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Revenues for ServiceMaster LawnCare grew a whopping 77%! Over five times the industry rate.

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Revenues for ServiceMaster LawnCare grew over five times the industry rate.

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Mode of action for *Bacillus thuringiensis* is by a toxin produced by the bacteria which attacks the mid-gut cells and moves to the body cavity. The toxin, produced during the manufacturing process, is the active ingredient in formulations. The toxin makes the use of *Bacillus thuringiensis* unique, because the mode of action is the result of a pesticide toxin made by a bacterium.

We can now recognize three different toxins from *Bacillus thuringiensis* attacking three different kinds of insects: caterpillars (*Lepidoptera*), mosquitos (*Diptera*) and beetles (*Coleoptera*). Only the bacteria attacking caterpillars and mosquito larvae have been registered for use to date.

Important progress has been made in the production, formulation and marketing of nematodes that attack immature forms of insects in the soil and on plants. The developmental stages of insects (larvae active at night on plant parts or pupae hidden from predatory natural enemies) are primary targets.

An essential condition for nematode survival is adequate moisture in or on the material inhabited by the immature insect. Moist soil and/or moist plant parts are ideal sites for the activities of *Neoaplectana*

*carpocapsae* nematodes. These nematodes can enter the body of an insect through any body openings, particularly the mouth and spiracle, into the respiratory system.

Nematodes are an important biological control agent because they respond to the presence of susceptible forms of insects and literally seek out their prey. *Neoaplectana* nematodes, which are marketed for use against insects, carry a bacteria that causes physical damage accompanied by rapid death. Further, the use of nematodes is attractive because they multiply in the body of the attacked insect which, in turn, increases nematode egg production. This action results in a continuous supply of nematodes to control additional generations (if moisture conditions are suitable).

### Biological herbicides

In the past five years, research activity has centered on possible biological herbicides.

For many years, we have accepted the idea of importing insects that have a specific appetite for certain weeds (a biological control). This has been accepted as a principle for control of the Klamath weed and Tansy ragwort in California and Oregon. In Australia, caterpillars are used to control cactus.

In addition, experiments continue in Florida for controlling aquatic weeds by using specific viruses that infect only the weeds.

Abbott Laboratories has registered Devine as a biological herbicide in agricultural systems using a natural enemy of the weed. Although it is temporarily for use only in certain counties in Florida, we can expect a continuing line of herbicides for biological control. Eventually, these developments will provide the professional landscape horticulturist with the necessary array of bio-rational agents for both weeds and insects.

### Product formulations

Bio-rational agents have been widely developed into a full range of formulations for their safe use and application with equipment used by horticulturists. Further, industry has been able to adapt a heat- and pressure-sensitive living product (the living bacteria and their toxins), to formulation procedures, and has maintained the activity of a bio-rational agent which could otherwise be harmed when exposed to procedures commonly used for formulating conventional chemical insecticides.

The production method for bacterial insecticides (for example, *Bacillus*

## Everything you always wanted to know about bio-rational agents, but were afraid to ask

**What they are:** Bio-rational agents are biological alternatives to conventional chemical pesticides. They are micro-organisms that attack and cause diseases of insects, mites and certain weeds. Of five principal groups of micro-organisms, bacteria, fungi and nematodes are



Milky spore disease bacteria invade grubs of Japanese beetles.

used in products marketed for landscapers.

**How they work:** Milky spore products are a good example of how biological control of insects take place. Milky spore products contain the resting spores of the bacteria *Bacillus popilliae*. These spores physically damage the mid-gut growth of the bacteria in the body cavity of beetle grubs, thereby destroying them.

Such products have been on the shelves for about 50 years. Newer formulations are available for control of flies, beetles and moths. Bacteria that attack caterpillars and mosquito are also available, and important progress has been made on nematodes that attack immature forms of insects in the soil and on plants.

**How biological herbicides work:** The concept behind biological herbicides is basically the same. In Florida, researchers are looking at specific viruses that infect only aquatic weeds, and Abbott Laboratories has registered a biological herbicide for use in certain counties. Landscapers can expect to add bio-rational agents to their weed-control arsenal in the near future.

**How bacterial insecticides are formulated:** Bacterial insecticides, such as those for caterpillars and mosquito larvae, include a final fluid suspension of bacteria. Dried products, like wettable powders, require a re-suspension of the stable powder in water. Dry, granular formulations are also available, eliminating the need to use spray equipment.

—Dr. John Briggs □



# Three ways Mazda trucks outperform the competition.



1989 Mazda B2200

If you're about to commit your company's resources to building a truck fleet, you've probably looked at Ford Ranger, Chevrolet S-10, Toyota and Nissan. But your shopping list isn't complete until you've taken a good look at Mazda. Because Mazda trucks offer some very important advantages over the competition.



**Mazda trucks: Number one in overall customer satisfaction for three straight years.\***

| 1986              | 1987              | 1988               |
|-------------------|-------------------|--------------------|
| MAZDA #1          | MAZDA #1          | MAZDA #1           |
| TOYOTA #2         | TOYOTA #2         | TOYOTA #2          |
| NISSAN #5         | NISSAN #3         | NISSAN #4          |
| CHEVROLET S-10 #6 | CHEVROLET S-10 #7 | FORD RANGER #8     |
| FORD RANGER #9    | FORD RANGER #9    | CHEVROLET S-10 #10 |



**Mazda B2200 Cab Plus.** Combining spaciousness with practicality, the Cab Plus is the first extended-cab compact truck that allows two adults to sit facing forward in optional rear jump seats.

**Mazda trucks: Offer a 36-month/50,000-mile "bumper-to-bumper" warranty—The best in the truck business.\*\***

| MAZDA                               | TOYOTA                              | NISSAN                              | FORD                                | CHEVROLET†                          |
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| 36 MONTH<br>50,000 MILE<br>WARRANTY | 36 MONTH<br>36,000 MILE<br>WARRANTY | 36 MONTH<br>36,000 MILE<br>WARRANTY | 12 MONTH<br>12,000 MILE<br>WARRANTY | 12 MONTH<br>12,000 MILE<br>WARRANTY |

**Mazda trucks: Offer the most truck for your money.††**

| Standard Features      | Mazda B2200 Base | Toyota Standard | Nissan Standard | Ford Ranger "S" | Chevrolet S-10 "EL" |
|------------------------|------------------|-----------------|-----------------|-----------------|---------------------|
| 5-speed                | Standard         | N/A             | Standard        | Standard        | Standard            |
| Automatic transmission | Optional         | N/A             | Optional        | N/A             | N/A                 |
| Double-wall cargo bed  | Standard         | Standard        | Standard        | Standard        | Standard            |
| Tinted glass           | Standard         | Optional        | N/A             | Standard        | Optional            |
| Steel-belted radials   | Standard         | Standard        | Standard        | Standard        | Standard            |
| Full carpeting         | Standard         | N/A             | N/A             | N/A             | N/A                 |

To find out even more ways Mazda outperforms the competition, contact:  
Fleet Department, Mazda Motor of America, Inc.  
7755 Irvine Center Drive, Irvine, CA 92718.  
Or call (714) 727-1990.

\* J.D. Power & Associates 1986 and 1987 Compact Truck CSI and 1988 Light-Duty Truck CSI customer satisfaction with product quality and dealer service.  
\*\* Warranty coverage without deductible. See your Mazda Dealer for limited warranty information.  
† GM's 36-month/50,000-mile "Bumper-to-Bumper Plus" Warranty requires \$100 deductible per visit after 12 months/12,000 miles.  
†† Comparisons with other makes based upon available competitive data.





### Example of Formulations and Pesticidal Activities of Biorational Pesticides Produced and Marketed for Gardens and Landscapes.

| MANUFACTURER/TRADE NAME   | FORMULATION             | CONTENT  |
|---|-------------------------|--|
| Biologic Co.<br>Chambersburg, Pennsylvania  |                         |  |
| <u>Insecticidal Nematodes for Caterpillars (Lepidoptera), Beetle Grubs (Coleoptera)</u> |                         |  |
| SCANMASK  | Granular and Liquid     | 7 Million Active Units per pint (granular)<br>One Billion Active Units per gallon (Liquid)     |
| Fairfax Laboratories<br>Clinton Corners, New York                                       |                         |  |
| <u>Insecticidal Bacteria for Beetle Grubs (Coleoptera)</u>                              |                         |  |
| DOOM  | Dust                    | 100 Million Spores per gm  |
| Abbott Laboratories<br>North Chicago, Illinois  |                         |  |
| <u>Herbicidal Fungus</u>  |                         |  |
| DEVINE  |                         | 6.7 × 10 <sup>5</sup> Live Chlamydo spores per ml<br>(3.2 × 10 <sup>5</sup> per pint)          |
| <u>Insecticidal Bacteria for Caterpillars (Lepidoptera)</u>                             |                         |  |
| DIPEL ES  | Emulsifiable Suspension | 17,600 International Units of Activity per mg<br>(63 Billion International Units per gallon)   |
| DIPEL 2X  | Wettable Powder         | 32,000 International Units of Activity per mg<br>(14.52 Billion International Units per pound) |
| DIPEL 4L  | Emulsifiable Suspension | 8,800 International Units of Activity per mg<br>(32 Billion International Units per gallon)    |
| DIPEL 6L  | Emulsifiable Suspension | 13,200 International Units of Activity per mg<br>(48 Billion International Units per gallon)   |
| DIPEL 6AF   | Aqueous Flowable        | 10,750 International Units of Activity per mg<br>(48 Billion International Units per gallon)   |
| DIPEL 8L  | Emulsifiable Suspension | 17,600 International Units of Activity per mg<br>(64 Billion International Units per gallon)   |
| DIPEL 8AF   | Aqueous Flowable        | 14,500 International Units of Activity per mg<br>(64 Billion International Units per gallon)   |
| DIPEL 10G   | Granular                | 1600 International Units of Activity per mg<br>(0.726 Billion International Units per pound)   |
| <u>Insecticidal Bacteria for Mosquito Larvae (Diptera)</u>                              |                         |  |
| VECTOBAC-AS   | Aqueous Suspension      | 600 International Toxic Units (ITU) per mg<br>(2.19 Billion ITU per gallon)                    |
| VECTOBAC-12AS   | Aqueous Suspension      | 1200 International Toxic Units (ITU) per mg<br>(4.84 Billion ITU per gallon)                   |
| VECTOBAC-G  | Granules                | 200 International Toxic Units (ITU) per mg<br>(0.091 Billion ITU per pound)                    |

SOURCE: The author

NOTE: This is a partial listing of biorational pesticides available.

Endorsement of the products mentioned is not intended, nor is criticism of products excluded.

thuringiensis for caterpillars and mosquito larvae), includes a final fluid suspension of bacteria. The fluid suspension contains living bacterial cells and their toxin products. Aqueous flowable and emulsifiable suspensions of the bio-rational agents reduce and avoid clumping of the bacteria and their microscopic toxin particulates.

Dried products like wettable powders require a re-suspension of the stable powder in water. The production material must be dried at a temperature that will not reduce the effectiveness of the bacterial agents or their products but assure successful suspension in water.

Producers and formulators also provide dry granular formulations that preserve the product's insecticidal

qualities. Applying granular and wettable powder formulations as dry materials to soil and turf allows the professional landscaper to penetrate larval habitats without using spray equipment. For example, a combination of wettable powder or granular formulations with fertilizer can be used with granular application equipment on sod.

As with chemical pesticides, a number of factors influence the decision to select an emulsifiable or flowable formulation (which differs only in concentration of the active agent). These factors are the equipment's large or low-volume spraying capacity, the nature and volume of spray mixture additives, and the recommended concentration of active ingredients needed to be in contact with

the target insect.

Some professional horticulturists may need to serve the interests of clients who have ornamental water ponds as part of the landscape. In that case, using any one of several formulations of larvicidal bacteria for mosquitos is an important addition to the service.

### Using biologicals

Aqueous suspensions and diatomaceous granules provide a suspension of larvicidal bacteria in the site. Sand granules (as carriers) deposit the bacterial insecticide in the bottom of the mosquito larval habitat.

Mosquito larvae that feed primarily at the surface encounter the bacterial insecticide in a suspension or as a floating formulation. Larvae which have a bottom-feeding behavior contact the bio-rational agent with the sand formulation which sinks and is not initially in suspension.

Granular formulations of bio-rational agents, depending on the physical qualities of the inert material, can release over an extended period of time. The granule's low solubility and the active ingredients' slow release extend the agent's residual period. This is true in ponds, in soil, in leaf axles or into the root/stem interfaces of plants.

Landscape professionals cannot expect to meet every client expectation for control of insects, mites and weeds using biological agents. However, major opportunities are now available to integrate bio-rational agents with chemical agents. That, in turn, provides the landscaper with a chance to retain the initiative for safety and effectiveness in professional programs.

In addition to their benefits to the applicator and consumer, bio-rational agents allow a high probability for the survival of beneficial organisms in the landscape ecosystem. This can reduce debate on the impact of conventional horticultural practices on honey bees, earthworms, ladybugs, green-lace wings, parasitic wasps and birds.

Next month, I will explore specifically the dreams and the realities in the quest to genetically engineer bio-rational agents.

LM

Dr. Briggs is professor of entomology at Ohio State University, Columbus, Ohio. His research and testing activities include Introductory Entomology and Biological Control of Insects and Weeds.





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## BANFF

Kentucky Bluegrass

Banff is a vigorous dwarf variety that was discovered on the Banff Springs Golf Course in Alberta, Canada. There, Banff survived twenty years of continual heavy watering, repeated attacks from snow mold, and close mowing on a putting green. Just imagine what it could do for you. Banff establishes quickly and forms a disease resistant, cold tolerant, dark green turf.

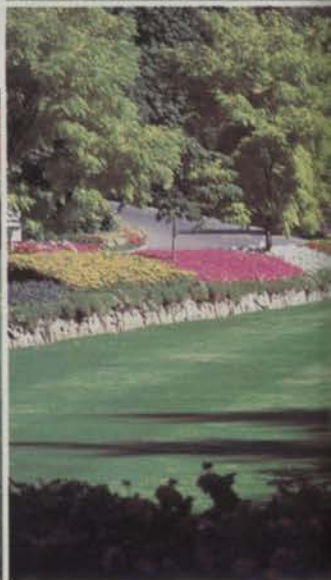
## Touchdown

KENTUCKY BLUEGRASS

Since Touchdown's discovery by the late Tom Rewinsky on the National Golf Links of America on Long Island, this elite bluegrass has become the top choice of sod producers. Its aggressive growth habit and rapid establishment crowds out weeds and Poa annua while developing an even, dark green turf.



Mustang is the tall fescue that looks like bluegrass. Its finer texture, darker green color, and wear and drought tolerance have made it the choice for sports field, sod, park, and home lawn use. Mustang is available straight or in TEAM — a three-way turf-type tall fescue blend that also contains Maverick II and Thoroughbred.



Colt is an Oregon produced variety that offers you domestic seed production benefits. It combines superior turf performance and turf quality with genetic adaptation to North American growing conditions. It is dark green, shade tolerant, disease resistant, and very winter hardy. Colt is a vigorous, low-growing variety that has excellent overseeding qualities.



For the fourth consecutive year Victory was the highest rated commercially available chewing's fescue in the national Fine Fescue Trials. Victory is a low growing, shade tolerant variety that has possibly the darkest green color of any other chewing's fescue. It exhibits superior uniformity and disease resistance, too. If you like picking winners, pick Victory.



# ty of reasons.



## CROSSFIRE

TURF-TYPE TALL FESCUE

Crossfire turf-type tall fescue is the only strategy you need for battling a summer ambush of heat and drought. Crossfire is a lower and slower growing variety of tall fescue that exhibits a very dark green color. It combines improved heat and drought tolerance with outstanding turf quality to produce a dense and durable turf. Crossfire's high marks in overall performance during its initial evaluation proved it was ready for the field. Let Crossfire show you how to endure a long summer siege.

## SPARTAN

HARD FESCUE

Spartan is a robust, advanced generation of hard fescue that is dark green, leafy, and persistent. It demonstrates excellent cold tolerance and creates attractive, low growing, low maintenance turf. Spartan mixes well with perennial ryegrass, Kentucky bluegrass, and other fine fescues. It is an outstanding component in many shady and low maintenance mixes suited for use on home lawns, parks, and golf course roughs.

## AMERICA

KENTUCKY BLUEGRASS

America is a low maintenance Kentucky bluegrass that has a dense dwarf growth habit, dark green color, excellent disease resistance, and good shade tolerance. Perfect in mixes, America is ideal for golf course fairways, sod production, playing fields, and home lawns.

Pickseed also produces the following quality turfgrass varieties: Agram chewing fescue, Jasper creeping red fescue, Jazz perennial ryegrass, Alpine Kentucky bluegrass, Exeter colonial bentgrass, and National creeping bentgrass.

## SHORTSTOP

TURF-TYPE TALL FESCUE



Shortstop is the little guy with big benefits. As its name implies, Shortstop is a slower and shorter growing variety of turf-type tall fescue. But don't let its stature fool you. Shortstop is plenty tough. It has heat and cold tolerance, disease resistance and is widely adapted. Shortstop forms a beautiful, dense, uniform turf of finer, darker green leaves.

## BRONCO

Kentucky Bluegrass

Bronco is a very wide bladed Kentucky bluegrass that was developed specifically as a mix companion for turf-type tall fescue. While its texture and color gives it the appearance of a tall fescue, the comparison between the two ends there. Bronco is elite Kentucky bluegrass all the way. Its been bred to be less dense so it won't crowd out tall fescue and yet still aggressive enough to fill in and repair damaged areas quickly. That's what makes Bronco ideal for sports turf use.

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# COMMON SENSE WEED CONTROL

Is it possible we chemical applicators are caught in our own web of "weed-free" marketing jargon and quick-fix chemicals? Come on, industry, let's get real.

by Phil Christian III

**C**ontrolling weeds in ornamental turf has emerged as one of the most difficult and perhaps most important issues we will face in the 1990s.

According to 1989 surveys, weeds—a natural part of the landscape—continue to be the single biggest source of customer dissatisfaction with lawn care companies. This is caused, in part, by an industry afflicted with unrealistic customer expectations on the amount of weeds acceptable in lawns.

Weeds that distract from the landscape's general appearance are considered symptoms of poor management. But a weed infestation that would threaten the actual health or vigor of the turf would far exceed any visual limits. Therefore, the real issue in weed control is how weeds affect the landscape's visual quality.

If we are going to talk about visual quality, we must set some criteria for how the landscape is viewed. The Mona Lisa, for example, is not very attractive when viewed under a magnifying glass. Step back a few feet within the visual range intended by the artist and it becomes a beautiful work of art.

The landscape, too, should be viewed first from a distance. "Curb appeal" should be judged by walking, standing or driving a few feet from the curb.

## On balance

Part of being in control of the landscape is keeping its various elements in relative balance. This means we must accept the existence of weeds as part of the system.

Weeds that detract from the general health and appearance or balance of the landscape are not acceptable. It is also true that some weeds are more acceptable than others. Some varieties of clover, for example, are the same color as turfgrass and grow at a similar rate. If the turf is correctly

lawn care operators. They have selected you to perform the services on their grass, and they expect your company to live up to all the promises they have heard.

**Your only defense against unrealistic demands and expectations is to tell the customer the truth: there is no such thing as "weed-free."** A company promises to control weeds to the extent that they will not distract from the appearance of a property when viewed from the curb. The one condition to the promise is that the customer and the landscape manager work with the company and follow its instructions to better manage the landscape for acceptable weed control.

You are in this together. We have trained the customer to believe our magic chemicals can provide a "quick fix" for weeds any time we choose to apply it. The truth is, there are numerous limitations to the application of chemicals. At

some point, excess application could do damage to the turf.

Weed control should be viewed as a landscape management issue. Weed control chemicals are used as a supplement to that management program, but they do have limitations.

Do customers understand exactly what their role is in managing weed control? Have they been told, for example, a spring pre-emergent has been applied and should be watered in, and they should avoid mowing for 24 hours, since incorrect mowing practices, hand raking and de-thatching can reduce the effectiveness of the weed control program?

How many times have we made a professional herbicide application

*continued on page 42*



mowed on schedule, small amounts of clover will not detract from the color or texture of the lawn.

But what about the owner who says, "Don't talk to me about balance or offensive weeds versus non-offensive weeds. You promised weed-free, and that is what I want."

This same customer has been conditioned over the years by the lawn care industry's marketing efforts to think "weed-free." Why? Because companies are agreeing to perform no-charge service calls when customers see a few weeds. The customer who has shopped around in the industry may have heard a variety of unrealistic claims or promises made by



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# The agronomics of weed control



Welcome to the '90s. Today, chemical weed control is viewed by some as an assault on public health and our environment. It's reasonable to believe that governments may further restrict the industry's use of all pesticides, including herbicides.

To continually treat weeds without correcting the management practices that are allowing them to occur leads to frustration and dissatisfaction among clients. Total elimination of weeds should never be the goal of weed control programs.

The challenge of the '90s is to get excellent weed control from less herbicide use.

The answer lies not in future pesticides, but in understanding and applying the principles of turfgrass management. The best method of weed control is to grow a dense turfgrass. That means five key agronomic principles must be well managed. Errors in executing any of these principles can affect turfgrass density and vigor and ultimately allow more weeds.

- 1) A well-adapted turfgrass must be selected.
- 2) It must be fertilized properly.
- 3) It must be properly mowed and dethatched.
- 4) It must be properly watered.
- 5) Pesticides must be used as necessary to control weeds and pests.

## Fertilization

Excellent weed control requires proper selection, application and timing of fertilizer. Managers should fertilize to produce dense turf, not dark green color. Over-emphasizing the importance of dark green color can cause disease and insect problems.

## Mowing and dethatching

Constant clipping removal wastes much of the applied fertilizer. Mowing the turf too closely creates stress that thins turf and allows weeds. Herbicide applications can be made totally ineffective by mowing. Mowing less than 24 hours after application can remove post-emergence herbicides before they are absorbed by the weed. When pre-emergence applications are not watered in, up to a third of the pre-emergence herbicide can be removed with clippings. Mowing weeds just before treatment reduces weed control by removing leaves that would otherwise catch and absorb herbicide.

Dethatching can destroy an effective pre-emergence herbicide barrier and thin turf, allowing weeds to become established. Turf should be dethatched when it can be forced to fill thin areas quickly.

## Watering

Frequent light watering encourages weeds and disease. Weekly, heavy waterings are more appropriate. Pre-emergence herbicides should be watered in, while post-emergence herbicides should be allowed to remain on the leaf tissue. Watering prior to post-emergence herbicide applications generally improves weed control.

## Overseeding

Overseeding bare or thin areas of the lawn must be carefully coordinated. Grass seed should be chosen for its adaptability and quality. Overseeding and weed control applications just don't mix. Most herbicides can prevent germination for at least a week after treatment and can damage young seedlings when applied too soon.

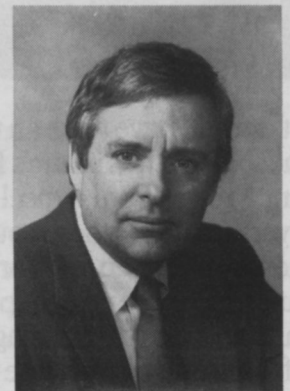
## Pesticides

Over-use of herbicides can cause weed problems by weakening the turfgrasses that provide primary protection against future weeds. Herbicides have been shown to reduce heat and drought resistance, inhibit root and rhizome growth and increase disease occurrence. Insect and disease problems must be detected and treated before extensive damage occurs.

## Communication

Communication with the customer improves weed control. The applicator must insist on proper mowing height with a sharp mower. Heavy infrequent irrigation should be encouraged. The applicator must communicate the purpose of each treatment and give specific management instructions on how to make the treatment most effective. When particularly difficult problems occur, providing pre-treatment instructions for watering and mowing can make a difference.

—Dr. Barry Troutman □



Dr. Troutman is director of education for the Professional Lawn Care Association of America.