

# Augmentative Biological Control of Insects: Possibilities for Vegetable Greenhouse Producers

Sylvia I. Rondon, Daniel J. Cantliffe and James Price

The implementation of biological control in Integrated Pest Management (IPM) programs should be considered in a protected crop production environment. Some vegetable crops grown under greenhouse systems are especially suitable for establishment of biological control because they are short term and relatively stable.

## Why Implement Biological Control in Greenhouse Systems?

In the greenhouse, the environment can be manipulated to enhance biological control and organisms can be introduced and maintained to provide adequate pest control (Jarvis 1997). The biological control approach now is practiced worldwide and is increasingly accepted by the greenhouse industry (Resh 1995). Biological control is complemented with the use of pest resistance plants, and cultural and mechanical tactics. The overall objective is to maintain pests below an economic injury level, which will minimize the economic losses. If pests cannot be controlled with biological, cultural and mechanical tactics, chemical control should be taken into consideration. Since vegetables are minor use crops, the need for non-pesticidal pest control is significant (Hoffmann and Frodsham 1993). Vegetables grown under greenhouse production are ideal targets for implementing biological control.

Much research has been performed regarding the implementation of IPM with emphasis in biological control for protected cropping systems (International Organization of Biological Control 2002). This work has included studies on whiteflies, thrips, mites, aphids, and other noxious greenhouse pests. Further research is still needed.

## Biological Control as a Suitable Alternative

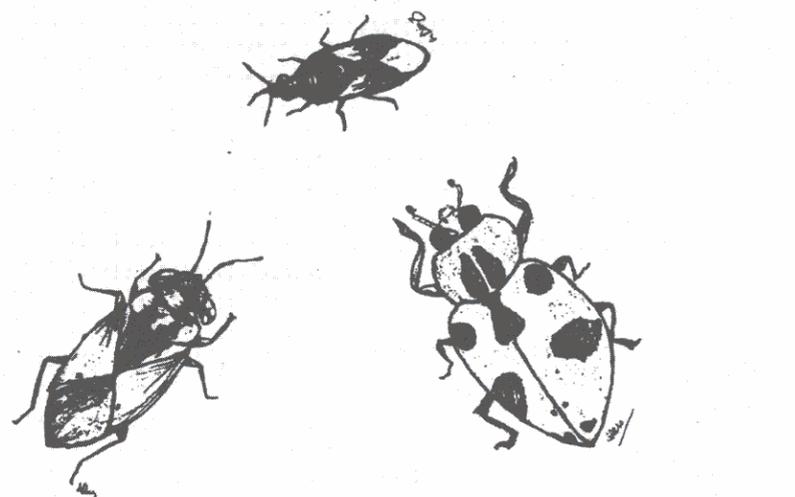
Biological control, the use of one organism to control another, is an effective way to reduce pest populations. The control agent might be a parasitoid, predator or microbial disease organism, which will attack the pest. When natural enemies are absent, or in a small number, releases of reared natural enemies should be made (Van Driesche and Bellows 1996). Insectaries sell these biological agents (<http://www.anbp.org/a-suppliers.htm>) and are currently available to the public. Beneficials include tiny wasps, lacewings, lady beetles, predatory mites, and others, which are

useful for pest control in a wide variety of crops including vegetables (Figure 1). These beneficial insects can be readily purchased and used (<http://www.hos.ufl.edu/protectedag/>). Success requires appropriate timing and the release of the correct number of beneficials per unit area. This rate will vary according to crop type, density of the pest on the crop (Hoffman and Frodsham 1993), and indirectly, performance of the beneficial.

The advantages of using biological control are that: 1) the beneficial organisms are not harmful to the environment, 2) in the long term it may be less expensive than pesticides, 3) it is effective if initiated early in the season based on scouting results, and 4) pests do not develop resistance against beneficials (Van Driesche and Bellows 1996). Despite these benefits, there are some negative aspects of biological control: 1) biological control does not completely eliminate pests, and some level of presence of the pest is necessary in order to sustain the beneficial population. In this situation, some damage may be observed. 2) Sometimes biological control can be more costly compared to the pesticidal option, 3) general knowledge of the behavior of the pest and the beneficial is needed, and 4) control sometimes is not as rapid as with a conventional pesticide.

Insecticidal soaps, insect growth regulators, and microbial insecticides are being used to control greenhouse pests, and they deliver some degree of safety for beneficials (Van

Figure 1. Some of the beneficials used in biological control (Graphics by Alex Diaz).



*Geocoris punctipes* (Say).

*Orius insidiosus* L.

*Coleomegilla maculata* DeGeer

Driesche and Bellows 1996). Even though the concept of biological control is not new, there are still some steps that need to be identified to successfully implement long-term control successfully.

#### Augmentative Biological Control of Insects

There are some steps that should be followed in order to

## Methods of Insect and Mites Control.

### Scouting and Monitoring

#### Cultural

- Resistance Varieties
- Pruning and Thinning
- Adequate Fertilization
- Sanitation
- Water Management

#### Physical

- Control of
  - Heat
  - Cold
  - Humidity
  - Light Regulation

#### Mechanical

- Exclusion (screens)
- Hand Destruction

#### Biological Control

- Habitat Manipulation
- Artificial Introduction

#### Chemical

- Insecticides and Miticides compatible with beneficials
- Growth Inhibitor

include biological control into a vegetable greenhouse management program (Figure 2). These steps will encourage the establishment of specific beneficials selected. Scouting and monitoring are key tools to be considered. The information developed will determine the appropriate time of release and the quantity of beneficials that to be used.

There are different approaches on how to use beneficials based on the objective of a program and the pest species to be managed. A greenhouse situation requires a cost effective rearing method and rigorous quality control (Hoy 1994), since natural populations are not dependable. Conservation biological control (the identification of factors that limit the success of a natural enemy and the modification of those factors to make the beneficials more efficient) and augmentative biological control (a method of increasing the population of natural enemies by mass rearing the beneficials and releasing them at the right time) are methods that can be implemented in a greenhouse system. These approaches provide immediate or delayed impacts on pest populations. There are some examples of successful augmentative biological control in greenhouse production of tomatoes and cucumbers through the periodic release of *Encarsia formosa* parasitoids *Phytoseiulus persimilis* predaceous mites, which control the greenhouse whitefly and the twospotted spider mite, respectively.

In a complete biological control program, tactics range from the use of chemicals that are the least detrimental to beneficials, to the release of beneficials as "biological insecticides". All these methods, as part of an IPM program will require biological and ecological information to be successful. Results from the latest research should encourage greenhouse growers and the private sector to support biological control as an alternative pest management system.

#### Literature Cited

Hoffmann, M.P., and A.C. Frodsham. 1993. *Natural Enemies of Vegetables Insect Pests*. Department of Entomology, Cornell University, Ithaca, NY. Cornell Cooperative Extension Publication. Pp. 63.

Hoy, M A. 1994. Parasitoids and Predators in Management of Arthropods Pests. In *Introduction to Integrated Pest Management*. (ed.) Metcalf, R.L. and W.H. Luckmann. 3rd edition. John Wiley and Sons Inc. Pp. 129-198.

International Organization of Biological Control. 2002. *Abstracts and Proceedings of the Working Group Meeting: Greenhouse, Nursery and Ornamental Landscape IPM Working Group*. Victoria, British Columbia, Canada.

Jarvis, W.R. 1997. *Managing Diseases in Greenhouse Crops*. American Phytopathological Society, St. Paul, Minnesota. Pp. 288.

Resh, H.M. 1995. *Plant Culture*. In *Hydroponic Food Production: a Definitive Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Grower*. 5th edition. Woodbridge Press Publishing Company. Pp. 429-479.

Van Driesche, R.G., and T.S. Bellows. 1996. *Biological Control*. Chapman and Hall. An International Publishing Company. Pp. 539.

Figure 2: