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ABSTRACT

This issue focuses on the costs of keeping up appearances by landscaping the environment. Although insects can be a threat to plant health, much of the injury they cause will only threaten plant appearance. The study comes from a survey of two groups, landscape specialists and homeowners, who were asked to identify which plants in a photograph series they would consider damaged and which they would want their landscape management company to treat. Six photographs of a widely-used shrub, commonly known as a burning bush, were prepared with varying discoloration and damage ranging from uninjured to half stippled white. The survey revealed that landscape specialists have the same general tolerance for plant injuries as their clientele. The possible value and application of this research to commercial business is explored, along with a description of a model of the integrated pest management (IPM) plan. The decision making model for use of the IPM is explained. A student quiz concludes the booklet. (EH)

ECONOMIC ISSUES

for Food, Agriculture and Natural Resources

PURDUE UNIVERSITY SCHOOL OF AGRICULTURE SPRING / SUMMER 1996, NO. 11

The Cost of Keeping Up Appearances

About the cover:
Dr. Cliff Sadof evaluating a pest problem.

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Spring / Summer 1996, No. 11

The Cost of Keeping Up Appearances

A LESSON IN DECISION MAKING...:

Growing plants for beautifying the landscape is big business. As a customer searches for the "greenest," "reddest," or "plumpest" produce in the supermarket, gardeners are seeking healthy-looking plants in a garden center to beautify their yards. Given a choice, most customers will purchase the fullest, strongest and healthiest-looking plants. Although insects can be a threat to plant health, much of the injury they cause will only threaten plant appearance. Garden center owners and nursery plant producers need to know the amount of cosmetic injury that is acceptable to potential customers so they can set the objectives for their pest management programs.

The presence of insects and disease on a plant can affect purchase decisions because of the detection of pests themselves or their effects on plant appearance. Consumers are not likely to purchase plants crawling with pests because of their inherent fear of insects and disease. More astute gardeners may also be thinking about how introductions of these pests to their yards may call for future pesticide use. Increased aversion to pesticides will cause many customers to demand pest-free plants. Pest-induced changes in plant appearance (e.g., defoliation) affect the decision to purchase a plant in ways that are much different from the presence of the pest itself. Consumer perception of plant appearance is subjective and based on personal tastes. Because garden centers can readily remove conspicuous insects, managers are interested in knowing how changes in plant appearance alone affect their purchasing decisions.

Clifford Sadof, professor in the Department of Entomology at Purdue University, has

studied changes in plant appearance caused by pests.

Sadof is interested in how much plant injury landscapers and gardeners are willing to tolerate. The results of his work could be used to help growers set management targets while allowing them to use the minimum amount of pesticides.

NOTE: Injury = leaf disfigurement or destruction
Damage = economic loss

To study this question, Sadof and a graduate student, Curt Alexander, prepared a series of six photographs of a widely-used shrub, commonly known as a burning bush. This ornamental plant is often used in landscaping. During long, hot dry months it can become infested with spider mites. The spider mites pierce the surface of the leaf and suck up the juice that bubbles from the puncture. This injures the leaf and causes the pierced area to become stippled with white flecks.

When infestations are high and go untreated, significant portions of the plant become discolored. This may be the first time some casual observers notice the injury. A closer look will show how individual leaves have been discolored. Any number of potential customers are likely to disagree on the amount of discoloration that makes a plant unattractive. They each have their own concept of what an attractive plant looks like.

The photographs prepared by Sadof and Alexander represented a range of discoloration from uninjured to half stippled white. This was based on the average discoloration of a random sample of 25 leaves taken from each plant. As it was important for people to react to the discoloration of the leaves, not the obvious presence of mites, webs, an indication of the most serious damage, were not visible in any of the photographs.

Two groups (landscape specialists and homeowners) were asked to identify the plants in the photographs they considered damaged, as well as those they would want their landscape management company to treat. The photographs represented discoloration of each plant on a scale of 1 - 6 with 1 representing no discoloration and 6 being half discolored.

RESULTS

This survey revealed that landscape specialists have the same general tolerance for plant injuries as their clientele. More than half the respondents from both the providers and recipients of landscape management services considered a plant with a discoloration ranking of 3.4 to be damaged. This represents approximately 5-10 percent leaf discoloration as seen in Figures 1 and 2.

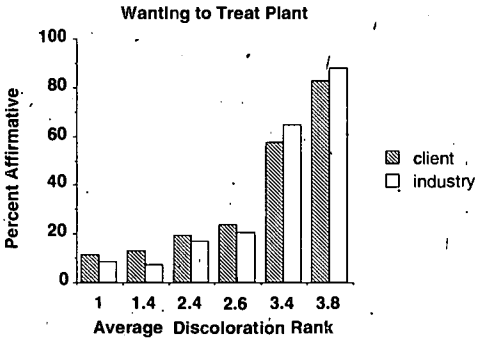

Figure 1

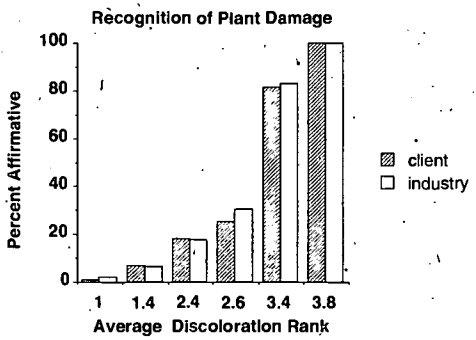

Figure 2

Also, the same level of injury caused landscapers and clients to want a plant to be treated.

Interestingly, there was quite a bit of variation in the responses of people to pest injury. About ten percent of the respondents wanted the uninjured plant to be treated even though fewer than five percent of them viewed the plant as damaged. At the other end of the spectrum, about ten percent of the clients and landscapers did not want a plant to be treated even though all respondents thought the plant was damaged. Sadof's impression of this difference is that clients and landscapers at either extreme are responding to their views about using pesticides and not looking closely at the conditions of the plant.

Sadof suggests that landscapers recognize the diversity of opinion among their clients and meet with them to set acceptable goals.

What Value and Application Would This Have to a Commercial Business?

As the public becomes more and more sensitive to environmental issues of safe water and food, more producers of plant materials are looking for ways to reduce the amount of pesticides they use. Integrated pest management (IPM) is such a plan. It restricts pesticide applications to occasions when the number of pests present threatens the value of the crop.

In the past, many growers used a "spray by the calendar" routine. Whether or not insects were present, spraying was done to ensure that pests did not attack valuable cash crops. The purpose of an IPM program is to minimize damage of a saleable product so that it is acceptable to the potential customer. For example, on crops such as melons or cucumbers without an IPM program, a grower may spray 10 to 12 times a season at a cost of

.$100-120 per acre. An IPM program may reduce the cost to $50-60 per acre by cutting the number of sprays in half. The savings on one spray can pay for the program.

Participants of IPM programs have behind-the-scenes support, with the likes of Sadof. Sadof meets regularly with participants of his IPM program to help them learn more about the insects that affect their plants and how to control them. By participating in Sadof's trainings, nursery managers can eventually become local experts. This knowledge can add value to their businesses, as growers look to them for advice on when to apply pesticides.

How Does an IPM Decision Model Work and How Is It Calculated?

To Spray or Not to Spray—

How are decisions made about applying pest controls to ornamental plants? Remember to consider what we know about the attitude of customers and whether we are working with professionals, owners or potential owners of landscape plants.

The Classic Decision-Making Model may be used by a producer of a crop such as soybeans which is valued for its weight or bulk. The model is referred to as an EIL (economic injury level) where

EIL = C/VID

EIL = number of injury equivalents per production unit (e.g., insects per acre, all of which live to attain their full injury potential), C = cost of the management activity per unit of production (e.g., $ per acre), V = market value (utility per unit of production (e.g. $ per pound or bushels), I = injury units per insect per production unit (e.g., proportion defoliated / insect per acre)], and D = damage per unit injury e.g., (pounds or bushel reduction per acre) / proportion defoliated). This type of model can be used

because the producer can measure the results by weighing the crop. The producer has no economic stake in the beauty of the plant, just in its yield. Pest management actions are taken to prevent insects from exceeding the EIL density.

USING BREAK-EVEN POINT TO MAKE A DECISION: The EIL is simply a decision-making tool to determine the break-even point in a management situation. This is the point where the cost of taking an action is balanced against the loss resulting from not taking an action.

For example, consider the following situation: The cost of applying a pesticide is $10 per acre. This gives C a value of $10. When the expected market value of the crop harvested from one acre is $1000, V = 1000. If an average insect can consume 0.01 percent of the leaves, I = 0.0001. Finally if each percent of leaves lost reduces yield by 1%, D = 0.01.

The denominator of the equation (VID) represents the potential gain from controlling each insect. In this case it is $1000 X 0.0001 bulk volume X .01 unit of volume lost per insect, or $0.001 lost per insect (one tenth of a cent per bug). The EIL is simply the number of insects it takes to equal the cost of applying a control to an acre of plants, C ($10), is 10,000 insects per acre.

In reality, a soybean farmer has little idea how much of the crop will be worth at harvest. He or she is also unsure about the weather and how it will influence the volume of crop yield, or the ability of pests to increase their numbers. Much of agricultural research involves developing techniques to help farmers make an educated guess based on the potential yield, price, and pest abundance.

In contrast to a soybean grower, crops produced by the nursery industry are valued for objective qualities such as size and number, as well as subjective qualities like plant appearance. Nursery managers use a decision-making model that is referred to as a Hybrid Model EIL because it combines subjective and objective measures of crop quality.

$$EIL = C/VIDK$$

where C = the cost of control (e.g. dollars per plant), V = economic value of undamaged good ($ per plant), I = proportion of injury per unit of pest density (discoloration or

defoliation, pest per plant), D = proportion of consumers perceiving damage per unit of pest injury ($ lost in sales per unit of injury per plant), and K = effectiveness of control. The key difference using the hybrid model is that the aesthetic quality of the plant is the primary consideration when calculating the value (V) and damage (D) coefficients for plants of a given size.

In landscapes, neither the classic or the hybrid model is appropriate for evaluation. Here, a third model called an aesthetic injury model is used because it only takes into account the level of injury that is acceptable to a consumer. The photographic survey of burning bush injury determined that most homeowners and landscapers wanted a control measure to be taken when only 10 percent of the leaves were discolored. As the damage approaches this 10 percent threshold, groundskeepers are told by their clients to JUST DO IT!!

In 1991, Sadof implemented an IPM program on Purdue University's campus that reduced pesticide use on campus trees and shrubs by more than 50 percent. It changed Purdue's landscape management philosophy from one of pest prevention to one of problem prevention. Sadof used his 10 percent threshold to develop a rule of thumb for maintance personnel involved in the IPM program. He also developed and tested Purdue Landscape IPM software, now available to the public, which manages plant inspection records and generates reports designed to facilitate management efforts and comply with EPA requirements for pesticide record keeping.

Prior to IPM, pesticides were applied to plants on the Purdue campus at specific times of the year as part of a pest-prevention program. Now pesticides are used only in areas where pests have been detected and essed as a threat. As a result of IPM, the

WHAT IS THE VALUE OF A NATURAL ENEMY (NE) WHEN OBSERVED?

Another consideration a grounds manager should be alert to is the presence of natural enemies (NE) that eat pests. When enough NE are present among pests on an infested plant, the problem may be controlled without pesticide applications. For example, if aphids are present on an ornamental crabapple in a landscape, and lady beetles appear, these natural enemies of the aphids will consume most of the population on the trees within the next 2 - 4 weeks without spraying.

landscape managers are more skilled and the cost of maintaining a beautiful campus has been reduced significantly.

Figures 3 and 4 illustrate an evaluation technique whereby an arborist (a caretaker of the landscape) can determine the action required by examining the plant quality and the agent (pest) severity of a tree.

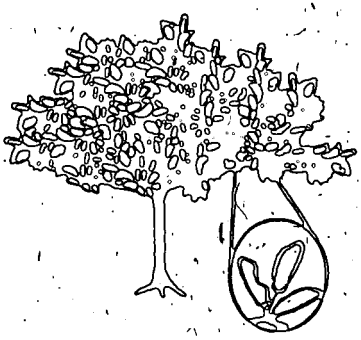

Figure 3

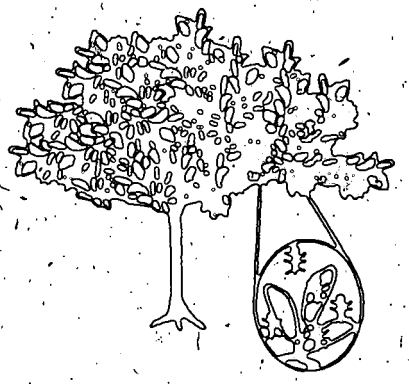

Figure 4

Researchers like Sadof study science which has application to a problem. This type of research is usually referred to as "applied research." Agricultural Research Programs (ARP) and the Cooperative Extension Service (CES) are intergal functions of the land-grant system of Purdue University. The primary mission of ARP is to research problems that face the taxpayers of Indiana.

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No. 11 The Cost of Keeping Up Appearances ***Spring /Summer 1996***

This issue discusses the development of an integrated pest management program developed at Purdue University for landscape professionals which allows pesticide materials to be applied only when the beauty of the landscape is endangered. Students will study the use of the Break-Even Point to illustrate making such a decision.

No. 10 Export Advantage—Adding Value to Indiana's Exports ***Fall 1995***

United States' agricultural exports are shifting from bulk grain and meal commodities to high-value fresh or frozen meat and poultry products. Find out what is causing this shift, what well-established and new world markets are emerging, and what this means for the food processing industry in the United States.

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No. 9 Food Processing and Marketing—New Directions, New Opportunities ***Spring 1995***

Through a joint effort of economic analysis and technology, the dying tomato processing industry in the Midwest, which had lost a major comparative advantage to California, was revitalized. Discover how the process of aseptic processing allowed the tomato industry to greatly increase its economies of scale and become the most competitive in the world.

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No. 8 Using Economics and Genetics to Produce Leaner Pork *Spring 1994*

A careful study of swine genetics and efficiency of production factors has helped producers select breeding stock to provide leaner meat without increasing production cost. This issue helps students understand the concept of net present value.

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No. 7 Strategic Marketing for Agribusiness *Winter 1993*

By understanding the marketing planning process and the economics of consumer buying decisions, managers of food and agricultural businesses can make better decisions to help their businesses become more profitable. In a case study format, this issue helps students understand the concept of demand elasticity.

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No. 6 Economic Development for Communities *Winter 1992*

Explore with students how successful economic development in a community involves an effort to export products and services to other communities, states, or nations and thus import dollars to the community.

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No. 5 Agricultural Chemical and Fertilizer Storage Rules—Costs and Benefits of Insuring Cleaner Water for Indiana *Fall 1991*

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No. 3 International Trade in a Global Environment ***Spring 1990***

Many factors affecting U.S. trade are beyond our control. However, the United States and its citizens do control macro economic policy, trade policy and domestic farm policy. Market, command and traditional economies, opportunity cost, along with other trade concepts including GATT (General Agreements on Trade and Tariffs), are discussed.

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No. 2 Commodities Trading—An Essential Economic Tool ***Fall/ Winter 1989-90***

This issue discusses the use of *commodities trading* (futures contracts and options) as an important economic tool to benefit both buyers and sellers in today's agricultural and natural resources marketing environment.

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No. 1 Value Added—Adding Economic Value in the Food Industry Spring 1989 *(first in the series)*

The concept of *value added* is discussed using the pork product, sausage, to add value by making frozen pizzas. Questions discussed include jobs created by value added processes and using value added to calculate *Gross Domestic Product.*

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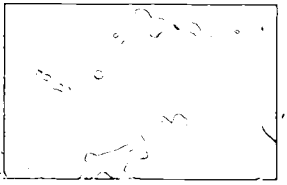
The CES provides trained Extension educators throughout the state who educate interested people through seminars and workshops, using the results of this research. In this effort, research and education go hand in hand to provide a continued improvement for quality of life in Indiana.



Sadof works with the nursery landscape industry to identify problems and provide advice. Problems like determining levels of acceptable plant injury are investigated in his research program. Results are translated to the industry in trade journals and in meetings. The next generation of industry professionals learn about his research when they take his class on ornamental insect pests.

SUMMARY

With increased awareness and concern for the environment and the need for businesses to always try and maximize their profits, management changes are required.

Applied research at Purdue University is conducted through the Agricultural Research Programs and communicated to the industry by the Cooperative Extension Service. Studies like those developed by Professor Clifford Sadof have resulted in ways to help meet these new goals of landscapers and garden center managers through the development of the Integrated pest management (IPM) approach.

A grower must decide the optimal time to spray for insects. However, the evaluation of the pest problem is assessed differently. This article discusses two types of evaluation as well as describes a third method that is more suitable for a landscape manager or an arborist. Such a person is hired to assess the beauty of the grounds rather than the individual plant's marketability (the job of a garden center manager) or the yield of a crop (a soybean grower).

Integrated pest management (IPM) is a program which allows the arborist to evaluate the situation and decide when to spray, based on the condition of the plant. This program reduces the number of sprays in a season which accomplishes both goals—saves production cost as well as reduces pesticide use.

Sadof and his colleagues, who are working to bring their research to growers, believe that IPM is a total educational process. As growers become more knowledgable, there may be savings that can be passed along to consumers.

Cliff Sadof

Cliff Sadof is an associate professor of entomology at Purdue University. Currently, he is responsible for developing strategies for managing plants with fewer insecticides. He has recently developed software that can be used to help landscape and nursery managers maximize the use of biological control. His research investigates how aesthetic standards of consumers drives pest managment in the ornamental industry. In addition, he continues to study how ornamental qualities of plants, such as leaf variegation, affect their susceptibility to pests. Recently, he has been working on methods to improve opportunities for biological control of insects in the landscape.

A native of New Jersey, Cliff attended Rutgers University, where he received his B.S. in Horticulture in 1980, and an M.S. in Entomology in 1982. After working as a statistician in the agrichemical division of FMC corporation, Cliff returned to graduate school at the University of Maryland where he received his Ph.D. in 1990.

The technical and professional assistance provided by Professor Sadof for this publication is greatly appreciated.

Quiz

1. What does IPM stand for in this text?
   A. International Pest Management
   B. Integrated Pest Management
   C. Integrated Program Management
   D. All of the above

2. Why have IPM programs been developed for ornamental plants?
   A. To save money for growers and landscape managers.
   B. To get rid of all insects regardless of cost.
   C. To encourage environmental measures.
   D. To maintain plant health.
   E. A, C and D are correct

3. How is evaluation of insect control different for soybeans than for crabapple trees for landscapes.
   A. The yield for soybeans can be measured in pounds on a scale.
   B. The crabapples can be counted.
   C. The yield of crabapple trees must be measured by a survey of consumer attitudes about plant appearance.
   D. An aesthetic value is calculated by the soybean grower.
   E. A and C are true
   F. All of the above are true

4. What is the primary function of the Cooperative Extension Service at Purdue University?
   A. To make results of applied research available to any interested citizens of Indiana.
   B. To educate growers in Indiana about only the most dangerous pests for crops and ornamental plants.
   C. To provide grade school children information for insect collections.
   D. To sponsor "Bug Bowl" in April.
   E. A and B are correct

5. "Spray by the calendar" is
   A. An integral feature of the IPM program developed by Professor Sadof.
   B. An outdated way of organizing spray schedules.
   C. Is a very accurate way to control most pests on soybeans.
   D. All of the above are true

6. "EIL" in the "classic" decision-making model refers to
   A. Equal insect level
   B. Economic Injury Level
   C. Insects per acre, all of which live to attain their full injury potential
   D. B and C are both correct
   E. No value in this equation

7. If I = 0.0001 of a tree's leaves are consumed by each insect, how many insects are needed to consume ten percent or (0.10) of the tree's leaves? Remember this is the "rule of thumb" Aesthetic injury level (AIE).
   A. 100 insects
   B. 10,000 insects
   C. 1,000 insects
   D. 10 insects
   E. None of the above are true

8. Why is the "classic" model not appropriate for evaluating ornamental plants in a garden center?
   A. Ornamental plants are sold for beautifying, not producing a cash value of its yielded fruit.
   B. Damage to appearance on an ornamental must be considered in evaluating the value (V) and damage (D)
   C. Only 10 percent yield in a cash crop can be tolerated by the grower.
   D. Both A and B are correct

9. Why is neither the "classic" or the "hybrid" model appropriate when evaluating plants in a landscape setting?
   A. The only consideration of a grounds keeper is that there are no insects on plants inspected.
   B. The plants are no longer managed for their saleable value.
   C. The grounds keeper only cares if someone considers the plant ugly.
   D. All of the above are true
   E. B and C are are correct

10. What is responsible for Sadof's impression: "Respondants are expressing their views about using pesticides and not looking carefully at the condition of the plant."
   A. Some respondents wanted no spray applied even though the plant was clearly injured.
   B. Some of the respondents wanted a plant sprayed even though there was less than one percent injured.
   C. The response to extreme levels of injury in the survey.
   D. All of the above are true

Answers: 1-B; 2-E; 3-E; 4-A; 5-B; 6-D; 7-C; 8-D; 9-E; 10-D

Solution steps to #7

1. acceptable level = amount of injury per insect X the number of insects of injury (AIL)
2. let X = number of insects
3. divide both sides of the equation by 0.0001
4. $\frac{0.10}{0.0001} = \frac{0.0001x}{0.0001}$

   $x = 1000$

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