Bio-Rational Materials for Pest Management

Dr. Charles H. Peacock

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BEST MANAGEMENT PRACTICES

Goals of Best Management Practices

The ultimate objective of Best Management Practices is to **protect natural resources both on and off the turf site.** This would include soils, air and water which are an integral part of the abiotic part of the site, but which are interrelated with the biotic components

Goals of Best Management Practices

- ***Goal 1*** *- To reduce or eliminate the offsite transport of sediment, nutrients and pesticides.*
- ***Goal 2*** *- To reduce the total chemical use through an IPM approach to turf management.*

Examples of how this can be accomplished include setting economic thresholds, using alternate pest control strategies and soil and plant tissue testing in fertilization programs.

Goals of Best Management Practices

- ***Goal 3*** *- To control the rate, method and types of chemicals being applied.*

This is supplemental to the IPM strategies in that it proposes using a risk assessment basis for making decisions on pesticide selection.

- ***Goal 4*** *- Use both biological and mechanical soil and water conservation practices.*

This encompasses design, construction and management principles.

Goals of Best Management Practices

- ***Goal 5*** *- To educate the public on the relationship of environmental issues and systems management.*

Participating in programs which promote sound land use management and which extend this in an outreach function to the public can play a critical role in making people aware of the objective of using Best Management Practices.

What is the "Organic" Approach?

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Sustainable Turf Care
Horticulture Systems Guide

Barbara Bellows
NCAT Agriculture Specialist
Published 2003
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IP123

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http://attra.ncat.org/attra-pub/PDF/turfcare.pdf
40 pages — 708K
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Abstract

This publication is written for lawn care professionals, golf course superintendents, or anyone with a lawn. Its emphasis is on soil management and cultural practices that enhance turf growth and reduce pests and diseases by reducing turf stress. It also looks at mixed species and wildflower lawns as low maintenance alternatives to pure grass lawns.

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ATTRA - National Sustainable Agriculture Information Service

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Organic and Least-toxic Turfcare Practices

Organic or least-toxic turf management reduces stress on the turf. Turf experiences stress from heat, drought, wetness, compaction, nutrient deficiencies or imbalances, and disease and pest infestations. To minimize stress on turf, you need to pay attention to the following principles:

- Establish and maintain a healthy soil environment.
- Include a diversity of species in the lawn environment.
- Use cultural practices that reduce stress on turf growth.
- Understand and work with your local soil and climate conditions.
- Use biological pest control methods.

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A Healthy Soil Environment for Turf

Good quality soil with an active population of earthworms, fungi, bacteria, and beneficial nematodes is critical for creating and maintaining healthy lawns. According to Dr. Eric Nelson (2), turfgrass specialist at Cornell University, "The challenge of the turfgrass manager is to become an expert not only in the management of what everyone can see above the ground, but in the management of beneficial soil microorganisms to maximize turfgrass health."

Fungi, bacteria, beneficial nematodes, and earthworms in the soil are important for the decomposition of thatch, enhancing soil aeration through the formation of soil aggregates, and reducing populations of soil-borne plant pathogens. To support a healthy and diverse population of soil organisms, soils need to have on-going additions of organic matter, a near neutral pH, and a balanced supply of

Integrated Pest Management IPM

- IPM is a program that uses information about turfgrass pest problems and environmental conditions which may precipitate these problems, and integrates these with turfgrass cultural practices and pest control measures to prevent or control unacceptable levels of pest damage.

IPM

Is a philosophy!!

IPM

It is a preventative approach incorporating a number of objectives including the following:

- development of a healthy turf that can withstand pest pressure
- judicious and efficient use of chemicals
- enhancement of populations of natural, beneficial organisms
- effective timing of handling pest problems at the most vulnerable stage, often resulting in reduced pesticide usage.

IPM

- It is an ecologically based system that uses biological and chemical approaches to control. As with BMPs, IPM strategies should be incorporated into every aspect of turf management especially as they relate to environmental impact.

IPM

programs rely on six basic components for plant and environmental protection

- *Genetic* - selecting improved grasses which perform well in specific areas and show a resistance to environmental stress and pest problems

IPM

programs rely on six basic components for plant and environmental protection

- *Regulatory* - using certified seed and sod to prevent unwanted weed contamination and guaranteeing true-to-type seed, sod and sprigs of the best adapted turfgrass species and cultivars

IPM

- *Physical* - mechanical removal of pests (i.e. hand weeding in selected areas) and cleaning equipment to prevent spreading of diseases and weeds from infected areas

IPM

- *Biological* - for a limited number of pest problems biological control can be used whereby natural enemies are favored or introduced to effectively compete with the pest; biological control can also include developing habitat to favor natural predation such as installing bird and bat houses thus favoring an increase in populations which feed on insects

IPM

- *Cultural* - following recommendations made for proper cultural practices which will maintain the turf in the most healthy condition and influence its susceptibility and recovery from pest problems. Proper application of practices such as proper mowing techniques, good nutrient management, sound irrigation management, aerification, vertical mowing, and topdressing should produce a high quality turf

Use only organic fertilizers!!

- Adds OM
  - One fertilizer application of a 6-2-0 material will add 700 lbs of OM/acre…
  - There is already 20,000 lbs of OM/acre in a soil that has 1% OM by weight!
- Organic fertilizers don’t contain any salts…

NUTRIENT CATEGORIES

- ANIONS (-)
  - NO_3^{-1}, HPO_4^{-2}, $H_2PO_4^{-1}$, SO_4^{-2}, Cl^{-1}, $H_2BO_3^{-1}$, MoO_4^{-2}
- CATIONS (+)
  - NH_4^{+1}, K^{+1}, Ca^{+2}, Mg^{+2}, Fe^{+2}, Mn^{2+}, Cu^{2+}, Zn^{2+}, Na^{+1}
- All are salts!

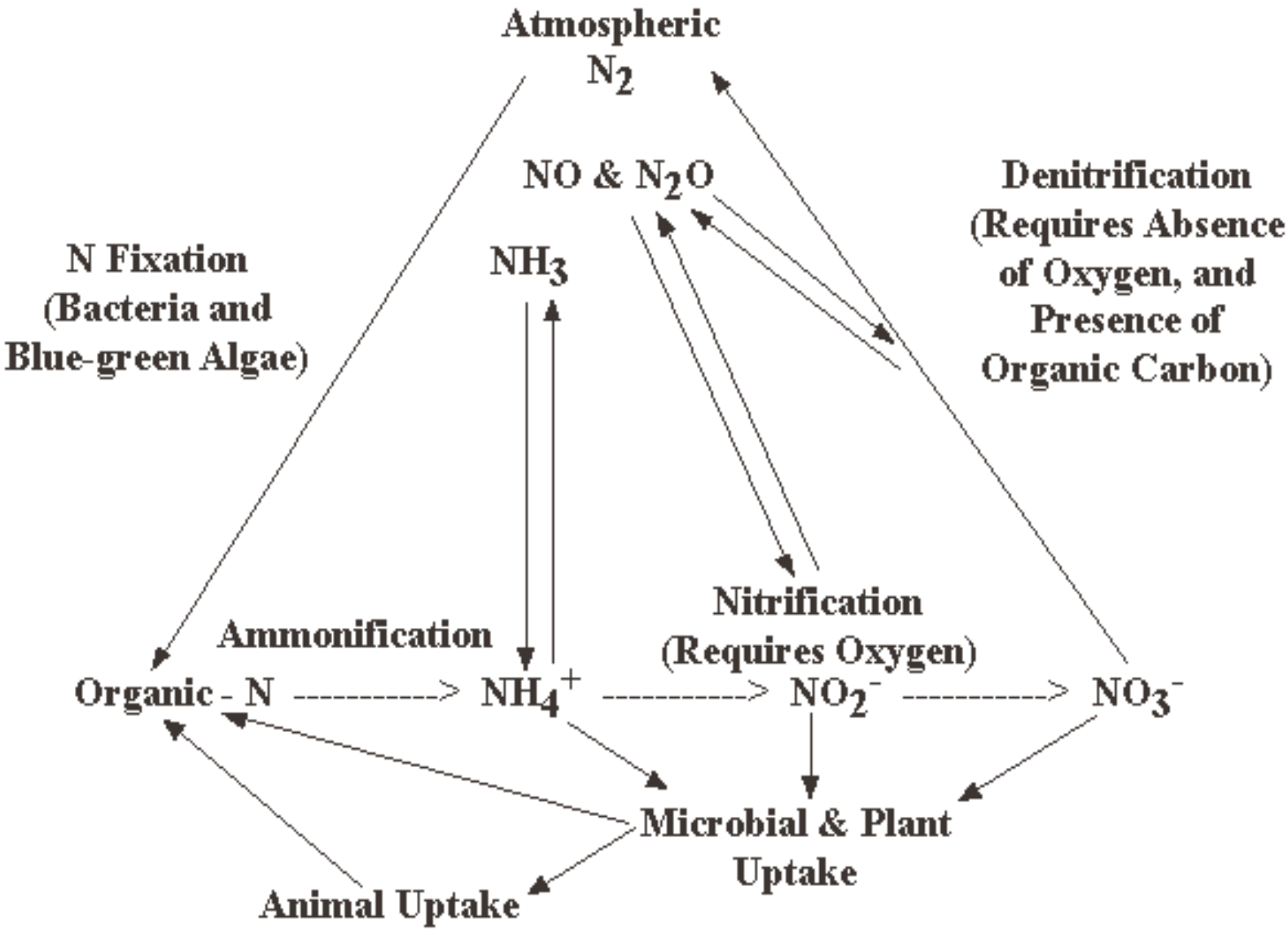


Figure 10. The Nitrogen Cycle as represented by the more important biologically mediated conversions of nitrogen into different oxidation states occuring within most aquatic and terrestrial ecosystems.

NITROGEN UPTAKE:

- Nitrate (NO_3^-)
- Ammonium (NH_4^+)

Mineralization

The decomposition of complex, N-containing organic molecules and the resulting release of NH_4

Nitrogen Sources

- Inorganic
- Organic
  - Natural Organics
  - Synthetic Organics
    - Fast Release
    - Slow Release

Nitrogen Sources

- Inorganic
  - Contain no Carbon
  - Can burn
  - Hygroscopic
  - Quick release (fast acting)
  - Examples
    - Ammonium Sulfate -21%N
    - Ammonium Nitrate-33%N
    - MAP, DAP

Nitrogen Sources

- Organic- contains carbon
  - Synthetic Organics
    - Chemically based
    - Low to moderate burn potential
- Coated products, UF, Methylene ureas, IBDU, SCU, Polymer Coated Urea, etc.

Nitrogen Sources

- Organic - contains carbon
- Natural Organics
  - Originate from plant or animal sources
  - Low burn potential
  - Slow release by microbes
  - Low N (3-12%)
  - Often high in P
  - Often very low in K

WHAT ARE ORGANIC FERTILIZERS?

- Technically any fertilizer carrier which contains a carbon atom as part of the chemical formula
- Would include urea, UF, IBDU, etc.
- Does not always mean slow availability

WHAT ARE NATURAL ORGANIC FERTILIZERS?

- Nitrogen is in a complex form
- Not readily water soluble
- Not readily available to the plant

HISTORY OF USE

- From 1800's until 1950's almost all fertilizers were of natural origins
- Cheap energy costs brought on development of higher analysis synthetics

NATURAL ORGANIC MATERIALS

SOURCE	% N
Blood meal	13
Bone meal	4
Animal tankage	7
Processed manures	3 to 6
Soybean meal	7
Feather meal	16

NITROGEN RELEASE FROM NATURAL ORGANICS

- Depends on the source of the carrier
- Depends on the processing of the carrier

NITROGEN RELEASE FROM NATURAL ORGANICS

- Depends on moisture availability
- Depends on soil temperature - need soil temperatures consistently above 60 F.

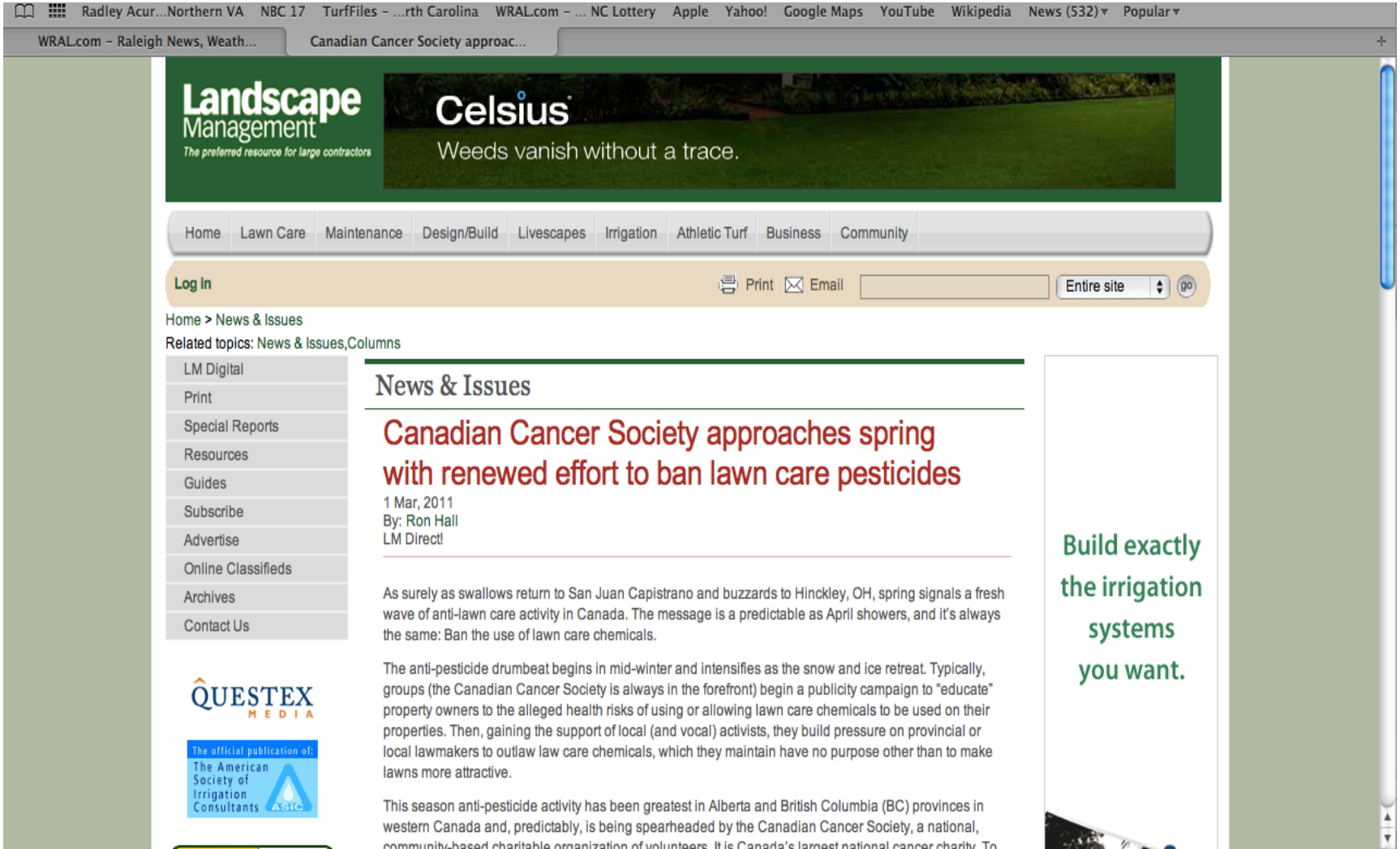
NITROGEN SOURCES

Nitrogen Carrier	Acidifying effect:
Ammonium nitrate	Medium
Ammonium sulfate	High
Urea	Medium
IBDU	Low
Ureaform	Medium
Natural organics	Low

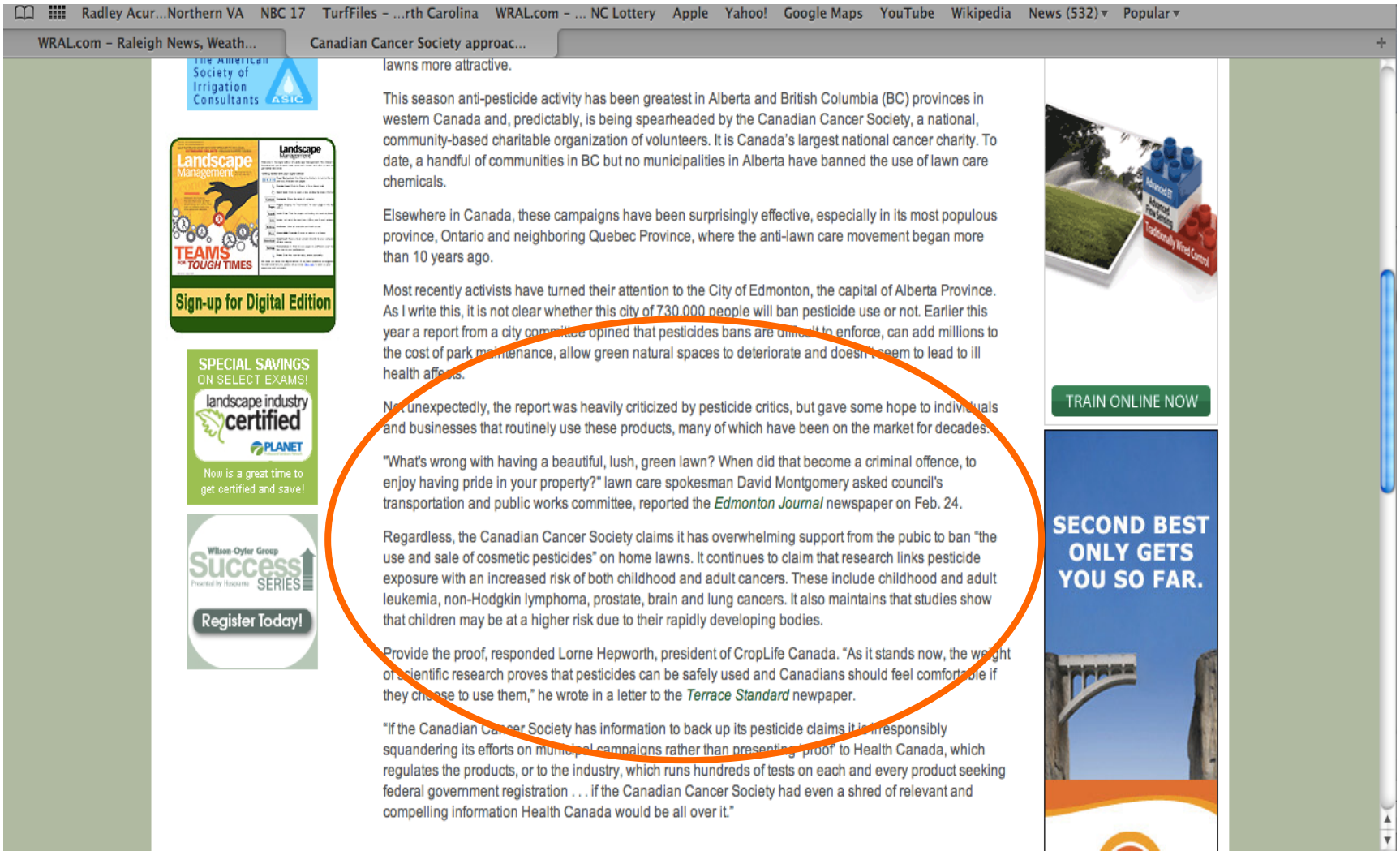
IPM

- *Chemical* - pesticides are a necessary and beneficial approach to turf pest problems, but use can be restricted in many cases to curative rather then preventive applications, thus reducing environmental exposure.

Ban Pesticides!



Ban Pesticides



CT Pesticide Ban

Connecticut's Lawn Care Pesticide Ban

Information for Schools and Day Care Centers

1. Why no pesticides?

The Connecticut legislature passed a law (P.A. 09-56) banning lawn care pesticide applications on the grounds of day care centers, elementary and middle schools (grade 8 and lower) as a result of residents' concerns about children's health and the environment. This ban went into effect for day care centers on October 1, 2009 and for K-8 schools on July 1, 2010. Some Connecticut municipalities have gone beyond the requirements of the law and have stopped using pesticides to manage turfgrass on all their municipal properties.

CT Pesticide Ban

4. Are there any pesticides that can be used under the new law?

There are some pest control products that can be applied. EPA has developed criteria for minimum risk pesticides, which are exempt from federal registration and do not bear an EPA registration number. The EPA criteria for these products can be found at http://www.epa.gov/oppbppd1/biopesticides/regtools/25b_list.htm. These pesticides are allowed for use on day care centers and K-8 school grounds in Connecticut. Pertinent statutes and regulations must be followed including the requirements that applicators who apply pesticides on school grounds must be licensed and schools under the control of a Board of Education must have a written pest control policy and a system of notification in place.

IPM

Pesticide selection is based on an ecological risk assessment approach that strives to use only pesticides that are based on effectiveness, are not toxic to non-target species, that act quickly and degrade quickly, are not soluble and not persistent.

IPM

Few pesticide applications should be made on a regularly scheduled basis. Exceptions may include pre-emergent herbicides and fungicides used to control specific diseases which are predictable based on site history and prevailing environmental conditions.

IPM

Additionally, materials must be applied strictly in accordance with label instructions, at labeled rates, under appropriate environmental conditions (i.e., no spraying on windy days or when rain is forecast), with a low-volume sprayer to reduce the possibility of drift or using a shrouded sprayer

IPM

Materials will be rotated for specific uses.

This will deter the development of resistant strains of pests which may require more frequent and/or higher rates of pesticide applications.

Bio-Rational Materials

- Pest control materials that are relatively non-toxic with few ecological side-effects are sometimes called ‘bio-rational' pesticides, although there is no official definition of this term. Some, but not all, biorationals qualify for use on organic farms.

Organic Materials Review Institute - OMRI

Crop Fertilizers and Soil Amendments

Activated Charcoal

Black Owl Premium Organic Biochar Soil Amendment (Biochar Supreme, LLC)

Garden Valley Naturals All Natural & Organic Biochar (Rexius Forest By-Products)

Alfalfa Meal or Pellets

Down to Earth Alfalfa Meal 2.5-0.5-2.5 (Down To Earth Distributors, Inc.)

Amino Acids – nonsynthetic

Amino Acid 80 12-0-0 (Grower's Secret, Inc.)

Amino Plus Amino Acids Organic 14-0-0 (JH Biotech, Inc.)

Bison Soil Nitrogen 12-0-0 (Bison Soil Solutions, LLC)

HYTB BioAmin Regulador de crecimiento no sintético Concentrado Líquido (Bioderpac S.A. de C.V.)

Ψ PHL (Dadelos AgroSolutions, SLU)

Taba (Kan biosys Pvt. Ltd)

AMINOVA 65 Compuesto de Aminoácidos (Zare Agrhos)

Bio Beast Plant Nitrogen 13-0-0 (Custom Formulations LLC)

Biodiversity Organic Nitrogen 12-0-0 (BioDiversity Products Inc)

BioLife S80 Organic Nitrogen Fertilizer Based on Hydrolyzed Proteins, Amino Acids (Suboneyo Chemicals & Pharmaceuticals P.

Ψ Tecamin Bionutriente a Base de L-Aminoácidos de Origen Vegetal Fertilizante Líquido Para Aplicación Radicular y Foliar (Agritecno Fertilizantes S.L.)

Ψ Tecomin Fertilizante Orgánico Liquido (Iberfol S.L.)

Ψ TRAINER (Italpollina Spa)

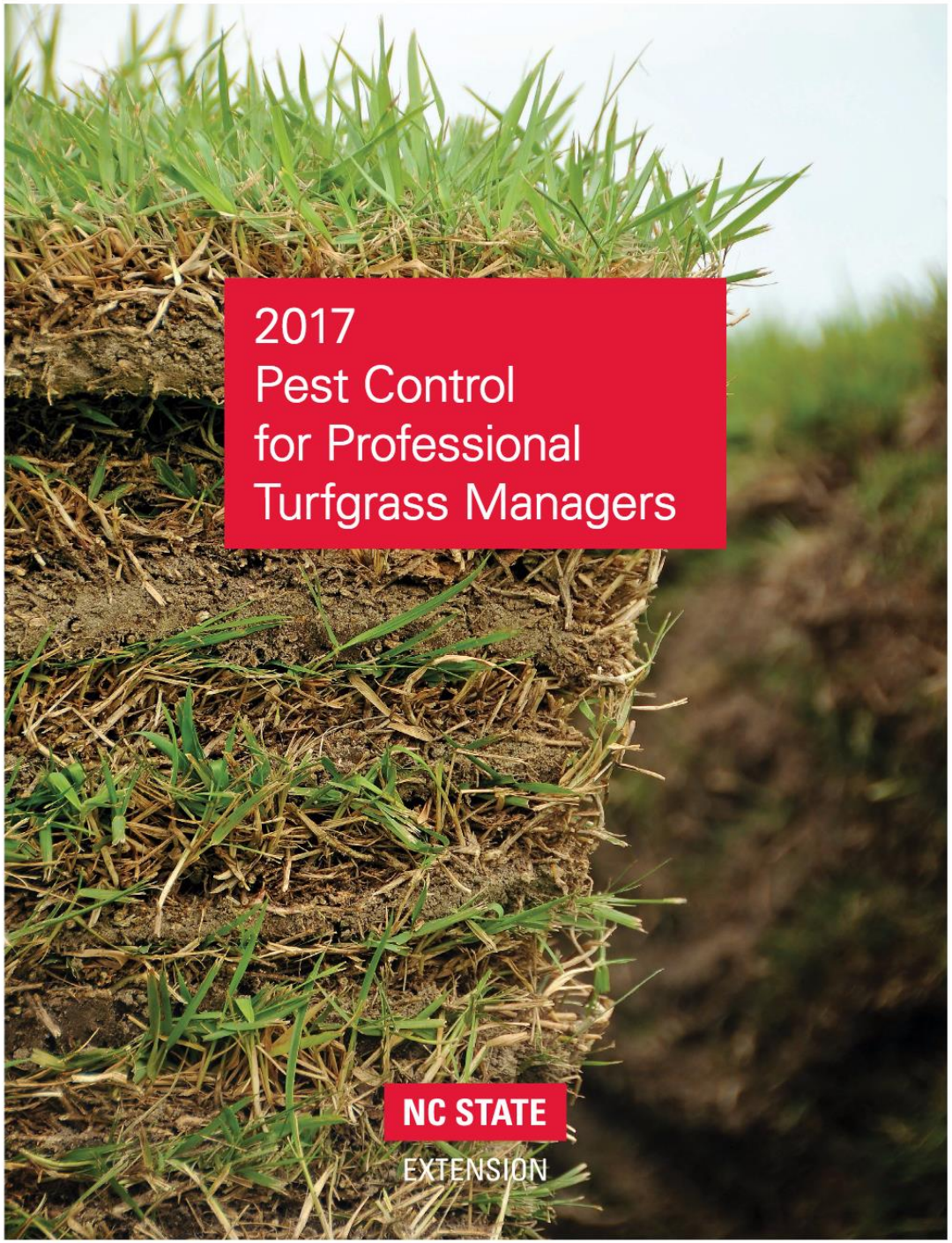
Trebol Fertilizantes Orgafertil Jardín Fertilizante Orgánico Líquido (Fertilizantes Y Foliares de Irapuato)

Trebol Fertilizantes Orgafol Fertilizante Compuesto a Base de Productos Orgánicos (Fertilizantes Y Foliares de Irapuato)

Wake Up Organo (Natural Resources Group)

Anaerobic Digestate – from manure feedstock

Products of anaerobic digestion produced with manure feedstocks are subject to the same restrictions as raw, uncomposted manure. They may only be (i) applied to


2017
Pest Control
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EXTENSION

Bio-Rational Insecticides

- Pyrethrum - It is one of the most commonly used allowed non-synthetic insecticides in certified organic agriculture.
- Derived from flowers in the Chrysanthemum family.

Bio-Rational Insecticides

- Pyrethroids = synthetic pyrethrins such as bifenthrin, cyfluthrin, cypermethrin, delta-methrin, lambda-cyhalothrin, permethrin

Not permitted by OMRI

Bio-Rational Insecticides

- Pyrethroids – labeled for:

Ants, red-imported fire ant, bees, wasps, billbug, chinch bug, cutworm, armyworm, fall armyworm, leafhopper, spittlebug, mole cricket, sod webworm, sowbug

Bio-Rational Insecticides

- Azadirachtin – insecticide for caterpillars

  key insecticidal ingredient found in the neem tree is azadirachtin, a naturally occurring substance chemically similar to insect hormones called "ecdysones," which control the process of metamorphosis as the insects pass from larva to pupa to adult. Blocks molting, thus disrupts life cycle.

Nontoxic to mammals. Low environmental impact unless introduced into aquatic environment where it is very toxic.

Bio-Rational Insecticides

- Azadirachtin – insecticide for caterpillars (cutworm, armyworm, sod webworm)

Advantages

naturally occurring material – extract from seeds of the Neem tree

nontoxic to mammals

In the UK, pesticides that contain Azadirachtin and/or neem oil are banned!

Bio-Rational Insecticides

- Azadirachtin – insecticide for caterpillars (cutworm, armyworm, sod webworm)

Disdavantages

must be ingested by insect when in early immature stages.

Cost - $63/pint or $5.25/1,000 sq.ft. for material

Azatrol EC Insecticide (Azadirachtin) - Windows Internet Explorer
http://www.planetnatural.com/site/azatrol.html
azadirachtin
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Soil Care
Soil Amendments
Soil pH & Test Kits
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Barriers & Repellents
Beneficial Insects
Biological Pest Control
Fungicides & Plant Disease
Home Pest Control
Insect Traps & Lures
Natural Pesticides
Soaps, Oils & More!
Garden Supplies
Gardening Equipment
Plant Protection
Seed Starting
Sprayers & Applicators
Pond Care
Indoor Garden Supply
Advanced Nutrients
Air & Water Pumps
Climate Controllers
CO2 Systems
EC, TDS & pH Testing
Growing Media
Hydroponic Nutrients
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Hydroponic Systems
Plant Propagation & Cloning

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Azatrol EC Insecticide (Azadirachtin)

OMRI Listed for use in organic production. Azatrol® is an azadirachtin insecticide (1.2%) formulated to provide broad spectrum insect control with very low environmental impact. A popular botanical insecticide/ miticide with multiple modes of action.

Anti-Feedant: Insects will feed less or not at all on treated plant tissue. Foliage is not damaged and insects ultimately starve to death.

Insect Growth Regulator (IGR): Insects will fail to mature and reproduce, eliminating populations over time, or keeping populations at acceptable levels.

Anti-Ovipository & Repellent: The likelihood of insect infestation is greatly decreased in treated plants. This also adds a preventive aspect to your control program.

Azadirachtin does not provide the quick "knock-down" of a contact poison. However, 21 days after treatment, insect control is comparable to the standards. The end result - insect pop... preventive treatment throughout the s...son, prior to insect infestation, the goal of protecting plants, ornamental flowe...and shrubs and trees will be accomplished. Non-toxic to honeybee...nd many other beneficials.

Product Label - PDF format
Material Safety Data Sheet (MSDS) - ...DF format
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Item: 16 oz. Concentrate

Price: **$63.50**

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Bio-Rational Insecticides

- *Bacillus thuringiensis* toxins

Spores and crystalline insecticidal proteins produced by *B. thuringiensis* are used as specific insecticides under trade names such as Dipel and Thuricide. Because of their specificity, these pesticides are regarded as environmentally friendly, with little or no effect on humans, wildlife, pollinators, and most other beneficial insects.

Bio-Rational Insecticides

- *Bacillus thuringiensis* toxins

Advantages

- act through a natural process after bacteria are ingested
- Cost – several cents per 1,000 sq.ft.

Disadvantages

- must be ingested – no residual
- may take up to 5 days for it to act

Bio-Rational Insecticides

- *Bacillus thuringiensis* - labeled for:

cutworm, armyworm, sod webworm;

The subspecies *galleriae* is labeled for white grubs under the trade name 'grubGoneG'

$10/1,000 sq.ft.

Bio-Rational Insecticides

- Spinosad – insecticide

Produced by a soil actinomycete

Spinosad is a mixture of the two most active naturally occurring metabolites (spinosyns A and D) produced by *Saccharopolyspora spinosa*

OMRI approved

Bio-Rational Insecticides

- Spinosad – insecticide for cutworm, armyworm, sod webworm, red imported fire ants)

Advantages

a high degree of activity on targeted pests and low toxicity to non-target organisms (including many beneficial arthropods)

Disadvantages

short residual (2 to 9 days)

not systemic

Cost - $5 to 7.50 per 1,000 sq.ft. just for material

Bio-Rational Insecticides

- Entomogenous nematodes
- Beneficial nematodes belong to one of two genera: *Steinernema* and *Heterorhabditis* are commercially available in the U.S.
- *Steinernema* is the most widely studied beneficial nematode because it is easy to produce.
- *Heterorhabditis* is more difficult to produce but can be more effective against certain insects, such as white grubs, and Japanese beetles.

Bio-Rational Insecticides

- Entomogenous nematodes
- Advantage – true biological
- Disadvantages - need moisture in the soil for movement (if the soil is too dry or compact, they may not able to search out hosts). Watering the insect-infested area before and after applying nematodes keeps the soil moist and helps move them deeper into the soil. Care should be taken not to soak the area because nematodes in too much water cannot infect.

Bio-Rational Insecticides

- Entomogenous nematodes
- Disadvantages - Exposure to UV light or very high temperatures can kill nematodes. Apply nematodes in the early evening or late afternoon when soil temps are lower and UV incidence is lower as well (cloudy or rainy days are good too). Nematodes function best with soil temperatures between 48Fº and 93Fº day time temperatures.

Bio-Rational Insecticides

- Entomogenous nematodes – labeled for:

cutworm, armyworm, mole crickets

Cost - $3/1,000 sq.ft.

Bio-Rational Insecticides

- Avermectin - naturally occurring compound generated as fermentation product by *Streptomyces avermitilis*, a soil actinomycete.

- Used in fire ant bait – not really a turf problem.

Bio-Rational Insecticide?

- chlorantraniliprole (Acelepryn) – reduced risk synthetic material

Table 21: Biorational Insecticides and Miticides

This table includes products that are registered as pesticides as well as some that are exempt from EPA registration. All of the registered pesticides listed are labeled with the EPA signal word "Caution", the least toxic EPA classification (see Pesticide Safety and Use). Most have low toxicity to bees and beneficial insects. None are federally restricted-use products. Most have dermal and oral LD50 values over 2,000 mg/kg (see Table 28 and 29 for LD50 values for insecticides and fungicides).

Insecticides	Trade Name	Target Pests	Comments
azadiractin	Amazin Plus 1.2%ME[OG]; Aza-Direct[OG]; AzaGuard[OG], Azatin O[OG]; XL; Azatrol EC[OG]; Azera[OG](M); Ecozin Plus 1.2%ME[OG]; Molt-X[OG]; Neemix 4.5[OG], Ornazin 3%EC	Aphids, caterpillars, leafhoppers, leafminers, thrips, whiteflies, beetles, and other insects	An insect growth regulator extracted from the seeds of the neem tree. works by contact or ingestion against immature stages, and has antifeedant properties.
Bacillus thuringiensis *subsp. aizawai*	Xentari[OG]	Caterpillars, as listed for *Bt kurstaki*, as well as cross-striped cabbageworm,	Use in rotation with Bt kurstaki products to prevent resistance. May be used in greenhouse or field.
chlorantraniliprole	Coragen	Caterpillars, Colorado potato beetle, leafminers	May be used as soil or transplant water treatment at planting, in drip or as foliar. Avoid run-off in surface waters. Non-toxic to bees.

Bio-Rational Insecticide?

- chlorantraniliprole (Acelepryn) – interrupts the normal muscle contraction of insects resulting in death. The mode of action of chlorantraniliprole is the activation of insect ryanodine receptors.
- Chlorantraniliprole acts mainly by ingestion and has little contact activity.
- It has been classified as non toxic to birds, mammals, and fish.
- Dr. Rick Brandenburg disagrees that this is a bio-rational material!

Bio-Rational Nematicides

- *Bacillus firmus* (Nortica) - The active ingredient in Nortica™ is the bacterium *Bacillus firmus* strain I-1582. This bacterium colonizes the root system of the turf and produces compounds that protect the root system from nematodes.

- Can be used anywhere nematodes are a problem as it is a true biological.

Bio-Rational Nematicides

- Abamectin (Avid) – a mixture of avermectins containing more than 80% avermectin B1a and less than 20% avermectin B1b. These two components, B1a and B1b have very similar biological and toxicological properties. The avermectins are insecticidal and antihelmintic compounds derived from various laboratory broths fermented by the soil bacterium *Streptomyces avermitilis*. Abamectin is a natural fermentation product of this bacterium.

Bio-Rational Nematicides

- Abamectin (Avid) – for use only on putting greens for sting and ring nematodes

Bio-Rational Nematicides

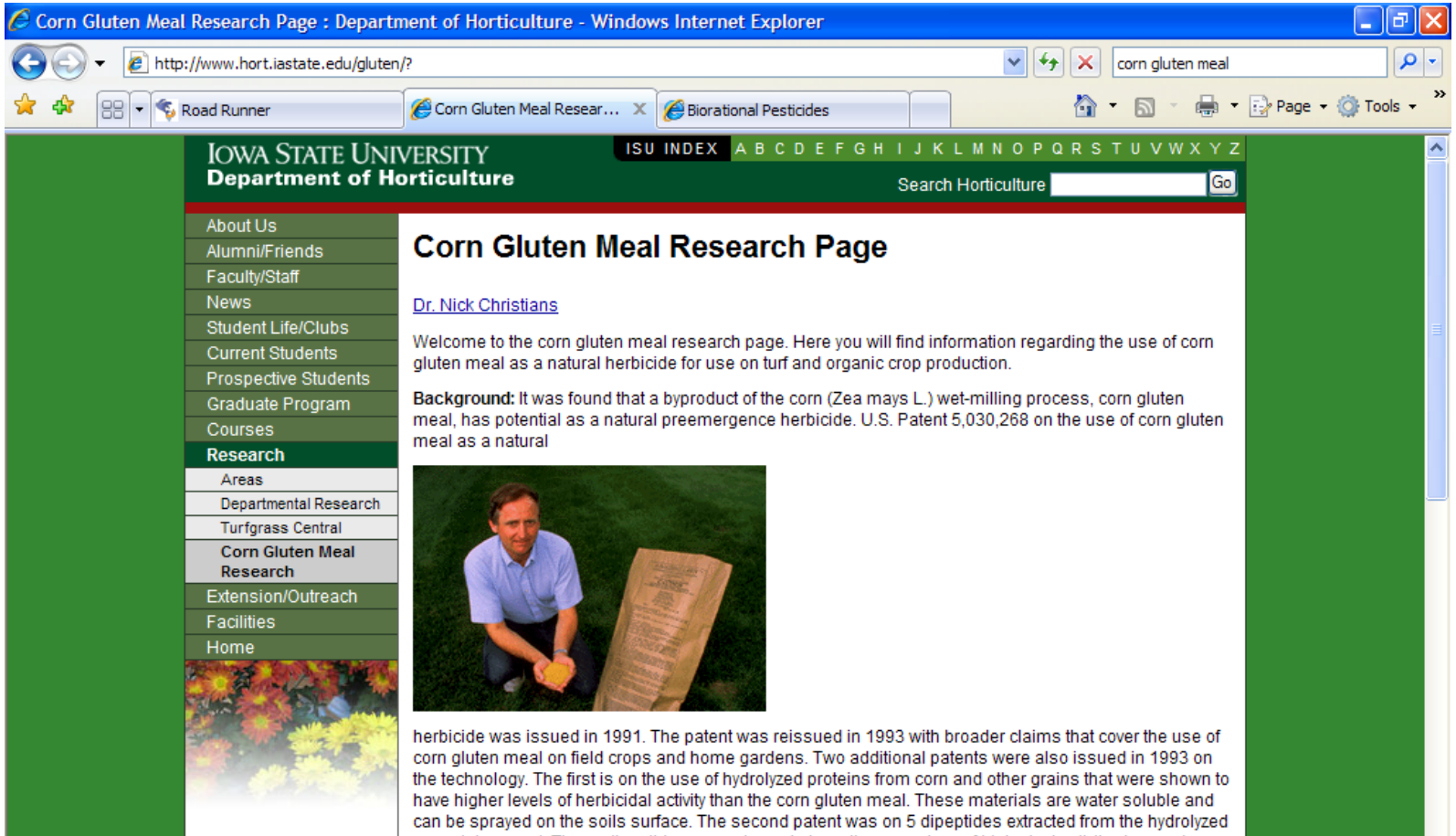
- Furfural (Multiguard Protect) - is an organic compound derived from a variety of agricultural byproducts, including corncobs, oat, wheat bran, and sawdust.
- Multiguard Protect is labeled for golf course tees and greens, practice greens, spot treatment of fairways, roughs and turf/sod farms.

Bio-Rational Fungicides

- Phosphorous acid (Allude, Jetphiter, Magellan, Resyst, Vital) – brown patch, Pythium blight and root rot;
- Mineral oil (Civitas) + proprietary pigment (Civitas Harmonizer) – dollar spot, gray leaf spot, Helminthosporium leaf spot
- Potassium phosphite (Appear) – Pythium blight and root rot

Bio-Rational Materials - Herbicide

- Corn gluten meal



Bio-Rational Materials

- Corn gluten meal

Bio-Rational Materials

- Corn gluten meal

How to use:

Apply 10 to 20 lbs/1000 sq.ft.

If no rain for 5 days, apply 0.25 in of water

Lasts for 5 to 6 weeks

Bio-Rational Materials

- Corn gluten meal (9-1-0)

Advantages

natural material and is nontoxic

provides 1 to 2 lbs N/1000 sq.ft.

Disadvantages

provides 1 to 2 lbs N/1000 sq.ft.

cost – $19.45 to $38.90/1000 sq.ft. just for the material.

IPM approach

- **monitoring** of potential pest populations and their environment;
- **determining** pest injury levels and establishing treatment thresholds;
- **decision making**, developing and integrating all biological, cultural, and chemical control strategies;

IPM approach

- **educating** personnel on all biological and chemical control strategies;
- **timing and spot treatment** utilizing either the chemical, biological or cultural methods;
- **evaluating** the results of treatment.

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