Chapter 3
Setting Injury and Action Levels

Total eradication of pest organisms is virtually impossible to achieve. A more realistic goal is to determine the "injury level"—the number of pests or the amount of pest-related damage that can be tolerated without suffering an unacceptable medical, economic, or aesthetic loss. The "action level"— the number of pests necessary for treatment to occur to prevent the injury level being reached—depends largely on pest biology and environmental conditions supporting the pest.

Determine Injury Levels First

Before you can determine the action level, you must first determine the injury level. This is the level of damage or the level of the pest population that causes unacceptable injury. The injury level will be higher than the action level (see Figure 3-1).

Three Types of Injury

There are three types of injury in IPM:

- Aesthetic injury is applied mainly to plants. This is injury that affects the appearance without affecting the health of the plant. There are few indoor pests or pests of structures that cause only aesthetic damage.
- Economic injury refers to pest damage that causes monetary loss, e.g., clothes moths destroying band uniforms or a plant disease that causes the death of a tree.
- Medical injury relates to human health problems caused by pests like rodents, flies, yellowjackets, poison ivy, etc.

Injury Levels Differ Depending on the Pest

The number of pests or amount of pest damage you can tolerate (another way to think of injury level) will depend on the kind of pest and its location. Columns of ants marching through an unused outbuilding is an entirely different situation from an ant invasion in the cafeteria. Many thousands of aphids can usually be tolerated on a tree, but one louse or nit on a child's head cannot.

Don't Set the Level too Low

One of the major causes of unnecessary treatments for pests is unrealistically low tolerance levels. Obviously, there is little leeway in tolerance for pests that have consequences for human health or the school budget, but for many other pests, the range of tolerance can be very wide. By understanding which kinds of damage are serious and which are unimportant and by simply changing the way we view pests and pest damage, we can avoid many unnecessary treatments. For instance, most trees and shrubs can support substantial populations of caterpillars, aphids, psyllids, or leafhoppers without coming to any harm. Lawns can still be very attractive and functional even though the grass is not all of one kind and there are a number of weeds mixed in (as long as they don't pose a tripping hazard, of course).

Determining the Injury Level

We all have intuitive, unspecified notions of injury level

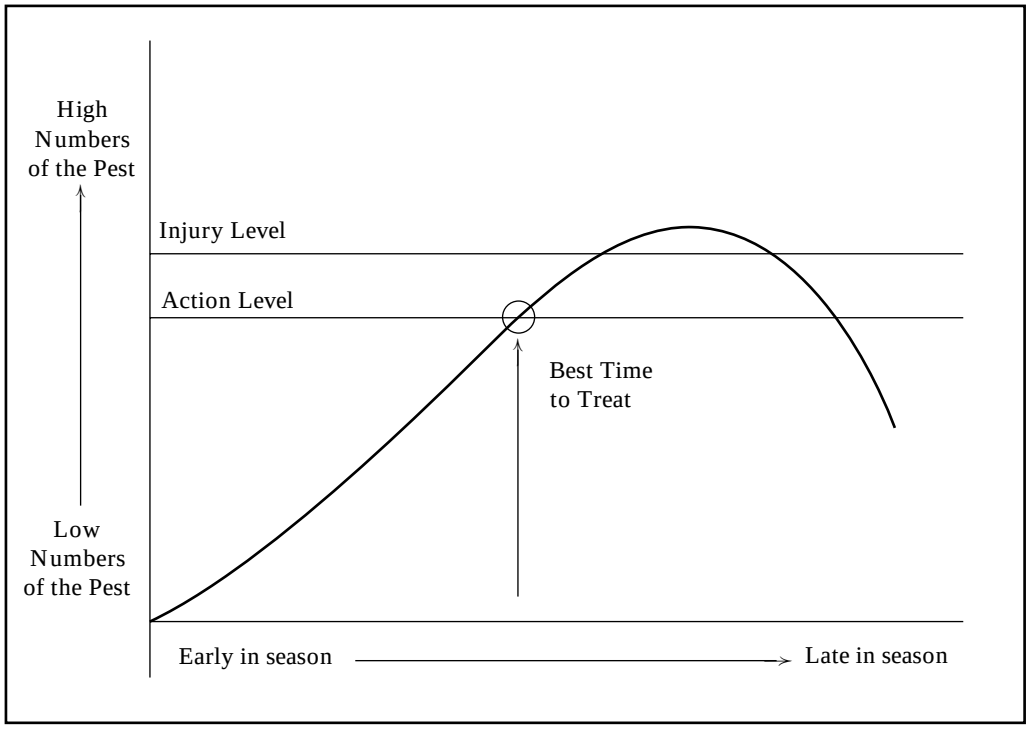

Figure 3-1. Graph Illustrating Injury and Action Levels

in various pest management situations, but these may not be accurate. In an IPM program, the aim is to try to make injury levels explicit and accurate. Monitoring is the only way to do this. It also takes knowledge and experience to understand the life cycles of pests, how fast their populations grow, and whether or not their damage will have serious consequences.

Example: Last year a chemical control was used when the aphid infestation in trees was first noticed by a school employee. This year, a monitoring program was initiated. Data collected indicated that 100 to 200 aphids per leaf produced no significant damage to the tree. In fact, the data showed that only when there were over 500 aphids per leaf did leaves start to drop from the tree. This level of aphids also began to elicit complaints about the sticky honeydew raining down from the tree.

Periodically, the injury level should be re-evaluated for each pest and for each site. Changes in weather conditions, plant cultivars grown, horticultural practices, level of IPM experience of employees, building renovations, etc., can affect the setting of injury levels.

Determine Action Levels Based on Injury Levels

The action level is the level of pest damage or number of pests that triggers a treatment to prevent pest numbers from reaching the injury level. The action level will be lower than the injury level (see Figure 3-1). Determining action levels involves making educated guesses about the likely impacts of numbers of pests present in a given place at a given time. In other words, you need to estimate how high you can let the pest population grow before you need to treat to prevent unacceptable injury. The action level must be determined and treatments applied before the injury level is reached.

Example: You know from previous observations that the injury level for the shade tree you are monitoring is 15 caterpillars per foot of branch. Current counts show 5 caterpillars per foot. These counts, weather data, and your experience lead you to expect the pest population will exceed the injury level in about two weeks, unless there is a surge in natural enemy activity or the temperature drops. Your choices depend on available time and resources:

(1) You can decide to set your action level at 5 to 7 caterpillars and schedule a treatment right away if it will be difficult to check again in a week.

(2) Because the trees are extremely valuable and because you see that caterpillars are starting to die from attacks by natural enemies, schedule another visit in one week. At that time, if natural mortality does not appear likely to keep pest numbers below the injury level, there is still time to apply an insecticide. In this case, set your action level at 7 to 10 caterpillars.

When an IPM program is first implemented for a particular pest/site, guidance on setting the action level may be available from existing school records, from the literature on the pest, through discussions with those who have experience managing the pest elsewhere, or from recollections of the problem in prior years by school staff.

Set Conservative Action Levels in the Beginning

During the beginning phase of an IPM program, it is wise to be conservative when establishing an initial action level. Set it low enough (i.e., low numbers of pests trigger treatments) to insure a wide margin of safety while learning monitoring methods. The initial action level should then be compared with other action levels for the same pest at different sites or locations. This is necessary to determine if the action level is set too high or too low, if treatments were necessary or not, and if they were properly timed.

The easiest way to collect comparative data is to set aside a portion of a school that remains untreated at the time another area is treated, or to monitor two schools where different action levels are applied to the same pest. By monitoring both sites, and comparing records, adjustment of the initial action level up or down can be evaluated.

Avoid "Revenge" Treatments

Sometimes action takes place after the injury level has been reached and the pest population has begun to decline naturally (Figure 3-2). These "revenge" treatments are generally useless at controlling pests, damaging to the environment, and an unnecessary expenditure of time and resources.

IPM Program Evaluation

One of the most important components of an IPM program is evaluating whether or not it's working, and fine-tuning it when necessary. Evaluation is rarely done in conventional pest control. Many people have become habituated to spraying on a regular basis, often without questioning the long-term efficacy or side-effects of what they are doing. An

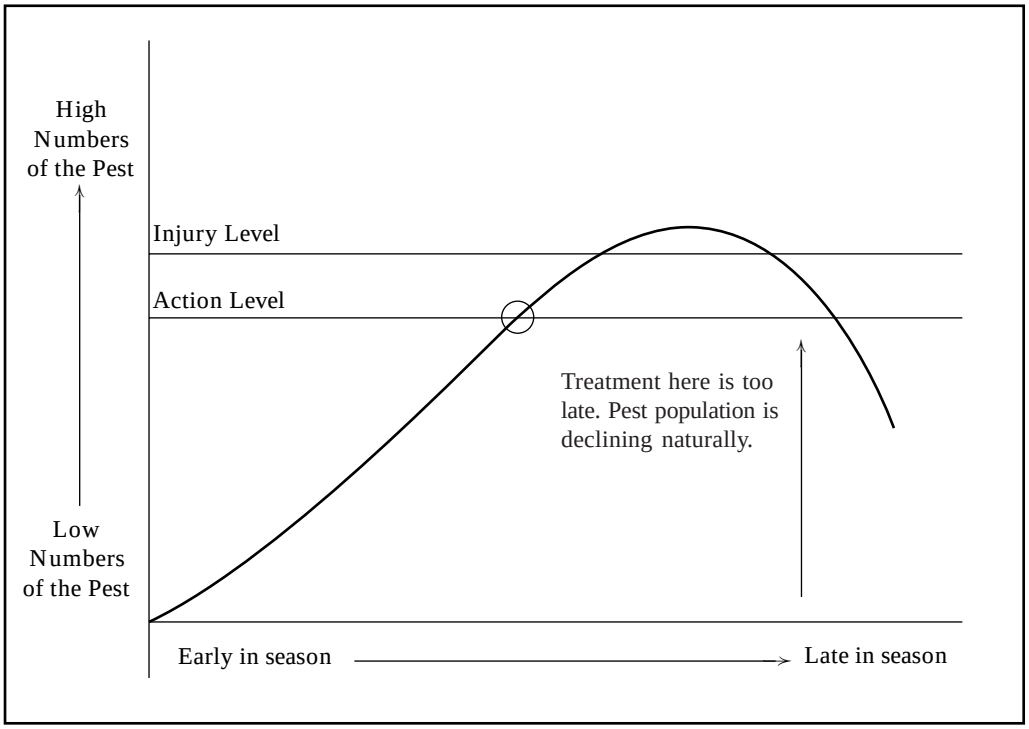

Figure 3-2. Graph Illustrating "Revenge" Treatments

IPM-oriented program would view the need to regularly apply a toxic material as an indication that the program wasn't working efficiently, and seek other solutions in order to reduce pesticide use and maximize effects of non toxic or natural controls.

For purposes of overall evaluation, it is helpful to view the IPM program as composed of many simultaneously occurring, interacting systems or processes:

- monitoring
- record-keeping
- decision making regarding treatment activities
- delivery of treatments
- evaluation of treatments
- collection and cataloging of reference materials on management of the pests
- education and training of school personnel in IPM
- communication to school personnel regarding IPM program plans and progress
- budgetary planning
- evaluation of overall IPM program

Each of these components should have, as part of the development of the initial program plan, some expressed objectives or criteria by which the component is judged successful or not. But, in addition, it is important to determine the following:

- Were all the necessary components to the program actually developed?
- Were they integrated successfully?
- Were the right people involved in the integration of the components into a whole program?

Questions to Ask After Treatment Action

At the end of the year, use monitoring data to answer the questions below and make any necessary adjustments in methods for the next season. After two or three seasons of fine-tuning, including modifying the habitat, redesigning parts of the school facility, or changing behavioral practices to discourage pests, you can generally expect problems to have lessened considerably, and in some cases disappear. After reaching this point, periodic monitoring rather than active management may be all that is needed.

- Was the pest population adequately suppressed (below injury level)?
- Was the pest population suppressed in a timely manner?
- Was the planned procedure used? If not, what was different?
- What damage was produced? What damage was tolerable?
- In the landscape, were natural enemies affected by treatments? How?
- If natural enemies were killed by treatments, will this cause problems elsewhere or at a later period?
- Were there any other side effects from the treatments? Any unanticipated consequences (good or bad)?
- If ineffective, should the treatments be repeated, should another kind of treatment be evaluated?
- Is the plant or structure worth maintaining? Can the site be changed to eliminate or reduce the problem for the same costs of treatment?

- What were the total costs of the treatment—costs of suppression vs. cost of damage, costs of side-effects or unexpected consequences, costs of risks from pesticides or benefits from reduction of pesticide, etc.

Assessing Cost Effectiveness

Cost effectiveness is central to a decision to continue an IPM program. Data from IPM programs in school systems and park districts across the country indicate that IPM costs no more than conventional spray programs, and often costs considerably less.

The Ann Arbor School District in Michigan has found that hiring a contractor to monitor 35 schools on a regular basis, and treat only if action levels were reached, resulted in only a single treatment (a crack and crevice application of low-toxic boric acid for cockroaches) during the course of a full year. In the first IPM year, this program cost the same as the previous conventional program. Costs were expected to drop the second year when in-house staff were scheduled to assume monitoring responsibilities (Cooper 1990).

Whether an IPM program raises or lowers costs depends in part on the nature of the current housekeeping, maintenance, and pest management operations. The costs of implementing an IPM program can also depend on whether the pest management services are contracted out, performed in-house, or both.

Prior to 1985, Maryland's Montgomery County Public Schools (MCPS) had a conventional pesticide-based program. Over 5,000 applications of pesticides were made to school district facilities that year. Public concerns about potential hazards to students and school personnel led to development of an IPM program that emphasized sanitation, habitat modification, and less-toxic baits and dusts in place of conventional sprays. By 1988, annual pesticide applications had dropped to 600, and long-term control of pests had improved.

According to William Forbes, pest management supervisor for the school district, under conventional pest control in 1985, the district spent $513 per building per year. This covered two salaries, two vehicles, and materials for two employees who serviced 150 sites. Only crawling insects and rodents were managed by in-house staff. An additional $2400 per building per year was paid for contracted services at 11 sites. By 1988, under an IPM program, those same 11 sites were being managed by in-house staff at a cost of only $500 per site per year. In addition, a total of 200 school buildings (33% increase) were serviced for a cost of $575 per building per year, which covered three salaries, three vehicles and supplies. No outside contracting was needed and the program covered virtually every structural pest, from pigeons to termites (Forbes 1990).

During the start-up phase, there are usually costs associated with conversion to IPM. These might include staff training, building repair and maintenance, new waste storage containers, screening, traps, a turf aerator, etc. However, these expenses are usually recouped within the first year or two of the program, and benefits continue to accrue for years.

Whether such costs are budgeted as a pest control expense or distributed to the building maintenance budget or the landscaping account depends on the budgetary format of the school system. In the long-term, training, repair and maintenance activities, and equipment purchases will reduce overall costs of the pest control operations, as well as other maintenance and operating budgets.

Bibliography

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Forbes, W. 1990. From spray tanks to caulk guns: successful school IPM in Montgomery County, Maryland. Journal of Pesticide Reform 10(4):9-11.

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