

Turfgrass/Lawns and Management

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In this class, we will cover:

**Brief introduction to turfgrass, and
common turfgrass species in Hawaii**

**Turfgrass Establishment, and
Common Cultural Management**

**Turfgrass Integrated Pest
Management**



The term "turf": comes from either the ancient Sanskrit word, *darbha*, or the old English word, *torfa*, both of which mean a tuft of grass.

Technically,

Turfgrass: the plant community only;

Turf: plant community + a portion of growing medium.



Different Expectations

Golf Courses

Athletic Fields

Home Lawns

Roadside/other



Most common turfgrass species in Hawaii

Bermudagrass (*Cynodon dactylon*)

Zoysiagrass (*Zoysia matrella* & *Zoysia japonica*)

St. Augustinegrass (*Stenotaphrum secundatum*)

Seashore Paspalum (*Paspalum vaginatum*)



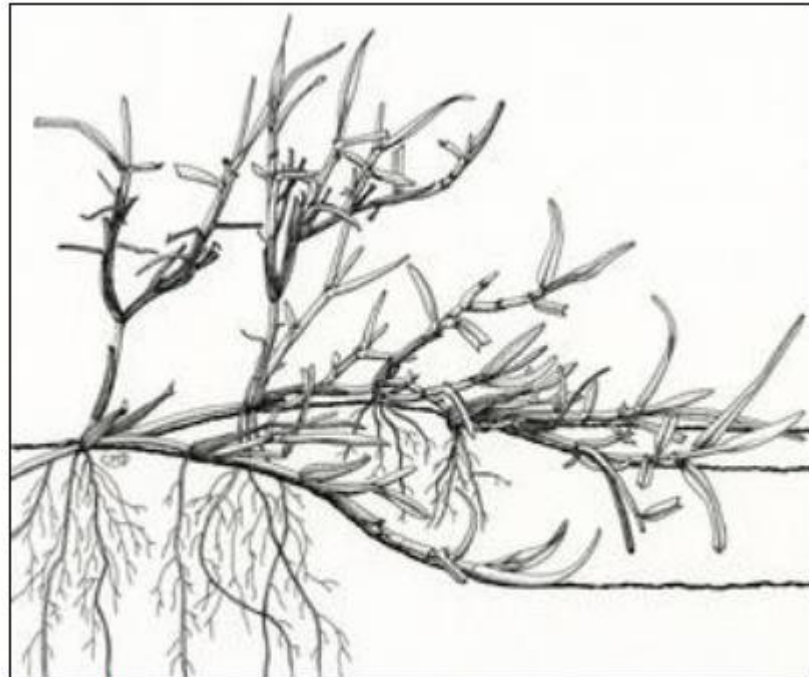
Bermudagrass

General Description

A warm season perennial that creeps by strong rhizomes and stolons and forms an excellent turfgrass. Most improved hybrid varieties are planted by stolons or sod. Often found as a wiry, spreading weed in northern states. Common south of a line from Maryland to Kansas and northern California



Seed head



Overall plant structure of bermudagrass



Bermudagrass

Bermudagrass has many uses including lawns, parks, utility turf, and especially golf courses and athletic fields.

Its major limitation is its lack of cold and shade tolerance. A high maintenance choice.



Bermudagrass

Tolerance Table

High Temperature
Low Temperature
Drought
Close Mowing
Low Fertility
Shade
Wet Soil
Wear
Salinity



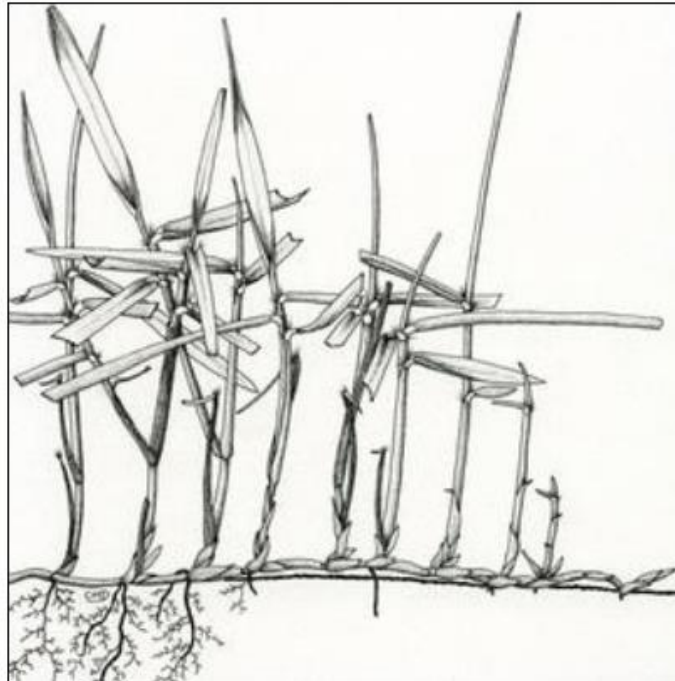
Zoysiagrass

General Description

A medium to fine perennial that spreads by short rhizomes and stolens. Develops into a desirable turf in warm areas but turns brown with frost in cooler areas. Nearly always planted vegetatively. Grown as far north as Connecticut west to Nebraska and then California. Performs best in hot dry areas



Seed head



Overall plant structure of zosiagrass



Zoysiagrass

Zoysiagrass produces a low-growing, dense turf that is very wear-resistant.

Its leaves are stiff and hard to mow without a sharp lawn mower.

Does not like compact soils.

High to intermediate maintenance choice.



Zoysiagrass

Tolerance Table



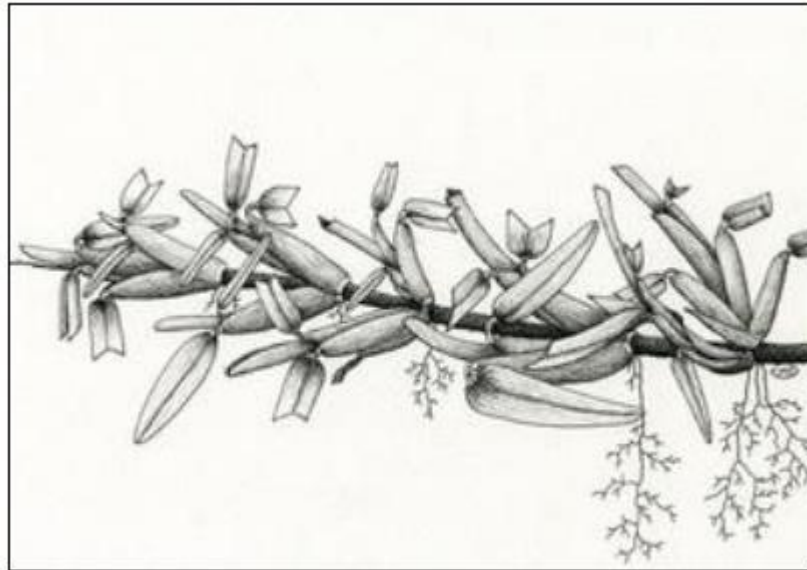
St. Augustinegrass

General Description

A dark green, leafy perennial creeping by extensive stolens. It provides a rather coarse, spongy turf in areas of the deep south. Found from southern Florida into Georgia and around the Gulf Coast through Alabama, Mississippi, Louisiana, and Texas. Occasionally cultivated in southern California.



Seed head



Overall plant structure of St. Augustinegrass



St. Augustinegrass

St. Augustinegrass is a coarse-textured species with medium to dark green color. Fast growing.

In fact, it exhibits the coarsest leaf texture of all turfgrasses grown in Hawaii.

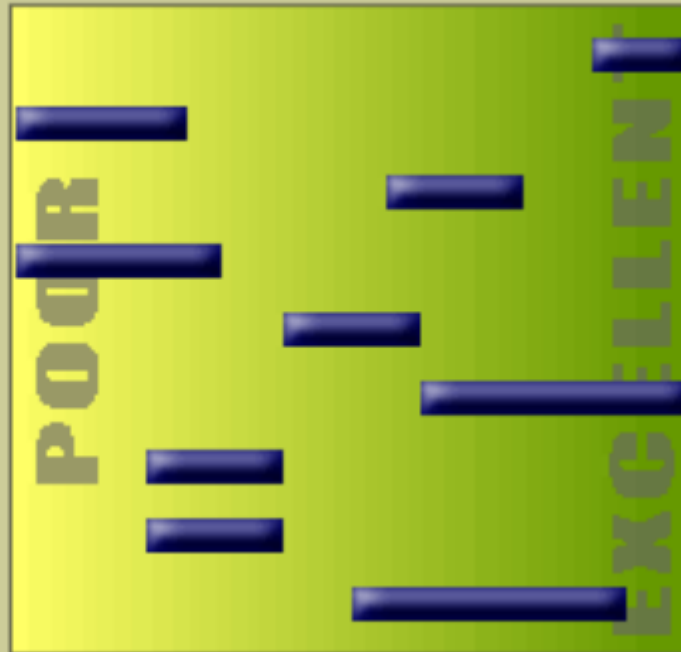
It has excellent tolerance to shade, and heat.



St. Augustinegrass

Tolerance Table

High Temperature
Low Temperature
Drought
Close Mowing
Low Fertility
Shade
Wet Soil
Wear
Salinity

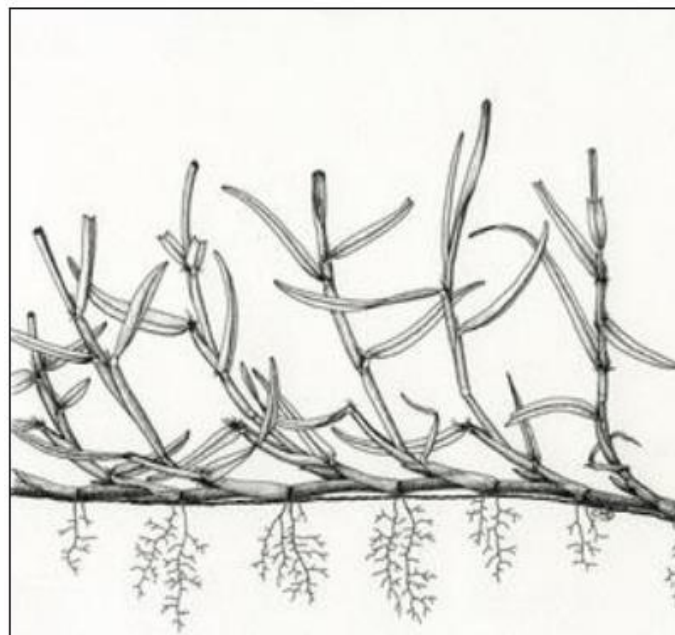


Seashore Paspalum

Seashore paspalum is a very salt tolerant warm-season grass with desirable turfgrass characteristics. This specialty grass is sometimes used in warm-season areas where either the soil or irrigation water has a high salt content. It does well near the ocean where it is subject to saltwater.



Seed head



Overall plant structure of seashore paspalum



Seashore Paspalum

Moderate maintenance.

Requires moderate amounts of water and fertilizer and needs frequent mowing to maintain a low cut.

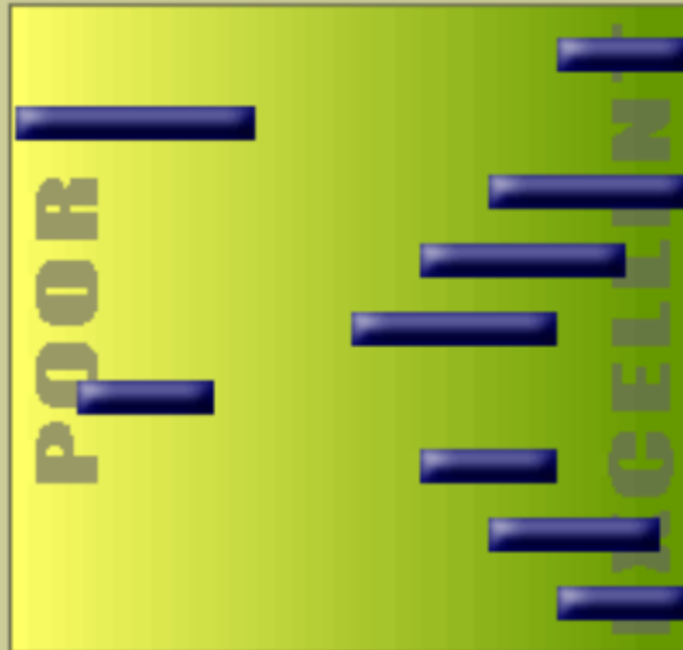
High tolerance for salt and heat, but poor shade tolerance.



Seashore Paspalum

Tolerance Table

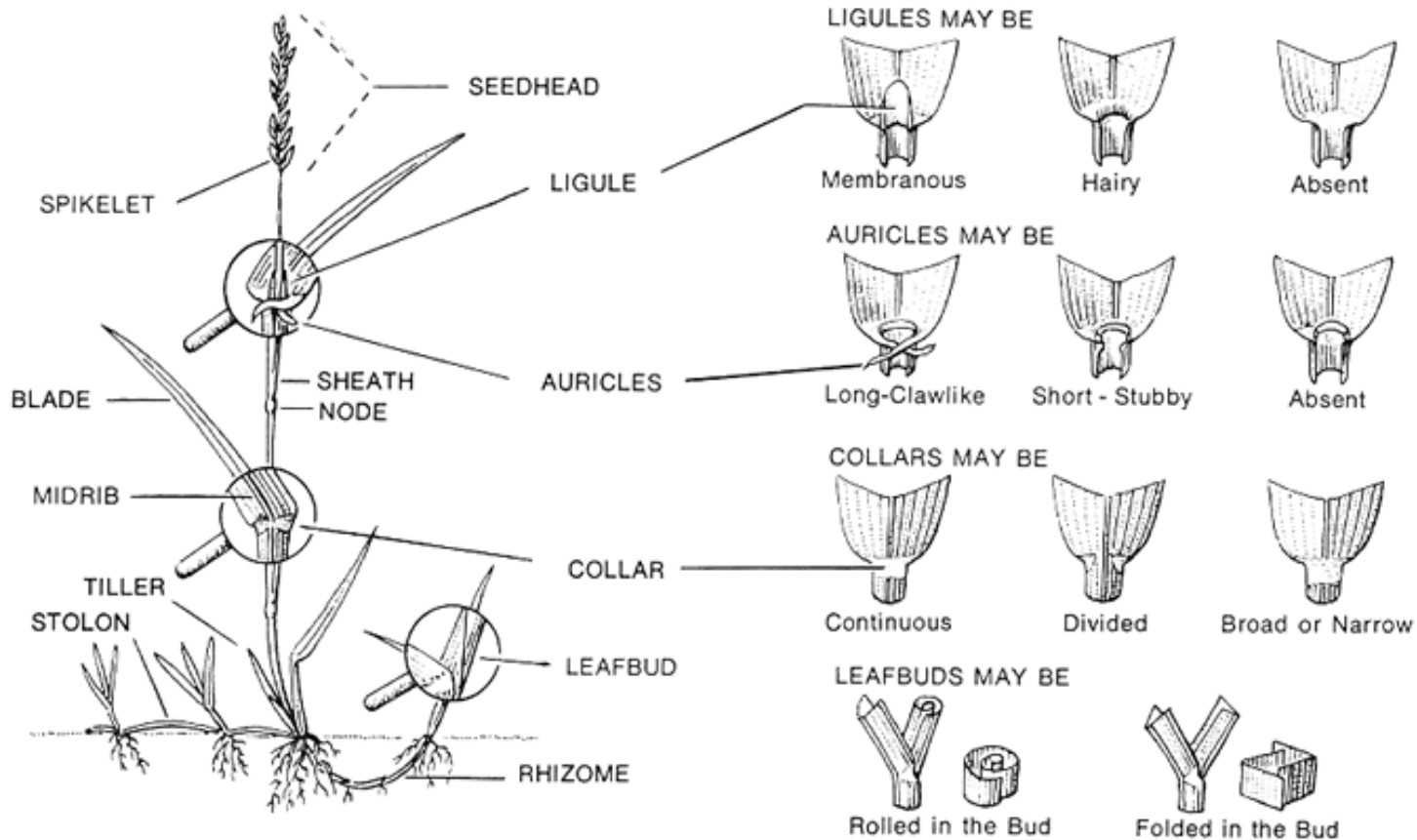
High Temperature
Low Temperature
Drought
Close Mowing
Low Fertility
Shade
Wet Soil
Wear
Salinity



Shade tolerance study



Parts of a grass plant



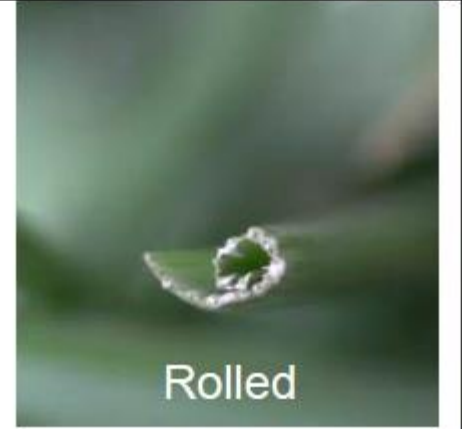
Bermudagrass →

Leafbud



← Seashore Paspalum

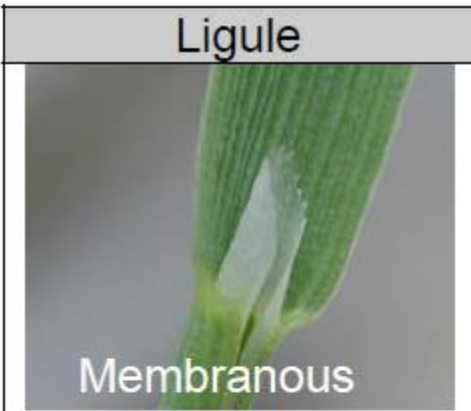
Zoysiagrass →



→ St. Augustinegrass



Ligule



Membranous

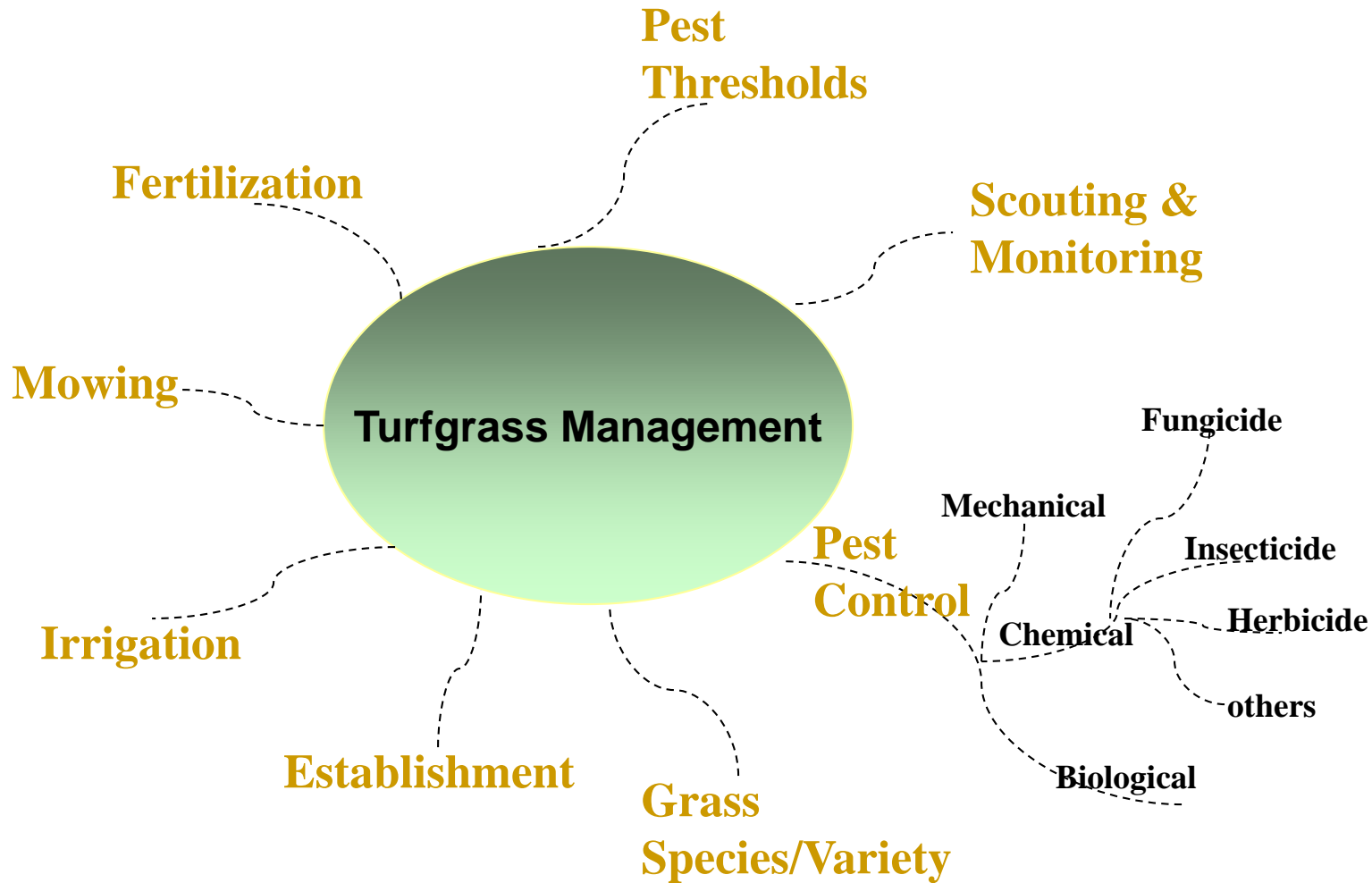


Fringe of Hairs



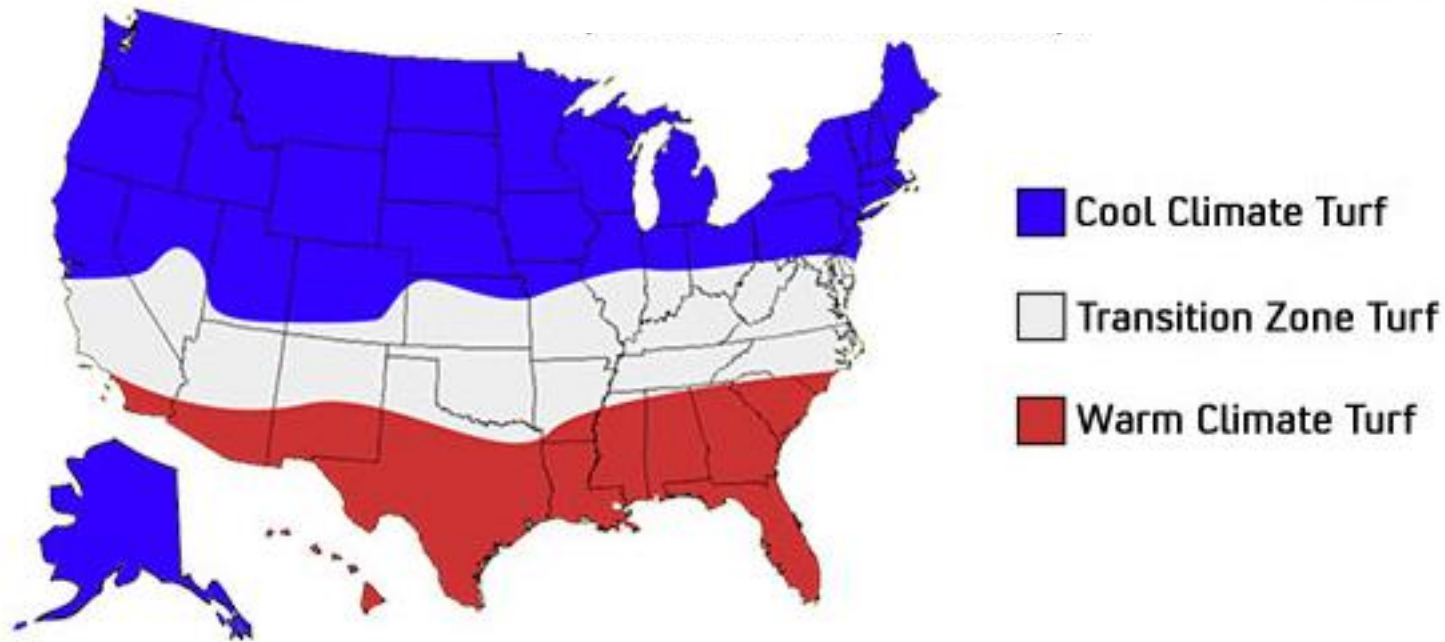
Absent





Proper Establishment

Right Grass for Right Place

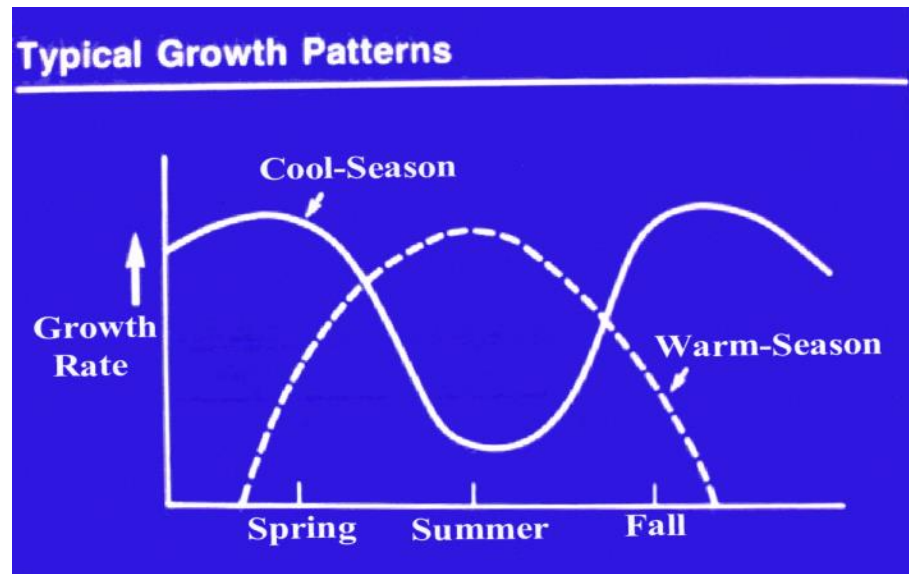


Some Common Cool-Season

- ▶ Tall Fescue
- ▶ Kentucky Bluegrass
- ▶ Perennial Ryegrass
- ▶ Creeping Bentgrass

Some Common Warm-Season

- ▶ Zoysiagrass
- ▶ Bermudagrass
- ▶ St. Augustine grass
- ▶ Seashore paspalum



Turfgrass Planting Soil Preparation

- ★ Soil Test
- ★ Install Irrigation if feasible/wanted
- ★ Weed & old grass removal
 - May take several cycles
- ★ Amend soil
 - Compost & Fertilizer
- ★ Till soil surface / roll and level
- ★ More weed control if necessary
- ★ Ready for Planting



Right Soil for Grasses

- ▶ Soil pH
- ▶ Macro-and micro- nutrients
- ▶ Organic matter
- ▶ Soil food webs
- ▶ Soil adjustment and amendment



Common Turf Establishment Methods

- ★ Seeds
- ★ Sod
- ★ Plugs/Sprigs
- ★ Hydromulch



Seeding

- Method that takes the most time, but the least expensive
- Stronger root system development
- Established by hand or tractor for bigger projects
- Needs to be evenly spread
- After planting, mulch the area
- Water regularly



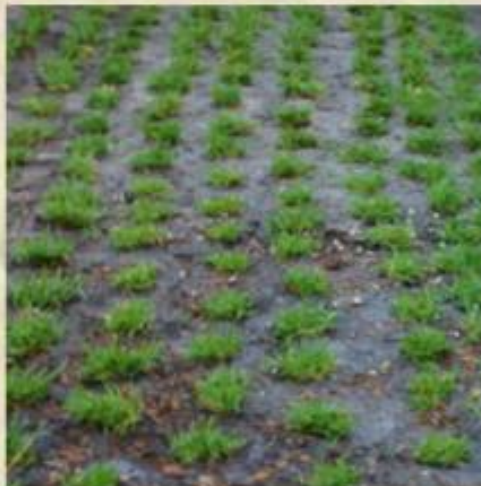
Sod

- Most popular way to plant in homes
- Easiest method
- Excellent soil erosion control
- Should be installed between 24-48 hours of harvesting



Plugs

- Small pieces of sod- 2 inches or more in width or diameter
- Planted 6-12 inches apart from each other
- Can be installed by hand or by a machine for bigger projects
- Requires more planting material than other methods



Plugs of Emerald zoysia

Recently planted



Nearly established



Sprigs

- A section of stem with crowns and roots cut from rhizome or stolon
- Sod is cut or pulled apart to provide sprigs
- Can be mechanically harvested and sold
- Highly perishable after harvesting, ideal to plant within 24 hours
- Planted 2 or more inches apart in 1-2 inches deep holes, then firm the soil around the sprig
- 1/3 of the sprig should remain above the soil surface



Hydromulch

- Method mainly used in very large areas
- Applied with a machine
- Mix of seeds, mulch and fertilizer in water
- Most affective on hillsides that are prone to erosion
- Establishes very quickly



Weed Control during Establishment

Seeding

- Important to get weed free (as much as possible) planting bed before seeding
- Hand weeding during establishment
- No herbicides until after several mowings

* Sodding

- Almost no weed problem

* Plugs/Sprigs

- Pre-emergent herbicides just after planting
- Careful spot spray with selective herbicides



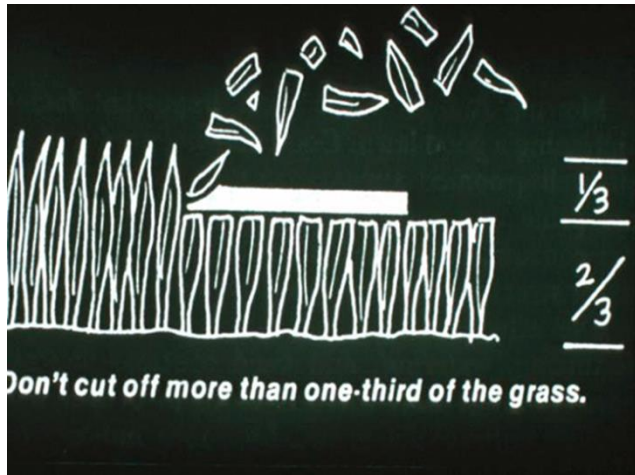
Cultural Management

- ★ **Mowing**
- ★ **Irrigation**
- ★ **Fertilization**
- ★ **Also: Verticut**
 - Thatch removal**
 - Soil aeration**
 - etc.**



Proper Mowing

- ▶ Mow at the Recommended Cutting Height
- ▶ Try not to remove more than 1/3 of blade at one time
- ▶ Rotary Mower (> 1"); Reel Mower (< 1")

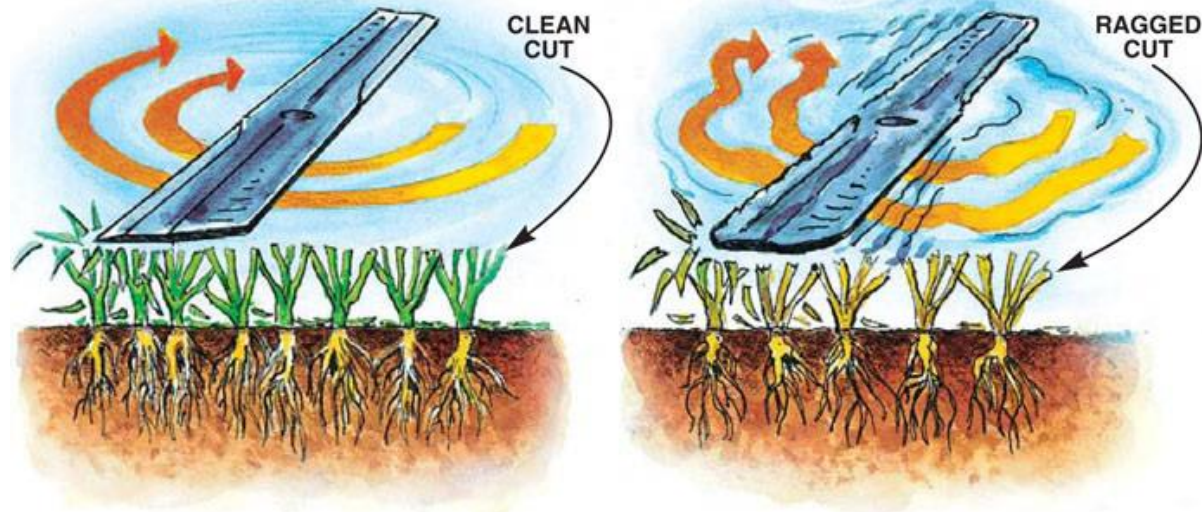


Grass	Mowing Height "
Tall Fescue	1.5-3.0
Kentucky Bluegrass	0.75-2.5
Perennial Ryegrass	0.5-2
Bermudagrass (common)	0.5-1.0
St. Augustinegrass	2.0-3.0
Zoysiagrass	0.5-2.0



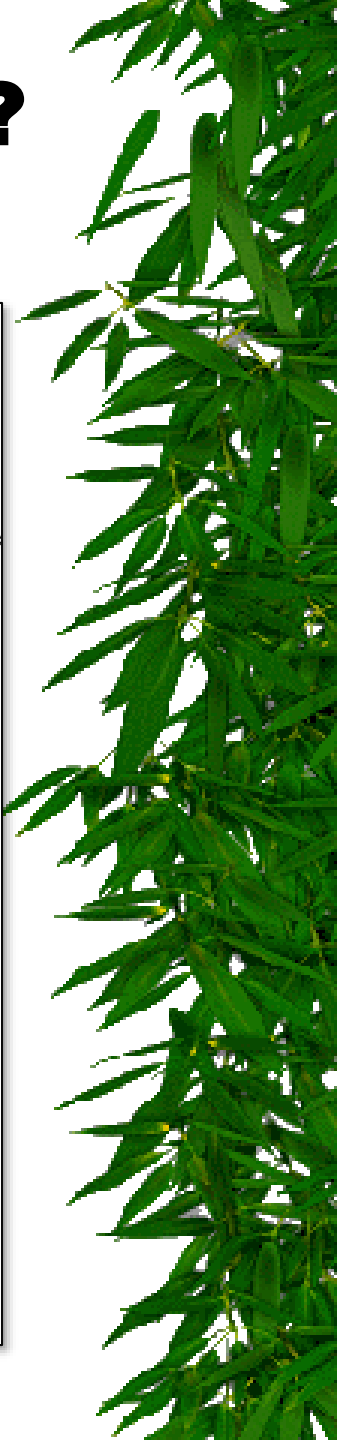
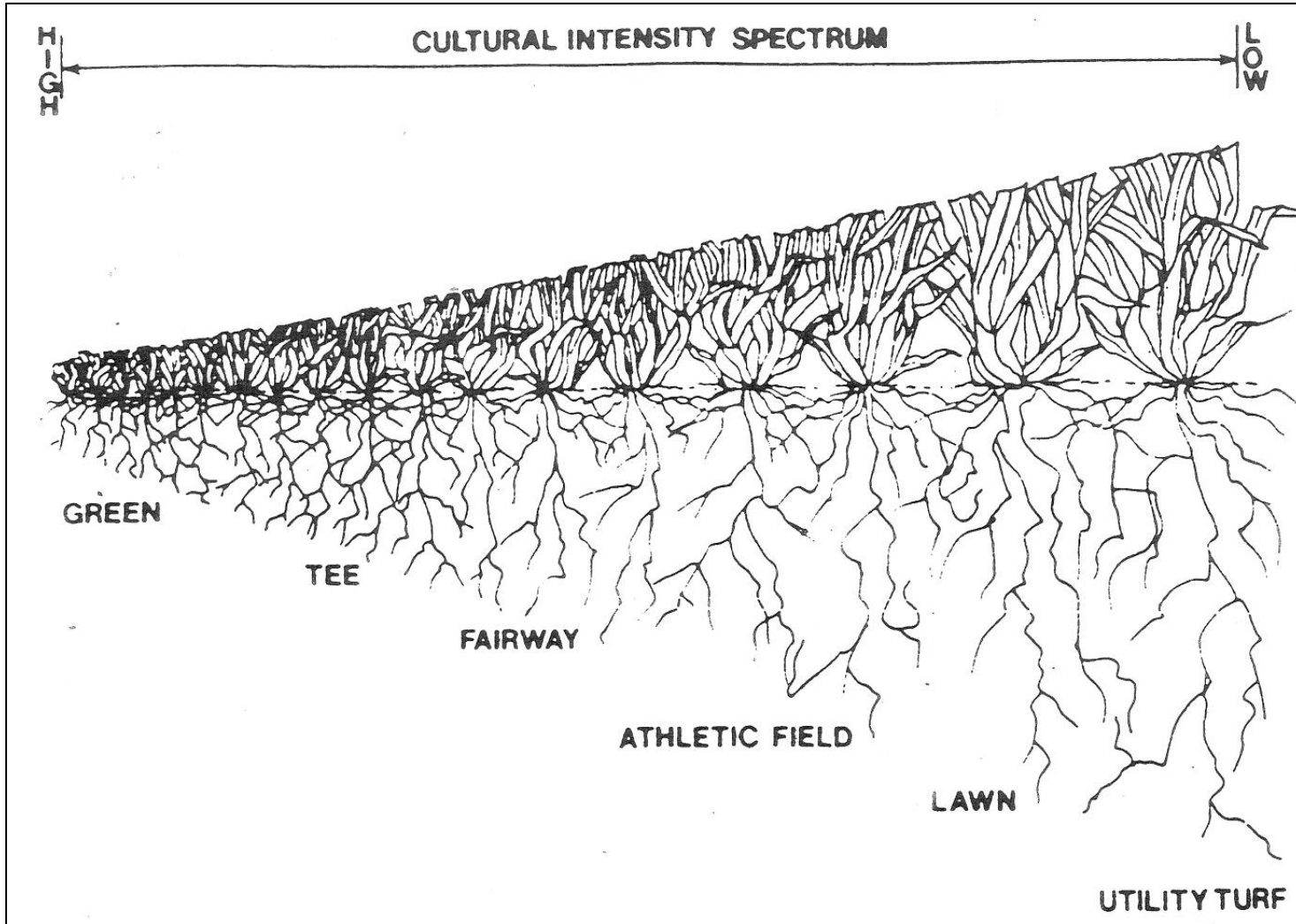
Proper Mowing

- ▶ Raise mowing height during high stress
- ▶ Sharp blade is essential
- ▶ Usually for home lawns, recycle clippings



Why is mowing height important?

Height of grass determines depth of roots.



If you mow too low

- The roots will grow more shallow
 - Grass dries out quickly and needs water more often.
- Can result in scalping of the grass
 - produces unsightly brown patches
 - usually exposes the soil surface and give weeds opportunity to invade.
 - Can cause erosion on closely mowed slopes



If you mow too high

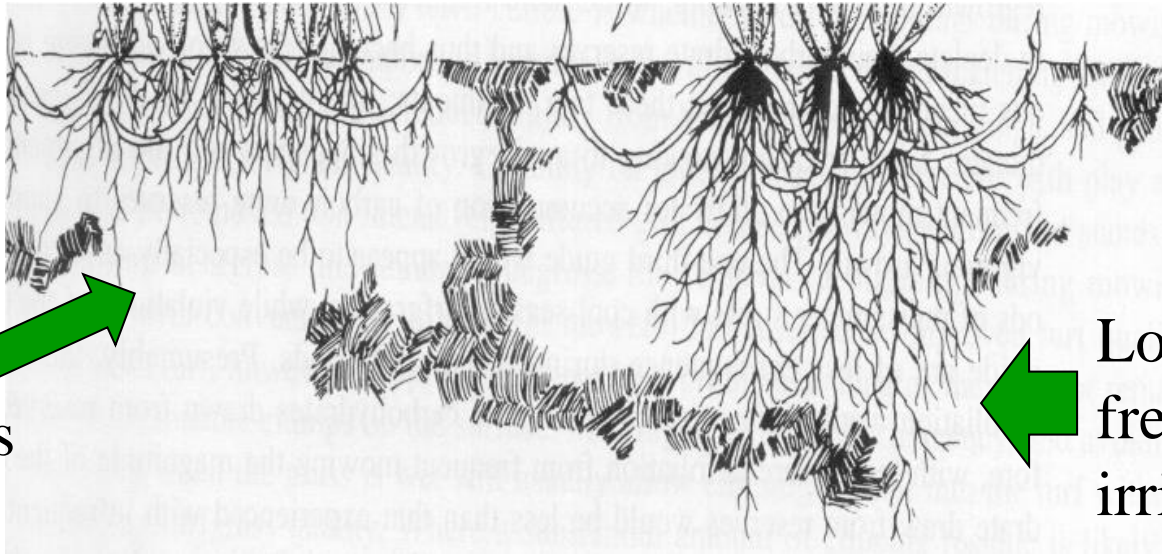
Lawn develops a thick layer of **thatch**

- gives the lawn a thick spongy texture
- interferes with **watering, fertilizing and mowing.**
- makes need for verticutting more frequent



Irrigation

- ▶ Only irrigate when needed (i.e. grass shows slight stress symptoms). “tough love” approach.
- ▶ But when irrigating, apply plenty water (enough to soak soil 6 to 8 inches deep)



Brief,
frequent
irrigations

Long, less
frequent
irrigations



Irrigation

- How to Tell if you have Enough Water
 - Catch cans
 - Use probe or screwdriver
 - Should easily penetrate ~6 inches



Irrigation

- **Early morning better**

- ▶ Usually less wind to deflect the sprinkler pattern
- ▶ Better water pressure in the system
- ▶ Soil moisture will be present during mid-afternoon heat
- ▶ Less disease/weed potential
 - Mid/late afternoon irrigation is not recommended



Fertilization: N P K

- Nitrogen (N) - for above-ground and root growth, and good green color (building block for protein)
- Phosphorus (P) - for root growth and formation of seeds and fruit
- Potassium (K) - for basic plant growth and helps plants withstand stress



Fertilization

Timing

- ▶ **Cool season grasses - fall emphasis**
- ▶ **Warm season grasses - summer emphasis**

Frequency, consider:

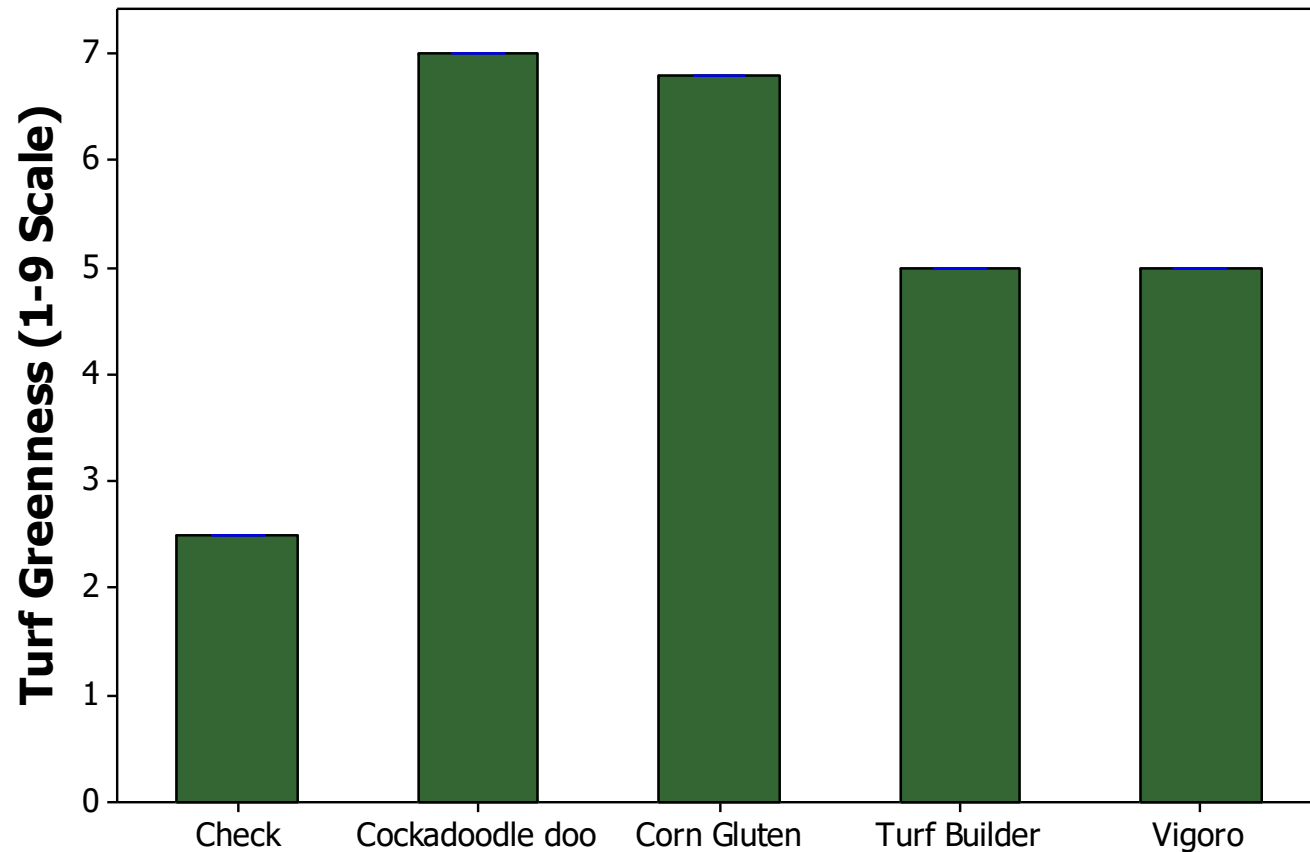
- ▶ **Quality expectations**
- ▶ **Mowing frequency**
- ▶ **Clipping management**

Organic and Traditional

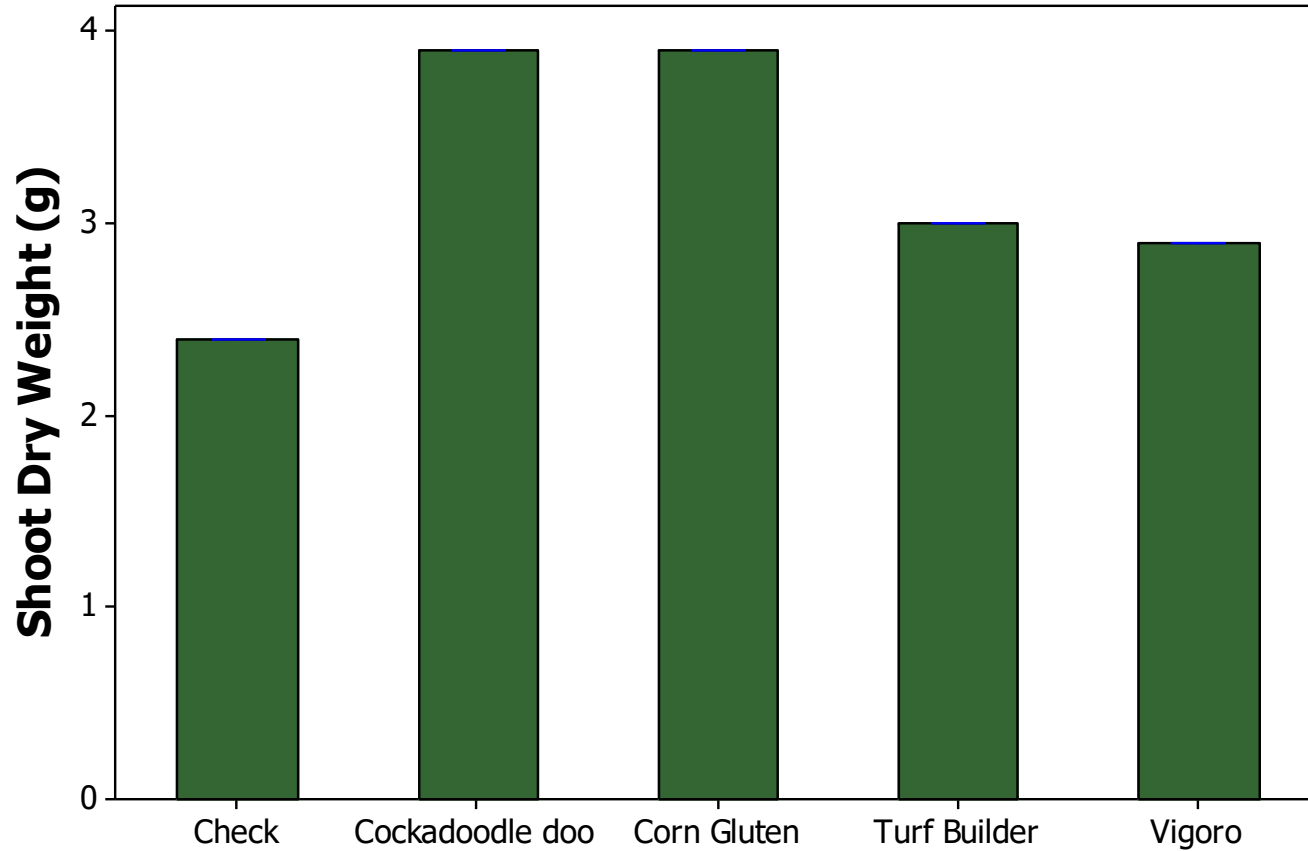


Organic and Traditional Fertilizer

Tall Fescue Quality
(16 weeks after fertilization)



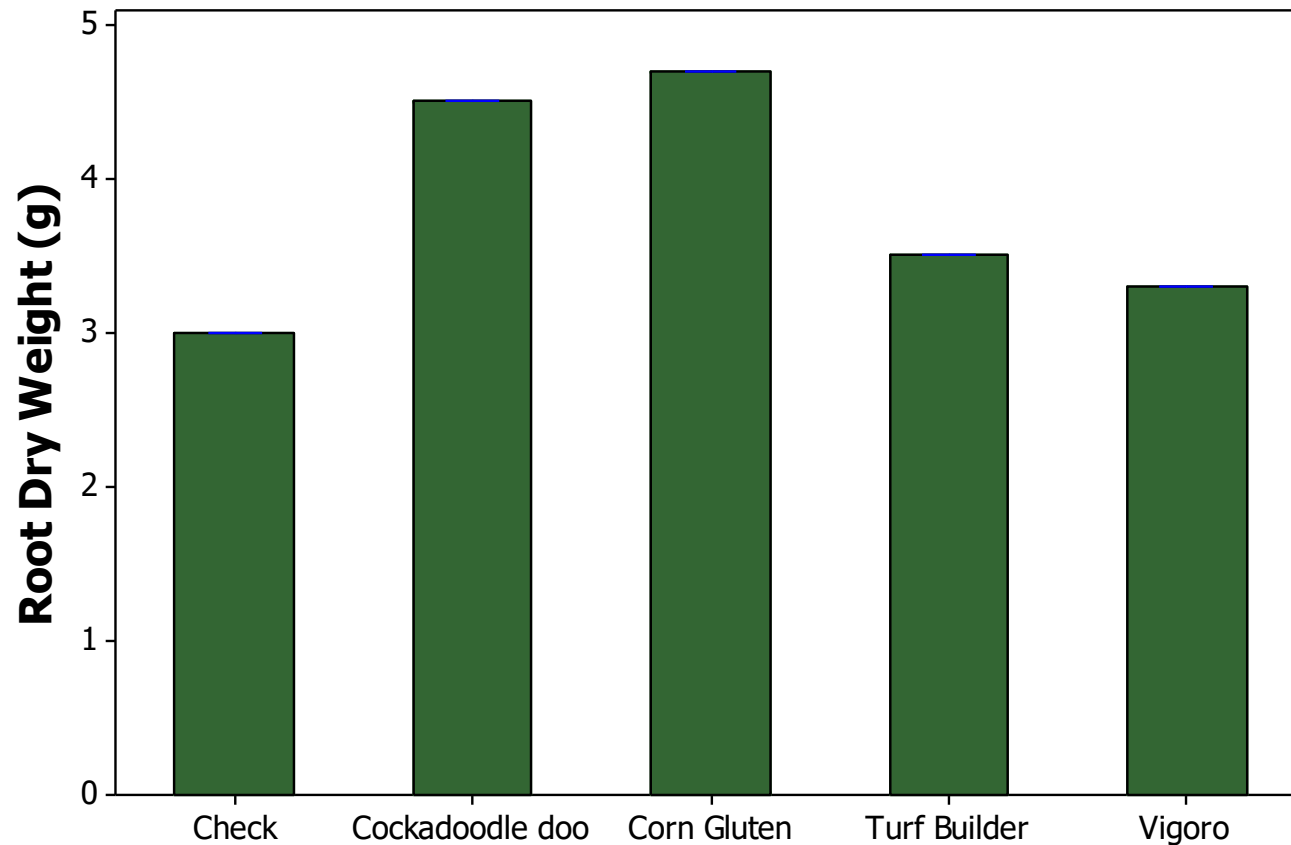
Shoot Dry Weight (4 months after fertilization)



Cheng et al., 2010. *Annals of Applied Biology*, 156: 25-37.



Root Dry Weight (4 months after fertilization)



Cheng et al., 2010. *Annals of Applied Biology*, 156: 25-37.



What can we learn from this study?

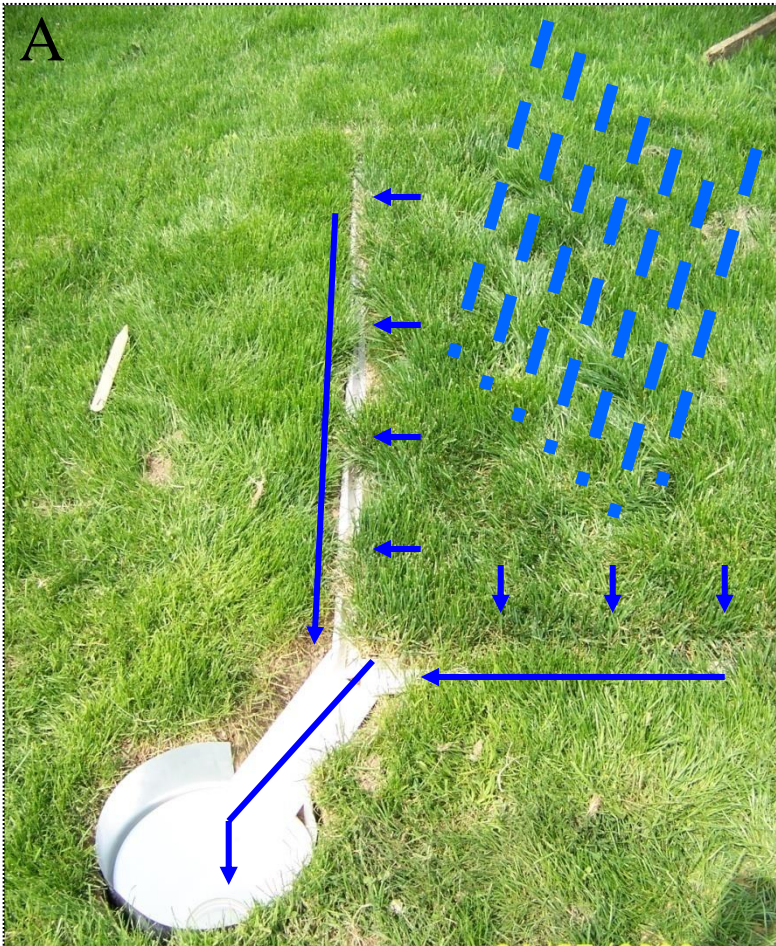
When applied properly, organic fertilizers could be as good as the commonly used Scotts Turf Builder, in terms of maintaining turf greening quality, and promoting turf root and shoot growth.

Or in a few cases, even better.

Cheng et al., 2010. *Annals of Applied Biology*, 156: 25-37.

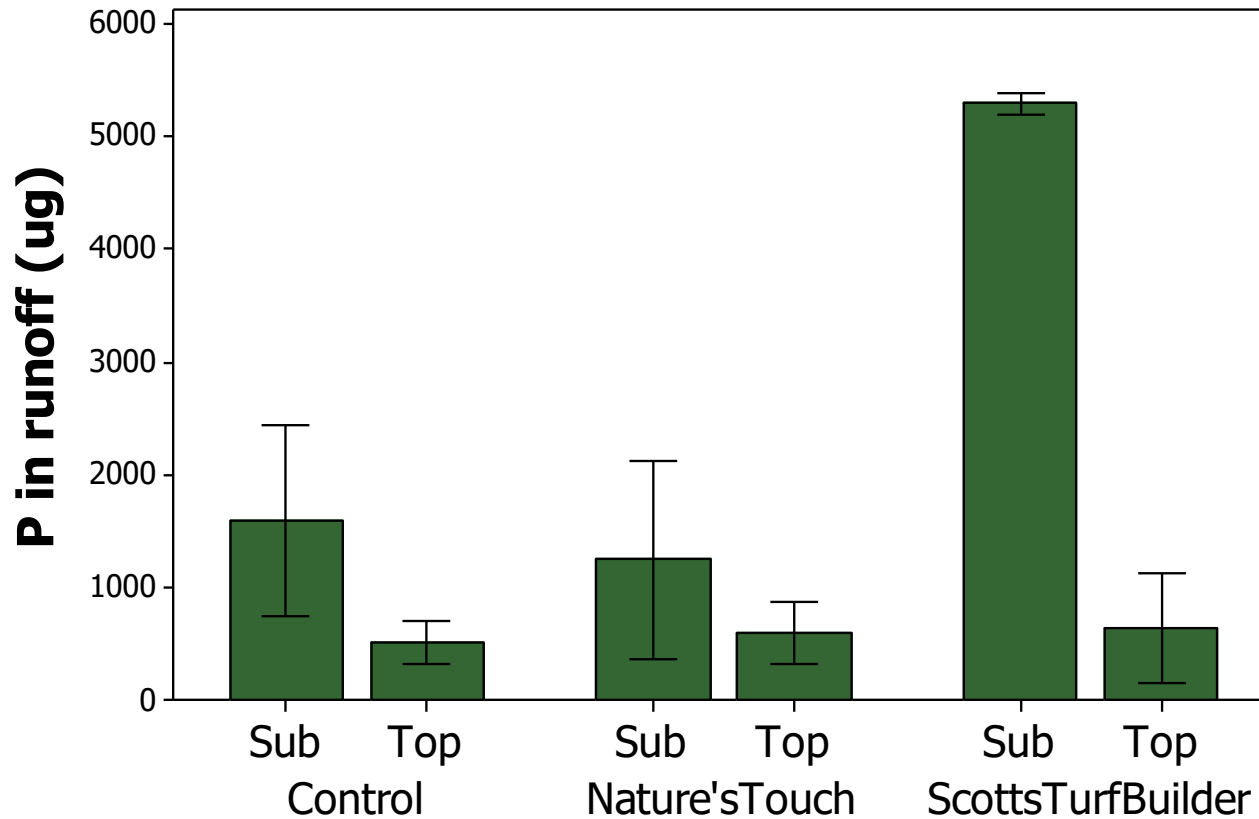


Environmental Concerns of Turf Fertilizers



Cheng et al., 2014. *Urban Ecosystems*, 17: 277–289.

N/P/K in runoff were a very small percentage of N/P/K applied.



Cheng et al., 2014. *Urban Ecosystems*, 17: 277–289.



What can we learn from this study?

Re-affirms that fertilizer nutrient losses via runoff from turfgrass are very low, even under high-intensity rains.

Keeping the above in mind, N/P/K losses via runoff from subsoil lawns are higher with inorganic fertilizer than with organic fertilizer.

Cheng et al., 2014. *Urban Ecosystems*, 17: 277–289.



I**n**t**e**g**ra**te**d** P**e**s**t** M**an**ag**e**m**e**n**t**********

Key Elements:

Integration of various management methods when feasible.

Monitoring.

Threshold.



Major Groups of Turfgrass Pests

- Insects
- Weeds
- Diseases
- Others, such as some nematodes, ants, slugs, earthworms, "secondary" pests



Prevention is Key

- ★ Many issues caused by insects, diseases, and weeds can be minimized or even possibly prevented by establishing and managing the turf properly!
- ★ Maintaining a healthy turf is the best weapon to fight against many insects, diseases, and weeds.



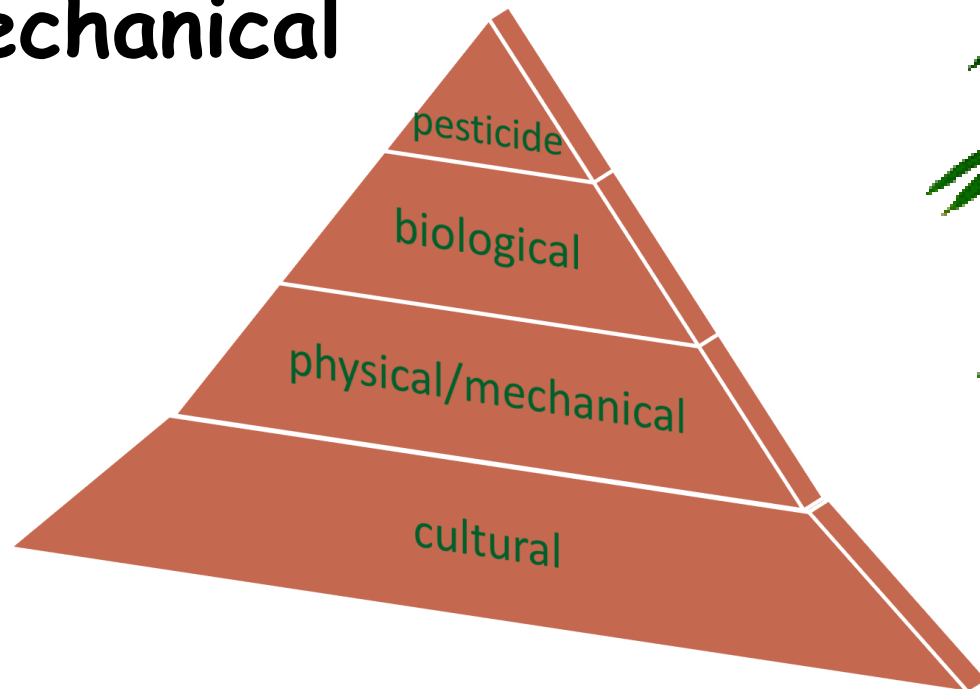
KNOWLEDGE is critical

- **Know what to kill/control**
- **Biology, ecology, and damage**
- **Acceptable threshold**
- **Early detection (monitoring)**
- **Effective management**



Control Options

- Cultural
- Physical/Mechanical
- Biological
- Chemical



Some Common Turf Insect Pests in Hawaii

Armyworms

Webworms

Cutworms

Billbugs

Certain ant species



Traditional Control

Cover Spray

Surface Insecticide

Billbugs

Webworms

etc.

Grub Insecticide

Preventive

IPM

Monitor & Risk (records)

Determine Treatment(s)

Area/Spot Treatment

Billbugs

Webworms

Armyworms

etc.

Monitor & Record



Biological Control: reduction of pest populations using naturally-occurring or introduced biological enemies, including predators, parasitoids, diseases, etc.

**2 examples: Entomopathogenic nematodes (EPNs);
Endophytes**



EPNs have broad pest host range, and can control some common turf pests in HI (such as webworms, cutworms, armyworms, and billbugs) at acceptable efficacy (for home lawns).

***Heterorhabditis* and *Steinernema* are commonly available/used.**



Source: <http://www.forestryimages.org/browse/detail.cfm?imgnum=1316021>



EPNs

Advantages

Broad pest host range.
Rapid kill.
Mass production.
Possible to use conventional application equipment.
Safe.
Little/no registration required.

Disadvantages

Cost of production.
Shelf-life.
Sensitive to environment.

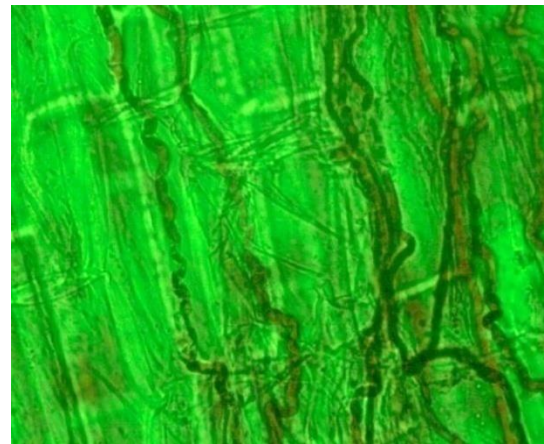


Endophytes

Endophytes: Beneficial fungi associated with certain turfgrass species, such as tall fescues, perennial ryegrass, and fine fescue.

Improved

- ◆ **stress tolerance**
- ◆ **insect resistance**



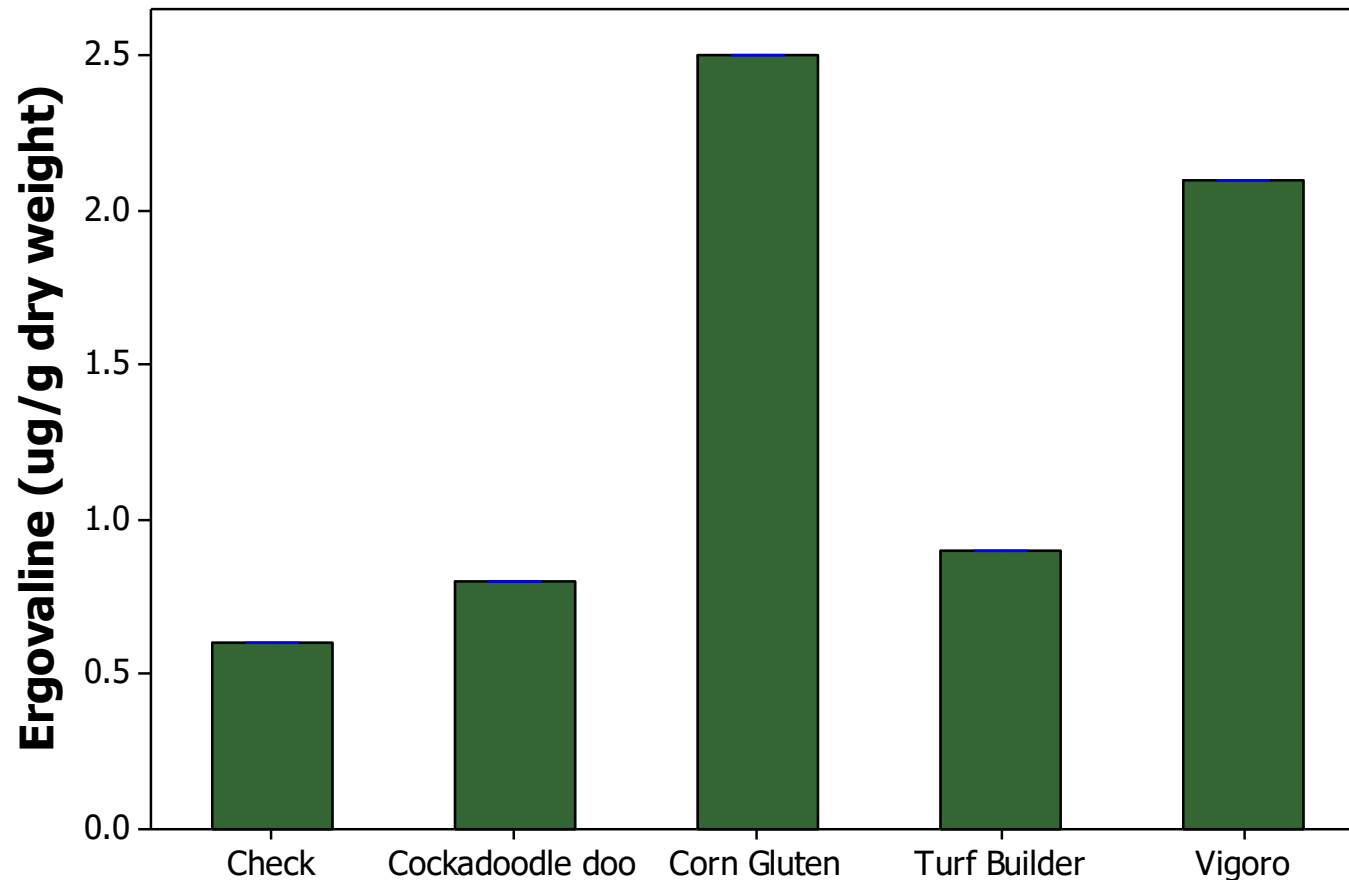
Endophytes

Produce alkaloids (highly concentrated in above-ground tissues).

Direct toxin or feeding deterrents to some surface-active insects, such as webworms, adult billbugs.



Some organic fertilizers result in high alkaloid contents in tall fescue shoots (4 months after fertilization)



Cheng et al., 2010. *Annals of Applied Biology*, 156: 25-37.



Brachymyrmex sp. (“flying”/rover ant) control in Hawaii





Turf (Zoysia) damaged by
armyworms

Billbug is an occasional turf pest in Hawaii. It attacks Zoysia, Bermuda grass, and other grasses.



Billbug damage on rough
(Bermuda grass) of a golf course



Oriental flower beetle



Common Turf Weeds

★ Broadleaf weeds:

Broadleaf Plantain



Dandelion



★ Grassy weeds:

Goosegrass



Crabgrass



★ Sedges



Weed: Plant Out Of Place



- Weeds are usually the result of a poor lawn, not the cause
- Healthy turf stand is usually the best weapon to fight against weeds
- High mowing height - (usually) less weed problems
- Wet soil - good for many weeds. Avoid irrigation late in the day



Herbicide alternatives for weed control in turfgrass?

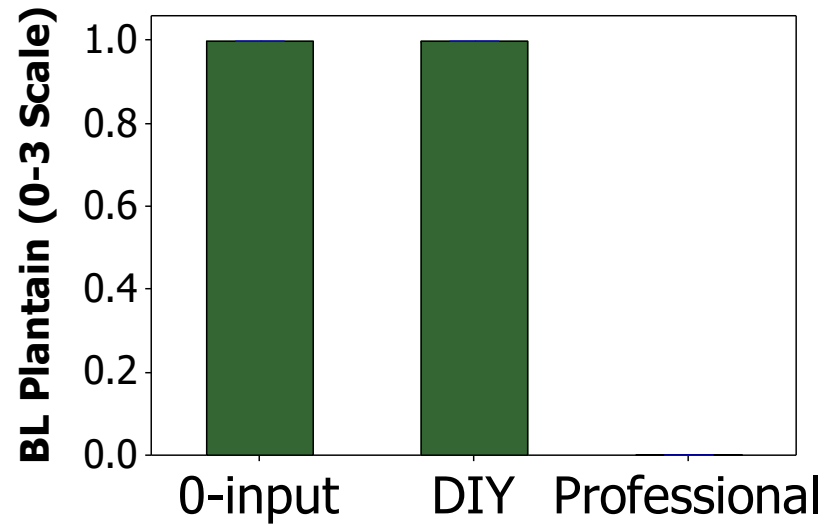
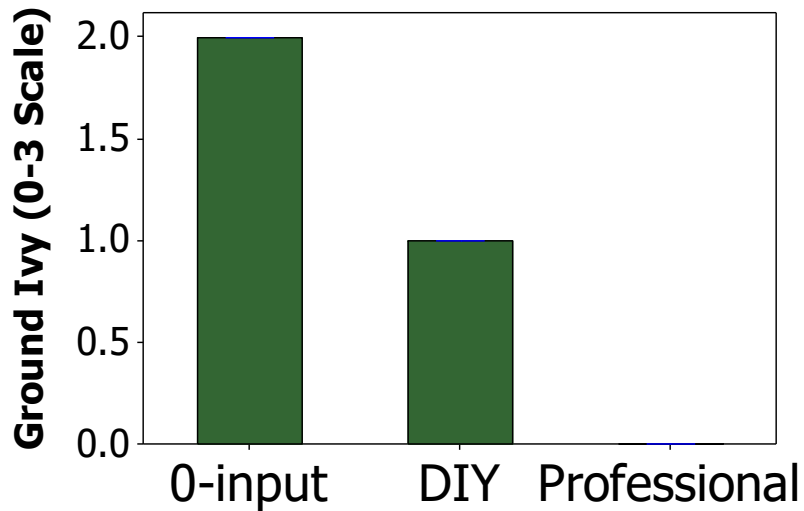
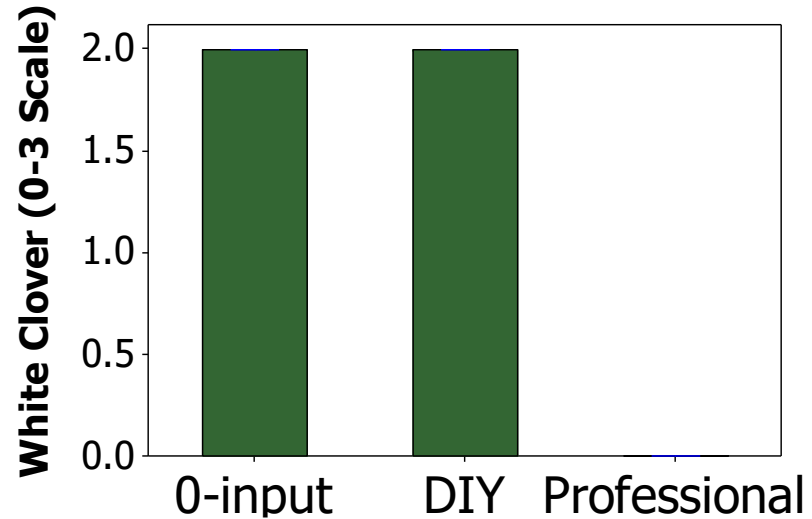
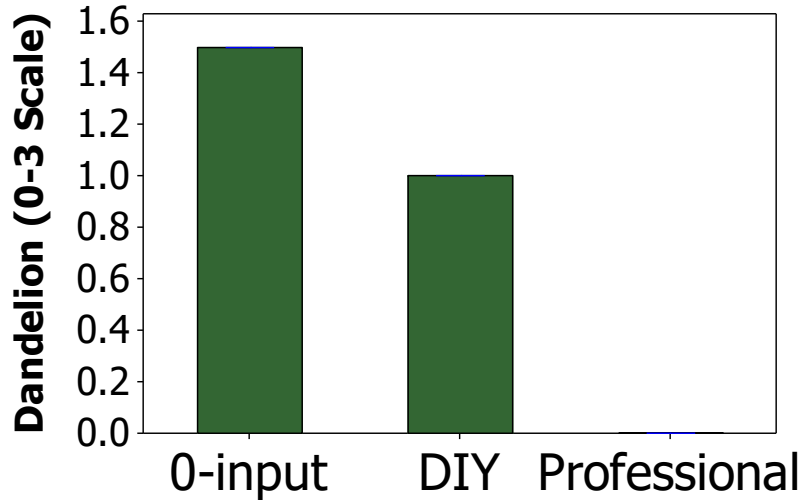
Corn gluten meal has shown some pre-emergent herbicide activity.

Rather expensive and weak as herbicide.

Most likely: nutrient value from decomposition - added fertility thickens turf and reduces weed invasion.



Real-world situation in 28 home lawns



Reason: Most likely improper applications (timing, dose, etc...)



PESTICIDE-FREE **WEED CONTROL**

BY ZHIQIANG CHENG
AND JOSEPH DEFRANK

Turfgrass areas (including golf courses, athletic fields, home lawns, recreation areas, utility areas, and more) have become a central part of urban and suburban landscapes throughout the US. In Hawaii, the golf and turf industries make a significant contribution to Hawaii's recreation and tourism-driven economy. In 2007, the size of Hawaii's direct golf economy was approximately \$1.4 billion (PGA, 2009).

Among broadly defined turf pests (insects, weeds, pathogens, nematodes, and others), weeds are usually under very high control demand. In fact, weed control is the most challenging problem to turf managers in Hawaii as well as on Guam



Figure 1. Weed mat covering a weedy turf plot in Magoon Facility, UH Manoa.

“Lights-out” weed control and turf renovation



Magoon Turf Research Facility



Research Project Year-1: 2015



Research Project Year-2: 2016



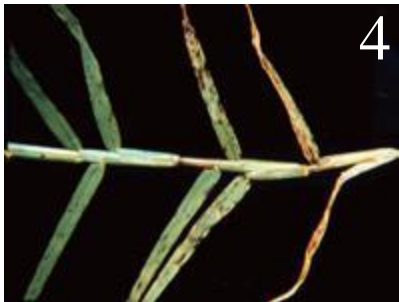
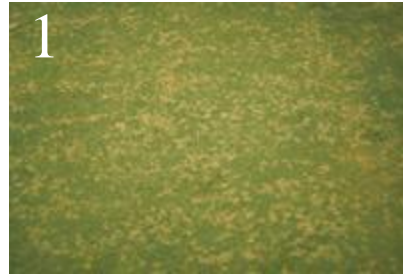
Weed: Plant Out of Place



Suppress Bermudagrass from seashore paspalum

Some Common Turf Diseases in Hawaii

1. Dollar Spot
2. Brown Patch
3. Rusts
4. Leaf Spot/Melting Out
5. Fairy Ring

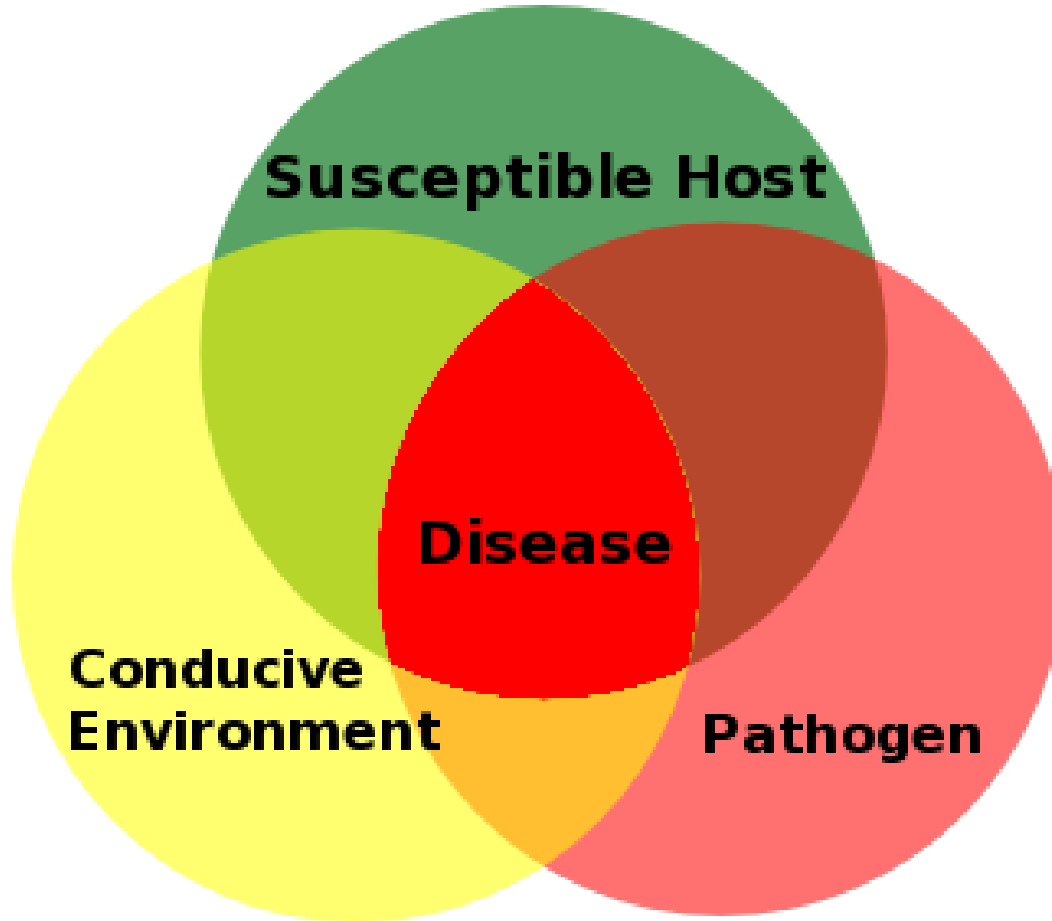


Root Diseases vs. Leaf Diseases

- ★ Root diseases cause more permanent damage to turf.
 - Turf often takes longer to recover from root diseases.
 - Some turf (such as Fescues) might have to be re-seeded or re-sodded after a severe root disease.
- ★ Leaf diseases can recover more quickly IF turf still has a healthy root system.
 - Many leaf diseases are due to weak pathogens, or are secondary diseases (stressed grass being vulnerable)



Disease Triangle

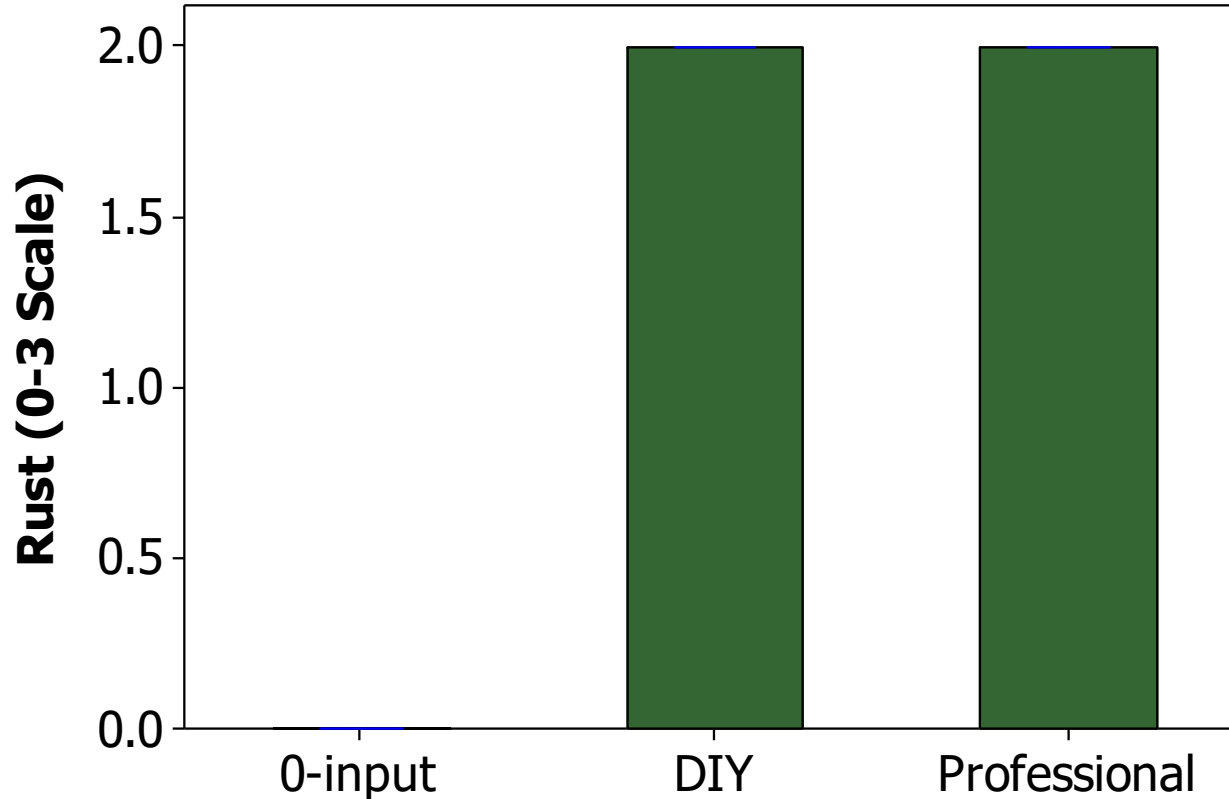


Some Helpful Practices

- ▶ **Resistant variety**
- ▶ **Avoid evening irrigation - wet grass = disease opportunity**
- ▶ **Fertilization - Promote healthy grass (but avoid high N while some diseases are active)**
- ▶ **Thatch management**



Real-world situation in 28 home lawns



Possible reasons – Professional and DIY managements might have: 1) excessive nitrogen applications; 2) more frequent irrigations (especially at wrong timing...)



Turf disease trials

“Mini ring”



Turf disease trials

“take-all patch”



Turfgrass Nematodes

> Plant-parasitic nematodes (PPNs) can cause:

Mechanical injury

Chemical injury

Inject pathogenic bacteria/fungi

> **Endoparasitic/Ectoparasitic**

> **Lesions/knots/galls/root rots/etc.**

> **Sandy soils in (sub)tropical zones**



Nematode Control

- ▶ For golf courses and athletic fields, limited types of nematicides are available.
- ▶ Relatively minor issue for home lawns.
- ▶ Keep lawns healthy and less stressed so they can better tolerate nematode damage.
- ▶ Chitin for home lawns – a non-chemical soil amendment that promotes growth of beneficial soil microbes which in turn negatively affect nematodes.
- ▶ Biocontrol methods?



Summary

Many lawn problems (water, nutrients, insects, diseases, weeds, etc.) can be minimized or even possibly prevented by establishing and managing turf properly.

Maintaining a healthy turf is the best weapon to fight against many insects, diseases, and weeds.

Prevention and early-detection are key.

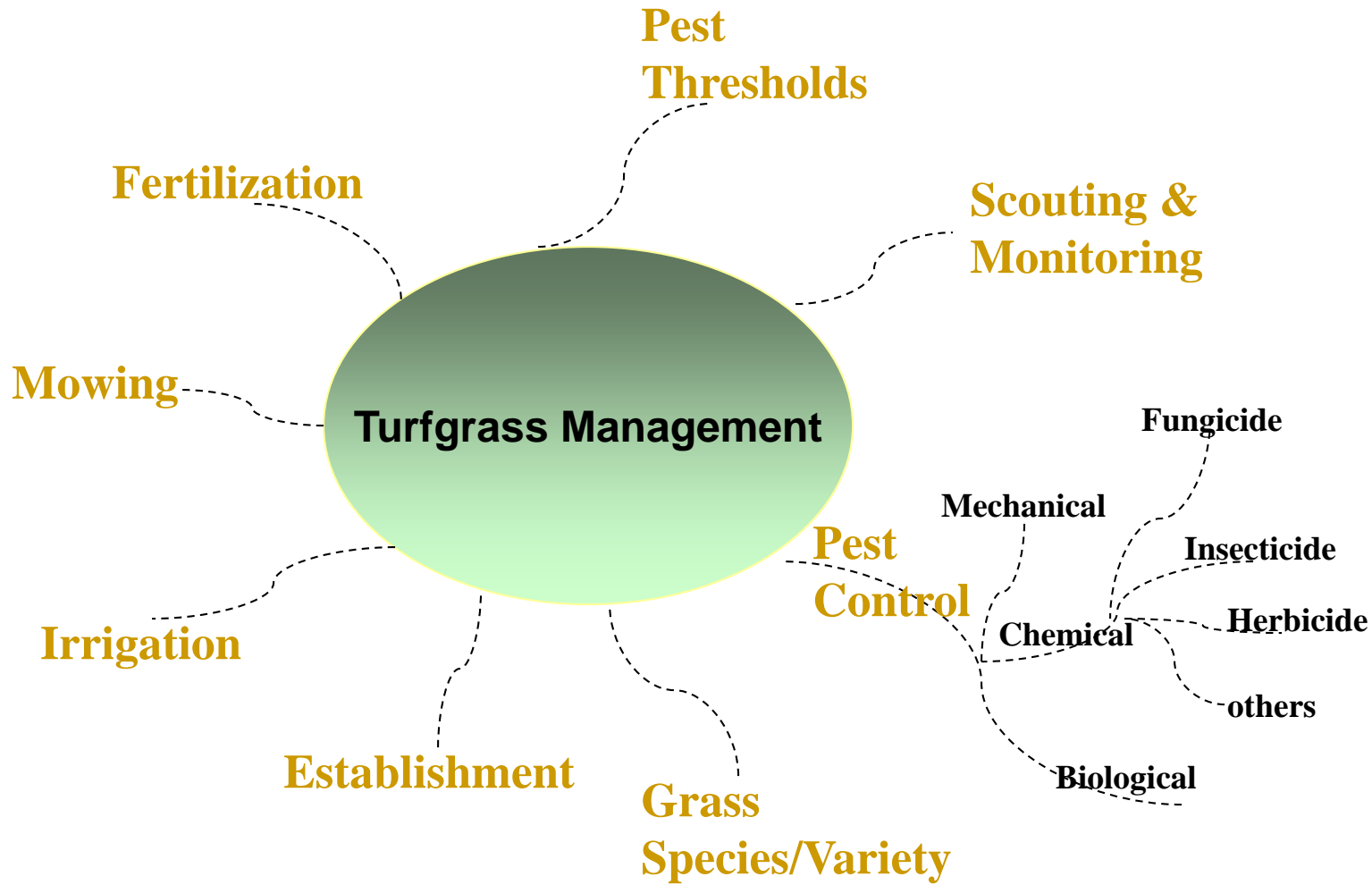


Summary (cont.)

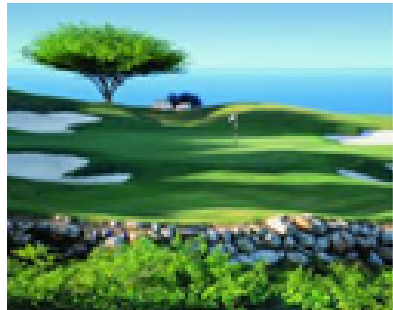
Management through a system approach: give cultural, mechanical, and bio-control approaches a try.

Lawn fertilizers generally do not cause severe environmental issues, when properly applied.





Turfgrass Pests and Management



PEPS/TPSS 418, Fall 2016

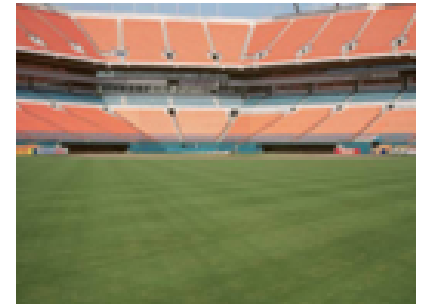
4 Credits, CRN 77221 or 77317

Instructor: Dr. Zhiqiang Cheng

Location: Gilmore 301

Lecture/Discussion: Mon. 10:30-11:45am; Thur. 1:20-2:35pm

Lab/Field Trip: Thur. 2:40 up to 5:00pm



Interested in a career in the “green” industry?



Learn common pests (insects, pathogens, weeds, nematodes, etc.) in turfgrass systems in Hawaii.



Discuss cultural/biological/chemical means to manage turf and pests.

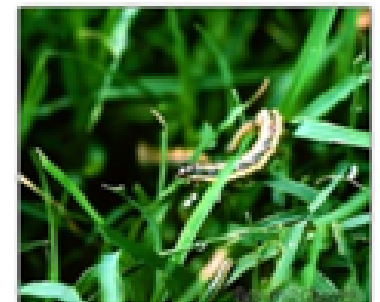


Field trips to golf course, athletic field, sod farm, and turf research facility.



Briefly on landscape pest management

Contact: cheng241@hawaii.edu; (808) 956-6416



Turfgrass Management Extension Program at UH Manoa <http://turfgrass.ctahr.hawaii.edu/>



University of Hawai'i at Manoa
College of Tropical Agriculture and Human Resources

Turfgrass Management at the University of Hawaii

Turf Team

Industry News

Research

Fact Sheets

Upcoming Events



Poipu Bay Resort, Koloa, HI

Research Updates

Suppressing bermudagrass in seashore paspalum turf

An emerging management challenge of seashore paspalum turf installations and maintenance in Hawaii in recent years is the infestation of the bermudagrass cultivar that was replaced or common bermudagrass. PI Z. Cheng and Co-PI J. DeFrank continue to receive inquiries from golf courses that use seashore paspalum to develop new grassy weed control options that do not depend on salt applications. This project will address this immediate need of Hawaii's turf/golf industry. An M.S. student who started in August 2016 is working on this 2-year project. Field trials are currently being conducted in UH Manoa Magoon research facility, West Loch Golf Course, and Hoakalei Country Club.

Management of take-all patch (Bermudagrass decline) of turfgrass in Hawaii

In collaboration with 3 golf courses on Big Island, Maui and Oahu, and with industry support from 2 major chemical companies, this applied research project was started in November 2015 to evaluate various fungicide programs against take-all patch (also commonly known as Bermudagrass decline) in both bermudagrass and seashore paspalum turf. Various fungicide rotation

Upcoming Events

Upcoming and Recent Events

January 19, 2017 - Pacific Agricultural Educational Seminar.

2017 Pacific Agricultural Educational Seminar will be held in Pearl Country Club. For details and registration, contact Gilbert Araki at gilbert@pacificagricultural.com

Continuing. State-wide Turf Pest

Management Survey. This state-wide survey targeting turf/green professionals in Hawaii intends to identify the updated turf pest management challenges and educational needs. Survey results will provide valuable information for the Turfgrass Management Program at University of Hawaii at Manoa to establish working priorities in service of the turf/green industry in Hawaii.

Please visit the survey link at: [State-wide Turf Pest Management Survey.](#)

The survey should take less than 10 minutes, on average, to complete. Thank you for your information and time!

November 29, 2016 - Turf and Surf: CTAHR's 2016 Tour for Legislators.

Turfgrass is featured in this CTAHR event for legislators. The first half of this event will be held

A Special Thanks...

We would like to thank many groups for your support of and collaboration with the University of Hawaii Turfgrass Management Program. [More »](#)



Turfgrass and Landscape Pest Management Lab at UH Manoa

<http://cms.ctahr.hawaii.edu/cheng>

UNIVERSITY of HAWAII at MĀNOA



Turfgrass and Landscape Pest Management

College of Tropical Agriculture and Human Resources

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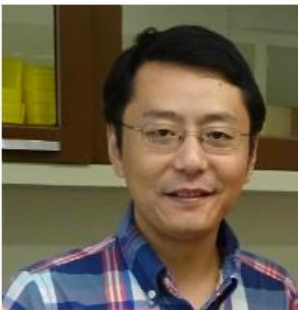
Publications

Media Coverage

Pest Inquiries

Links

Welcome to the website of
Turfgrass and Landscape Pest Management Lab
Dept. of Plant and Environmental Protection Sciences, CTAHR
University of Hawaii at Manoa



Dr. Zhiqiang Cheng is the principal investigator of Turfgrass and Landscape Pest Management Lab. Dr. Cheng's main goal is to conduct research, extension and education on turf and landscape pest management, and based on



Key References & Resources

University of California IPM Online

University of Georgia

Louisiana State University

The Ohio State University, Turfgrass
Identification

And some other sources (books, papers,
www, etc.)

