# Implementation of Integrated Pest Management in California Bedding and Container Color Plant Production

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## INTRODUCTION

Bedding and container color plant production in greenhouses is an important and growing component of California's ornamental horticulture industry. Production of these plants is rapid with a typical eight to ten week crop cycle. Most growers make their profits from quick turnover of large numbers of plants, which results in low tolerance for pest injury and a perception that the generally slower biological control options that are available are not appropriate. It is not unusual for there to be one to three pesticide applications made weekly during the entire crop cycle. As a result there has been little IPM adoption in this commodity.

Recently water quality and supply have moved to the forefront of critical issues in California agriculture; this will necessitate a move to production systems that use less water and preserve water quality. Most bedding and container color growers use overhead irrigation that is based on a schedule, rather than on plant hydration status. This is wasteful, expensive, and creates conditions favorable to pest development (Fig. 1). Some growers also capture runoff for reuse, and this recycled water is a source of pathogens.

Although greenhouse growers are using increasing amounts of reduced-risk pesticides, there is still considerable use of 'older' materials such as diazinon, chlorpyrifos, acephate, and malathion (Fig. 2). These materials can be significant urban waterway pollutants and reducing their use is a California Department of Pesticide Regulation priority. In addition, the majority of fungicide use by this industry is of materials at high risk for resistance (Fig. 3).

To address these issues we have formed a Bedding and Container Color IPM Alliance with major funding from the CA Department of Pesticide Regulation and the USDA Nursery and Floriculture Research Initiative. Despite the challenges of a large number of key pests, rapid plant turnover, and limited tolerance for plant damage, many of the tools for IPM adoption by this industry exist. The job of this Alliance will be to show growers how to put together what is already there, along with a few novel tools, into an effective IPM program.

## GOALS

This project runs from October 2009 to May 2012 and has two goals:

***Goal 1:*** achieve a 30 percent reduction in the number of pesticide applications in the collaborating greenhouses (compared to pesticide use in the prior year).

***Goal 2:*** have fewer than 15 percent of all insect and mite control applications at collaborating greenhouses be organophosphates, pyrethroids, or carbamates at the end of the project. These classes currently comprise 31 percent of all arthropod control applications in CA greenhouse container production (CA Department of Pesticide Regulation, 2007 data).

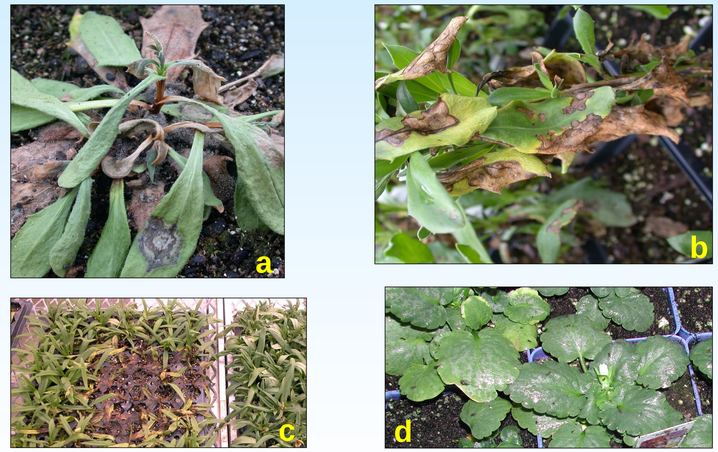



**Figure 1. Many bedding plant pests are exacerbated by excessive irrigation.** These include the fungal leaf blights botrytis (a) and anthracnose (b) as well as root rots (c). Incorrect water use can also favor moisture-loving insect pests such as fungus gnats (d). Photos a,b,c by B. Whipker.

| *Active ingredient (ai)* | *Total no. of applications of this ai* | *Percent of all applications for insects and mites* | *Key pests targeted* | *IRAC[1] mode-of-action group* |
|---|---|---|---|---|
| Abamectin | 2742 | 13.10 | Mites, thrips | 6 |
| Imidacloprid | 1384 | 6.61 | Aphids, whiteflies | 4A |
| Acephate | 1265 | 6.04 | All insects | 1B |
| Spinosad | 1236 | 5.90 | Thrips | 5 |
| Dinotefuran | 1049 | 5.01 | Aphids, whiteflies, fungus gnats | 4A |
| Fluvalinate | 1034 | 4.94 | All insects, mites | 3 |
| Bifenthrin | 1012 | 4.83 | All insects, mites | 3 |
| Azadirachtin | 862 | 4.12 | Aphids, thrips | 18B |
| Permethrin | 776 | 3.71 | All insects, mites | 3 |
| Bifenazate | 705 | 3.37 | Mites | 25 |

[1]Insecticide Resistance Action Committee (www.irac-online.org)

**Figure 2. Top ten arthropod control materials used in CA greenhouse potted plant production by number of applications.** The five most used materials (shaded area) represent 37% of all applications for arthropod control. Data from California Department of Pesticide Regulation, 2007.

| *Active ingredient (ai)* | *Total no. of applications of this ai* | *Percent of all applications against plant pathogens* | *Key pests targeted* | *FRAC[1] mode-of-action group* | *FRAC resistance risk* |
|---|---|---|---|---|---|
| Thiophanate-methyl | 2643 | 13.83 | Fungal pathogens and water molds | 1 | High |
| Mefenoxam | 2584 | 13.53 | Pythium, Phytopthora | 4 | High |
| Iprodione | 1691 | 8.85 | Fungal leaf blights | 2 | Medium-high |
| Phosphorus acid | 1499 | 7.85 | Pythium, Phytopthora, downy mildew | n/a | n/a |
| Fosetyl-AL | 1356 | 7.10 | Pythium, Phytopthora, downy mildew | 33 | Low |
| Azoxystrobin | 1074 | 5.62 | Fungal pathogens and water molds | 11 | High |
| Fludioxonil | 912 | 4.77 | Fungal pathogens | 12 | Low-medium |
| Chlorothalonil | 806 | 4.22 | Fungal pathogens | M5 | Low |
| Mancozeb | 728 | 3.81 | Fungal and bacterial leaf blights, downy mildew | M3 | Low |
| Copper sulfate | 673 | 3.52 | Fungal and bacterial leaf blights | M1 | Low |

[1]Fungicide Resistance Action Committee (www.frac.info)

**Figure 3. Top ten pathogen control materials used in CA greenhouse potted plant production by number of applications.** The five most used materials (shaded area), three of which are at high risk for resistance, represent 51% of all applications for pathogen control. Data from California Department of Pesticide Regulation, 2007.

## OBJECTIVES

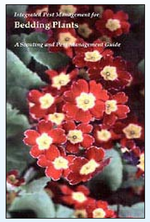
- ***Objective 1.*** Form a collaborative, interdisciplinary IPM team.
- ***Objective 2.*** Enhance pest identification and monitoring skills as well as understanding of pest thresholds and tolerances among collaborating growers.
- ***Objective 3.*** Promote wider use of arthropod biological control through the release of natural enemies and the use of entomopathenogenic bacteria and fungi.
- ***Objective 4.*** Introduce chlorine dioxide, silica, and effective microorganisms (EM Technology®) as novel pest control tactics to the bedding and color plant industry.

## THE IPM PROGRAM

Components of the IPM program include:

- Monitoring for key arthropod pests to facilitate early control. Scouting aids and simplified monitoring procedures will be developed.
- Irrigation based on plant need rather than schedule. This will decrease leaf wetness and reduce water splashing between plants, thereby reducing pathogen spread. This will also reduce excess moisture that can favor fungus gnat development and weed growth.
- Use of a novel water disinfection method, chlorine dioxide, to reduce pathogens in irrigation water. This material has worked well in food agriculture and shows great promise for greenhouse disease control.
- The addition of EM Technology® is expected to improve overall plant health, decrease the need for fungicides and improve post harvest pot life.

## PROJECT RESOURCES




A web site, grower manual, and scouting aids will be produced to assist with IPM implementation. Presentations at grower meetings and papers in trade journals will also report on our progress.

A bedding plant IPM manual produced by the NY State IPM Program is currently available at www.nysipm.cornell.edu/publications/bpguide99

## ACKNOWLEDGEMENTS

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