# Manage pests as a system

Integrated pest management (IPM) combines approaches to control pests while minimizing environmental disruption. It is a continuing decision process, not a single pesticide or technique.

## 1. PREVENT, OBSERVE, DECIDE AND RECHECK

**Prevent problems**
Make establishment harder

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**Monitor and identify**
Check pests and damage

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**Choose and evaluate**
Act if needed; check results

Prevention can include crop rotation and resistant varieties. Monitoring establishes which organism is present, how abundant it is and whether damage is increasing. Correct identification also helps distinguish pests from beneficial organisms. After a control is used, reassess the field and adjust the plan.

## 2. EXTENSION: A THRESHOLD IS A DECISION TRIGGER

An action threshold marks conditions at which control is warranted; finding one insect does not automatically justify spraying. In crop economics, the economic injury level is where the value of crop loss equals the cost of control. An economic threshold is set earlier, allowing time to act before that injury level is reached. Thresholds depend on the pest, crop and growth stage; there is no universal pest count for every field.

## 3. IPM DOES NOT MEAN ZERO PESTS

The objective is to keep pest damage at an acceptable level while limiting unnecessary harm. Some pests can be tolerated, particularly when natural enemies are suppressing them. IPM does not rule out pesticides: limited, targeted chemical control can be part of a wider program when monitoring indicates a need. Routine calendar spraying without checking pest conditions misses the evidence-based logic of IPM.

Decision process and pesticide use: US EPA, Integrated Pest Management Principles.
Economic injury level: University of Minnesota Extension, Fact-based Aphid Recommendations.
Threshold as an earlier trigger: University of Minnesota Extension, Soybean Pest Management.

Scope: College Board AP Environmental Science CED, Topic 5.14, p. 110.

# Combine complementary controls

The syllabus emphasizes biological and physical controls, with limited chemical use. Crop rotation, intercropping and natural predators are examples of methods that can work together.

## 1. FOUR FAMILIES OF CONTROL

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| CULTURAL | **Change the growing system**<br>Rotate crops over time to interrupt suitable pest life cycles. Intercropping grows different crops together in space; it can make the crop environment less favorable to some pests. |
| BIOLOGICAL | **Use natural enemies**<br>Predators consume pests; parasitoids develop in or on hosts and eventually kill them. Some pathogens infect pests. Conserving beneficial organisms supports biological control. |
| PHYSICAL / MECHANICAL | **Block or remove pests**<br>Screens or other barriers exclude pests. Traps, hand removal and mechanical weeding reduce access or abundance without relying on a chemical toxicant. |
| CHEMICAL | **Use a targeted intervention**<br>When needed, choose an effective, lower-risk pesticide option suited to the identified pest. Limit unnecessary exposure rather than treating every field or organism alike. |

## 2. COMPATIBILITY MATTERS

A broad-spectrum insecticide can kill natural enemies as well as pests, weakening biological control. Select methods that support one another. Reducing pest habitat, conserving predators and using selective treatment when justified is more coherent than adding unrelated controls.

## 3. BIOLOGICAL DOES NOT AUTOMATICALLY MEAN SAFE

Introducing a natural enemy can create non-target effects. Specialist evaluation of host range and ecological risk is important. Conserving useful natural enemies already present is different from casually releasing an unfamiliar species into an ecosystem.

Required methods and examples: College Board, STB-1.C.1 and STB-1.C.2.
Control families: University of California Statewide IPM Program, What Is IPM?
Natural enemies, compatibility and risks: UC IPM, Biological Control and Natural Enemies.

Scope: College Board AP Environmental Science CED, Topic 5.14, p. 110.

# Balance protection, cost and impact

IPM aims to protect useful crops while reducing disruption to the surrounding ecosystem. Success requires monitoring both pest damage and the consequences of the management program.

## 1. BENEFITS: LESS RELIANCE ON PESTICIDES

Using prevention and nonchemical controls can reduce pesticide use and the associated risks to wildlife, water quality and human health. Avoiding unnecessary applications also helps protect beneficial species. These are reductions in risk, not promises of zero exposure or zero environmental impact. A program still needs to control the target pest effectively; simply using fewer chemicals is not enough if severe crop damage continues.

## 2. DRAWBACKS: KNOWLEDGE, TIME AND EXPENSE

IPM can be complex and expensive to establish and manage. Scouting, correct identification, record keeping and coordinating several controls require time and expertise. Results also depend on the crop and local pest conditions. Evaluate the full program cost, including labor and crop losses, rather than assuming that a lower pesticide bill always makes the whole system cheaper.

## 3. ILLUSTRATIVE FIELD DECISIONS

This is a conceptual example, not a treatment recommendation. A grower observes aphids, checks crop damage and records the abundance of natural enemies across representative plants.

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| **Below the threshold** | If pests remain below the relevant action threshold, continue monitoring and prevention rather than automatically spraying. |
| **Control becomes justified** | If monitoring meets the applicable action criteria, select a suitable control while considering harm to natural enemies. |
| **After the intervention** | Resample the field. Compare pest abundance, damage and beneficial organisms with earlier observations; revise the strategy if necessary. |

Benefits, complexity and expense: College Board, STB-1.D.1 and STB-1.D.2.
Identification, monitoring and follow-up: UC IPM, What Is IPM?
Threshold-based control decisions: US EPA, Integrated Pest Management Principles.

Scope: College Board AP Environmental Science CED, Topic 5.14, p. 110.