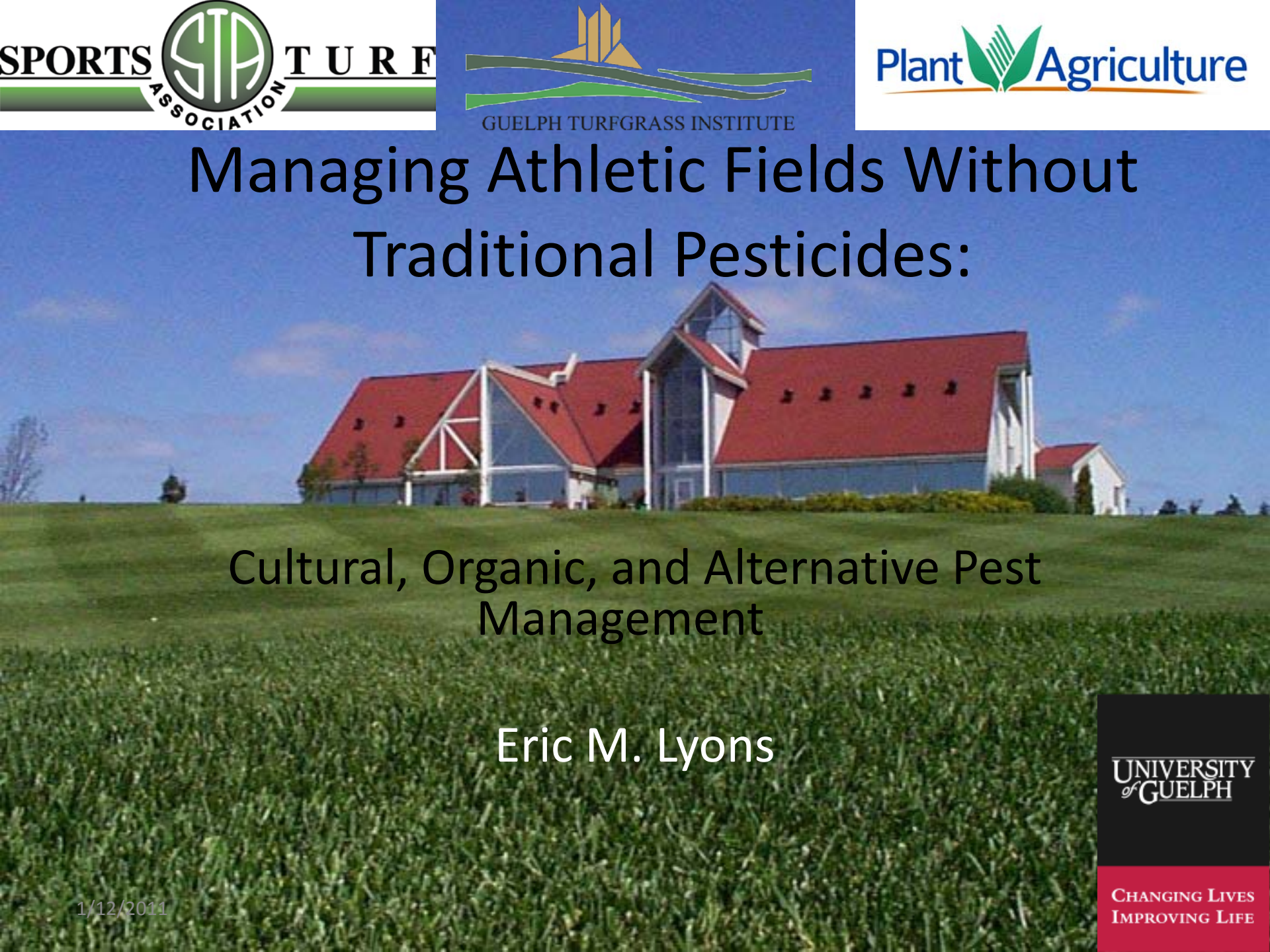
SPORTS STA TURF ASSOCIATION

GUELPH TURFGRASS INSTITUTE

Plant Agriculture

Managing Athletic Fields Without Traditional Pesticides:



Cultural, Organic, and Alternative Pest Management

Eric M. Lyons

UNIVERSITY of GUELPH

CHANGING LIVES IMPROVING LIFE

Philosophy

- Prevent the pest
  - Proper Management
  - Manage Use
- Compete with the pest
  - Maximizing growth
  - Compete with overseeding
- Eliminate the pest
  - Alternative acceptable controls

Basic Management

- Mowing
- Fertility
- Irrigation
- Thatch Control
- Overseeding
- Managing Use
- Establishing Turf

Mowing

Effects of Mowing

- As a cultural practice
  - Most directly affects the grass plant
  - The most frequent maintenance action
  - Greatly underestimated

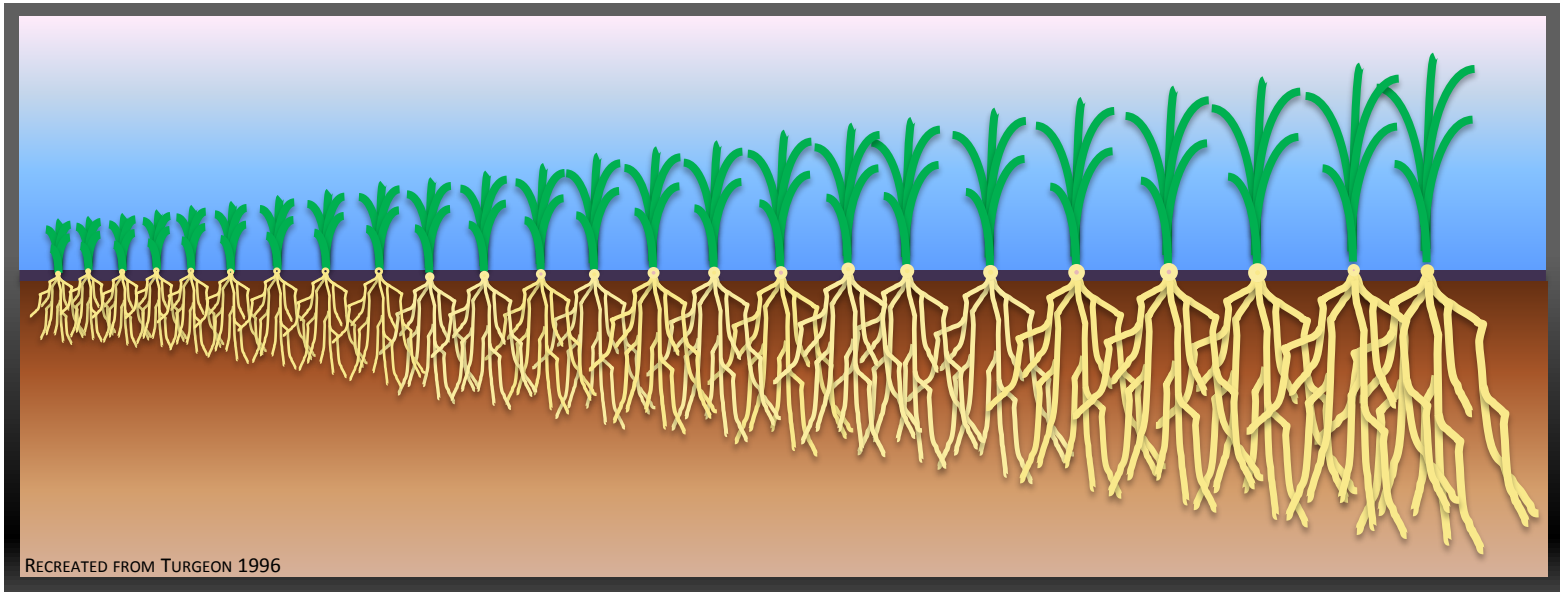
How mowing affects the plants

- Height of cut (HOC) and frequency influence plant size
- Frequent mowing increases lateral growth and tillering

How mowing affects the plant

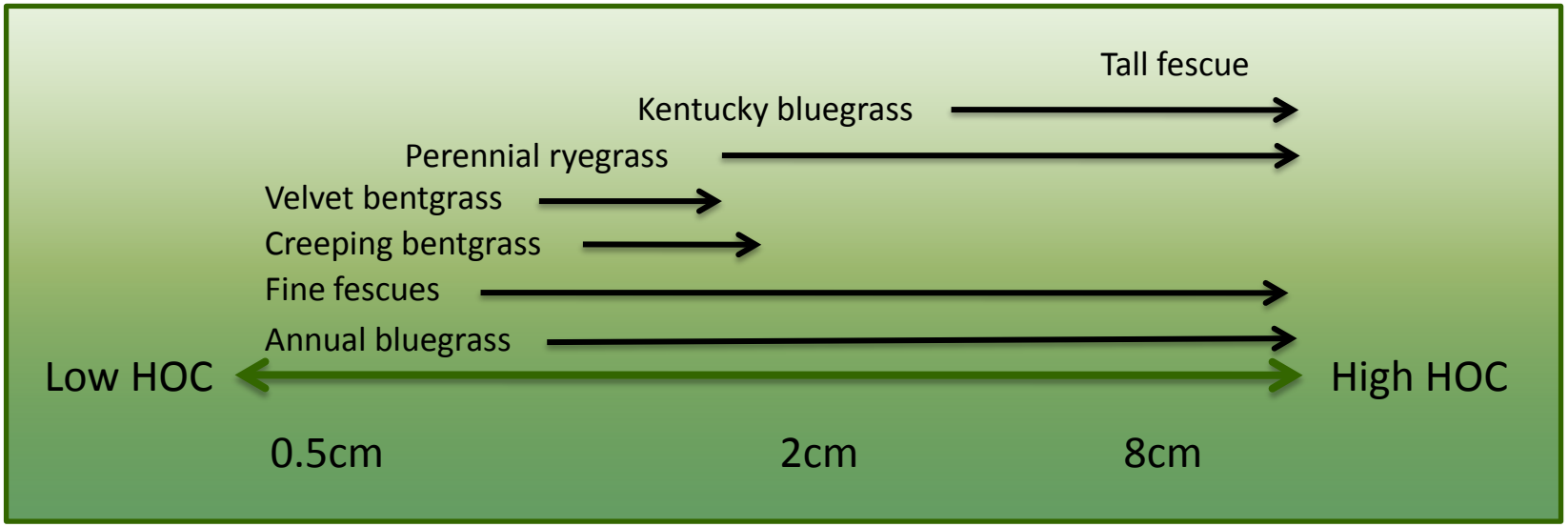
- "Self-thinning law"
  - The shorter and more frequently a grass is mowed, the more dense and finer textured it will be (McCarty, 2005)
- Limiting factors include:
  - Light quality and quantity
  - Water
  - Nutrients

HOC vs Density



DETERMINING HOC

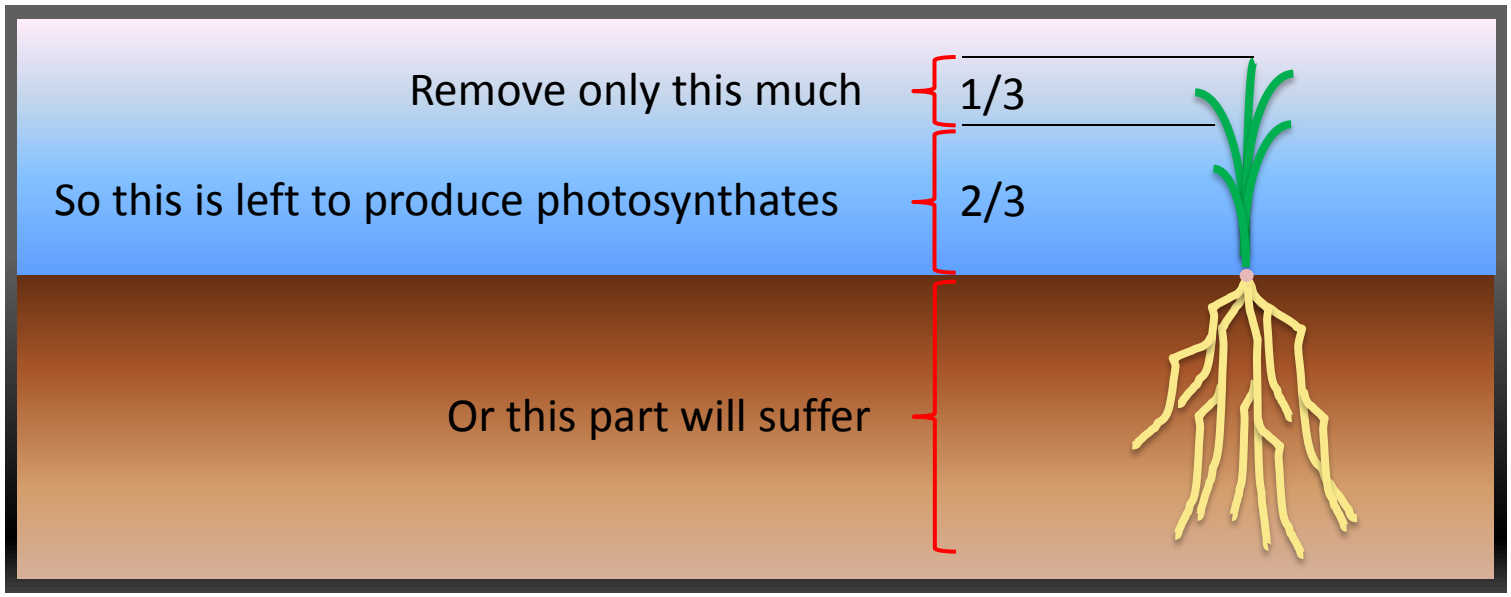
- Species and variety specific



Determining Frequency

- Remove no more than 1/3 of topgrowth at one cutting
  - Height of cut and growth rate determine frequency
  - Growth rate influenced by amount of available nitrogen, time of year/temperature

Determining Frequency

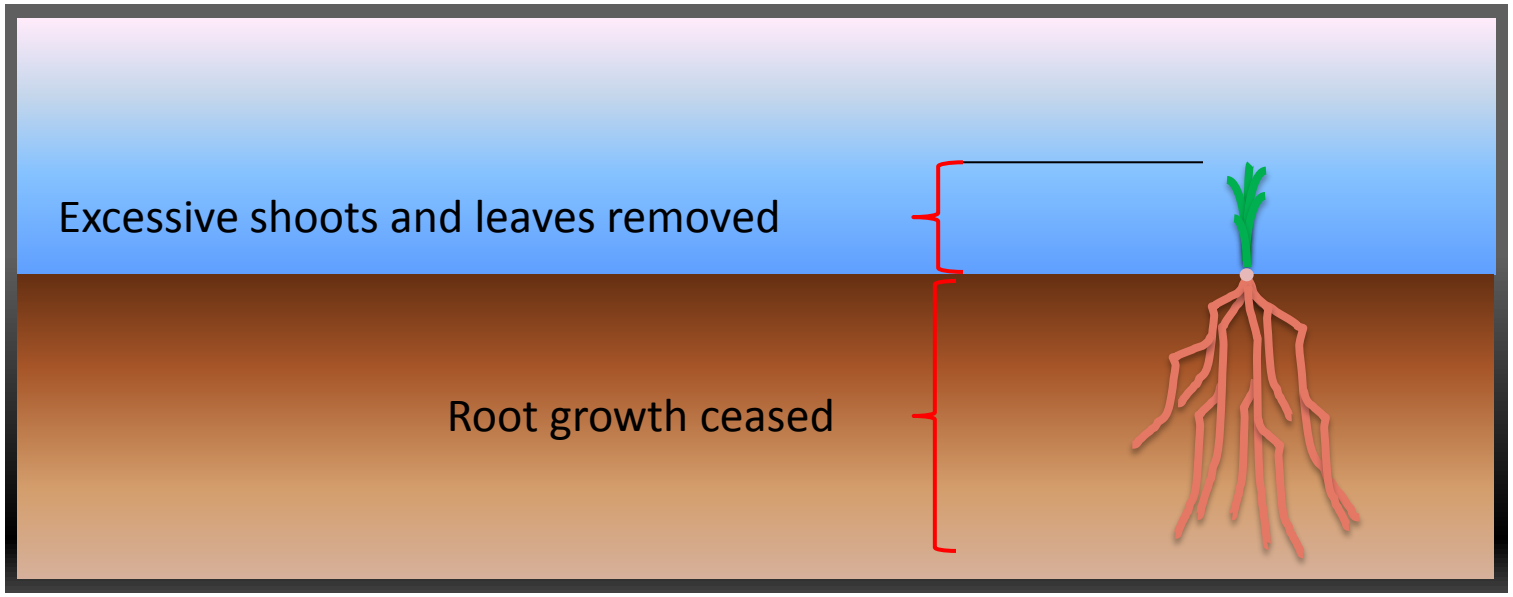


Determining Frequency

Desired HOC:	Mow at:	Desired HOC:	Mow at:
1/8 in	3/16 in	3mm	5mm
1/4 in	3/8 in	7mm	10mm
1/2 in	3/4 in	13mm	19mm
1 in	1 ½ in	25mm	38mm
2 in	3 in	51mm	76mm

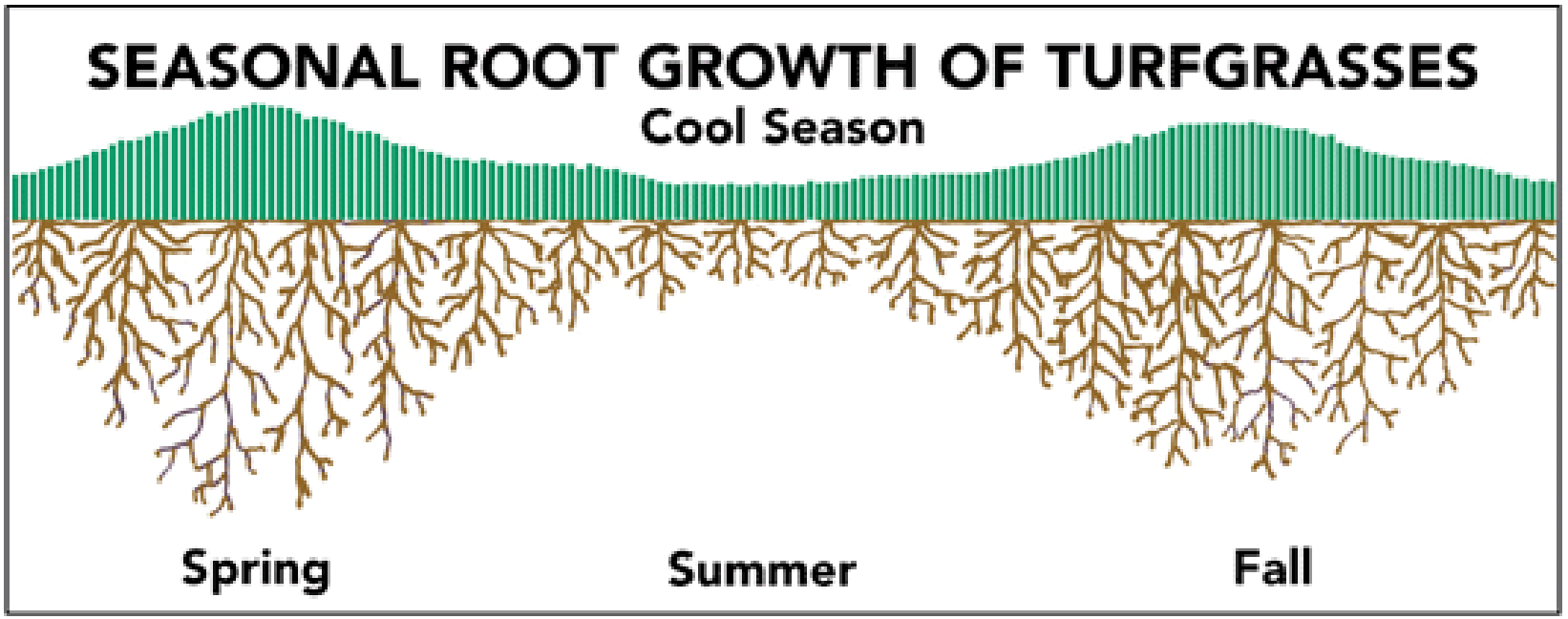
Determining Frequency

- Scalping
  - Removes excessive amount of shoots and leaves
  - Stops root growth temporarily



Mowing - Timing

- Frequency of mowing can change with seasons
  - Increase growth rate in spring and fall
  - Reduced growth rate in the stress of summer



Determining Frequency

- Scalping
  - Removes excessive amount of shoots and leaves
  - Stops root growth temporarily

Choosing a mower

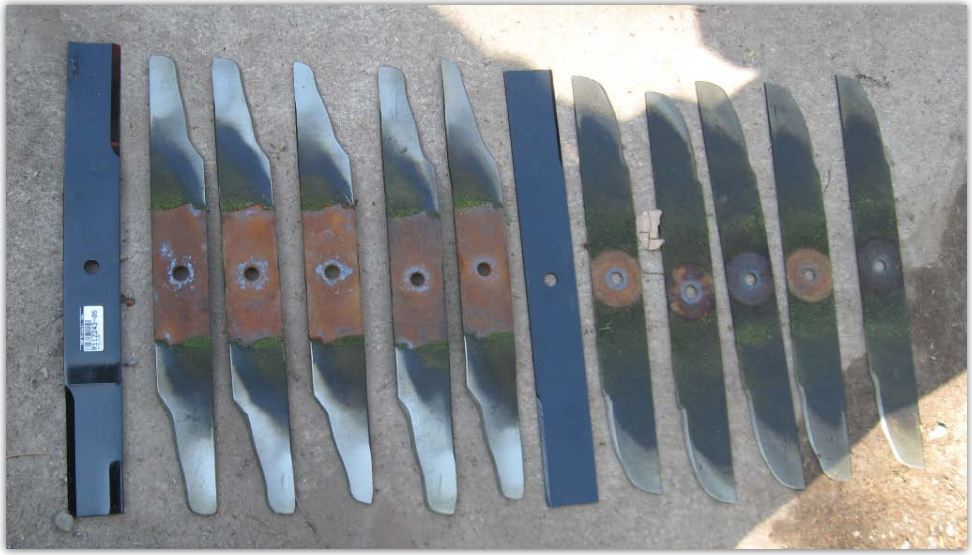
-Ability to maintain

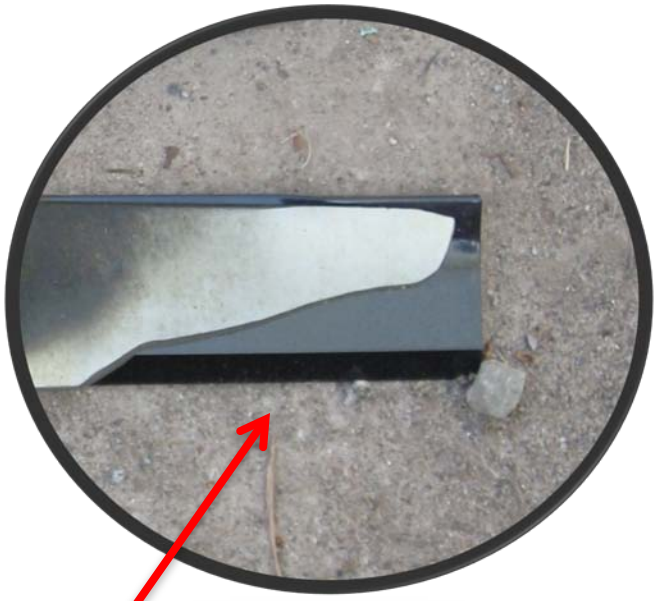
Can you keep them sharp?

Choosing a mower -Ability to maintain

- Sharpening rotary blades
  - Ideal interval – after every four (4) hours of use
  - Realistic interval – after every eight (8) hours of use
    - Have extra sets on hand to reduce mower down-time for blade changes

Time to replace





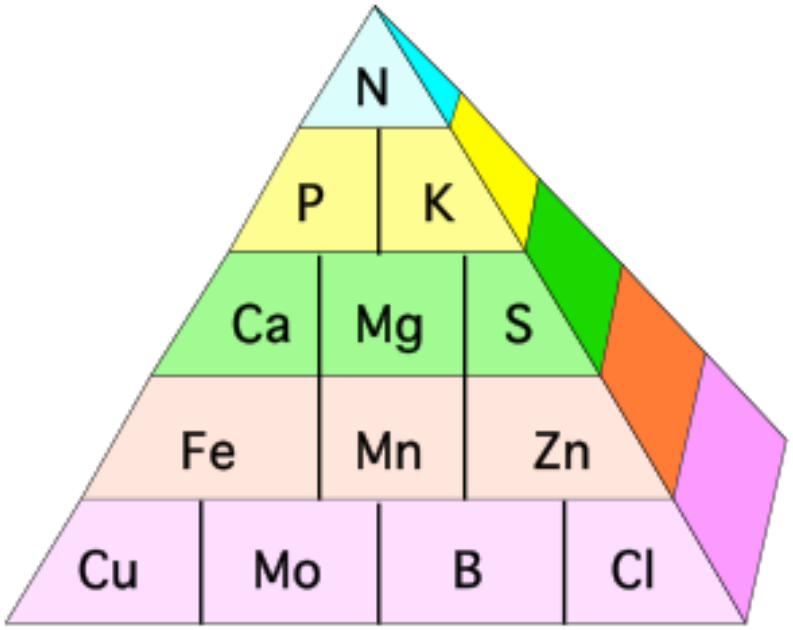
Get Miffed

Mowing

Equipment Problems

Fertilization

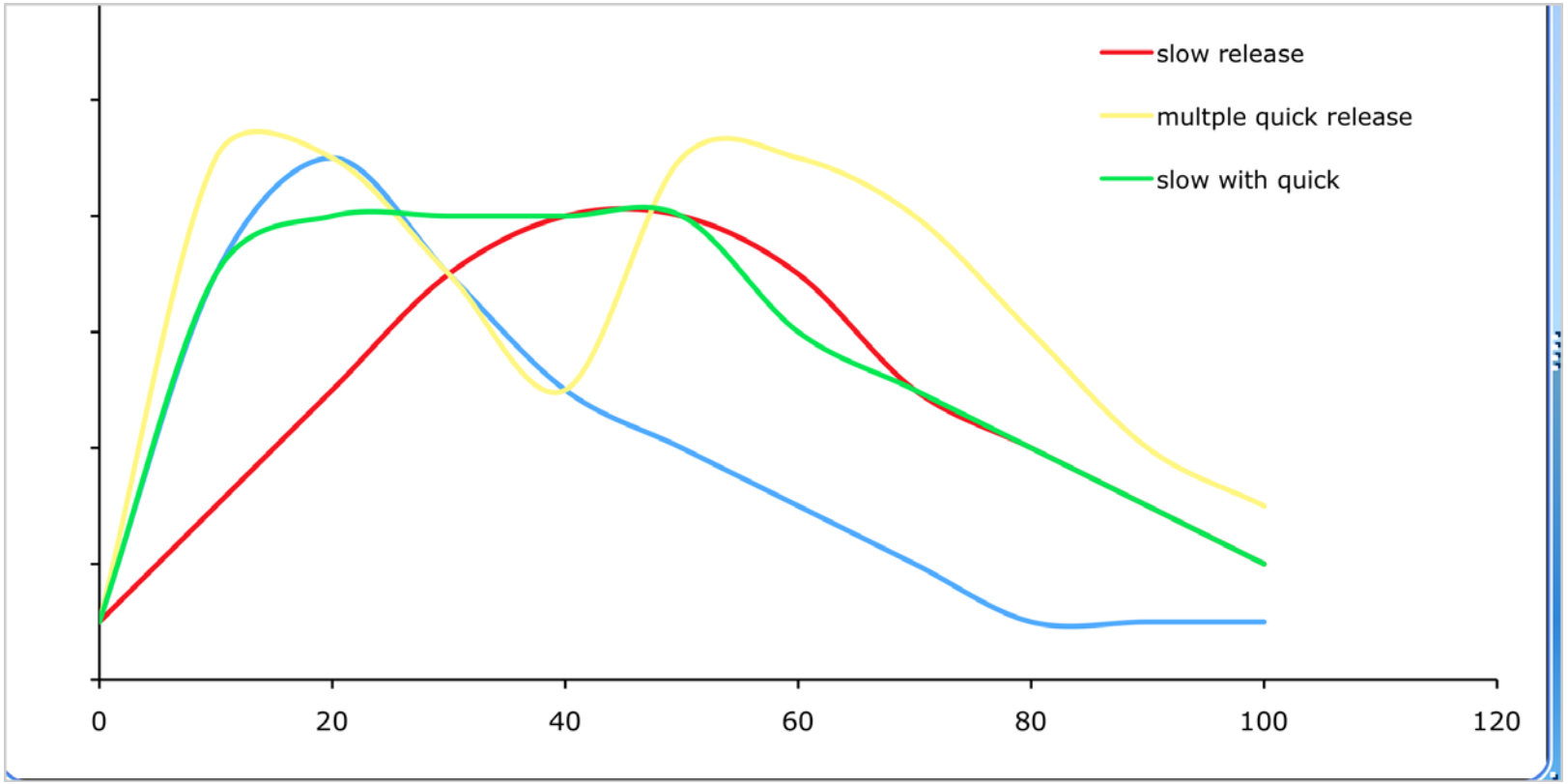
- Provide the enough mineral nutrients for optimal growth
- Nitrogen typically drives growth and recovery
- Optimal growth is a balance between recovery and excessive growth



Advances in fertilization

- Synthetic Fertilizers
  - Flush of growth
  - Loss to environment
- Controlled release
  - Steady growth
  - Better plant uptake
  - Lower amounts per season
  - Loss of control (once it is down, its down)

Growth response

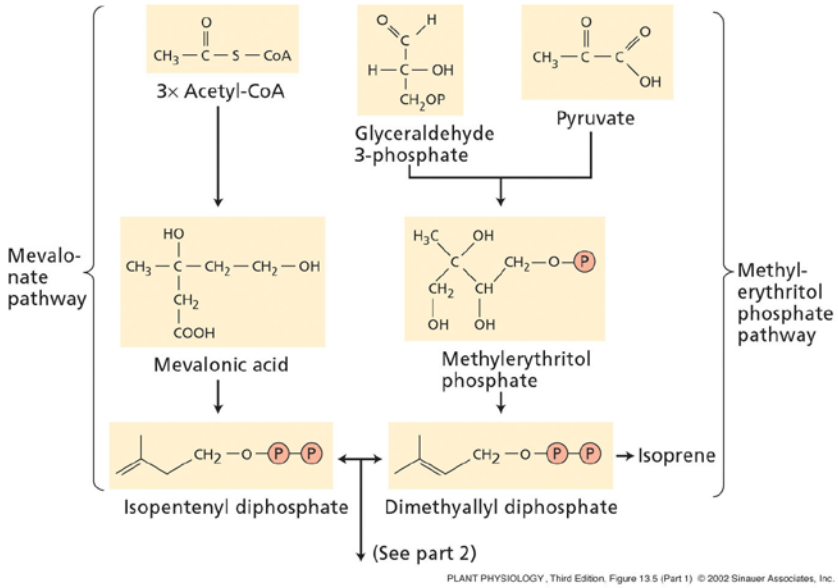


Mechanisms of Release of Slow Release

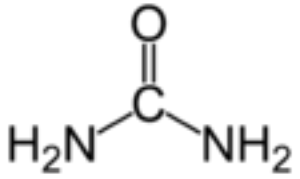
- SCU – Dissolving of coating – Water
- IBDU – hydrolysis – Water
- Methylated / Formaldehyde Urea- Microbial activity – Temperature (Water present)
- Polymer Coated Urea – Diffusion through micropores – Temperature (Water present)

What are Organic Fertilizers

Organic Chemistry?



- Chemistry of Carbon Containing compounds
- Primarily looking at petroleum products
- Carbon containing products were once part of an Organism
- Urea?



Organic (as Defined by the USDA)

- Organic food is produced without using most conventional pesticides; fertilizers made with synthetic ingredients or sewage sludge; bioengineering; or ionizing radiation.
- Organic meat, poultry, eggs, and dairy products come from animals that are given no antibiotics or growth hormones.

Types of Organic Fertilizers

- Manures and animal products
  - Hog, poultry, dairy
  - Bone meal
- Plant Products
  - Alfalfa pellets, Corn Gluten, Kelp, leaf litter
- Mined nutrient sources
  - Calcium Nitrate (not organic in Canada), rock phosphate

Types of Organics Con.

- Sewage Sludge
  - Not allowed for Organic certification
- Composts
  - City sources
  - Teas

Mechanisms of Release of Organic Fertilizers

- Microbial activity
- Dependent on Temperature
- Water must be present but more water does not speed the release.

Why Organics?

- Feeding the soil
- Particularly important for tilled fields
  - Soil carbon
- Full nutrient spectrum
  - From living organisms so contains things living organisms need

Organics in Turf?

- Carbon not an issue
  - Introduce O_2 through aeration
  - Can add full spectrum of nutrients
- Other Benefits?
- First a bit on synthetic fertilizers

Nitrogen Content

Synthetic

- Percent N High
- Cost per bag: High
- Cost per unit N: Variable
- Very consistent
  - Guaranteed analysis
  - All inert ingredients known and consistent

Organic

- Percent N Low
- Cost per bag: Variable
- Cost per unit N: High
- Consistency dependent on product
  - Some have guaranteed analysis, inert ingredients may change
  - Some have no analyses

Things to consider about Organics

- C:N ratio
- Benefits in terms of fertility
- Application issues
- Added benefits beyond fertility (agronomic)
- Added benefits beyond fertility (environmental)

Carbon to Nitrogen Ratio

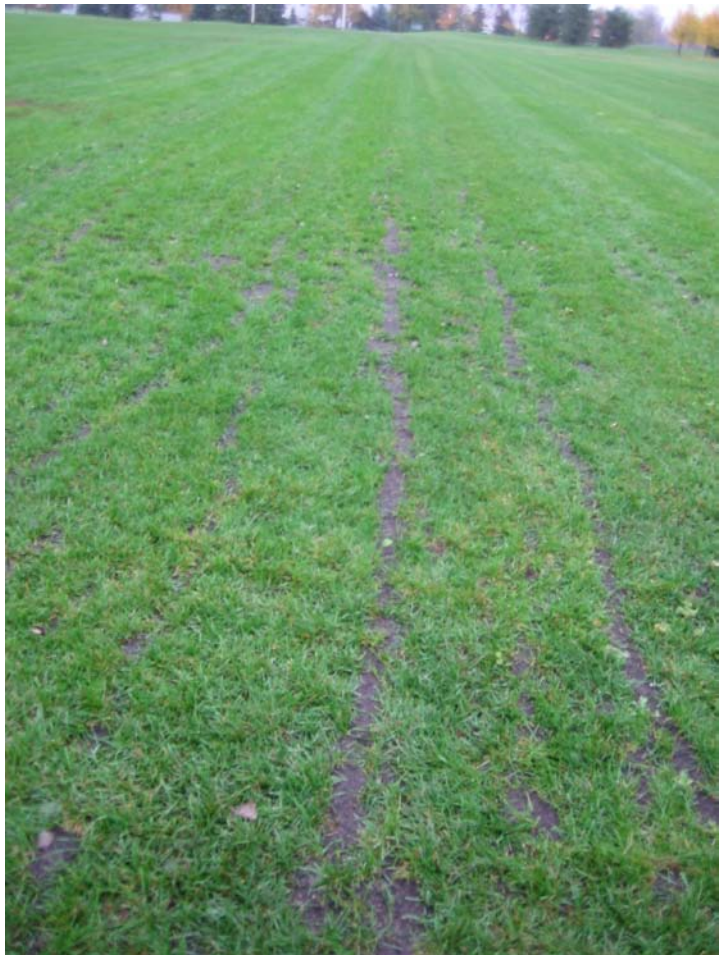
- Microbes need nutrients, carbon (energy) and nitrogen (proteins)
- As the amount of Carbon in the soil increases microbes will start to make nitrogen unavailable in the soil

Unwanted ingredients

- Heavy metals
- Undesirable pH
- Most bagged and marketed products have worked on quality control
- Local products best cost and have environmental benefits but often inconsistent

Application issues

- Inconsistent spread
  - Often must be applied very dry
  - Need specialized equipment
- Smell
- Debris and other unwanted materials



Societal Considerations

- People want Organics
- Happy-feel-good products
- Smell

Making Decisions

- All fertilizers have advantages
- All fertilizers have drawback

Irrigation

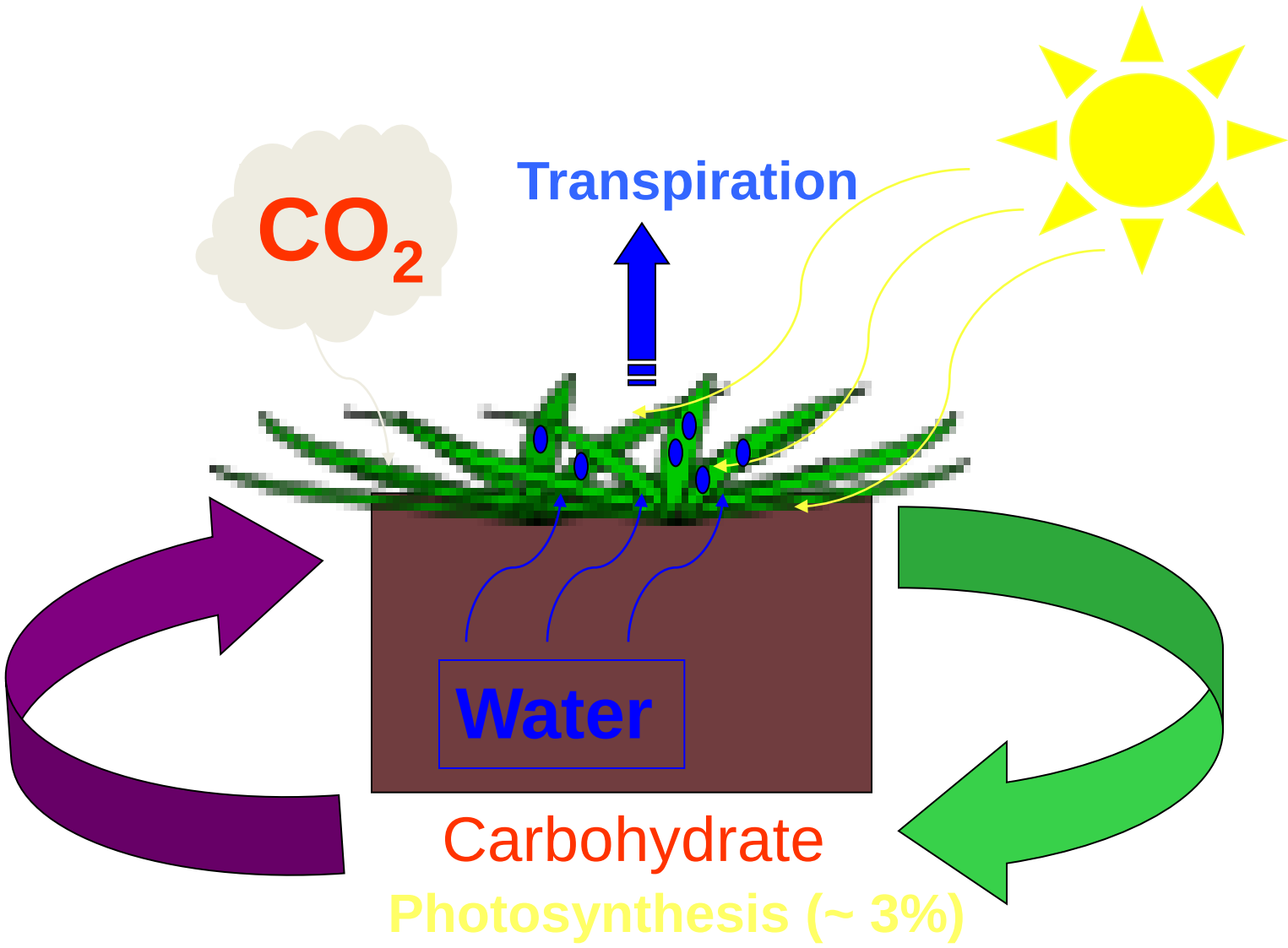
Water Philosophy
Intelligent Use of Water

- Plant Growth
- Chemical Applications
- Use up Effluents
- Tournament play and field use

Soil Plant Relations

- Proper Irrigation Management
- Textural Triangle
- Particle size and shape
- Compaction and Thatch

HOW IS WATERED USED IN PLANTS?



Excessive Water

- Oxygen Deficit
- Leeching of Nutrients
- Wasted Water and Power
- Turf quality suffers and could lead to closures

Evapotranspiration

- Modified Penman equation
- Time based Schedule vs. E.T
- Formula Inputs
- Evaporation through Soil
- Transpiration through the Plant

Factors That Influence Scheduling

- Mowing Heights
- Mowing Schedules
- Use
- Weather
- Equipment (sprinkler type)
- Soil Type
- Turf type

Overseeding

Slit Seeder

Rotary Spreader

Overseeding

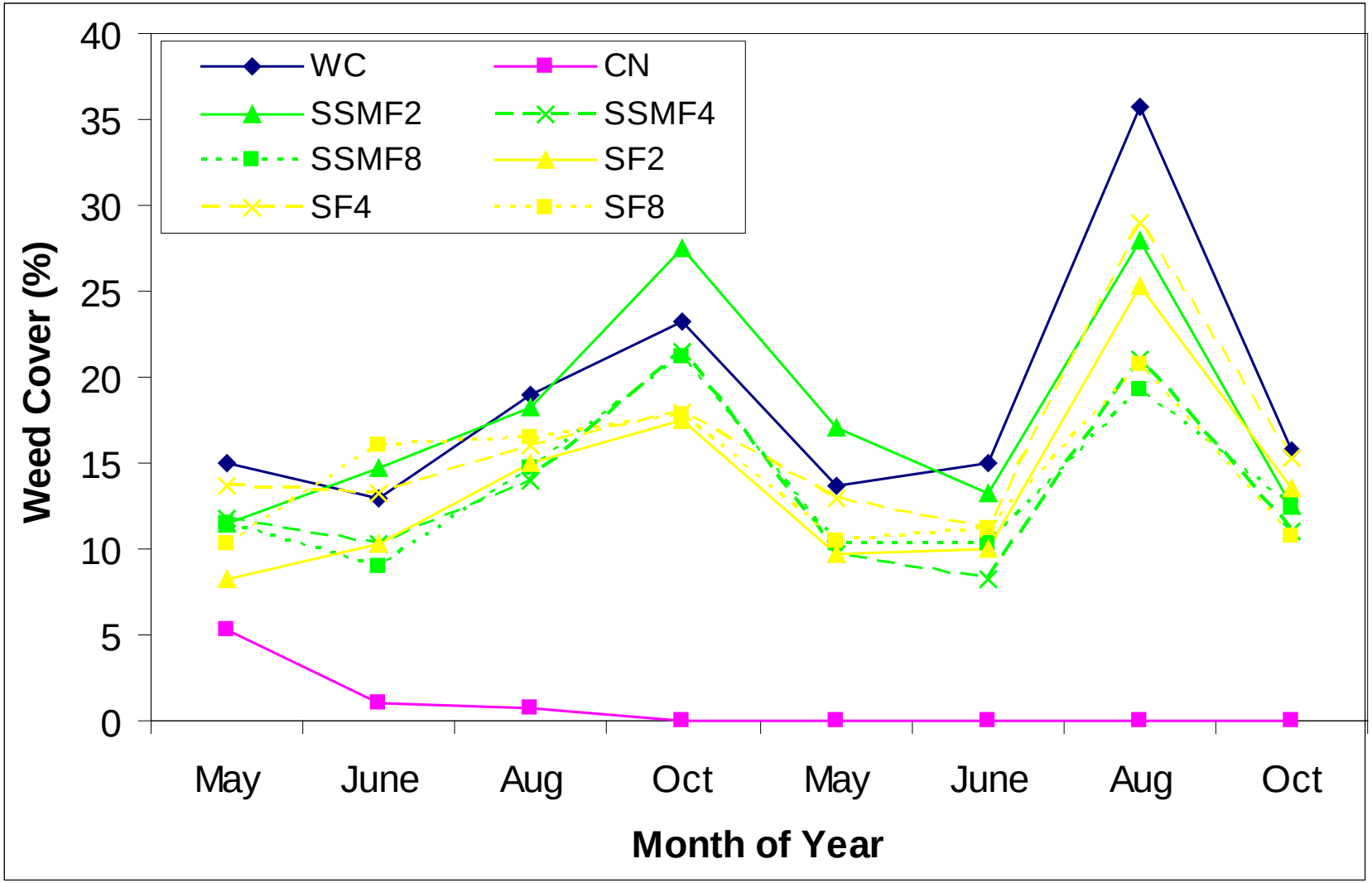
not just for the fall anymore

June

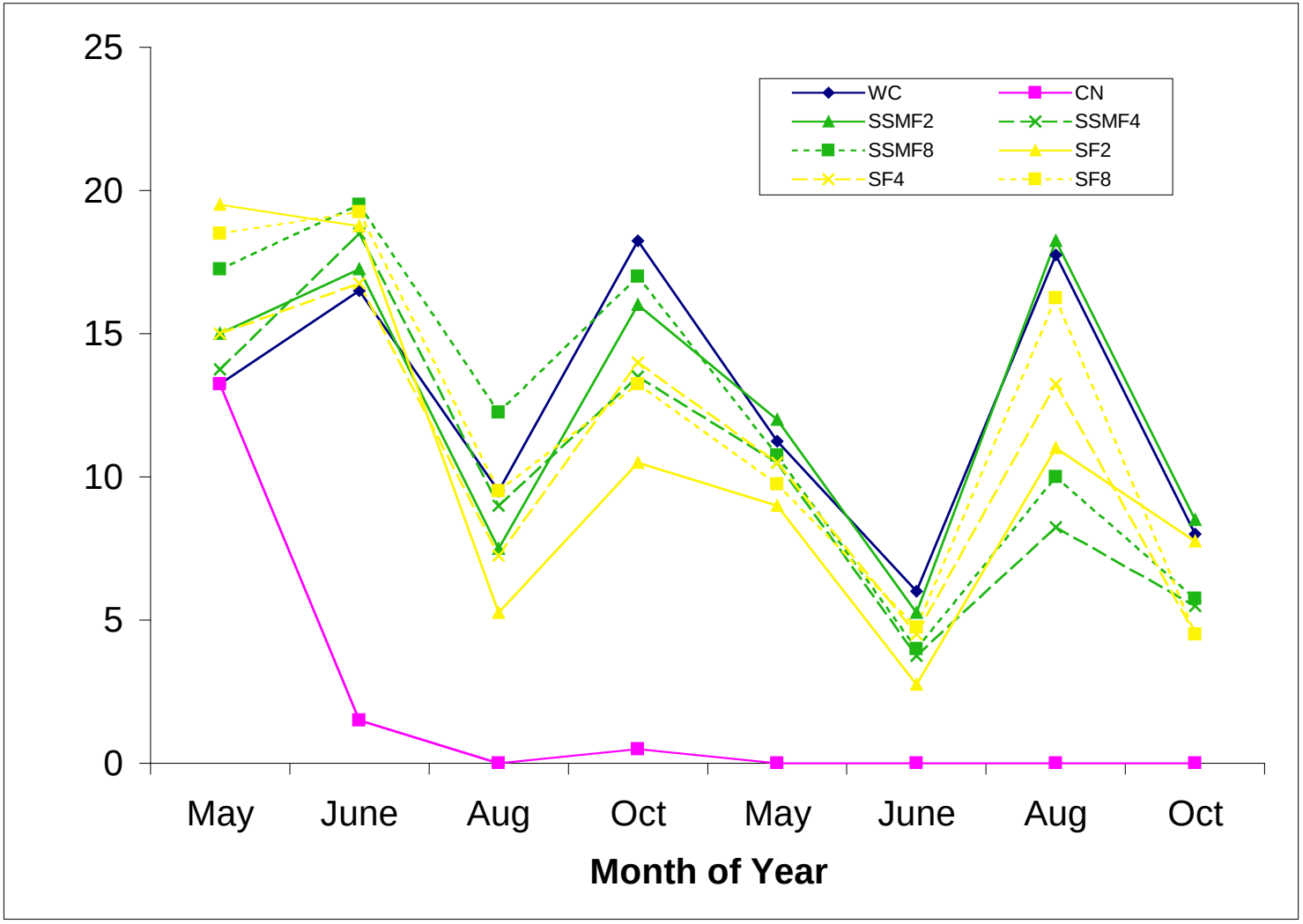
August

October

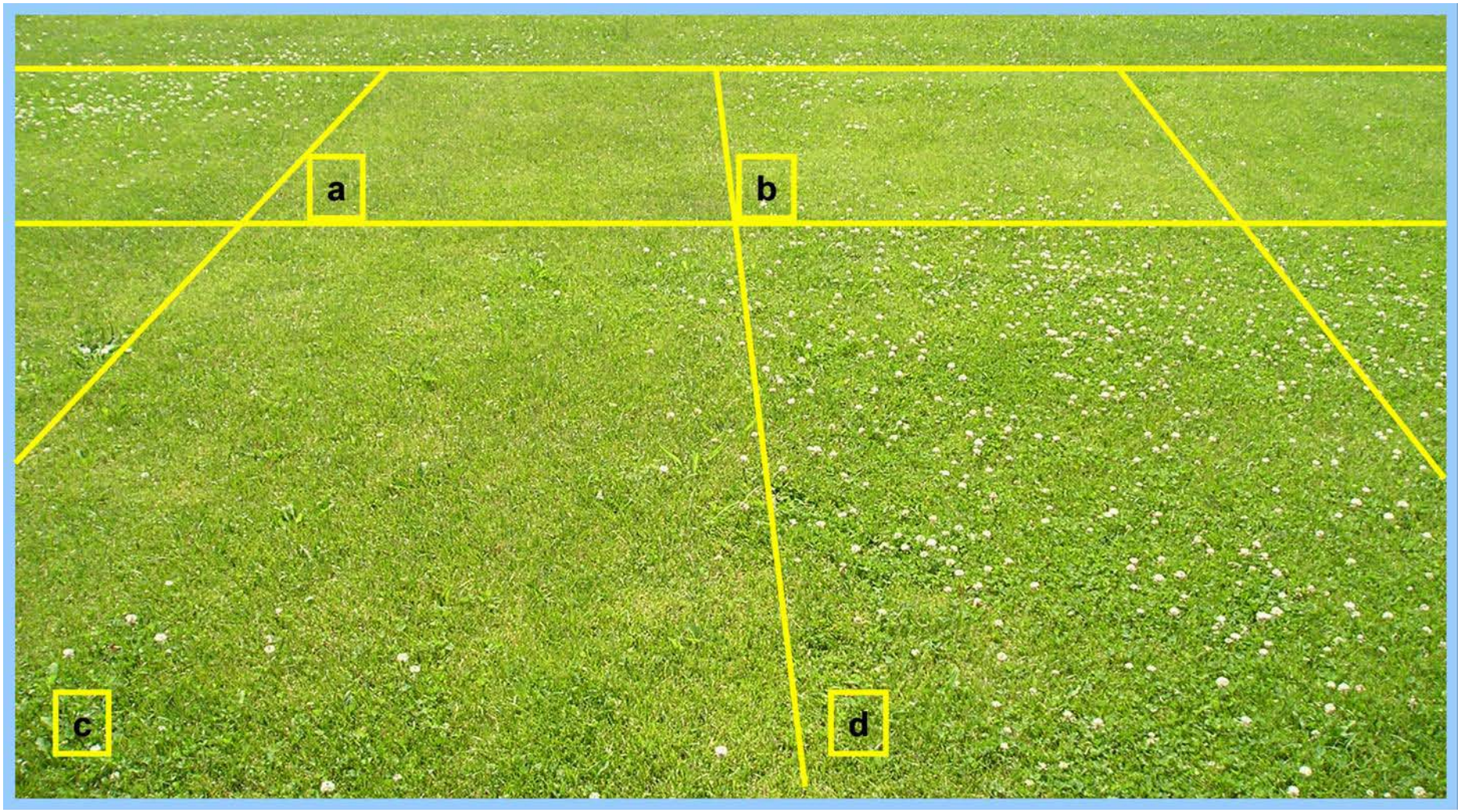
Weed Cover in GTI Irrigated Trial in 2005 and 2006



Weed Cover in GTI Non-Irrigated Trial in 2005 and 2006

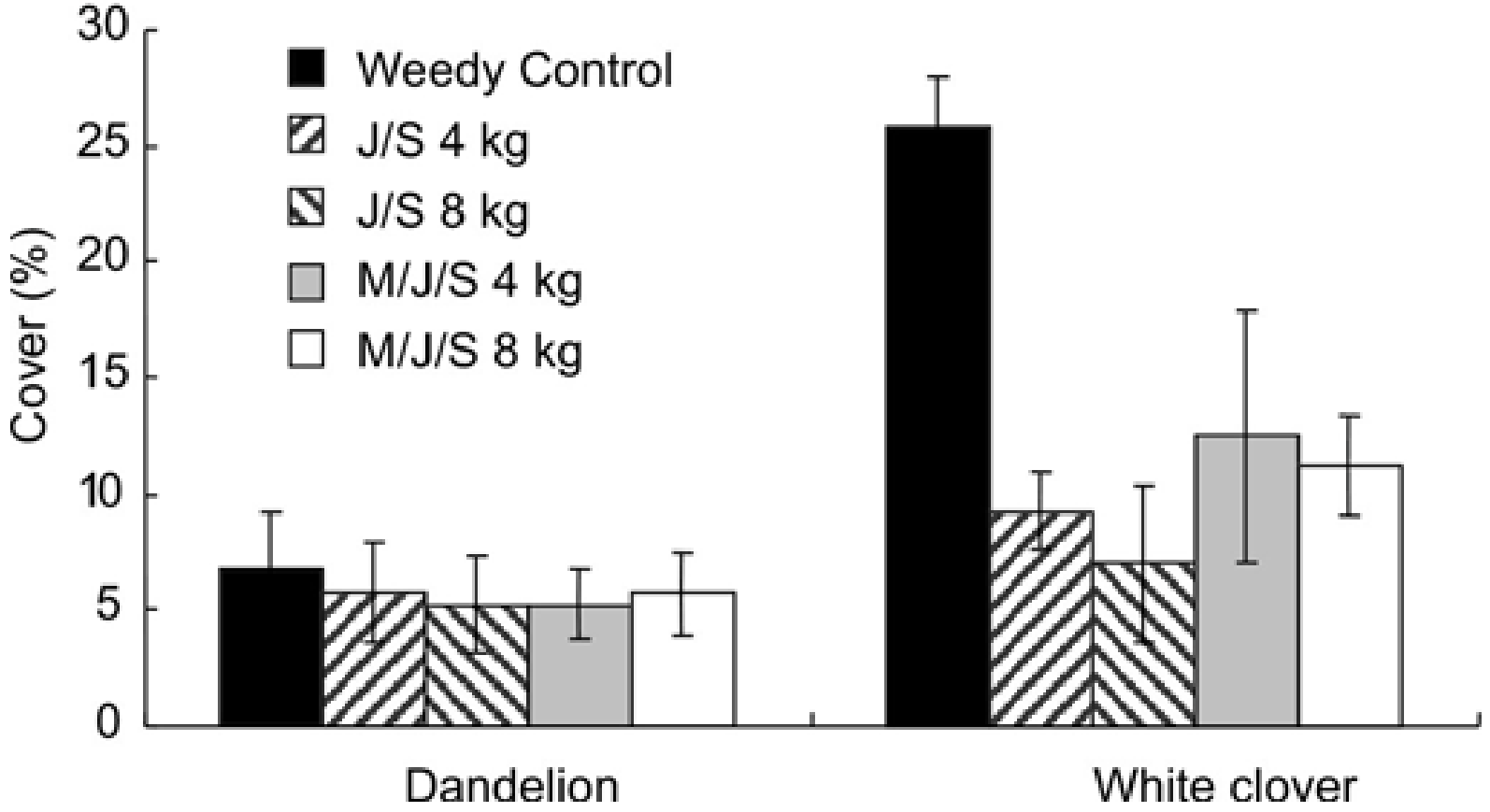


Irrigated Trial – August 2006



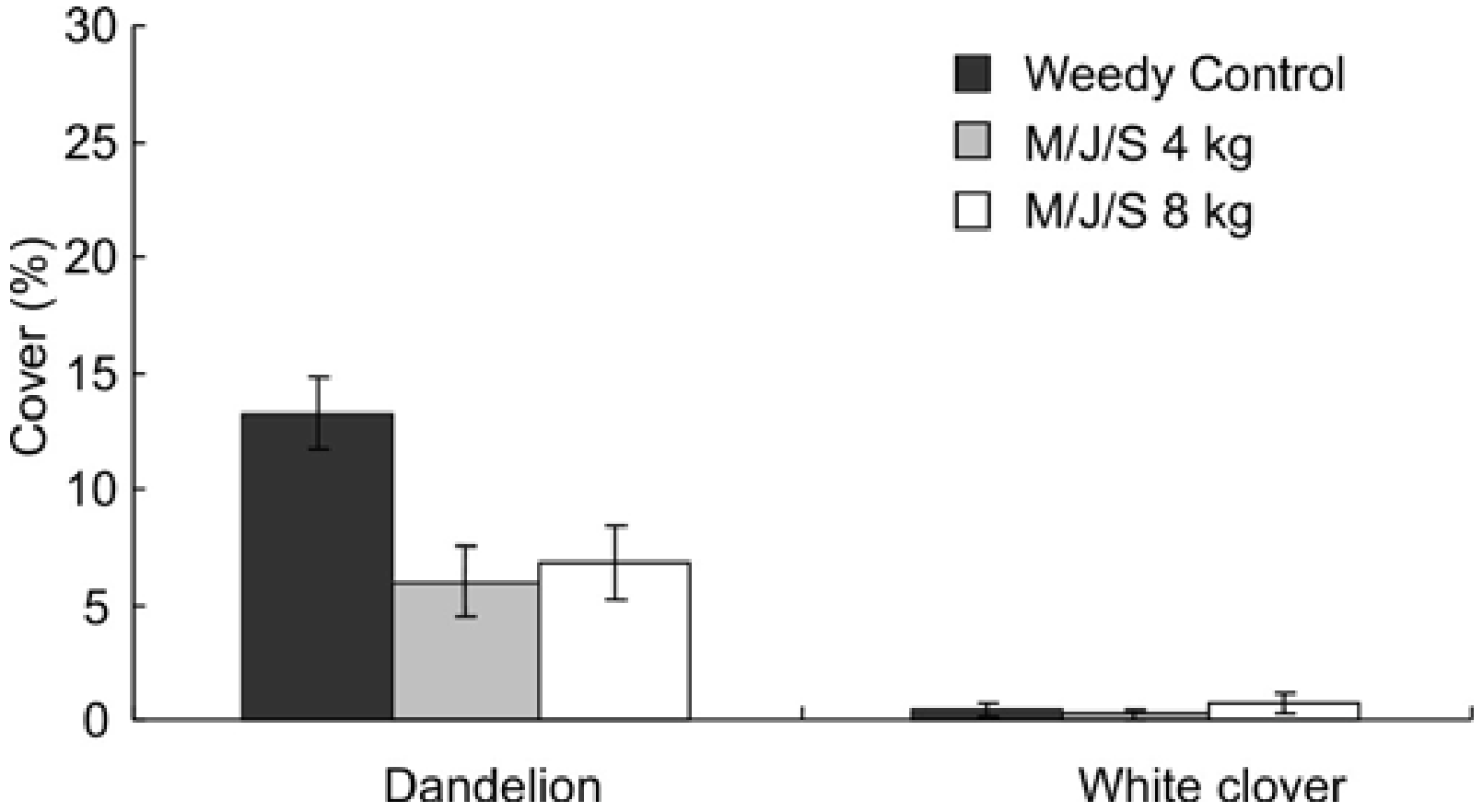
- a & b Overseeded in May/July/September
- c Overseeded in July only
- d Weedy Control

GTI
Irrigated



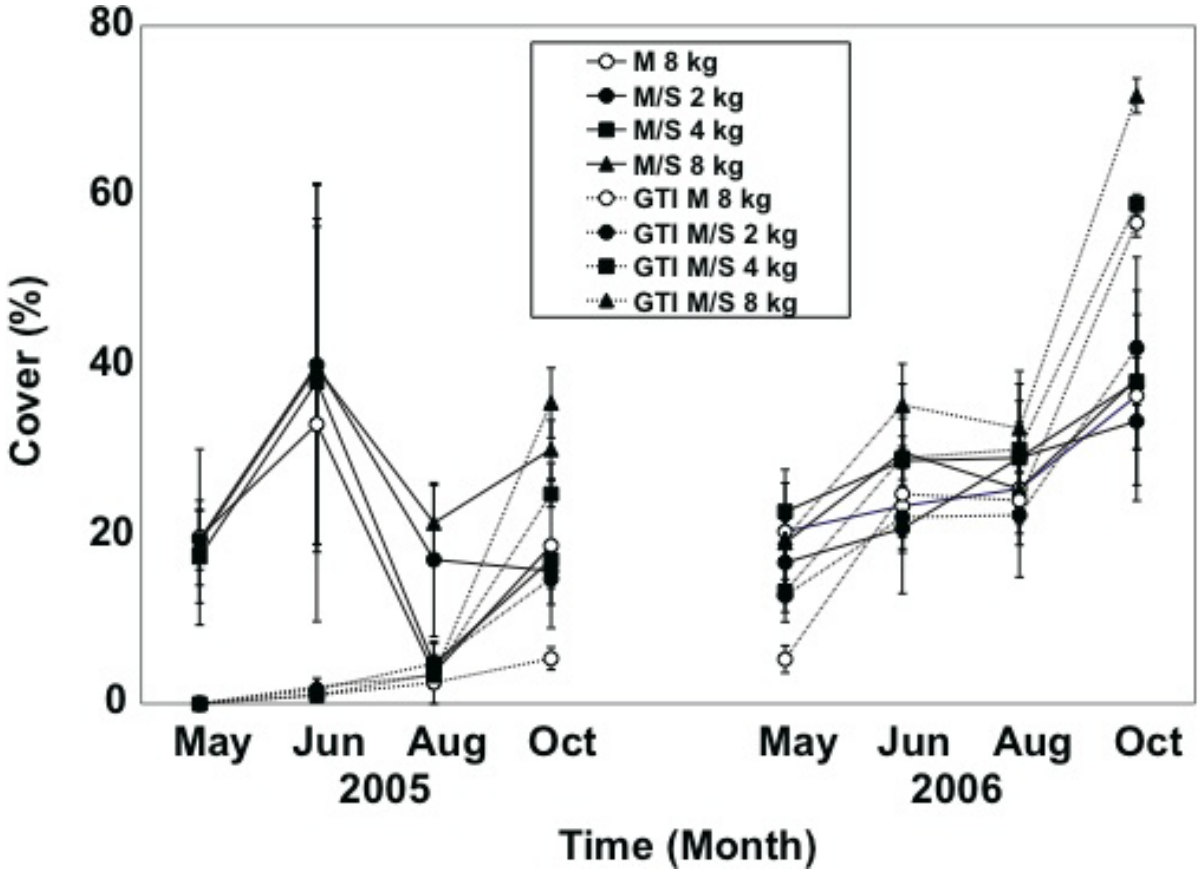
Weed Technology 2008 22:231–239

GTI
Non-Irrigated

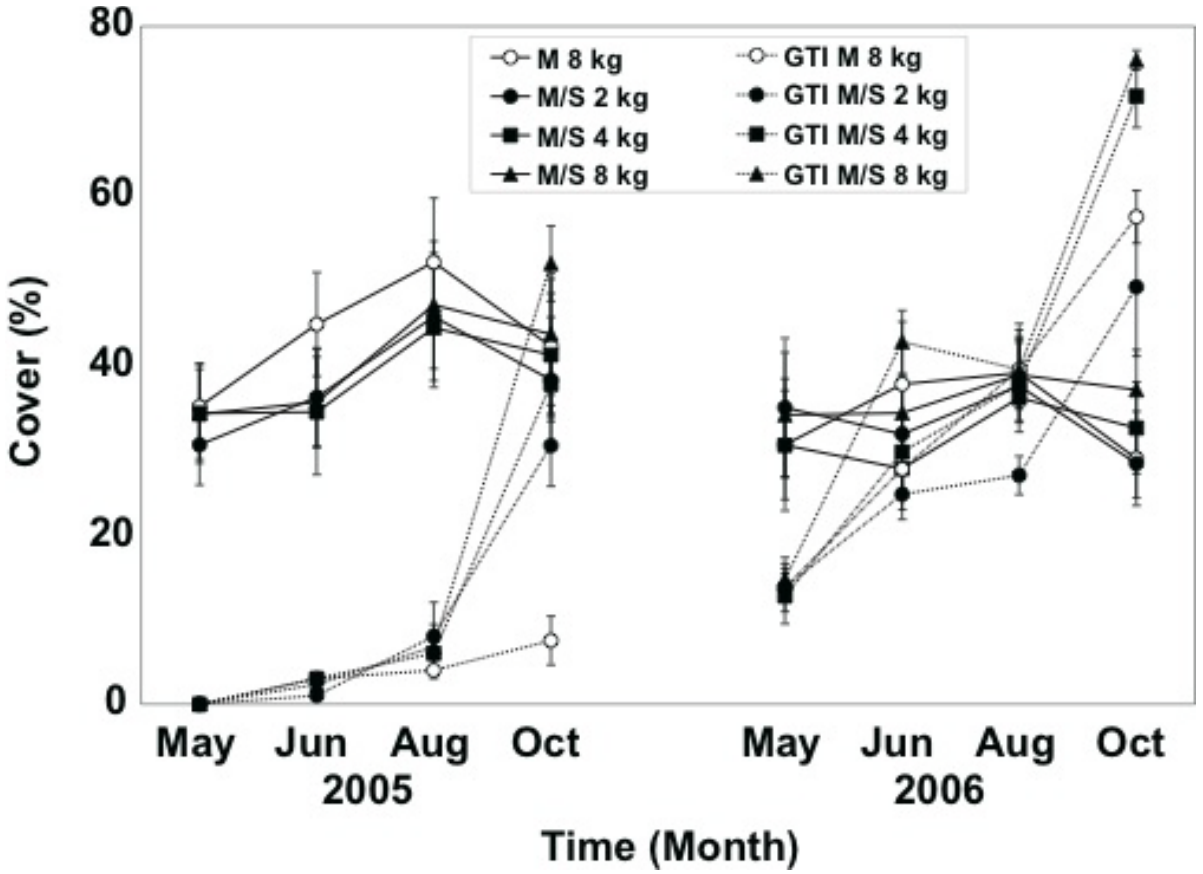


Weed Technology 2008 22:231–239

Perennial Ryegrass Populations Irrigated



Perennial Ryegrass Population
Non-Irrigated



Summary

- GTI Non-Irrigated and Irrigated Trials
  - **Significant differences between heavily overseeded and non-overseeded/lightly overseeded plots**
  - **Amount of applications does have a significant effect on weed cover**
    - **Frequent applications + High Rates = Fewer Weeds**

Overseed Heavy and Often

- Small amounts have little effect
- Clumps can become a playing hazard

Due Diligence

Tires and Vandalism

HOURS OF USE

Repairs and Recovery

Wear on Sand

Catch Fields Before They Fail: Communicate to Booking

User Groups

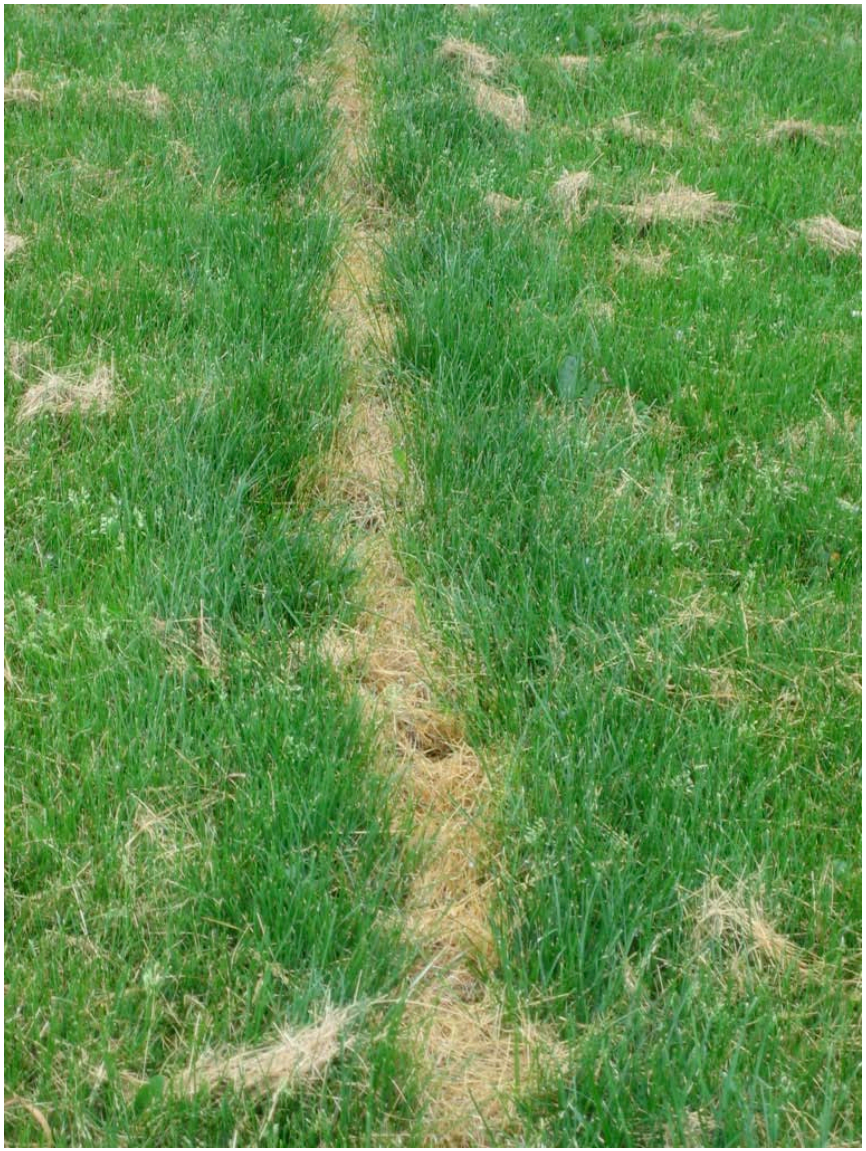
- Starts with professionalism on the part of the sports turf manager
- Educate when possible
- Use opportunities to create communication
- They are the voters

Excessive Traffic

Working with User Groups

Lines

Burning Lines



Alternative Pest Management

- Situation in Ontario/Canada
- Products and progress
- Making sense of New Products

Are any pesticides allowed?

- Class 11 (Ontario) pesticides permitted
- Requires pesticide applicators license
  - Must hold a valid Ontario Landscape Exterminator license
  - Must post Green sign indicating application

What this means for Turfgrass Management

- A change in attitudes about pest management
- When you don't have the tool you need…
  - you adapt
- Make use of remaining tools
- The most important tool in the toolbox
  - The turfgrass manager

Education

- Use of pesticides sometimes takes the place of knowledge of the pests
  - This has to change
- Proper management requires thorough knowledge of all pests
  - Allows you to take advantage of alternative practices
- Be aware of current research and new products

Identification of Pest Problems

- Proper identification of pests
- Ability to recognize conditions that could lead to pest issues
- Differentiate between abiotic stressors and biotic pests through proper diagnostic techniques

Lawns And Sports Fields

- Weeds
  - # 1 issue (debatable)
  - Not damaging
  - Fill a void
  - Chief prevention practice
    - Avoid the voids!
  - Low tolerance
  - Numerous alternative methods available
  - Importance as indicator species

Lawns and Sports Fields

- Insects
  - More complicated
    - Can be extremely damaging to turf
  - Need to understand life cycles and biology to properly manage
  - Very few alternative options available

Lawns and Sports Fields

- Diseases
  - Not common on athletic fields
  - Could have moderate impact if present
  - Primarily managed with cultural practices
    - Very sensitive to environmental conditions
  - Rapid identification key to prevent spread and damage

Monitoring Program

- Series of inspections or counts
  - Should be done at regular intervals
    - Insect pressure can increase rapidly
- Written records of observations and counts
  - Allows for prediction of future issues
  - Many situations can be transferred to different properties

What to monitor and record

- Species of turf and their locations
- Weather conditions (temperature, humidity, rainfall)
- Counts of pests
- Counts of beneficial species (if present)
- Notes or counts of damage or symptoms
- Site conditions that could be relevant
- Growth stages of nearby plants
  - Plant phenology

Monitoring Techniques

- Visual Inspections
  - Yes or no observations
  - Presence of weeds or insects that could worsen over time
  - Need knowledge of potential threats and how to properly diagnose them
  - Look out for abiotic stressors as well

Monitoring Techniques

- Counting methods
  - Only relevant when visual inspections suggest a problem
  - Allows for collection of historical data

Monitoring

- What to record
  - As many observations as possible
    - Turf symptoms
    - Pests
    - Weed encroachment with location mapped out
- The more information collected and recorded the easier to prevent future problems

Stress Management

- Of extreme importance as prevention of pest issues is key
- Best defense is to start with a healthy turf stand
  - Once turfgrass plants are in place, weeds will not be able to easily invade
  - Insect pests may still be present, but symptoms will be lessened

Managing Turf for Stress Reduction

- Mowing
- Irrigation
- Fertility
- Cultivation

Cultivation

- Aerification
- Power raking
- Improves root health and subsequently plant health

http://www.patersonyardworks.com/web_images/img_2159.jpg

Thatch

- Undecomposed organic matter between turf surface and soil
- Small amount positive
  - Cushions crown
  - May reduce soil compaction
  - Releases beneficial nutrients upon decay
- What happens when excessive?

Excess thatch

- Less water retention
  - Larger pore spaces
- Water repellency (Hydrophobicity)
- Reduces infiltration of fertilizers to rootzone
  - May bind certain products (organics)
- Harbors insects and pathogens
- May increase soil compaction

Thatch and its effect on roots

- Roots bound in thatch layer
- Often compacted soil underneath
  - Excess moisture and anoxia
- Increased hydrophobicity

Causes of thatch

- Shallow, frequent irrigation
- Excess soluble nitrogen
- Improper (non-neutral) pH*
- Poor drainage*

* Affect microbial activity

Thatch remediation

- Vertical mowing (Power raking) is the most direct way to remove excess thatch

Soil Compaction

- Often seen in athletic fields and near roads
- Many factors can contribute to increased BD
  - Constant use
  - Use when soils are wet
  - Lack of cultivation
  - Soil layering
    - May be a result of compost additions if not incorporated

Effects of Compacted Soils

- Physical barrier to root growth
- Reduced oxygen availability
- Reduced water infiltration

http://www.turftenders.net/images/diagnosis/Poor_Compacted_Soil_Covered_with_Plastic_Mesh_and_Fabric.jpg

Managing soil compaction

- Cultivation (frequent)
  - Core aeration
  - Should be done at least once per season
- Benefits of deep tine cultivation

Poor Roots and Stress Tolerance

- Drought
- Wear and use tolerance
- Insect damage
- Competition against weeds

Controls

Combination of Controls

- Cultural management
- Physical/mechanical controls
- Biological controls
- Allowed Chemical controls

Cultural Management

- Mowing
  - Can reduce mowing height to remove a number of weeds
    - Dandelion, plantain, prostrate knotweed will remain
- Irrigation
  - Dry out soils enough to favor turf
    - Not so much that turf is stressed

Cultural Management

- Over-seeding
  - Research has shown that over-seeding with perennial ryegrass reduces weed populations significantly
  - Incorporate rapid germination and shade tolerance into sports fields
    - PRG and Tall fescue

Weeds as Indicators of Management Practices

Weed	Conditions
Black medick (*Medicago lupulina*)	Low fertility; Drought
Chickweed (*Stellaria media*)	Thin turf; Excess moisture, Shade
Clover (*Trifolium repens*)	Low N; Drought: Compaction
Crabgrass (*Digitaria* spp.)	Thin turf; Low fertility; Compaction
Moss (Various species	Heavy shade; Low fertility; Low pH; Compaction
Plantain (*Plantago* spp.)	Low fertility; Drought; Low HOC
Prostrate knotweed (*Polyhonum ariculare*)	Compaction; Low fertility; Drought
Rough bluegrass (*Poa trivialis*)	High fertility; Excess moisture; Shade

Adapted from Turf IPM Manual, OMAFRA

Physical/Mechanical Control

- Manual or machine-aided removal of pests
- Placement of barriers to reduce pest invasion
  - Mulch mats, landscape fabric, etc.
- Examples
  - Hand weeding
    - Effective when populations are low
  - Hoeing
  - Trimming
  - Mowing

Physical/Mechanical Control

- Flame torching
- Infrared heating
- Manual removal of insect pests
- Pheromone traps

http://www.rittenhouse.ca/content/images/Big/w_torch4.jpg

Photo by Paul Brown

Physical/Mechanical Controls

- Effective when populations are low
- May not kill weeds completely
  - Only above-ground material destroyed
- Important to remove root when hand-weeding

Weed Biological Controls

- Very few options available
- Efficacy is extremely variable
  - Often need specific environmental conditions
- Application must be done in specific environment and conditions

Biological Controls

- Insect bio-controls
  - Entomopathogenic nematodes
    - Microscopic worm-like animals that kill variety of insects
    - Specific to insect type
    - Need to be applied
    - Very sensitive to environmental conditions
      - Soil T > 12C
      - Must irrigate both before and after treatment
    - Sensitive to low soil moisture
    - Extremely sensitive to UV light

Photos by Ken Carey

Cultural management

- Soil moisture key
  - Vertical movement based on soil moisture
  - Eggs need moisture
  - *Avoid watering during peak beetle activity*
- Irrigation once infested masks symptoms
- Balanced fertility
  - In fall, promotes recovery
  - In spring, high N encourages shoot growth
- No resistant cultivars of cool-season grasses known

Biological control

- Natural enemies
  - Ground beetles, ants, parasitic wasps, etc.
  - Conservation through spot-treatment
  - Parasitic insects keep populations down more in Europe
- Entomopathogenic nematodes
  - Must ensure you choose the proper ones specific to these pests

Monitoring:

-Most often use traps to monitor presence of adults
-Japanese beetles often arrive when morning glory vines finally start to take off and begin to climb

http://undergrowth.org/system/files/images/morning_glory_5_0.jpg

Diseases

- Rust
  - Nuisance disease
  - Characterized by red pustules on leaves
  - Increase N
  - Decrease shade and improve air circulation
  - Increase mowing frequency
  - Decrease leaf wetness

Source: Compendium of Turfgrass Diseases, 3rd Ed.

Diseases

Necrotic Ring Spot

- Thatch management
- Fertility
- Use of non-host species
  - PRG

Photos by Gurpreet Mand

Final Step: Changing Attitudes

- Customers/end users need to be informed of changes due to ban
- Must be able to accept some level of damage
- Work to change end user expectations

Summary

- Important to remember that you are the best tool you have
- Educate yourself to rise above and beyond the masses
- Stress management and maintaining healthy turf critical

Summary

- Knowledge of pest cycles and understanding turf adaptation is key
- Substitute funds for pesticides for seed and labor

New Pesticides:
What do they look like?

Eric M. Lyons

Class 11 Pesticides

- *Pesticide Classification Guideline for Ontario*
  - www.ene.gov.on.ca/en/land/pesticides/pestcide-classification.pdf

- A Class 11 product is not considered as such until it is classified by the Ministry of the Environment

Regulations regarding use

- Must post residential or non-residential sign
- Must maintain a current license
- www.ene.gov.on.ca/en/land/pesticides/factsheets/fs-commericaloperators.pdf

- All products applied must be registered under the Pest Control Products Act

Class 11 Herbicides

- Acetic Acid
- Sarritor
- Fiesta
- Organosol
- Corn Gluten Meal
- More each year

Non-selective

Acetic Acid

Torching

Fiesta

Fiesta

Fiesta

7 DAT

30 DAT

Fiesta

15 DAT-2

Organosol

Sarritor

Many More Products

- CGM
- Spray CGM
- New Biologicals

Advice

- Keep licensing current
- Understand new products and equipment needed to use them
- Price points will change, Keep up to date

Making Sense of New Products

Why?

- Onslaught of new products
  - Turf industry classically accepting of new products
  - Small area low application costs high revenue per Hectare treated
- Organics
  - Local
  - Smaller distribution

Why?...

- Desire for environmentally friendly management
- Pesticide bans
  - Turfgrass managers grasping for stuff that works
  - “Efficacy” Standards are changing

What is Efficacy Testing?

- Classically products must be shown to work to get PMRA registration and a label
- Standard for a product threshold for a efficacious product was 85% reduction from the control

New Products

- Reduced investment into independent research
  - Smaller local companies (in line with ideals of organic management)
  - Readily available substrates
  - Harder to patent and control rights
    - Companies cannot control IP

Difficulties to the End user

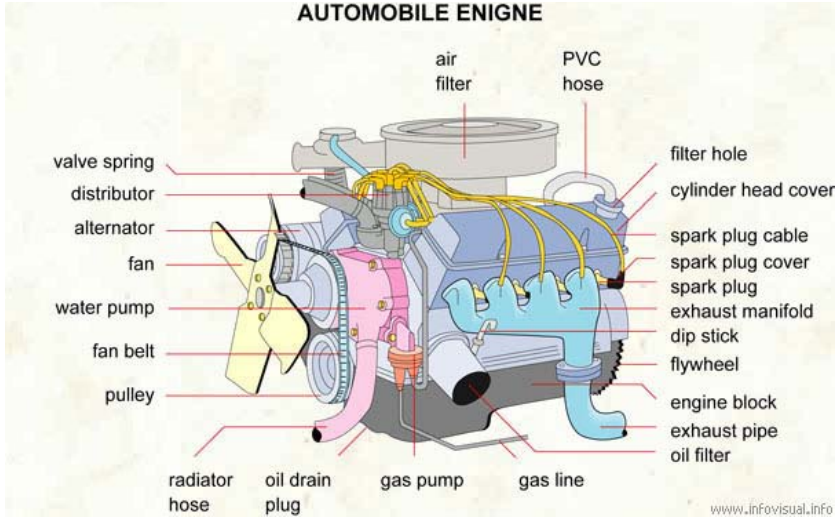
- Best application procedures may not be determined
- Confounding factors may not be identified
- Little independent verification of efficacy
  - Success get bragged about
  - Failures are not talked about

What Can the End User Do?

- Understand turfgrass ecology and *Mode of Action* of products
- Choose products with independent research
  - Provide return for companies that invest in product testing
- Understand the “theory” behind the mode of action
- Trials and testing

Mode of Action

- The explanation of how the product works
  - Sometimes confirmed
  - Sometimes still in theory
- Speeding Ticket Story



How Do I Find Out the Mode of Action?

- Ask
  - Sales Representatives
  - Google
  - Colleagues
  - Turfgrass Information File (TGIF)
- Confirm
  - Google
  - Colleagues
  - Trade Journals
  - Research Journals
  - BASIC BIOLOGY/CHEMISTRY

Turfgrass Information File

Worldwide Access to Turfgrass Science Information

A cooperative project of the United States Golf Association and the Michigan State University Libraries' Turfgrass Information Center

With special thanks to 

for their support of TIC

Guided Search

Log Out | Help | Feedback

For instructions and examples, press the Help button above.

Other Search Options

Basic Search

Power Search

Browse Options

Browse Turf Topics

Browse Full-Text Journals **(Logs out)**

What's NEW in Turfgrass Research

Search for: as a Anywhere Browse Index

AND as a Anywhere Browse Index

AND as a Anywhere Browse Index

In:

All publication types | All years | all sectors | All kinds of items

Limit to: USGA® Publications | Full-text Content | Exclude abstract-only records

Maximum records to display: All (Default)

Search Clear

Experiencing Difficulties? Contact the Turfgrass Information Center

Search results from the

Turfgrass Information File

A Unique Resource for Turfgrass Researchers, Practitioners, and Students

A cooperative project of the United States Golf Association and the Michigan State University Libraries' Turfgrass Information Center

With special thanks to Scotts. for their support of TIC

Back to Search | Display Format - Sort: Brief Table - Default | Records/Screen 10 Display | Display Marked Records | Clear Marked Records | Log Out | Help | Feedback

Page: [1]
Download Results:

Retrieved 3 Record(s). Displaying 1 through 3.

Mark	Item is a	Title - Items linked where available (Items may require software - see More Detail)	Author and Source	More Detail	TGIF #
☐	Newsletter Article	Making the move to grey water at Woodbine	Gault, Sean. 2008. *Sports Turf Manager* [STA]. Summer. 21(2): p. 1, 8-9, 11-13.	MORE Ab Kw	**137937**
☐	Newsletter Article	Bill 64: The proposed Cosmetic Pesticides Ban Act	Pavely, Ken. 2008. *Sports Turf Manager* [STA]. Summer. 21(2): p. 5.	MORE Ab Kw	**137940**
☐	Newsletter Article	Sarritor granular bioherbicide	Watson, Alan. 2008. *Sports Turf Manager* [STA]. Summer. 21(2): p. 16-17.	MORE Ab Kw	**137945**

Log Out | Help | Feedback

Web Images Videos Maps News Books Gmail more ▼ Web History | Search settings | Sign in

Google Sarritor Search Advanced Search

Search: the web pages from Canada

Web Show options... Results **1** - **10** of about **20,000** for **Sarritor**. (**0.24** seconds)

Sarritor
Sarritor is a biotechnology company specializing in the development of naturally occurring pest control products that are environmentally friendly and easy ...
www.**sarritor**.ca/ - Cached - Similar

Frequently Asked Questions
If **Sarritor** comes in direct contact with any broadleaf plants, including vegetables and flowers, some damage may occur. Direct application to any type of ...
www.**sarritor**.ca/faq.html - Cached - Similar

Show more results from www.sarritor.ca

Natural Weed Control - **Sarritor** & Dr Green - RedFlagDeals.com Forums
12 posts - 12 authors - Last post: 30 Jan
They also provide **Sarritor** (natural weed destroying fungus) which I .... GreenLawn provides **sarritor** as their fall weed control because it ...
www.redflagdeals.com › ... › Home & Garden - Cached - Similar

The Grass is Greener: **Sarritor**: fact or fiction?
7 Feb 2009 ... I've been hearing a lot about **Sarritor** as an effective weed control and thought it was about time to explore this product, since some lawn ...
ecolawn.blogspot.com/2009/02/**sarritor**-fact-or-fiction.html - Cached - Similar

[PDF] **Sarritor** Granular Biological Herbicide (COMMERCIAL)
File Format: PDF/Adobe Acrobat - Quick View
Sarritor Granular Biological Herbicide (COMMERCIAL). 4260864 Canada Inc. 104 Rhapsodie, Notre-Dame-de-l'Ile-Perrot,. QC J7V 8P1 Canada. Ph: (514) 220-7142 ...
pr-rp.pmra-arla.gc.ca/PR_SOL/pr_web.ve1?p_ukid=11869 - Similar

EnjoyGardening » **Sarritor**
The product is called **Sarritor**, and it's the latest in what are referred to as biological control agents. Biological controls (or biocontrols, ...
www.enjoygardening.com/?p=1120 - Cached - Similar

Rittenhouse | **Sarritor** Information
Rittenhouse is the sole providor of **Sarritor** application tools. ... **Sarritor** Inc . is a biotechnology company based in Montreal, Canada, specializing in the ...
www.rittenhouse.ca/asp/AboutUs.asp?LID=2019 - Cached - Similar

:: Dr. Green :: Certified **Sarritor** Natural Lawn Treatment 1-877 ...
Sarritor This product was developed by a company called '**Sarritor**' and has been ...
Sarritor is a naturally occuring fungus that is native to Canada that is ...
www.doctorgreen.com/**Sarritor**.html - Cached - Similar

Evaluate Your Knowledge

- Does the product still make sense
- Is the basis for it unsound or just unknown
- A lack of knowledge justifies doubt but does not confirm lack of efficacy

Determining Efficacy

Experimentation

The Answer??????

Tenants of Research

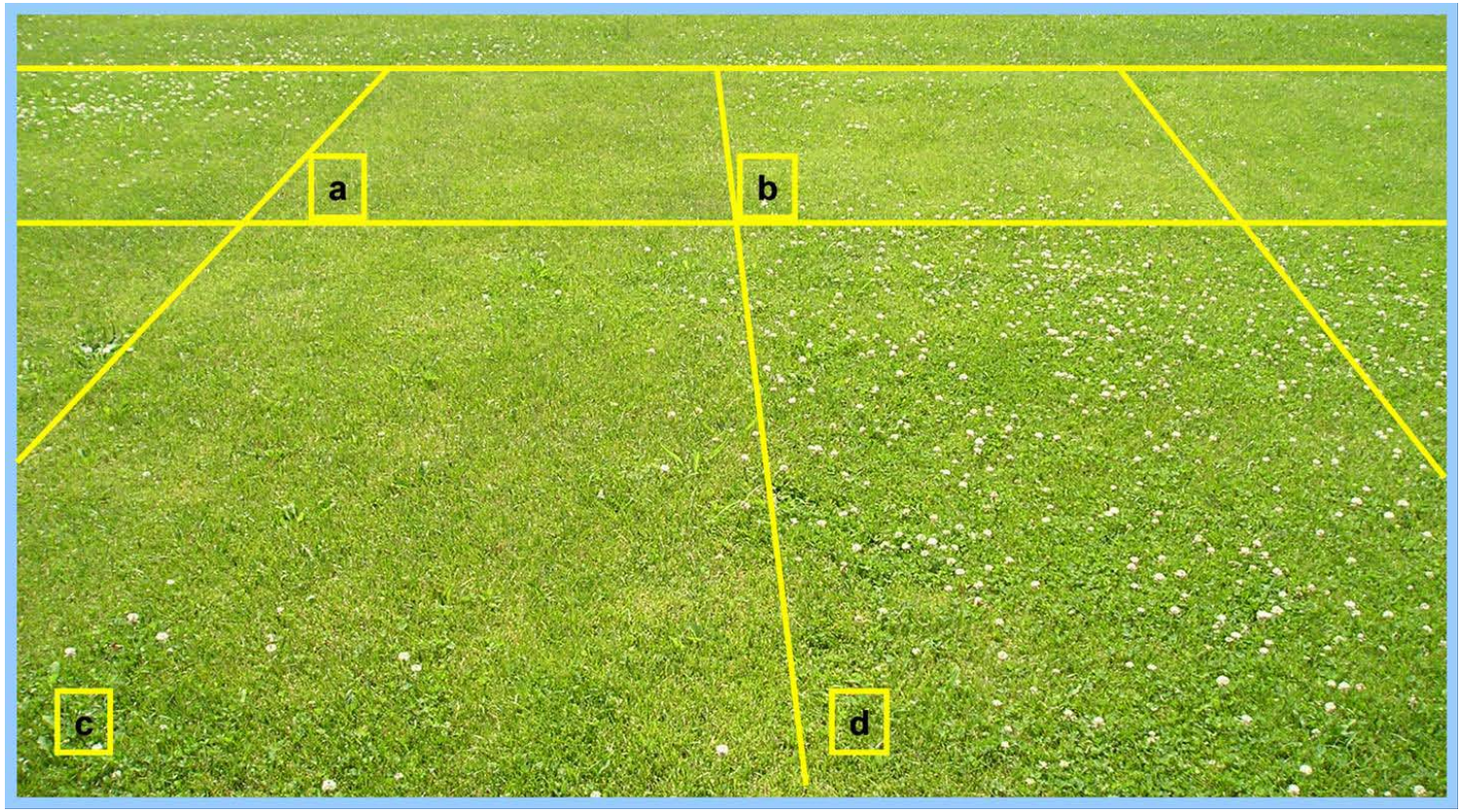
- Randomness
- Replication
- Measurements
- Repetition
- Review

Evaluating Research

- Where
- What
- Who
- Funding

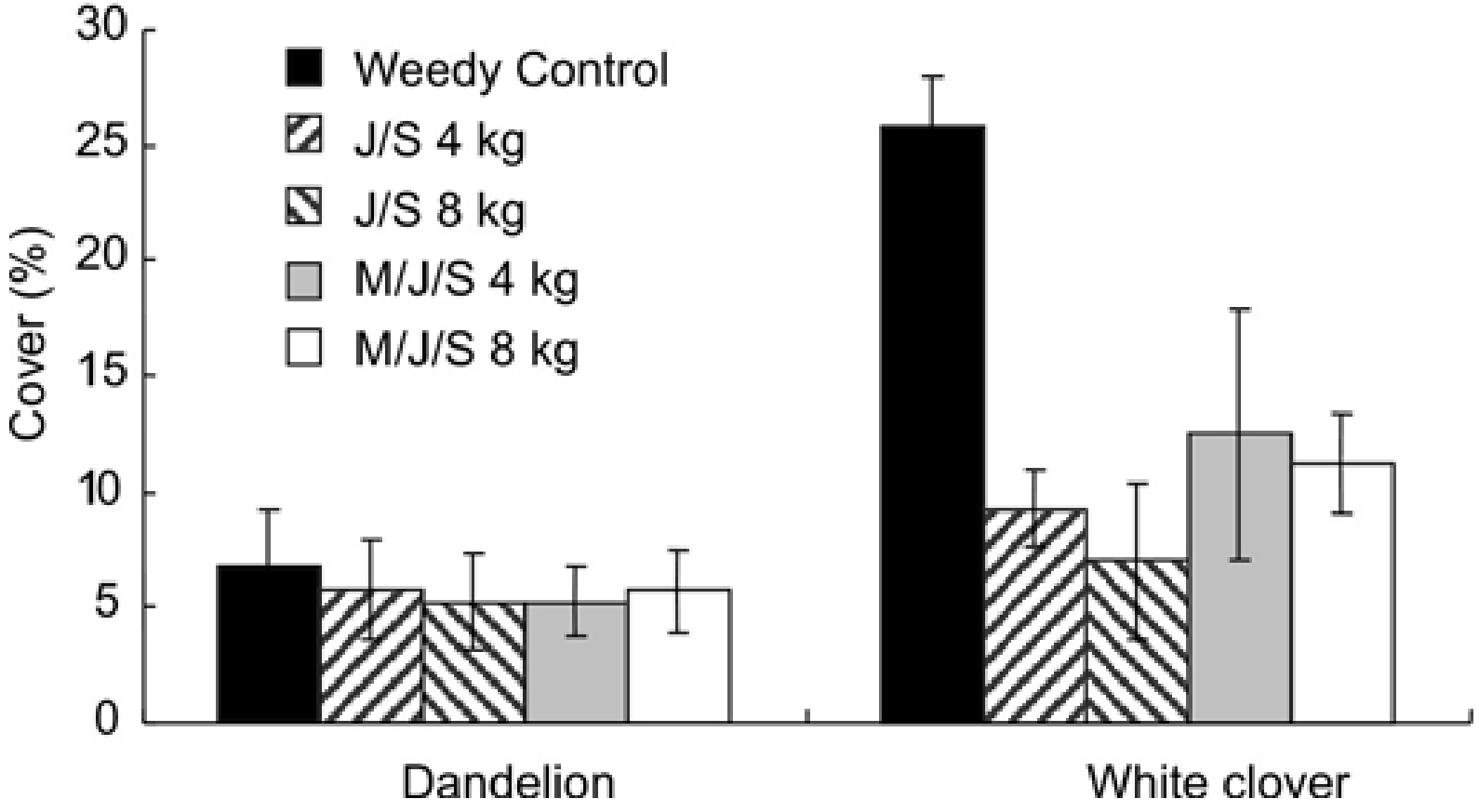
Where?

What Were the Treatments?



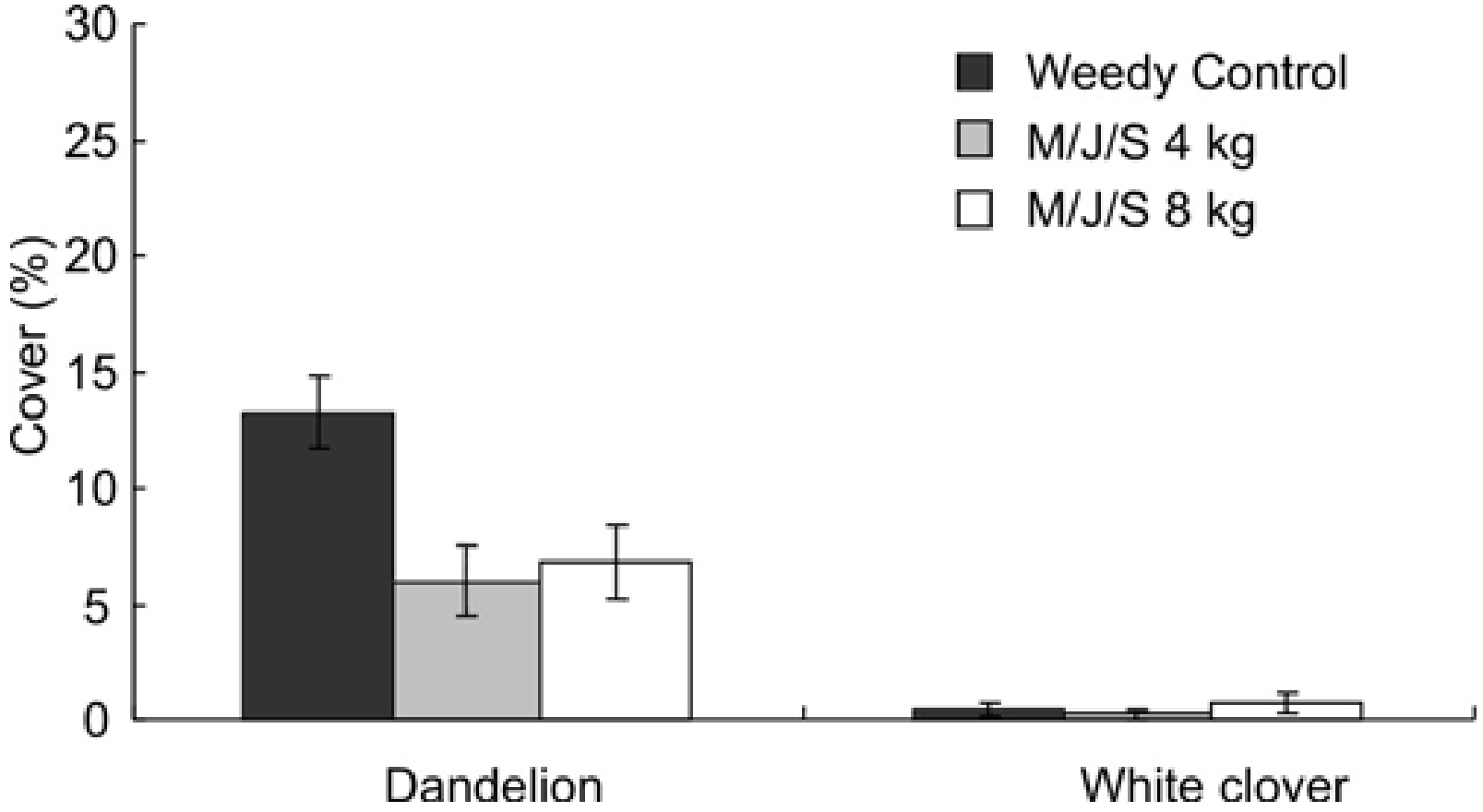
- **a & b Overseeded in May/July/September**
- **c Overseeded in July only**
- **d Weedy Control**

GTI
Irrigated



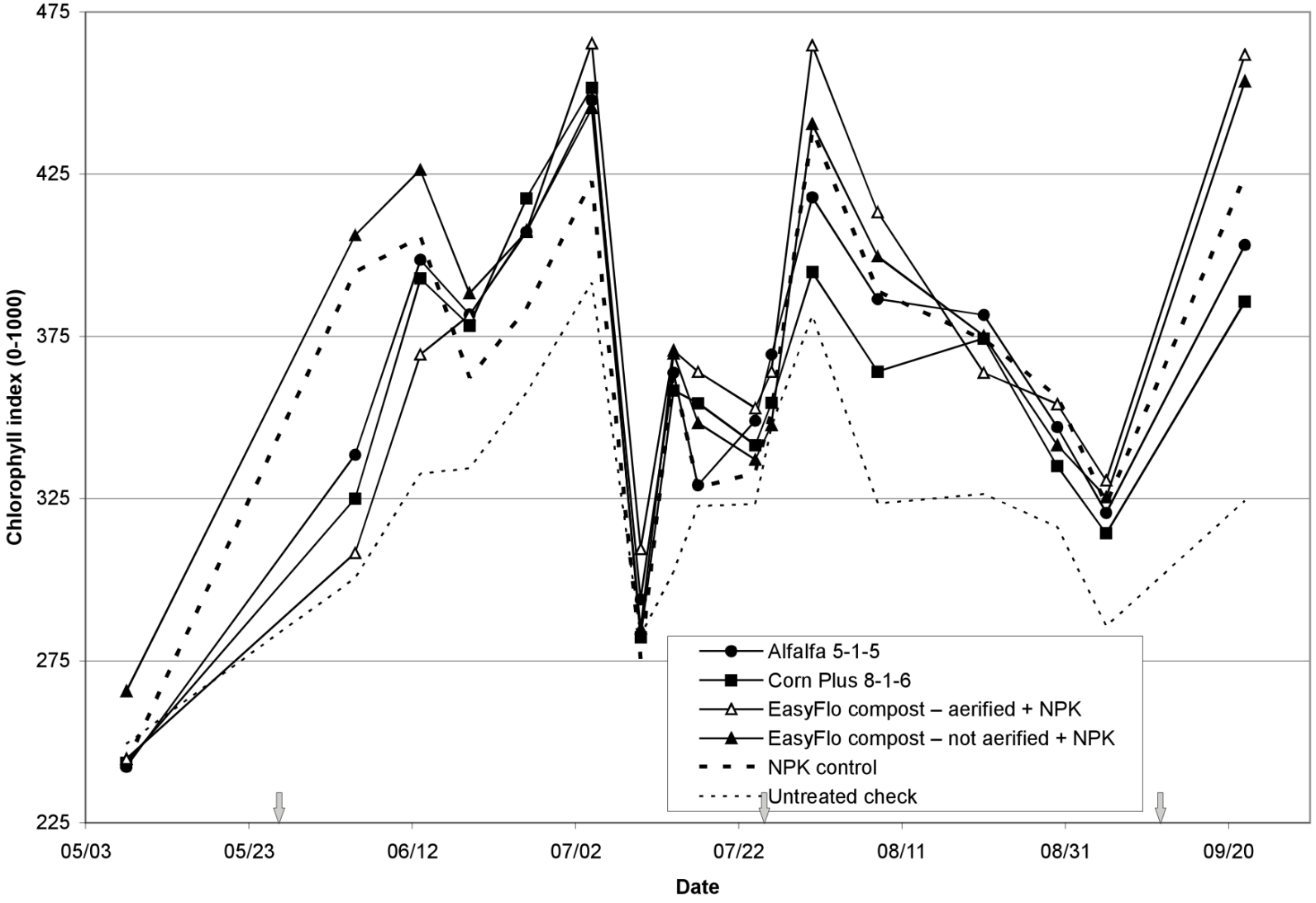
Weed Technology 2008 22:231–239

GTI
Non-Irrigated



Weed Technology 2008 22:231–239

What was Being Measured?



GTI Annual Report 2007 19:52

Significance

Controls

Who Performed the Research?

- Universities
- For profit research consultants
- By the company itself

Who Funded the Research?

- Government
- Grower groups
- Companies

How to Wade Through It

- Use common sense
- Acquire the original research
- Set up test plots
  - Understand replication
  - Leave check plots
  - Look at it for more than one year
  - Pay attention to the environment

SPORTS STA TURF ASSOCIATION

GUELPH TURFGRASS INSTITUTE

Plant Agriculture

THANK YOU

SLIDE CONTRIBUTORS:

- KATERINA S. JORDAN
- SEAN JORDAN
- STA BOARD

UNIVERSITY of GUELPH

CHANGING LIVES IMPROVING LIFE