Natural Turf Management Professional Training

A Systems Approach

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Today's Agenda:

- What is a turf system?
- Soil biology basics
- Soil testing and results
- Turfgrass nutrition
- Cultural practices
- Sports field management

Chip Osborne

Background & Experience

Recreation, Parks,

& Forestry Commission

Marblehead, MA

What is a "systems" approach?

- The opposite of a product approach.
- Understanding how the system works, and how to make it work for us.

The Systems Approach to Turf Management

- Basic understanding of soil biology
- Exclusive use of natural organic products
- Revised cultural practices

History and Description of Conventional Turfgrass Management

- Conventional turf management has its origins in WW II era
- Found that these chemicals worked effectively against insects, weeds, and fungal pathogens
- First market was the agricultural market, with promises of higher yields
- Yields skyrocketed, but today those same farms have yields per acre less than 1930
- Substantial soil damage – many years to recover.

- 1950-1960 – homeowner market develops
- Clover was part of every grass seed mix – natural source of N
- They convinced us clover was a weed.
- Now we needed their synthetic fertilizer.
- Monoculture of C3 & C4 was born

Differences……..

Conventional Management

- synthetic fertilizers
- chemical pesticides
- quick fix
- product-based
- treats symptoms
- applications by calendar
- multiple applications
- low mowing height

Differences……..

Natural Management

- natural organic products
- soil test is basis for inputs
- sustained benefit
- solves problems
- builds healthy soil

Part One: Soil Biology Basics:

Basic Soil Biology

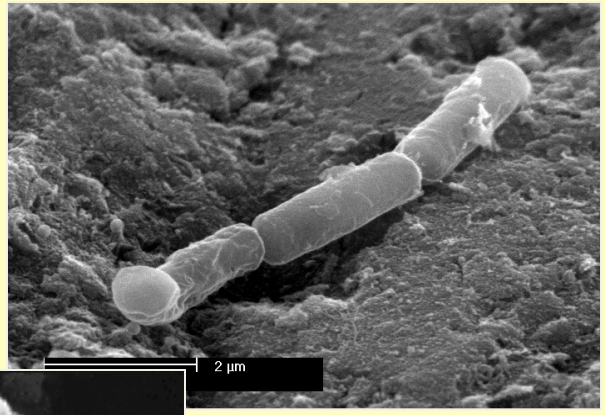
- Nature has put in place everything we need to grow grass
- Our job is to optimize that system and create the ideal environment
- Stop practices that are compromising that system

What's in the soil?

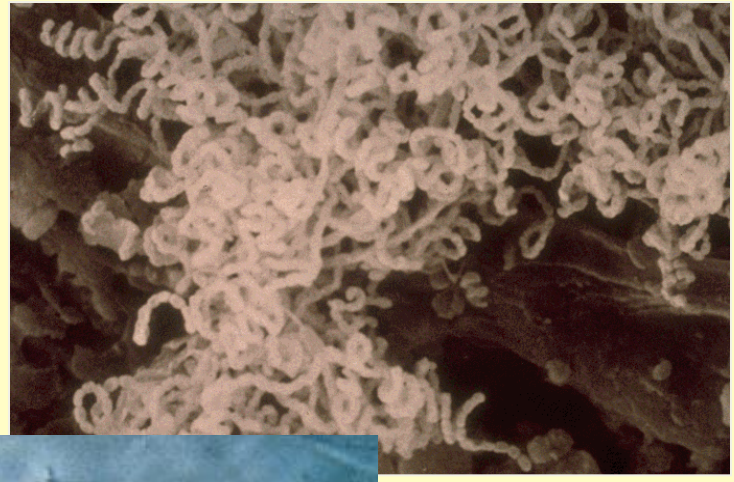
Billions of organisms competing for survival and the chance to reproduce.

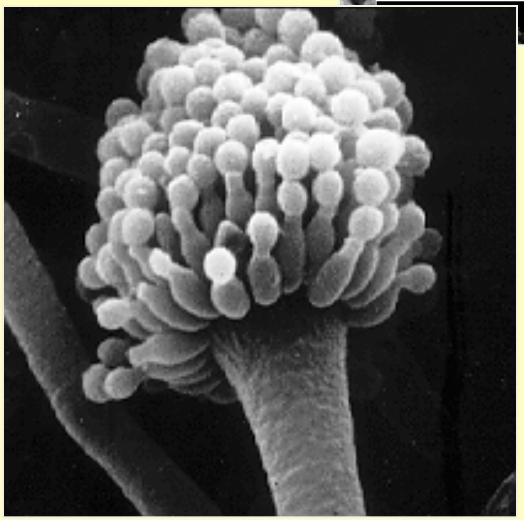
Microorganisms in Soil

Bacteria



Actinomycetes





Fungi

Mycorrhizae

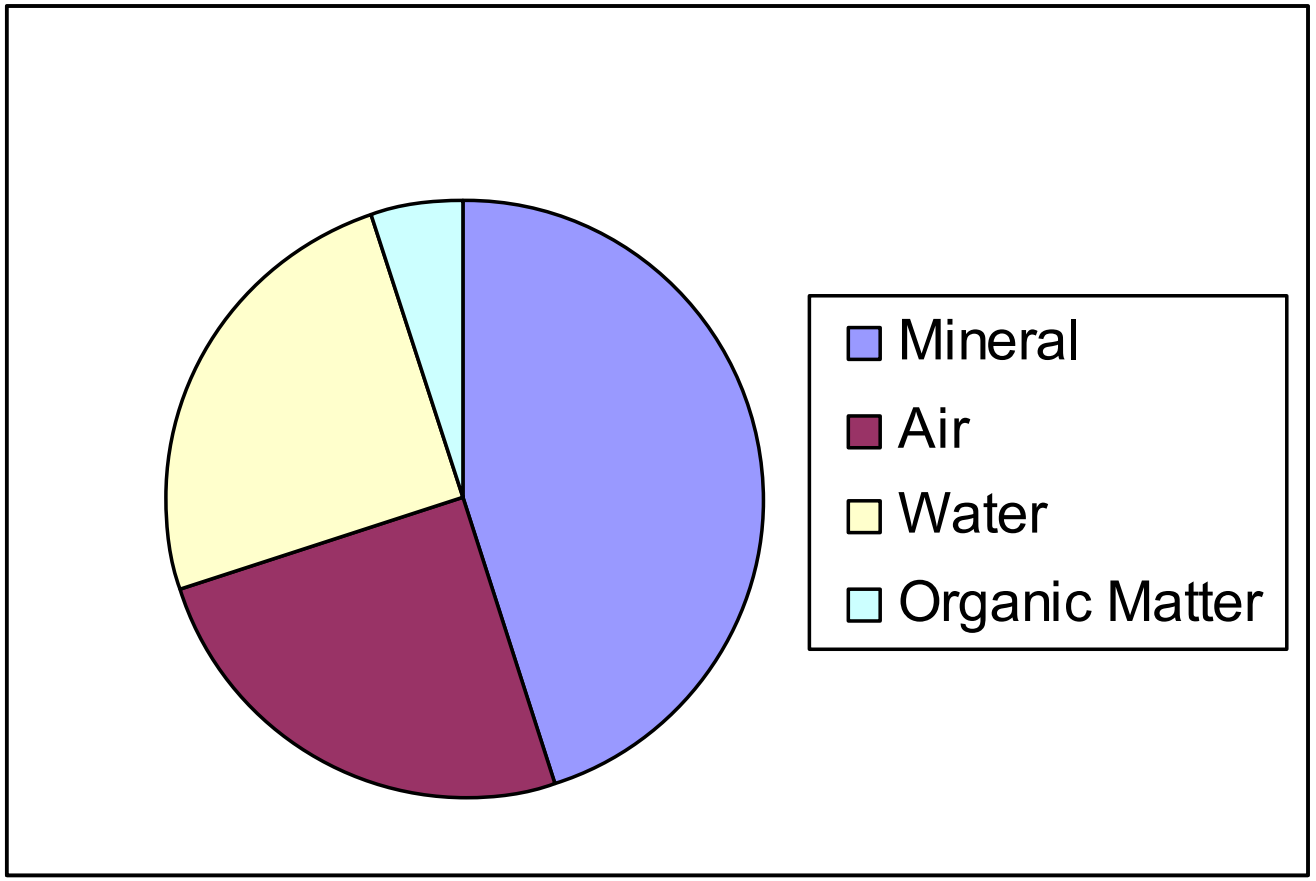
In every teaspoon of agricultural soil there are…

❖ Bacteria	100 million to 1 billion
❖ Fungi	6-9 ft fungal strands put end to end
❖ Protozoa	Several thousand flagellates & amoeba One to several hundred ciliates
❖ Nematodes	10 to 20 bacterial feeders and a few fungal feeders
❖ Arthropods	Up to 100
❖ Earthworms & potworms (enchytraeids)	5 or more

Years of a chemical program

- Will significantly compromise biological activity
- May result in compacted soil
- Pathogens may outnumber beneficials
- Our job is to rebuild soil biology

Typical Non-Forest Soil



Benefits of Soil Organic Matter ("OM")

- **Benefits of OM for soil:**
  - Structure (esp. water holding capacity)
  - Chelation of micronutrients
  - pH buffering ability
- **Benefits of OM decomposition:**
  - Aggregation
  - Nutrient release
  - Biological activity

If soil is low in OM and does not have sufficient resources

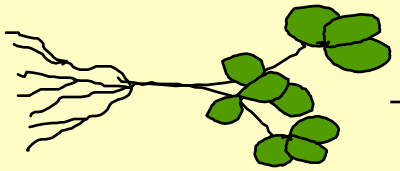
- **OR**

If soil is extremely compacted and anaerobic (no oxygen)

Microbial life will not survive in large amounts

Effects of OM additions

Add organic matter



Increase biological activity (& diversity?)

May reduce soil-borne disease

Decomposition

Pore structure improved

Aggregation increased

Nutrients released

Humus formed

Improved tilth

HEALTHY PLANTS

Increasing OM with Compost Topdress

Compost is “Black Gold”

- Microbial life in the soil is the key to a healthy turf system
- Compost is the best source of OM and beneficial micro-organisms
- OM is the major energy source for plant life
- Millions of beneficials each handful
- Compost nurtures the development of the soil system

Compost by Definition

Compost is the product of an aerobic process whereby microorganisms break down and decompose various forms of organic matter.

The organic matter is called "feedstock" or "substrate" and can be made up of a variety of materials.

The feedstock can be random materials or specific materials can be chosen to meet a particular recipe.

Organisms use the substrate as a food source

They produce heat, CO2, water vapor, and humus

Humus is a highly stable by-product of decomposition process

Nutrients and pH (near neutral) are stabilized

Finished compost is rich in nutrients and microbial life

High % humus and OM

Ideal soil conditioner and turfgrass topdress

Compost Quality

There are no national criteria, standards, guidelines

Need to rely on testing or own assessment

Quality determined by several criteria

- **No offensive odor**
- **No remnants**
- **Looks like quality soil**
- **Should be mature**

Rate of Application

3/4 to 1 cubic yard / 1000 square feet

1/4” to 3/8” depth —1/2” too thick

Immature Compost

Wants to finish

Pulls N from soil

Damaging to turf

Causes turf to yellow

Chlorophyll decreases

Photosynthesis reduced

Carbohydrate production drops

Turf weakens

Compost Tea

- Will be one of the foundations of a complete natural program in the future
- 100 gals high quality, aerobically extracted and brewed compost tea contains same number of organisms as 1500 to 2000 lbs of compost

Compost Tea

- Compost tea addresses soil biology only – not Organic Matter percentage.
- As OM% reaches target levels, we can rely on compost tea to feed/ activate biology

Brewing Compost Tea

- Liquid extract of high grade compost or vermicompost
- Add food sources
- Add inoculants
- ¾ : 1 to 1:1 Fungal to Bacterial ratio for turfgrass
- 18-24 hour extraction and brewing process

Application of Compost Tea

- Apply with tractor pulled boom sprayer with 50-200 gal tank capacity
- Backpack sprayer
- Spray tank with long hose
- Rate 15-25 gal / acre
- Be gentle—living organisms

Part Two: Soil Testing

Soil testing is the basis for all inputs in a natural turf program.

Soil Testing

- Insert soil probe 3-4 inches into soil
- Take multiple samples for reach field
- Mix samples together, remove debris
- Let air dry overnight
- Pack in baggie, ship to lab

Soil Testing: Type 1 Nutrient Analysis

- pH levels – C3 grasses thrive in 6.5 to 7.0
- Organic Matter (OM) percentage - 5-8%
- Calcium-Magnesium ratio – 8:1 best
- N P K - Nitrogen, Phosphorus, Potassium
- Cation Exchange Capacity (CEC)

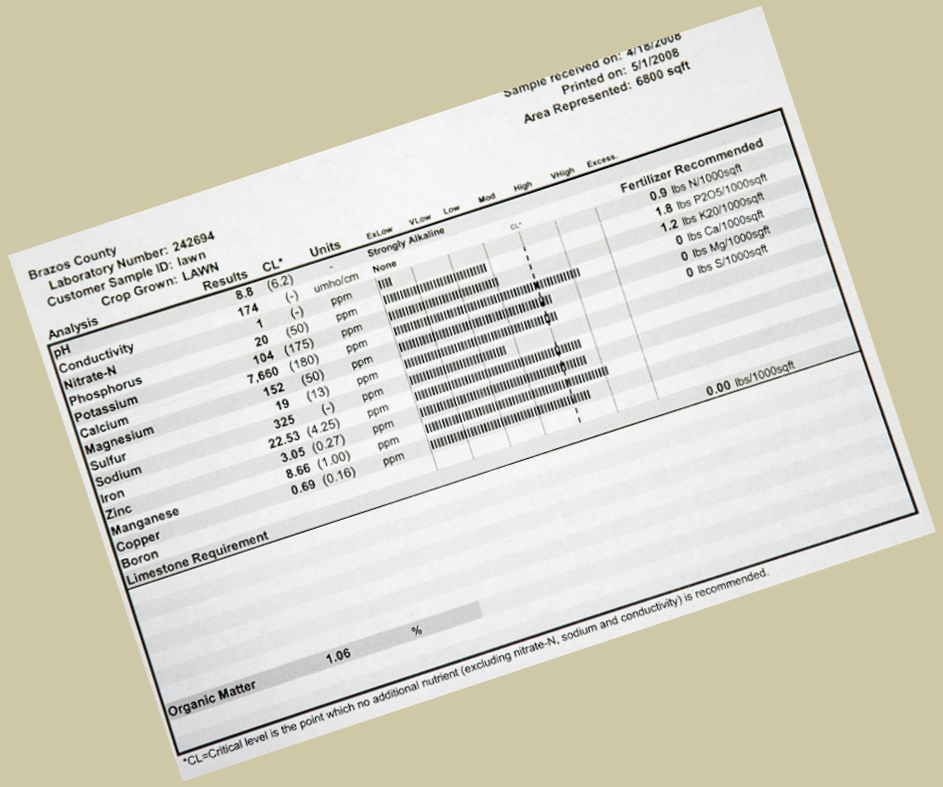
Soil Testing: Type 2 Textural Analysis

- Percentages of sand, silt and clay
- Key to soil's ability to hold nutrients
- Indicates potential water holding capacity
- Classification of soil, ie: sandy loam, etc
- Indicates tendency of soil to become compacted

Soil Testing: Type 3
Soil Foodweb Analysis

- Bio-assay of soil micro-organisms
- Indicator of life in the soil
- Can be expensive - $250

Interpreting a Nutrient Soil Test



Brazos County
Laboratory Number: 242694
Customer Sample ID: lawn
Crop Grown: LAWN

Sample received on: 4/15/2008
Printed on: 5/1/2008
Area Represented: 6800 sqft

Analysis	Results	CL*	Units	Strongly Alkaline	Fertilizer Recommended
pH	8.8	(6.2)		None	
Conductivity	174	(-)	umho/cm		0.9 lbs N/1000sqft
Nitrate-N	1	(50)	ppm		1.8 lbs P2O5/1000sqft
Phosphorus	20	(175)	ppm		1.2 lbs K2O/1000sqft
Potassium	104	(180)	ppm		0 lbs Ca/1000sqft
Calcium	7,660	(50)	ppm		0 lbs Mg/1000sqft
Magnesium	152	(13)	ppm		0 lbs S/1000sqft
Sulfur	19	(-)	ppm		
Sodium	325	(4.25)	ppm		
Iron	22.53	(0.27)	ppm		
Zinc	3.05	(1.00)	ppm		
Manganese	8.66	(0.16)	ppm		
Copper	0.69				
Boron					
Limestone Requirement					0.00 lbs/1000sqft
Organic Matter	1.06		%		

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended.

- pH
- Available Nitrogen
- Phosphorus
- Potassium
- Calcium
- Magnesium
- Iron
- Zinc
- Copper
- Boron

And… OM %!

Addressing pH with Lime

Remember pH varies in different regions of the country

To raise soil pH –only if indicated by soil test. C3 Grasses prefers 6.5-7.0

Calcium/Magnesium ratio determines type of lime to use: Calcitic lime if Ca levels low; Dolomitic if Magnesium is low

Apply lime in Fall if possible, but can be applied early Spring

50 lbs. per 1000 ft maximum rate in 1 application…may have to do a split application.

Lime can take 100 days to breakdown and effect a change in pH of soil.

- **Never apply lime unless indicated —if pH is above 7 lime will cause problems**

- **Liming materials contain Ca, Mg, or a combination of the two**

- **Calcium carbonate is the standard liming material -- liming materials are based on a calcium carbonate equivalent**

Part Three: Turfgrass Nutrition

Natural vs. Synthetic Fertilizer

Conventional Fertilizer

- Nitrogen from urea
- Synthetic, inorganic
- Water soluble
- Quick release – rapid uptake
- Encapsulation
- Multiple apps
- Leaves soil quickly
- Cost increases

Natural vs. Synthetic Fertilizer

Natural Fertilizer

- Nitrogen from plant, animal or mineral source
- Water insoluble
- Slow release – microbial action
- Sustained benefit
- Measured growth
- Cost effective

Plants can only use inorganic N

- Synthetic fertilizers work fast – the N is already inorganic
- Natural fertilizers work more slowly as microbes convert organic N to inorganic

Evaluating the Nutrient Requirements of Turf

- Nutrient Levels
- Nutrient Availability--this involves pH
- Interactions between nutrients—balance
- Environmental Conditions

Grass obtains nutrients it needs from

- Soil Minerals
- Organic Matter
- Fertilizer
- Atmosphere

(lesser extent)

Fertilizer Nutrients

- NO_3^- Nitrate Nitrogen
- NH_4^+ Ammonium Nitrogen
- K^+ Potassium (ionic form)
- H_2PO_4 Phosphorus (orthophosphate)

These nutrients do not provide energy needed for growth—they are not plant food

They are raw materials (catalysts) which together with sunlight, water, and CO_2 enable the grass plant to produce organic compounds (sugars, carbohydrates, starches, amino acids) necessary for growth

Photosynthesis

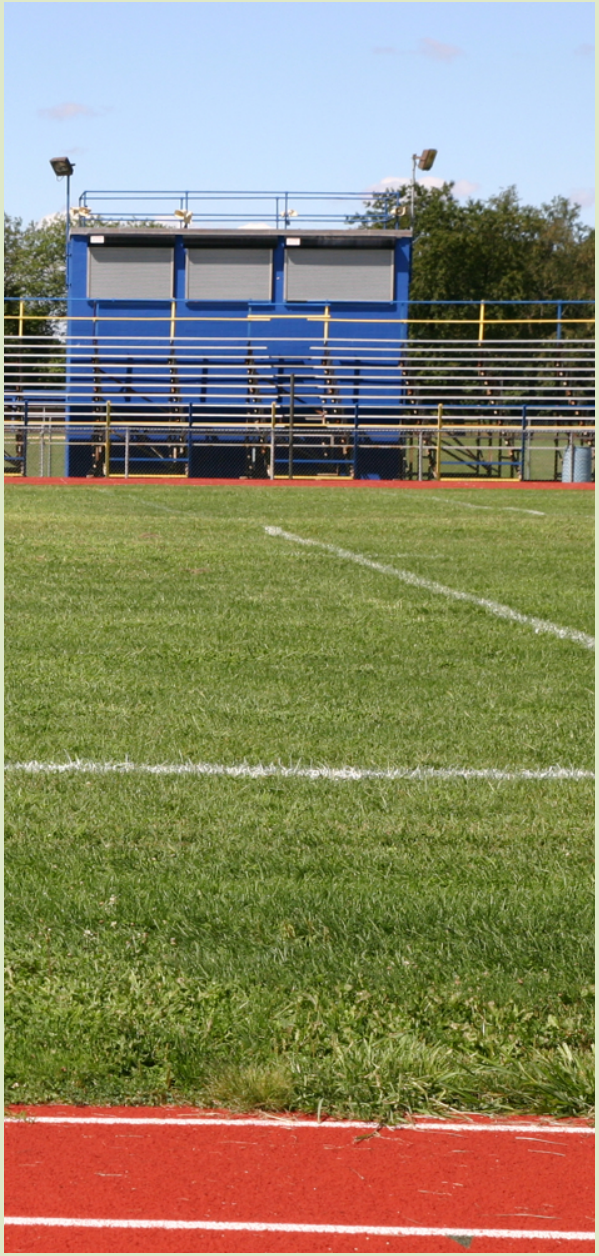
Nutrients in the “available” forms are water-soluble and taken up by the roots

Management and environmental conditions determine whether nutrients leach, volatilize, or are utilized by microorganisms before being taken up by the grass

Following a SOLUBLE NITROGEN application to turf…

Conventional fertilizer

- Growth rate increases sharply 2 days after application
- Peak growth rate 7-10 days after application
- Tapers off to original growth rate in 4-6 weeks
- Peaks and Valleys



Peaks and Valleys of nutrient availability have a detrimental effect on grass

Short bursts of growth followed by a period of slow growth can

- deplete carbohydrate reserves
- reduce root development
- eventually thin a turf system over the long term

Managing Nitrogen

- Always match N input to growth pattern of cool-season grasses
- No high N in early spring or summer
- Moderate peaks and valleys
- Organic N sources build up reserve N
- 5 lbs of N per 1000 SF from all sources

Nitrogen Comparison: Synthetic vs. Organic

Managing Nitrogen

Natural, organic	3%-13% N
Bridge product	14%-18% N
Synthetic	19%-30%+ N

Non-Traditional Sources of Nitrogen

Managing Nitrogen

- Compost topdress
- Compost tea
- Liquid fertilizer
- Clippings returned
- Microbial inoculants

Traditionally turf response to nitrogen has been measured by:

- Growth Rate (Yield)
  - Color

These are not the most important criteria for determining quality

What we look for:

Root Growth

Carbohydrate Reserves

Shoot Density

Stress Tolerance

More difficult to measure than growth & color

Other Soil Amendments

- **Mycorrhizal fungi** –
  - Colonize plant roots
  - Assist in nutrient and moisture transfer from soil to roots
  - Inoculate the soil with liquid or dry product
  - Improves efficacy of organic fertilizers

Other Soil Amendments

Humates –

- Apply to turf as a soil amendment to directly address soil health and quality
- Liquid or granular humic acid
- Humus is a key component of soil OM-all soil functions interact at some level with humus
- Response of turf is evident
- 5-10lbs/1000 sq ft granular
- 8oz/1000 sq ft liquid

The Real Trick in Fertilization

The key to the successful management of fertility is to deliver enough N in the spring to achieve optimum shoot growth without excess at the expense of root growth and to deliver enough N in the fall to address the aggressive root growth

Part Four: Cultural Practices

Managing turf naturally is about reducing and eliminating stresses

- **Environmental** - Temperature, rainfall, etc.
- **Mechanical** – foot traffic, mowing, tractor tires, other equipment
- **Pests** – weeds, insects and disease

Cultural Practices for Natural Turf Management

- Mowing
- Irrigation
- Aeration
- Over-seeding

Mowing Properly

- Keep mower blades sharp throughout the season
- Never cut more than 1/3 at a time
- Use mulching mower
- Leave grass clippings on turf except on game day cut

Seasonal Mowing Heights

- First spring mowing – 2 inches to remove any over-wintering fungus. Remove these clippings.

- During growing season: gradually raise height to 3-3.5 inches when possible

- Keep it HIGH through summer.

- In the fall, gradually reduce height of your cut to allow for sun on seed.

- Final cut in fall – back down to 2 inches.

High Mowing is the best “Herbicide”

- Mow high 3”-4”
- Think “lush”

Avoid “scalping” = major stress to grass plant

- Longer grass blade = deeper root system & > photosynthesis
- Deep roots = drought resistance

Leave Clippings on the Turf

Clippings do NOT cause thatch.

Broken down quickly by saprophytic fungi (saprophytes are the decomposers)

Valuable source of OM

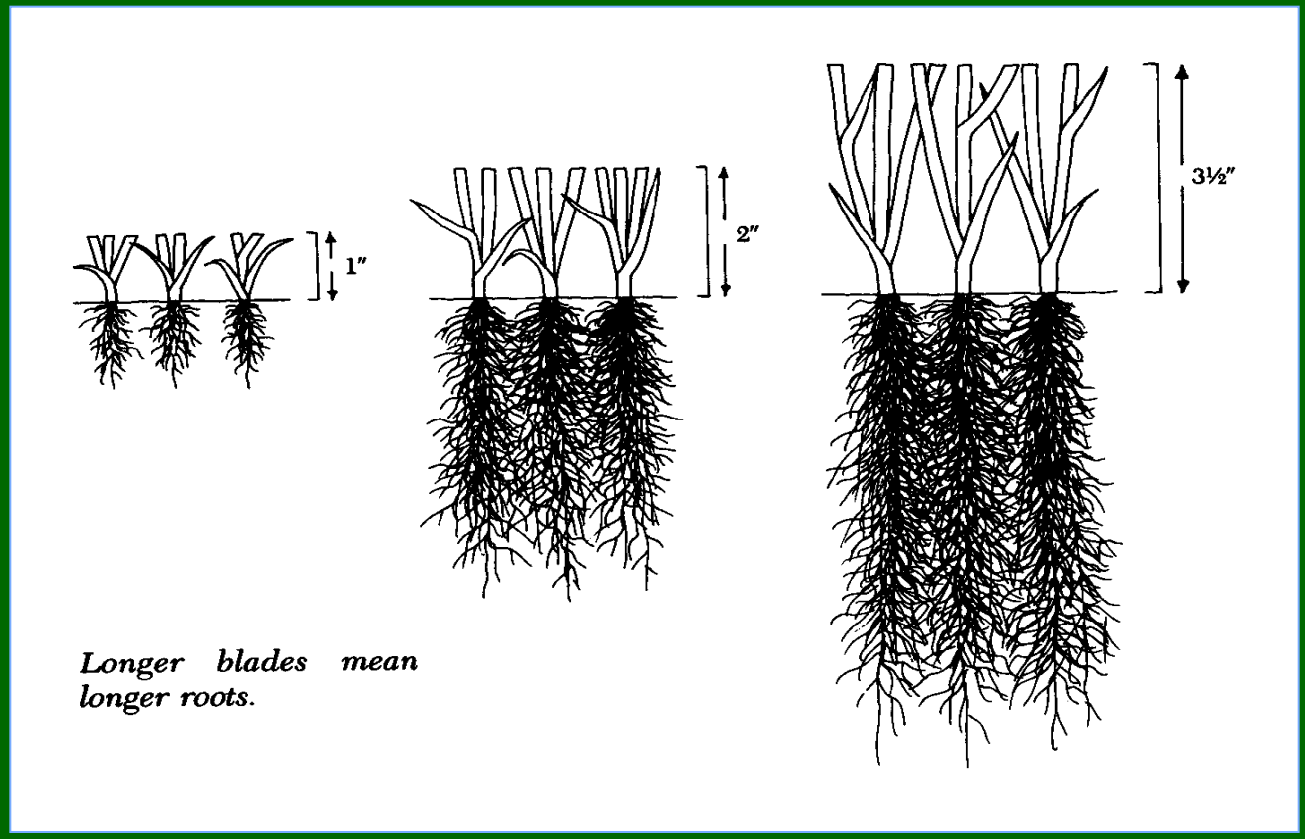
Leaving clippings will give you

1# N / 1000 square feet a year

Root to Shoot Ratio

Close mowing reduces the amount of leaf area available for photosynthesis, reducing plant vigor

Longer grass blade = deeper/denser root system



Irrigation Management

Water – too much of a good thing?

- Grass can be damaged by “kindness”
- Over-watering causes more problems that it solves
- Only water turf when it needs it
- 2” weekly maximum
- 1” should suffice
  - 1” water will penetrate sand 12”
  - 1” water will penetrate sandy loam 8”
  - 1” water will penetrate clay loam 6’

- Deep thorough irrigations are preferable to repeated shallow irrigations
- 2X weekly as opposed to daily or every other day
- Much of the water from short waterings with irrigation systems never reaches the root zone
- Over-watering is a direct cause of fungal disease
- Wet soils destroy root systems

Compaction

- The greatest enemy of turfgrass
- With heavy use or traffic, air particles are squeezed out
- Aeration introduces air back into turf system

Relieve Compaction with Aeration

Aerate when turf is ACTIVELY GROWING and only when needed to relieve compaction

Athletic turf suffers from constant use and is aerated regularly.

Ways to aerate: core aerators, slice seeding, seed-a-vator (shattering of soil) ~ and beneficial organisms in soil.

Over-seeding

"The infusion of new seed into existing turf is, in essence, an injection of youth into a natural aging process."

- Paul Sachs

Over-Seed Heavily

- Rake well, or aerate and de-thatch first if necessary.
- Spread ¼” to ½” of compost either mixed with or to lightly cover seed
- Apply seed by spreader or hand-broadcast
- Lightly tamp or press seed into compost to ensure good SEED-TO-SOIL CONTACT.
- Water it in and keep moist, but not soaked.

Fall is the Season

- Long, warm days = GOOD FOR WEEDS!
- Short, cool days = GOOD FOR GRASS SEED!
- Mid-August to the end of September is best time for seeding a field
- Fall should be the *only* time for new construction
- No weed pressure, days shorter and cooler
- Purchase good seed, native to area ~ C3 cool-season grasses
- Endophytically-enhanced Fescues
- Nurse crop: Annual Perennial rye for fast, temporary fill in Spring if needed to stop crabgrass. Re-seed in fall.

Endophytically Enhanced Seed

- Naturally occurring fungi / symbiotic relationship with seed / both benefit
- Endophyte resides in veins of sheath, not in root
- In exchange for carbohydrates from plant it gives the plant alkaloids and other chemicals that have beneficial and protective effects on the grass

Thatch: A build-up of dead grass, roots, stems

Some thatch is Ok

Heavy thatch indicates soil deficient in microbial life

<u>Bluegrasses are naturally high thatch producers</u>

- Thatch is a build up of dead blades, crowns, and plant parts in the area just above the soil
- Roots and stems begin to grow horizontally in the thatch layer
- As the thatch layer thickens air flow in the area of the crown diminishes and damage results
- Surface grazing insects and fungal disease survive in the thatch layer

- Remember all grass grows from the crown and if thatch weakens the crown turf quality rapidly diminishes
- Finger test for thatch ½ “ OK
- Clippings do not cause thatch
- Clippings need to come into contact with the saprophytes in the soil to properly decompose
- When thatch is thick clippings can’t come into contact with the soil

Management

Mechanical by verti-cutting, power raking, and aerification

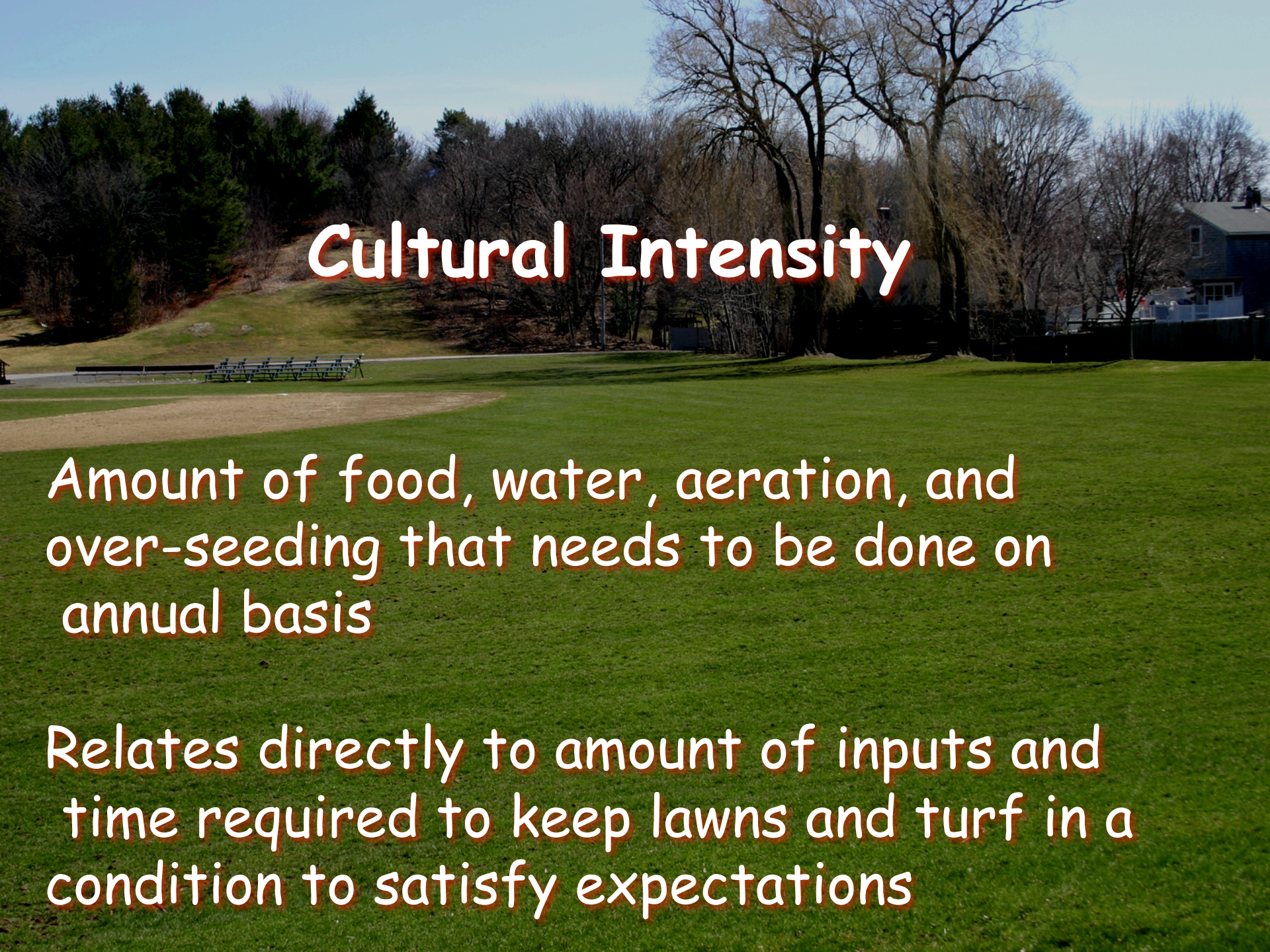
Compost, compost tea, plugs from core aeration all help to disolve thatch. As the microbial life works its way into the soil, it “eats” through the thatch layer

Part Six: Sports Field Management

Managing Expectations

Low level inputs = low cost yields low expectations

High level inputs = higher cost yields high expectations



Cultural Intensity

Amount of food, water, aeration, and over-seeding that needs to be done on annual basis

Relates directly to amount of inputs and time required to keep lawns and turf in a condition to satisfy expectations