops are annuals or perennials. Generally, crop diversity can be achieved in time or space using crop mixtures, crop rotations, border crops or windbreaks, or plants known to be attractive to beneficial insects. Landscape complexity will generally favor populations of beneficial insects while lack of complexity will generally increase insect pest outbreaks. Adding plant complexity to a system can be achieved by providing sites which beneficial insects may use to obtain nectar or pollen, survive on alternative insect pest species, find habitats in which to increase their numbers or as sites in which to overwinter. However, since the interactions in agricultural systems are complex, one also has to be concerned about potential detrimental interactions.

Habitat manipulation to increase biological control requires knowledge about plant biology, potential interactions with other components of the systems such as plant diseases, and a general understanding of the life cycle and habits of the insect pests and their natural enemies. For example, if one tried to encourage the build up of beneficial insects by adding other plants to the system, those same plants may also harbor diseases or host insect pests that could affect the cash crop. Some ecologists caution that the potential benefits of habitat manipulation for natural enemy increase may be outweighed by the potential liabilities, but a better understanding of the components of the particular system should help avoid such situations. Perhaps a good guideline is that rather than trying to incorporate as much diversity into agricultural systems as one sees in natural settings, it may be more appropriate to select a specific tactic that will provide the benefits

sought. For example, if one is interested in encouraging the early buildup of lady bird beetles to feed on pests of sweet corn, planting some corn early may provide a suitable habitat for ladybird beetles that may move to later plantings of corn. Another example would be to incorporate plants that flower for long periods of time and are attractive to natural enemies.

When a pest species feeds on a wide variety of native plants (for example, the tarnished plant bug), it is difficult to manipulate the habitat to encourage natural enemies.

Flowering plants may provide nectar that can increase the life span of a beneficial species and number of eggs it can produce. Such flowering plants can be used as part of the farm's saleable crops as well as provide needed landscape diversification. In choosing which plants to use to add diversity, a good rule of thumb would be to avoid plants in the same family since they may also serve as hosts for insects and diseases of the cash crop. Weeds may also play a significant role in adding plant diversity. Flowering weeds in the families Compositae (daisy), Labiatae (mint), and Umbelliferae (dill, Queen Anne's Lace) are often cited in the literature as being able to support stable populations of natural enemies.

The spatial layout of the planting is also an important consideration and the goal would be to use a spatial scale for planting habitats for beneficial insects that would encourage them to easily find their pest hosts. For example, planting flowers around smaller blocks of the cash crop would likely be more beneficial than to have large blocks of the cash crop planted a distance from the flowers. Likewise, planting "corridors" of the flowers may allow natural enemies to move freely and rapidly between the cash crop and the flowers. Harvesting plants in such a manner to retain populations of natural enemies can be important. Strip planting, rather than planting large blocks at different times, may allow natural enemies to move easily from one planting to another. However, one should also be careful that such practices do not encourage pest populations to also move more readily between plantings.

The vegetation surrounding the crop field is an important refuge and habitat for many beneficials. It is typically not intensively managed and contains a high diversity of plant species. In order for beneficials to readily move into the crops, the distance to the center of crop fields should not be too large. Weeds are also hosts for many species of beneficials. While low levels of weeds can be tolerated for this purpose, clearly the ability of weeds to reduce yields makes this a very limited option.

There are no hard and fast rules that can be provided on how to design the farm landscape to increase populations of natural enemies since each farming operation is different and has different constraints. Some farming operations specialize in only a very few annual crops on a relatively small area while others may have annual and perennial crops grown on widely separated patches of land. The goal is clear for either situation; try to add diversity

in the landscape since that will provide more stability for the natural enemies to provide control of pest insects. Consider the crops you need to grow and then consider how you can add diversity. Experiment and be observant. It would also be advisable to start on a small basis as you work to encourage the buildup of beneficial insects through habitat manipulation.

For more on this subject, see the publications listed below.

Altieri, M. A. and C. I. Nicholls. 2004. Biodiversity and pest management in agroecosystems. Haworth Press

ATTRA 2003. Farmscaping to Enhance Biological Control. http://www.attra.org/attra-pub/farmscape.html

Pickett, C. and R. Bugg, eds. 1998. Enhancing Biological Control. University of California Press.