Mushroom Integrated Pest Management

Handbook
The PA IPM Program is a collaboration between the Pennsylvania Department of Agriculture and The Pennsylvania State University aimed at promoting Integrated Pest Management in both agricultural and nonagricultural settings.

This publication was developed by the PA IPM program with the cooperation of the American Mushroom Institute.
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Introduction

In this handbook we have addressed the most important pest organisms with the potential to reduce mushroom yield and quality. The handbook is intended for growers, as well as researchers, as both an educational tool and a reference manual. Recommendations presented here are not intended to bind growers in their decision-making processes. Rather, they should serve as a guide for developing effective Integrated Pest Management (IPM) programs. Each grower should develop specific operating procedures and checklists specifically tailored for individual use. In addition, as technology is always changing, this handbook will be updated periodically.

The handbook is divided into two parts, covering the theory of IPM and the practical aspects of IPM in mushroom growing. The theory section defines IPM and gives it historical perspective. It also explains the concepts of pest management and types of control, and the importance of understanding pest life cycles and biology. The section on IPM in mushroom growing describes how unique features of mushroom crops can be used effectively in IPM, and how the theory of IPM can be applied effectively.

Mushroom growing lends itself naturally to IPM. It is one of the few forms of agriculture in which the crop is grown inside climate-controlled buildings. This offers two advantages not available to most other crops. First, control of the internal environment of the growing room provides an important weapon against many pests. Temperature and humidity manipulations, for instance, are two of many cultural options available in mushroom pest control with IPM. Second, since the crop is grown indoors, pests can be excluded. This control measure is unavailable to farmers of field crops, who have little control over pest invasion. An effective IPM program takes advantage of these particular characteristics of mushroom growing.

Other features of mushroom production make IPM a necessity, not an option. With production measured in pounds per square foot rather than in bushels or tons per acre, mushroom growing is very dense farming. If a pest gets into a room, it can spread rapidly because of the large amount of food available within a relatively small space. In addition, many pests cannot be controlled using chemical pesticides, either because there are no products labeled for mushroom use, or because materials don’t even exist for a specific type of pest organism. Increased regulations are driving up the cost of producing new pesticides, making it difficult or impossible for chemical manufacturers to invest in a minor-use crop like mushrooms. Usually, we are forced to rely on pesticides developed for other commodities. An IPM program that excludes pests and takes advantage of the ability to manipulate the growing environment not only is a more effective means of pest control but also allows limited dependency on chemical pesticides.

These features make the IPM approach the most effective and economical means of long-term sustainable pest control. Anyone trying to control pests without IPM eventually will end up at the mercy of those arthropods and mushroom diseases. We hope this manual will help you avoid that fate.
I.
Theory of
Integrated
Pest
Management
A. History, Definitions, and the Economic Threshold

Shelby J. Fleischer

Integrated pest management is the [information-based] selection, integration, and implementation of pest control based on predicted economic, ecological and sociological consequences.


Council of Environmental Quality

History, Definitions, and the Economic Threshold

Vernon M. Stern was working for the Westside Alfalfa Pest Control Association in the San Joaquin Valley, California, a big association of growers involving 10,285 acres when it formed in 1945. The association was organized to help decide when to apply insecticides against the alfalfa butterfly.

The alfalfa butterfly was not the most serious pest in alfalfa, but at times it flared up and caused very serious loss. Alfalfa growers had materials like calcium arsenate at their disposal, and they used these materials frequently, but at significant expense and with hard work. The growers formed an association after entomologists showed that a parasitoid controlled the butterfly most of the time, and that growers could make many fewer pesticide applications if they could estimate how well the parasitoid was controlling the butterfly larvae early in the crop growth cycle.

The association hired people to do the fieldwork and calculations and to give advice. The Westside Alfalfa Pest Control Association called this “supervised control.” The system was successful, and soon the Westley Pest Control Association and the Tracy Pest Control Association formed in other parts of California.

These efforts at supervised control declined rapidly when DDT and other new insecticides came into use. By the late 1940s, over 90 percent of acreage was treated with new materials, calcium arsenate fell into disuse, and the Pest Control Associations disappeared. The new materials worked well for less cost, so Vernon M. Stern went to graduate school with Ken Hagen, the first person in charge of the Westside Association, and Robert van den Bosch, who had also been in charge of the Association for a period of time. They worked with Professor Ray F. Smith, who had initially organized the Pest Control Associations.

It was not long before another insect, the spotted alfalfa aphid, came into the San Joaquin Valley, and by 1955 this aphid was resistant to pesticides. Smith and his students (Stern, van den Bosch, and Hagen) imported an exotic parasitoid and studied native predatory insects. Both the parasitoid and the predators were effective when not destroyed by pesticides. They then found insecticide materials and use patterns that were relatively selective, allowing the natural enemies to coexist with the valuable insecticide tools.