Advanced Integrated Pest Management (IPM) for Turfgrass Systems

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TEXAS A&M AGRILIFE EXTENSION

Review: What is IPM?

IPM, or integrated pest management, is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties.

Review: What is IPM?

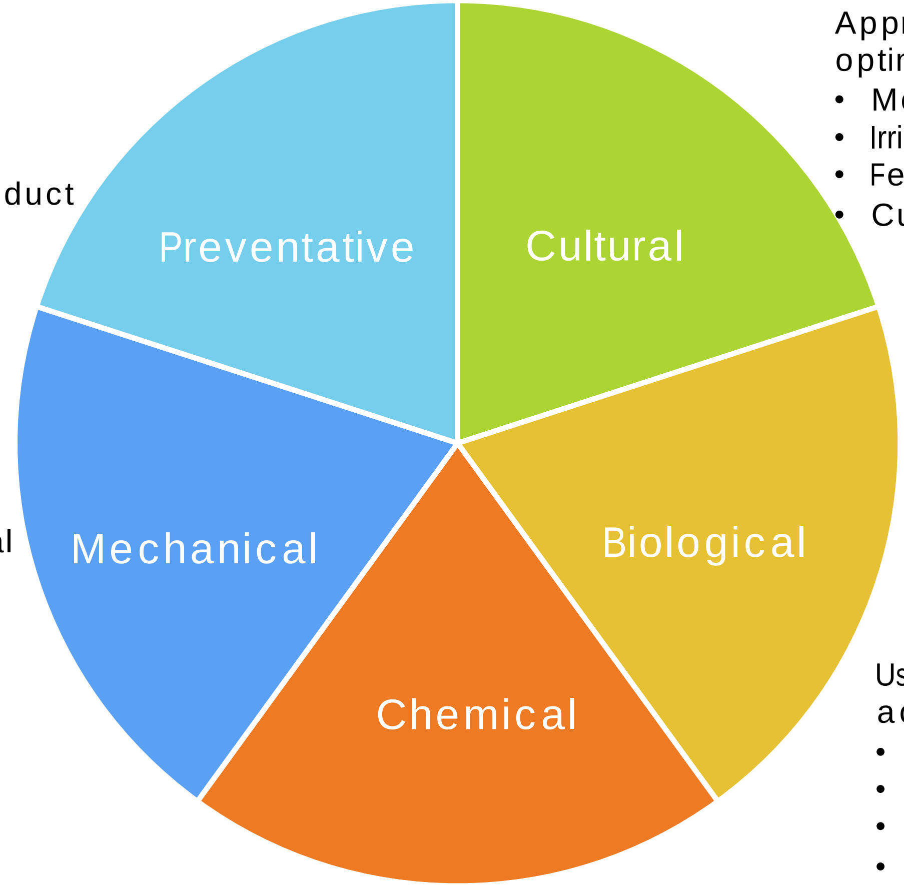
- In research conducted in agronomic cropping systems, IPM strategies resulted in
  - significantly reduced pest incidence of 32-75%
  - reduced total input costs of 15-21%
  - an increase in net profit of 54-88%
  - And improved conservation of natural enemies over non-IPM areas

Dhawan, A. K., Singh, S., & Kumar, S. (2009)

Review: What is IPM?

Responsible sourcing of:
- Seed
- Sod
- Compost
- Topsoil/Topdressing Material
- Or any other introduced product

Appropriate cultural practices to optimize turfgrass health:
- Mowing
- Irrigation
- Fertilization
- Cultivation (aeration, verticutting)



- Erecting Barriers
- Using Traps
- Hand-pulling or physical removal
- Sanitation
- Mowing (fire ants, mites, select weeds)

Introduction of protection of “natural enemies”
- Conservation: avoiding use of pesticides that kill natural predators
- Augmentation: release of natural enemies (predators, parasites, pathogens)

Use of chemical pesticides (based on action threshold)
- Herbicides
- Fungicides
- Insecticides
- Nematicides

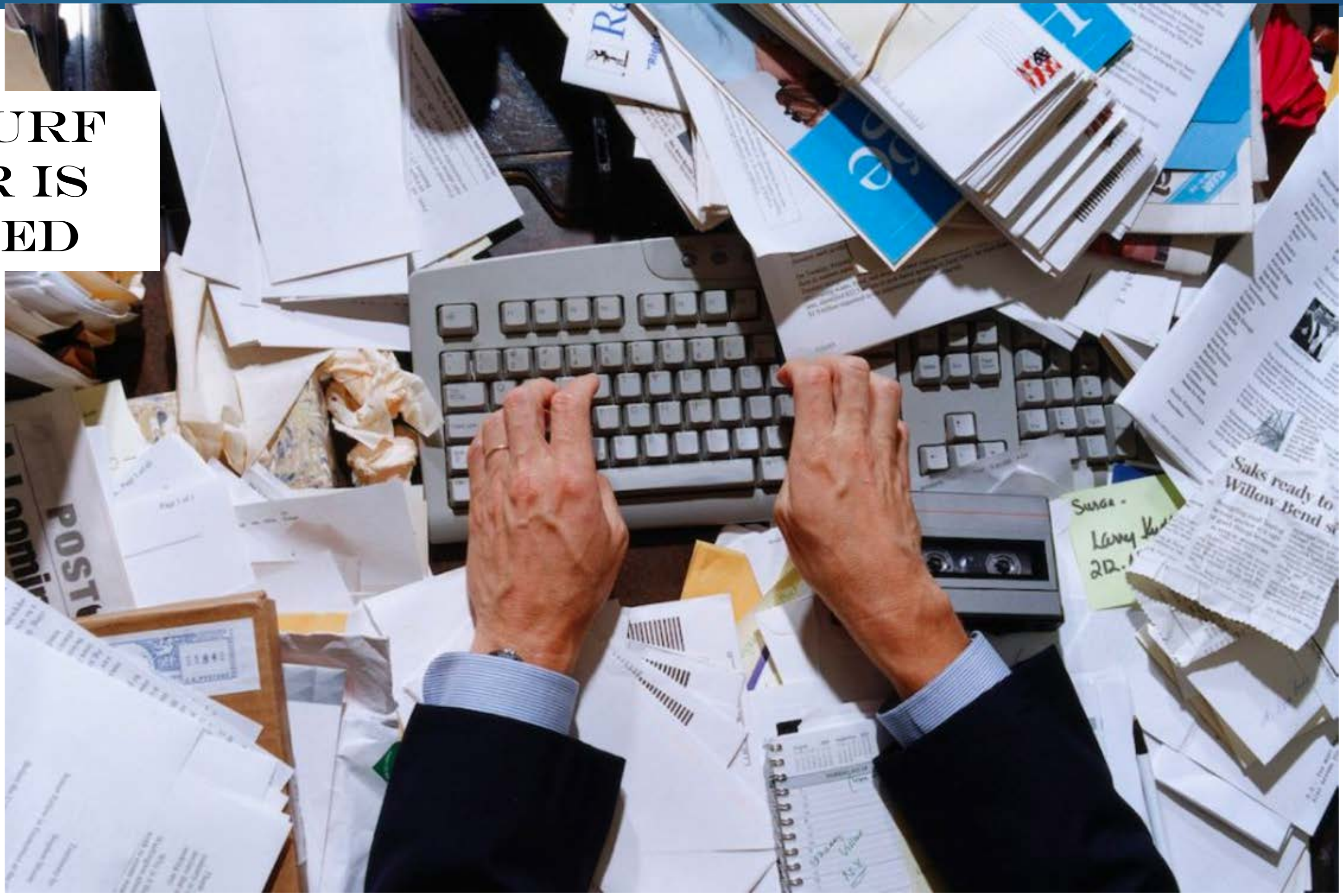
Outline: Steps for Designing an IPM Program for Turfgrass

1. Develop a Record Keeping Program
2. Assess Site Conditions and Characteristics
3. Survey Pests at the Site
4. Determining Pest Response Threshold Levels
5. Decide whether control measures are appropriate
   1. Mechanical
   2. Biological
   3. Chemical

Designing an IPM Program for Turfgrass Systems

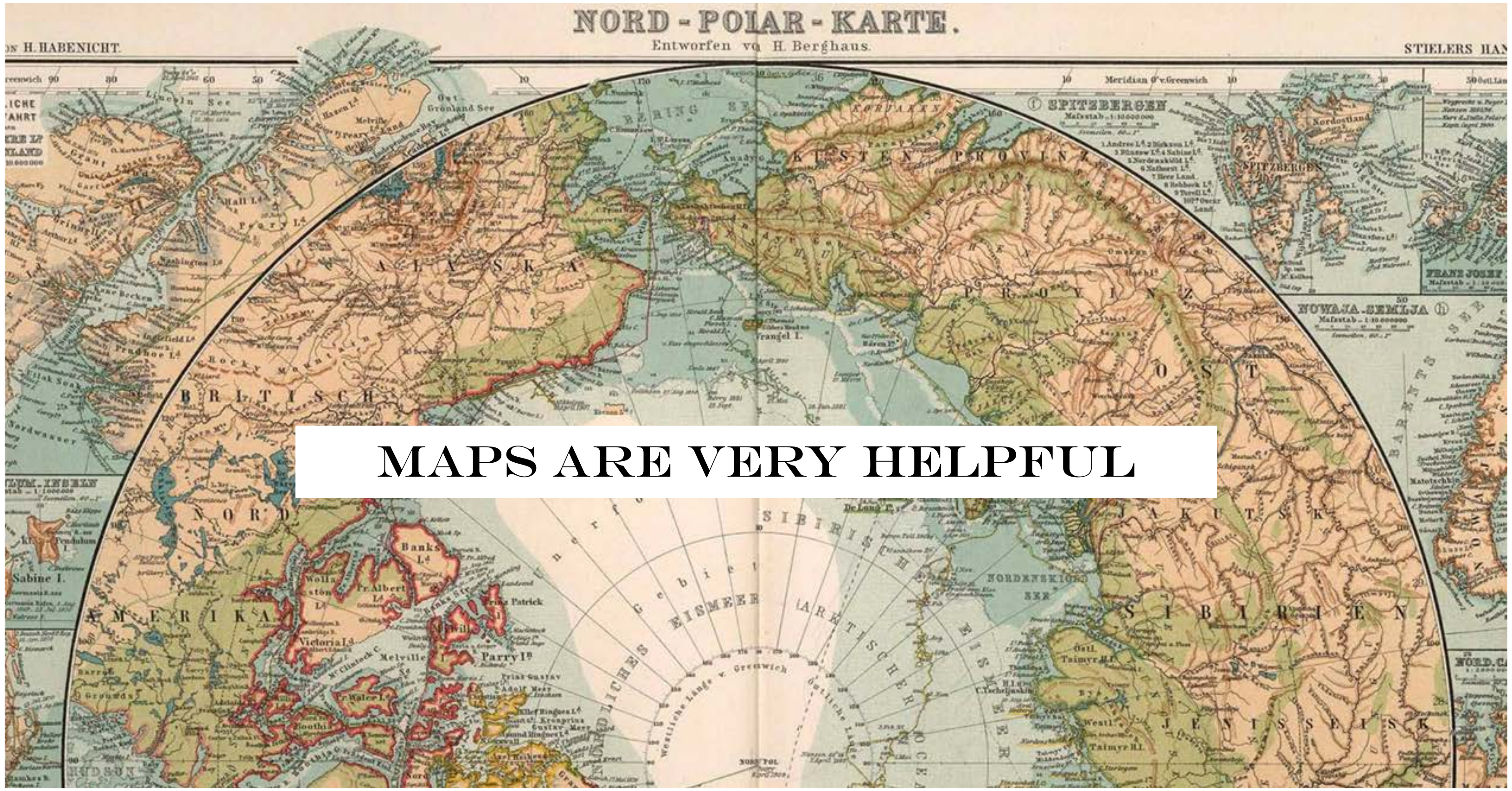
1. Develop a Record Keeping Program

A GOOD TURF MANAGER IS ORGANIZED



Designing an IPM Program for Turfgrass Systems

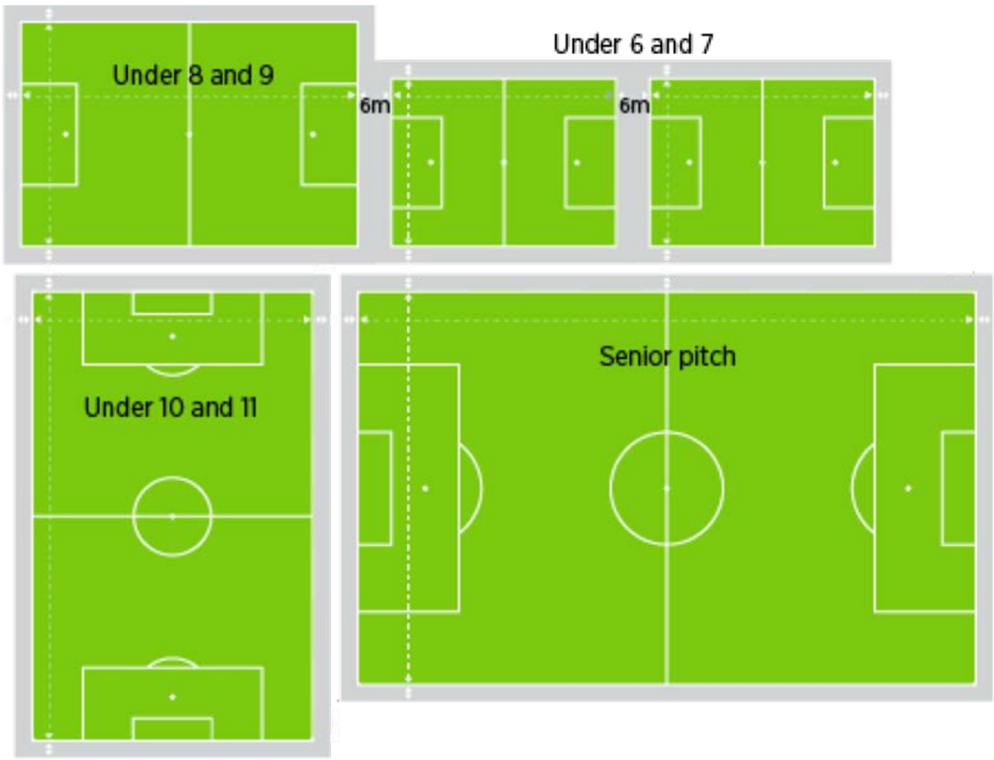
1. Develop a Record Keeping Program



MAPS ARE VERY HELPFUL

Designing an IPM Program for Turfgrass Systems
1. Develop a Record Keeping Program

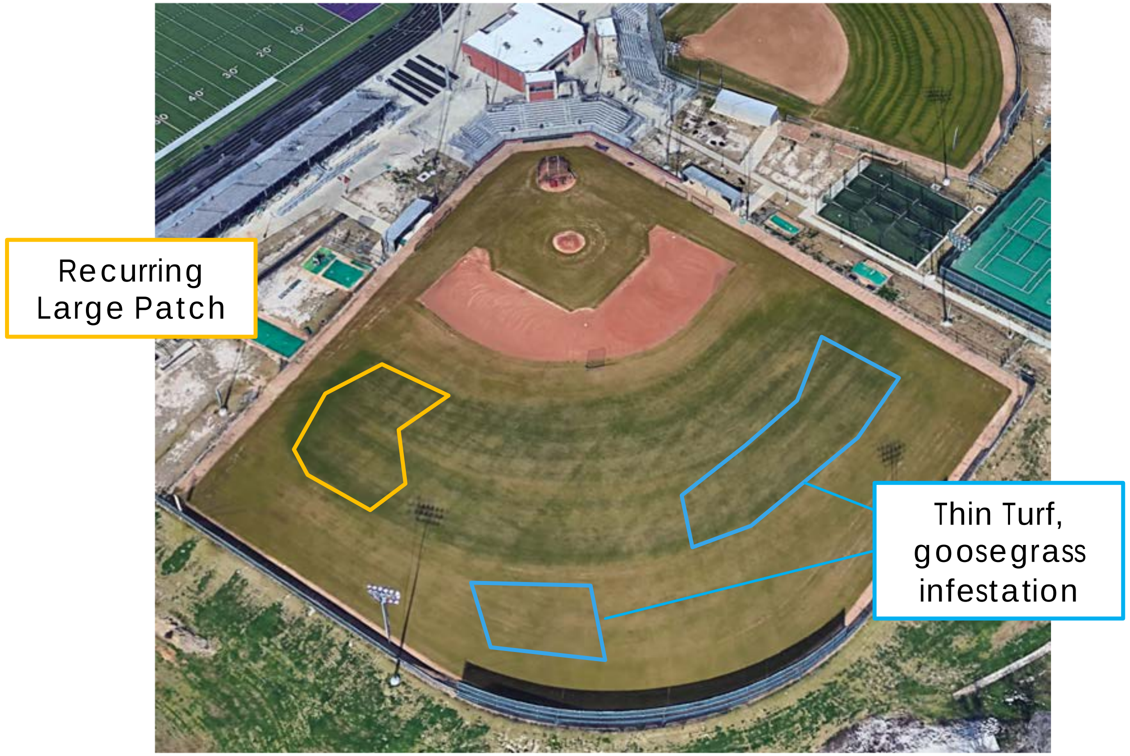
Draw by hand, use copies of existing maps/diagrams, or create new ones in basic software programs.



Use maps and records to
1. Track pest infestations
2. Track turf health and performance
3. Track management practices

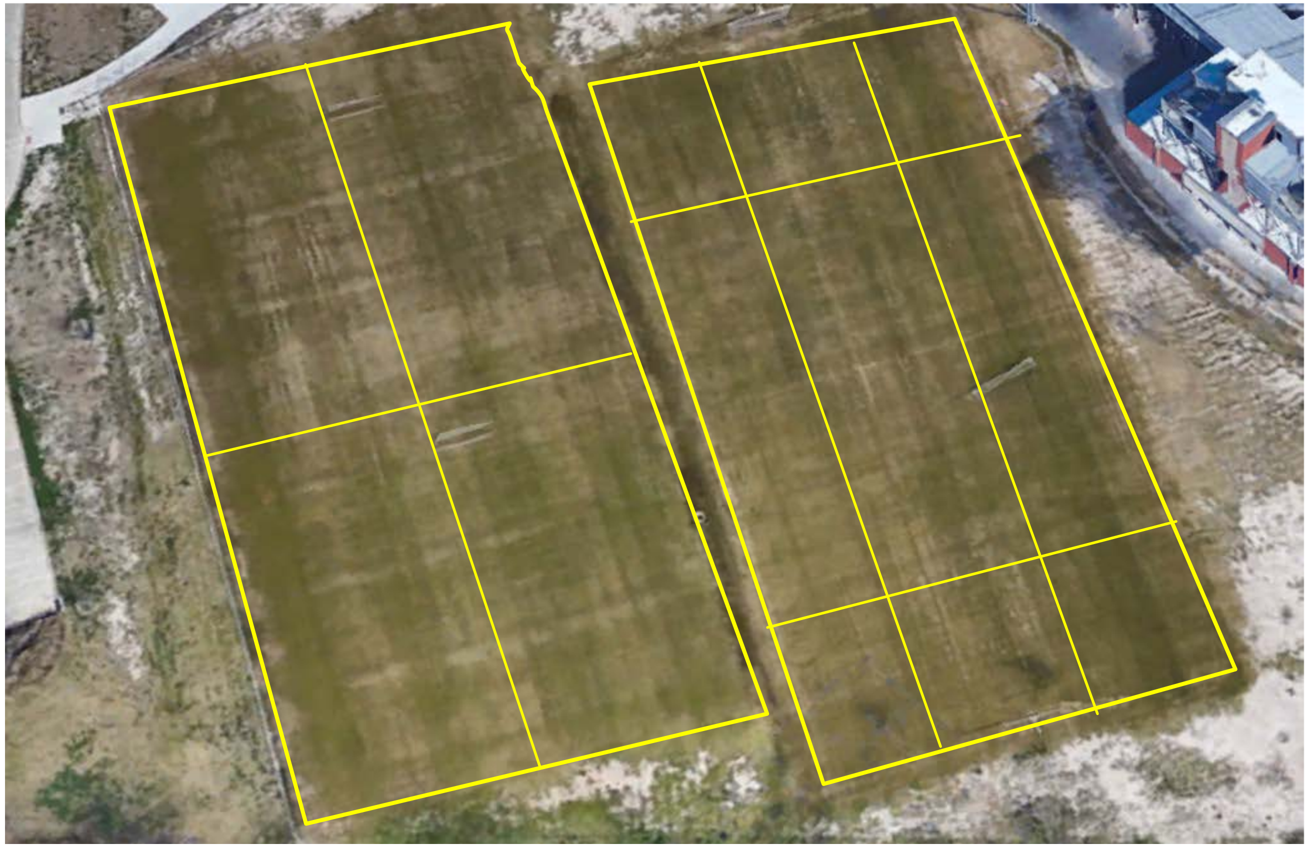
Designing an IPM Program for Turfgrass Systems
1. Develop a Record Keeping Program

Use Google Earth



Designing an IPM Program for Turfgrass Systems

1. Develop a Record Keeping Program

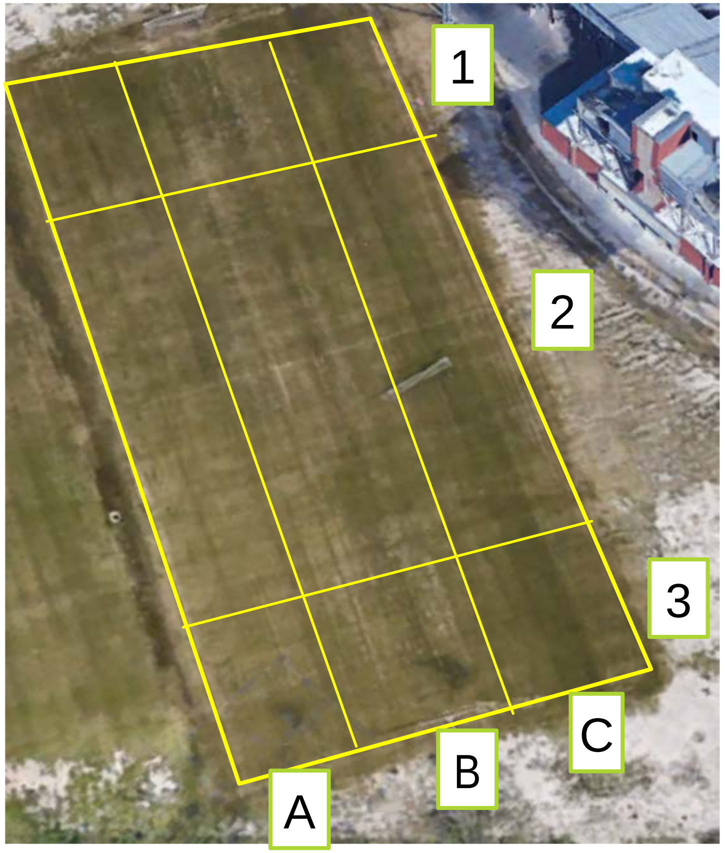


Areas can be divided up in sections to track site-specific management needs.

You can defer to using basic quadrants/halves, or create sections based on known variability and site-specific needs.

Designing an IPM Program for Turfgrass Systems

1. Develop a Record Keeping Program



	2020 Observation Log: Field 2 - Girls Soccer				
	1a	1b	1c	2a	2b
Jan	Poa	Poa			Poa
Feb	LP, Poa	Poa	LP		Poa
Mar	LP, Poa	Poa	LP		Poa
Apr	Poa	Poa			Poa
May	Poa				
Jun		Goosegrass	Goosegrass		Goosegrass
Jul					

In addition to tracking management practices including inputs, irrigation scheduling, etc – keep track of when and where pests appear or turf appears weakened. This will help you to better target and time control methods.

Targeted applications are generally more cost-effective than broad-spectrum applications.

Designing an IPM Program for Turfgrass Systems
1. Develop a Record Keeping Program

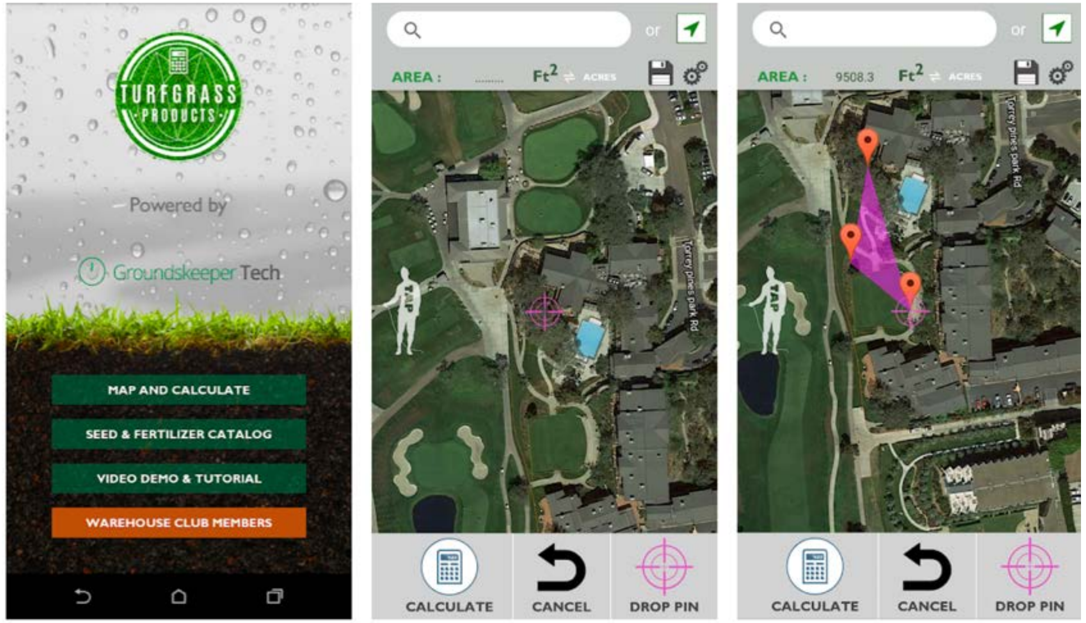
- Commercial landscapes, parks, and campuses can be divided into units based on priority
- High priority = greater visibility, more inputs

Designing an IPM Program for Turfgrass Systems

1. Develop a Record Keeping Program

There are even some apps that can help you both with mapping and managing your turfgrass areas.

Turfgrass Products will help you calculate area and fertilizer/seeding requirements.

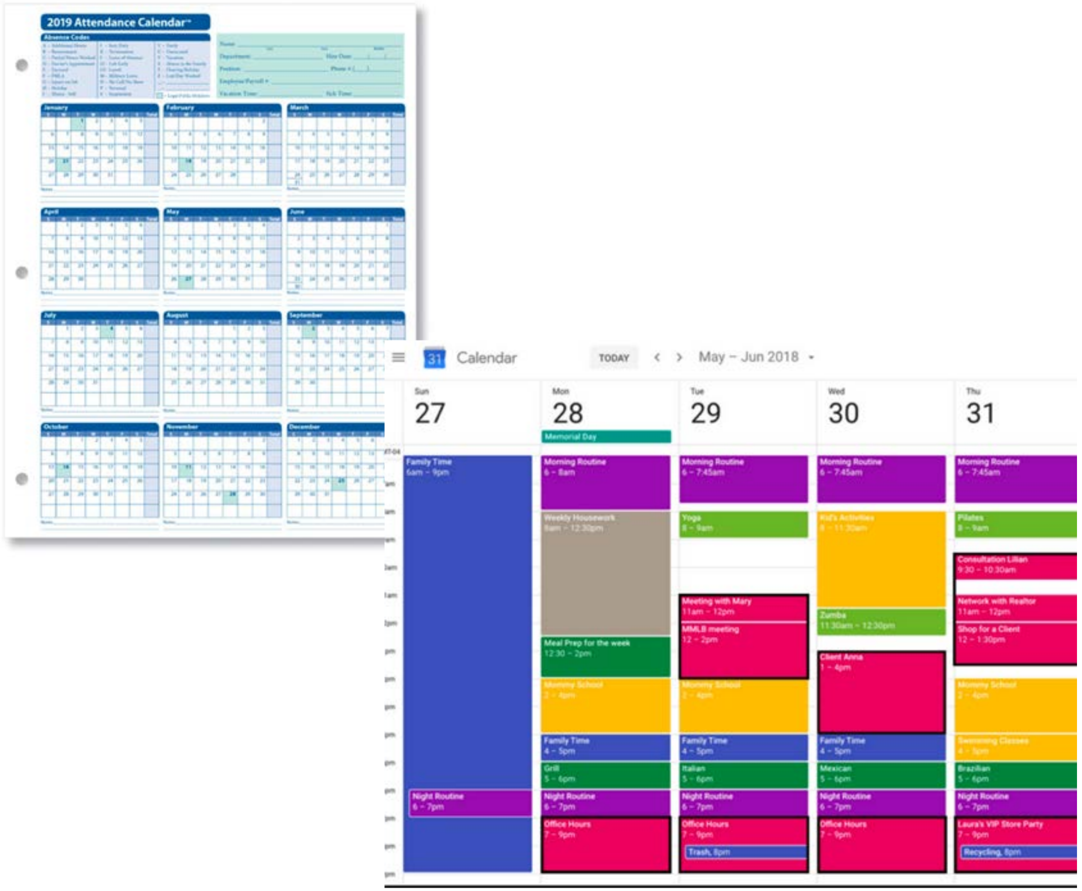


Designing an IPM Program for Turfgrass Systems

1. Develop a Record Keeping Program

Track all management decisions using a detailed calendar including mowing, fertilization, irrigation, and pest control programs.

Google maps and similar applications will allow you to have a separate calendar for each field – and to grant permission to staff to share in updating responsibilities.



Designing an IPM Program for Turfgrass Systems

2. Site Assessment

Establish your baseline. What site-related information will affect the health of your turfgrass and the degree to which it can withstand pest infestation?

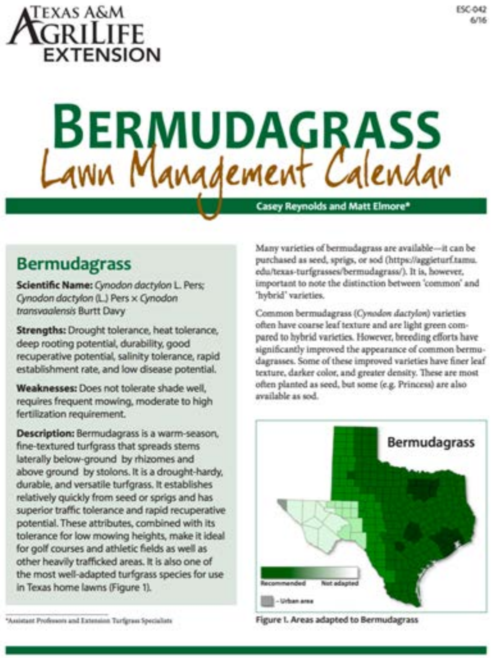
Considerations

- Species Characteristics and Appropriateness
- Shade/Lighting
- Drainage
- Compaction
- Restricted Air Movement
- Nutrient Management
- Current Cultural Program
  - Mowing
  - Irrigation
  - Cultivation

Baseline Information on BMPs

BMP: Best Management Practices

Extension and Other University Resources



TEXAS A&M AGRILIFE EXTENSION

ESC-042
6/16

BERMUDAGRASS Lawn Management Calendar

Casey Reynolds and Matt Elmore*

Bermudagrass

Scientific Name: *Cynodon dactylon* L. Pers; *Cynodon dactylon* (L.) Pers × *Cynodon transvaalensis* Burtt Davy

Strengths: Drought tolerance, heat tolerance, deep rooting potential, durability, good recuperative potential, salinity tolerance, rapid establishment rate, and low disease potential.

Weaknesses: Does not tolerate shade well, requires frequent mowing, moderate to high fertilization requirement.

Description: Bermudagrass is a warm-season, fine-textured turfgrass that spreads stems laterally below-ground by rhizomes and above ground by stolons. It is a drought-hardy, durable, and versatile turfgrass. It establishes relatively quickly from seed or sprigs and has superior traffic tolerance and rapid recuperative potential. These attributes, combined with its tolerance for low mowing heights, make it ideal for golf courses and athletic fields as well as other heavily trafficked areas. It is also one of the most well-adapted turfgrass species for use in Texas home lawns (Figure 1).

Many varieties of bermudagrass are available—it can be purchased as seed, sprigs, or sod (https://aggieturf.tamu.edu/texas-turfgrasses/bermudagrass/). It is, however, important to note the distinction between 'common' and 'hybrid' varieties.

Common bermudagrass (*Cynodon dactylon*) varieties often have coarse leaf texture and are light green compared to hybrid varieties. However, breeding efforts have significantly improved the appearance of common bermudagrasses. Some of these improved varieties have finer leaf texture, darker color, and greater density. These are most often planted as seed, but some (e.g. Princess) are also available as sod.

Bermudagrass

Recommended Not adapted

– Urban area

Figure 1. Areas adapted to Bermudagrass

*Assistant Professors and Extension Turfgrass Specialists

Sports Fields: www.stma.org

SportsTurf MANAGERS ASSOCIATION

Experts on the Field, Partners in the Game.
www.stma.org

SAFE
The Foundation for Safer Athletic Fields

Water Conservation Best Management Practices for Sports Facilities

The demand for potable water for agricultural, residential, and industrial use is expected to increase in the future while our supply of naturally occurring water will remain essentially unchanged and some rivers and lakes will continue to decrease in size.

When rainfall is insufficient and water resources become limited, supplemental irrigation required to sustain plantings, such as turfgrass and other landscaping plants, is often the first to be placed on water use restrictions. When managing turfgrass and other landscaped areas, reduce water use to the lowest possible level to conserve and protect our most precious natural resource. Water conservation should be implemented for both economic and judicious reasons. Always comply with local and state water use regulations and restrictions.

The following provides various best management practices (BMPs) regarding water conservation that can be easily applied at sports and recreation facilities. Applying water responsibly can conserve resources and save money while still maintaining a healthy, safe turfgrass surface and aesthetically pleasing landscape.

Photo courtesy of Cale Bigelow, Ph.D., Gregg Munshaw, Ph.D.

Selecting Turfgrasses to Reduce Water Use

Turfgrass species vary in terms of appearance, appropriate uses, cultural requirements, pest resistance, and stress tolerance. Individual cultivars or varieties within species provide additional options for effectively matching grasses with growing conditions and desired performance. By knowing the strengths and weaknesses of potential species and cultivars, you can select grasses adapted to your site and management program. Turfgrass planted in its' appropriate environment ultimately conserves water.

Best Management Practices When Selecting Turfgrasses:

Consider the following when choosing a turfgrass species for your site:

1

Your Resource for Safer Fields • Brought to you by the **Sports Turf Managers Association** and its charitable Foundation, **The SAFE Foundation** • ph. 1-800-323-3875 • www.stma.org

Golf Courses: www.gcsaa.org

Texas BMP Template Anticipated Spring of 2020

BMP
GCSAA USGA

Section 1 Planning, Design, and Construction

The construction phase of any industry's infrastructure poses the

maximize/integrate environmentally favorable characteristics into the property. This often requires the involvement of golf course architects, golf course superintendents, civil engineers, soil scientists, agronomists, irrigation designers, ecologists, etc.

Best Management Practices

- Assemble a qualified team
  - Golf course architect
  - Golf course superintendent
  - Clubhouse architect
  - Irrigation engineer
  - Environmental engineer
  - Energy analyst
  - Economic consultant
  - Civil engineer
  - Soil scientist
  - Geologist
  - Golf course builder
  - Legal team
- Determine objectives
- Complete a feasibility study
  - Are needs feasible given existing resources?
  - Financial
  - Environmental
  - Water
  - Energy

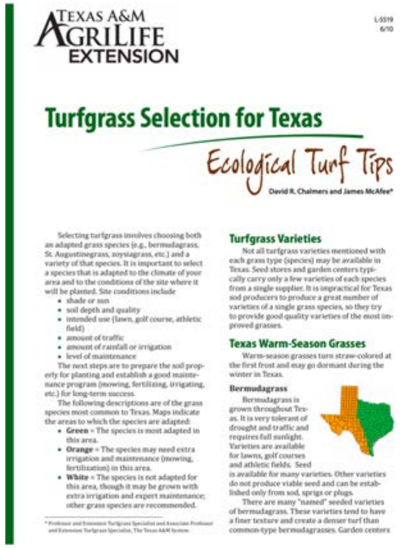
- Labor

sustainable maintenance practices in the development, maintenance, and operation of the course.

- Design the course to minimize the need to alter or remove existing native landscapes. The routing should identify the areas that provide opportunities for restoration.
- Design the course to retain as much natural vegetation as possible. Where appropriate, consider enhancing existing vegetation through the supplemental planting of native vegetation/materials next to long fairways, out-of-play areas, and along water sources supporting fish and other water-dependent species.
- Design out-of-play areas to retain or restore existing native vegetation where possible. Nuisance, invasive, and exotic plants should be removed and replaced with native species that are adapted to that particular site.
- Greens
  - Select a location that has adequate sunlight to meet plant specific needs and provides sufficient drainage.
  - Choose a green size and sufficient number of hole locations that is large enough to accommodate traffic and play damage, but not so large that it is not sustainable with your resources.
  - Select an appropriate root-zone material as designated by the USGA.
  - Consider the number of bunkers as it relates to resources available for daily maintenance.
  - Greens should be irrigated separately from surrounding turf.
  - Select a turf species/variety that meets the needs of the stakeholders while adhering to the principle of "right plant, right place."

1-1

Baseline Information on Appropriate Species and Cultivar Selection


TEXAS A&M AGRILIFE EXTENSION

Turfgrass Selection for Texas

Ecological Turf Tips

David R. Chalmers and James McAfee

Turfgrass Varieties

Texas Warm-Season Grasses

Bermudagrass


TEXAS A&M AGRILIFE EXTENSION

BERMUDAGRASS SELECTION

for Athletic Fields in the Transition Zone

Chrissie A. Segars, PhD, Extension Turfgrass Specialist, Texas A&M AgriLife Extension Service, The Texas A&M University System

Table 1. Recommended bermudagrass cultivars for athletic fields in the transition zone

Seeded Bermudagrass	Vegetative Bermudagrass
Riviera*	Astro
Monaco*	Latitude 36*
U-3 (Common)	Northbridge*
Yukon*	Patriot*
	Tahoma 31*†
	TifTuf†
	Tifway419

Extension and Other University Resources

TABLE 1A.

TURFGRASS QUALITY RATINGS OF BERMUDAGRASS CULTIVARS
GROWN AT SEVENTEEN LOCATIONS IN THE U.S. 1/
2013-17 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	ENTRY #	AL1	AR1	AZ1	CA3	FL3	GA1	IN1	KS2	KY1	MD1	MO1	MS1	NC1	OK1	TN1	TX2	VA1	MEAN
*TIFTUF (DT-1)	24	7.1	7.2	7.4	6.7	6.3	6.3	7.0	5.5	7.3	6.7	6.3	7.0	6.5	6.1	7.5	7.8	6.2	6.8
*TAHOMA 31 (OKC 1131)	32	5.9	8.0	6.7	5.8	5.7	6.0	7.7	5.5	7.3	7.6	6.9	6.8	5.7	6.2	7.4	7.0	6.5	6.8
JSC 2-21-18-V	12	5.7	7.7	7.0	6.2	6.4	6.5	7.1	5.7	7.3	7.7	6.3	6.9	5.9	5.8	7.3	7.4	6.4	6.7
11-T-510	23	6.6	7.2	7.0	6.4	6.0	5.6	6.4	5.5	7.0	6.6	6.3	6.8	6.1	6.0	7.4	7.7	6.3	6.6
*LATITUDE 36	2	6.1	7.8	6.6	5.9	5.8	5.8	7.8	5.5	7.4	7.4	5.1	6.8	5.8	6.1	7.3	7.1	6.3	6.6
JSC 2-21-1-V	11	4.8	7.5	6.7	5.7	5.5	6.2	7.4	5.6	7.5	7.2	6.1	6.8	5.2	6.1	7.3	7.3	6.4	6.6
OKC 1163	33	5.1	8.6	7.1	6.2	4.7	6.1	7.0	4.9	7.1	6.2	6.2	6.7	4.9	6.0	6.9	7.5	6.9	6.5
OKC 1302	34	5.2	7.0	5.4	5.9	5.8	5.9	7.0	5.7	7.1	7.4	4.2	6.5	5.6	5.9	7.3	7.0	6.3	6.4
*PATRIOT	3	5.3	7.4	5.7	5.3	6.4	5.6	7.1	5.4	7.1	6.6	5.7	6.0	5.7	5.2	7.1	5.1	6.7	6.4
*TIFWAY	1	6.0	7.0	7.5	6.6	6.0	5.6	6.7	5.0	6.7	6.9	3.6	7.0	5.4	5.8	7.3	7.0	5.6	6.3
*RIVIERA	17	4.3	6.4	6.0	5.6	5.8	4.9	6.7	5.0	7.0	6.1	6.0	6.0	4.4	5.5	7.6	5.6	6.7	6.3
*MONACO (JSC 2007-13-S)	14	4.1	6.7	5.5	5.6	5.6	5.0	6.1	5.1	7.1	6.3	6.0	6.1	4.5	5.5	7.5	5.8	6.9	6.3
FAES 1325	25	5.5	6.4	7.2	6.1	6.0	5.4	6.0	4.6	6.3	5.4	4.2	6.4	5.3	5.7	7.9	6.2	5.5	6.3
*ASTRO	35	4.7	6.7	6.3	5.7	5.9	5.5	6.0	5.1	6.8	5.8	5.2	6.5	5.2	5.8	7.2	6.6	6.1	6.2
11-T-251	22	5.6	6.3	6.6	5.9	5.8	5.5	6.5	4.2	7.1	6.1	4.0	6.9	4.7	5.7	7.3	7.1	5.3	6.2
FAES 1326	26	5.6	7.2	6.1	6.5	5.8	5.3	6.2	5.0	6.6	6.1	3.7	6.1	4.2	5.5	7.4	6.9	6.0	6.2
MBG 002	7	4.1	6.1	6.6	5.5	5.7	5.0	6.1	5.0	7.1	4.7	5.4	6.0	4.6	5.6	7.5	5.8	5.9	6.2
JSC 2009-2-S	15	4.2	6.3	5.9	5.2	5.7	4.9	6.0	5.0	6.8	6.1	5.7	6.1	4.3	5.5	7.7	5.3	6.2	6.2
JSC 2009-6-S	16	3.8	5.7	6.0	5.3	5.7	4.5	6.3	5.1	6.9	5.6	6.0	6.2	4.4	5.6	7.4	5.4	6.5	6.2
JSC 2007-8-S	13	3.9	6.1	5.7	5.5	5.8	4.7	6.1	5.1	6.9	5.8	5.8	6.0	3.7	5.5	7.6	5.5	6.5	6.2
FAES 1327	27	5.8	6.5	6.8	5.8	5.9	5.7	6.4	4.6	6.4	5.6	3.4	6.3	5.4	5.7	7.2	7.3	5.3	6.1
OKS 2011-1	9	3.9	6.0	5.6	5.5	5.6	4.8	5.9	4.9	6.8	5.3	5.0	6.1	3.9	5.3	7.5	5.0	5.8	6.0
*CELEBRATION	4	4.5	5.5	6.8	5.4	5.5	5.4	5.5	4.4	6.3	5.6	4.0	6.3	5.0	5.5	7.5	6.0	5.4	6.0
*PRINCESS 77	6	4.5	6.1	6.4	5.8	5.7	4.6	6.6	3.2	6.7	4.0	4.5	5.9	4.6	5.4	7.4	6.4	5.1	6.0
12-TSB-1	20	5.1	5.7	6.7	5.6	5.9	4.6	6.2	2.9	6.6	4.6	4.3	6.1	4.5	5.3	7.3	6.4	4.8	5.9
*YUKON	18	2.8	4.6	5.3	5.3	5.7	4.3	6.7	4.9	6.6	4.1	5.3	5.3	4.1	5.2	7.5	6.0	6.1	5.8
BAR C291	31	3.4	5.8	5.5	5.1	6.0	4.8	5.5	4.7	6.5	4.1	4.8	5.6	4.0	5.3	7.3	5.1	5.7	5.8
OKS 2011-4	10	3.2	5.7	5.4	5.1	5.8	4.9	5.6	4.4	6.8	4.5	4.8	5.7	4.1	5.2	7.5	4.3	5.5	5.8
PST-R6CT	30	2.7	5.5	5.1	5.3	5.4	4.9	6.2	4.6	6.7	3.8	4.4	5.9	3.4	5.1	7.4	6.0	4.7	5.7
PST-R6P0	28	2.5	5.0	5.5	5.3	5.3	5.0	6.1	4.6	6.6	3.7	4.5	5.8	3.9	5.1	7.4	4.2	5.0	5.7
OKS 2009-3	8	3.2	6.0	5.2	5.1	5.2	4.8	5.5	4.2	6.1	4.6	4.5	5.8	3.8	5.1	7.3	4.6	5.3	5.6
MSB 281	21	3.6	3.5	5.7	5.0	5.2	5.1	6.1	3.2	6.3	5.8	3.4	6.7	4.3	4.7	6.9	4.8	5.3	5.6
*NORTH SHORE SLT	19	2.8	5.7	5.6	5.0	5.4	4.6	5.5	4.4	5.6	3.6	4.2	5.4	3.3	5.0	7.5	5.0	4.7	5.6
PST-R6T9S	29	3.0	4.4	5.3	4.9	5.2	4.6	6.3	4.0	5.7	3.9	4.3	5.9	3.6	5.0	7.2	4.4	4.8	5.4
*NUMEX-SAHARA	5	1.9	5.1	4.7	5.0	5.6	4.4	5.5	3.8	5.9	3.8	3.9	5.2	2.9	4.6	7.5	4.0	3.7	5.3
LSD VALUE		1.1	0.9	0.9	0.5	0.6	0.7	0.9	0.6	0.8	1.1	0.9	0.4	0.8	0.3	0.5	1.1	1.0	0.3
C.V. (%)		14.7	9.1	8.8	5.5	6.3	9.6	8.0	8.2	7.5	11.8	12.2	3.9	11.4	3.8	4.4	11.5	10.9	7.5

*/ COMMERCIALLY AVAILABLE IN THE USA IN 2018

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT ONE ENTRY'S MEAN FROM ANOTHER ENTRY'S MEAN. STATISTICAL DIFFERENCES OCCUR WHEN THIS VALUE IS LARGER THAN THE CORRESPONDING LSD VALUE (LSD 0.05).

2/ C.V. (COEFFICIENT OF VARIATION) INDICATES THE PERCENT VARIATION OF THE MEAN IN EACH COLUMN.

National Turfgrass Evaluation Program (NTEP)
https://ntep.org

Advanced Approaches to Site Assessment

- Remote Sensing Technology
  - UAV
  - Satellite Imagery
- Handheld and Mobile Sensor Devices
  - NDVI Meters
  - VWC meters (TDR/Capacitance Probes)
  - EC Meters
  - Infrared Thermometers

Research for Advanced Site Assessment

Handheld versus mobile data acquisitions for spatial analysis of natural turfgrass sports fields

Straw, C. M., Grubbs, R. A., Tucker, K. A., & Henry, G. M. (2016).

Properties Measured:

- Soil Moisture
- Soil Compaction
- Turfgrass Vigor

X 4 Sports Field Locations
Athens, GA

And 2 different sampling grid sizes:
4.8 × 4.8 m and 4.8 × 9.6 m

Handheld versus mobile data acquisitions for spatial analysis of natural turfgrass sports fields

Straw, C. M., Grubbs, R. A., Tucker, K. A., & Henry, G. M. (2016).

Handheld Devices

Field Scout TDR 300 Soil Moisture Meter

($1500 with similar devices ranging from $250-$2000)

Field Scout SC 900 Soil Compaction Meter

($2,000 with similar devices ranging from $150 – $2,000)

Field Scout CM 1000 NDVI Meter

(~$3,000 but similar devices are closer to $1,000)

Handheld versus mobile data acquisitions for spatial analysis of natural turfgrass sports fields

Straw, C. M., Grubbs, R. A., Tucker, K. A., & Henry, G. M. (2016).

Mobile Device

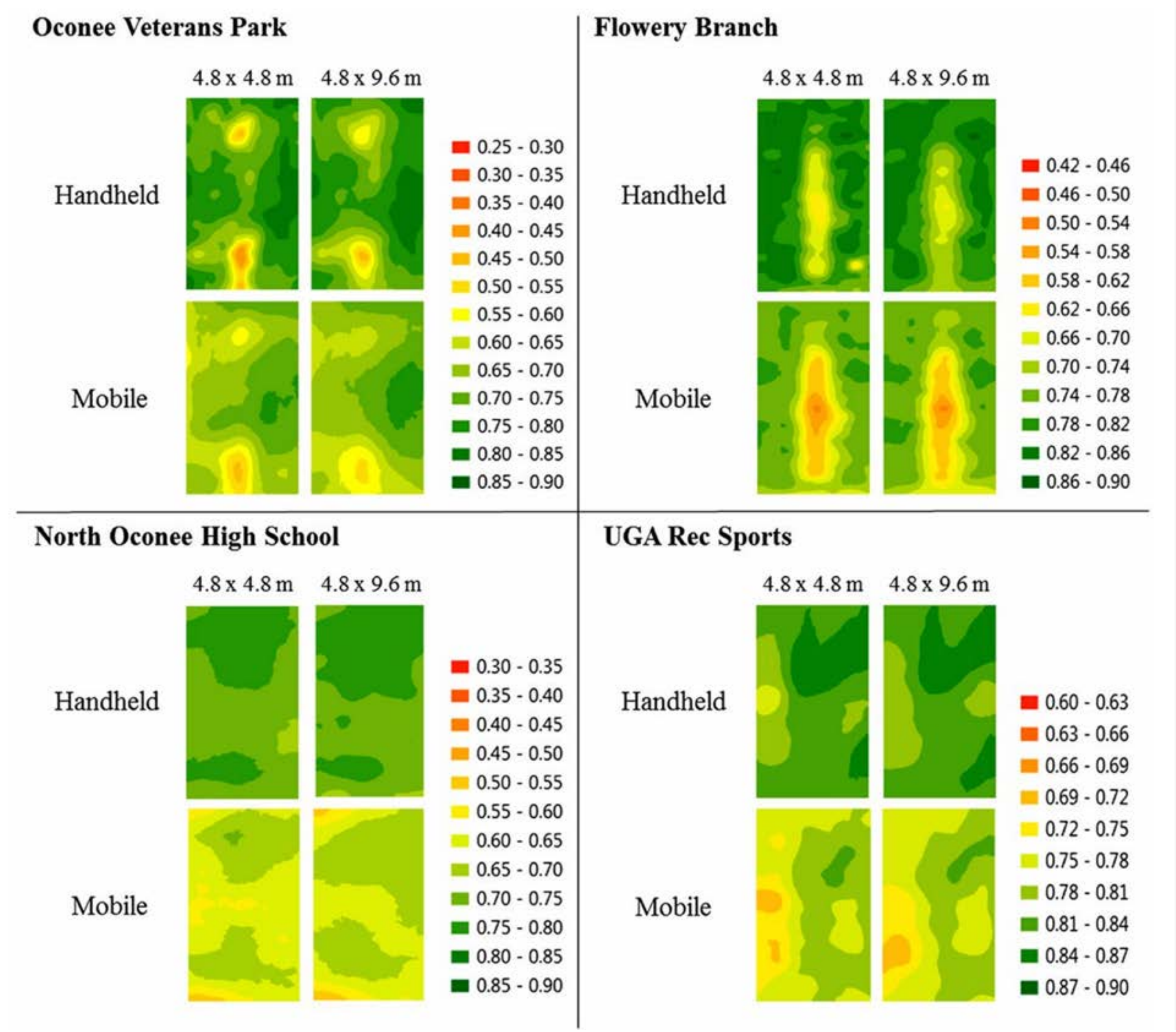
Toro Precision Sense 6000

- GPS
- Volumetric Water Content
- Soil Compaction/Penetration Resistance
- Soil Salinity
- NDVI

Spatial Maps

- NDVI (Normalized Difference Vegetation Index)
  - Correlates to Plant Vigor
  - 0 to 1, 1 = "best" '
- Similar patterns between handheld and mobile devices, but at different magnitudes.
- Data collected at 4.8 × 4.8 m and 4.8 × 9.6 m sampling grids did not differ greatly throughout the study on any field

Conclusion: Handheld NDVI meters can effectively demonstrate general spatial trends that correspond to turfgrass vigor, while perhaps not doing so at quite the same magnitude as mobile devices.

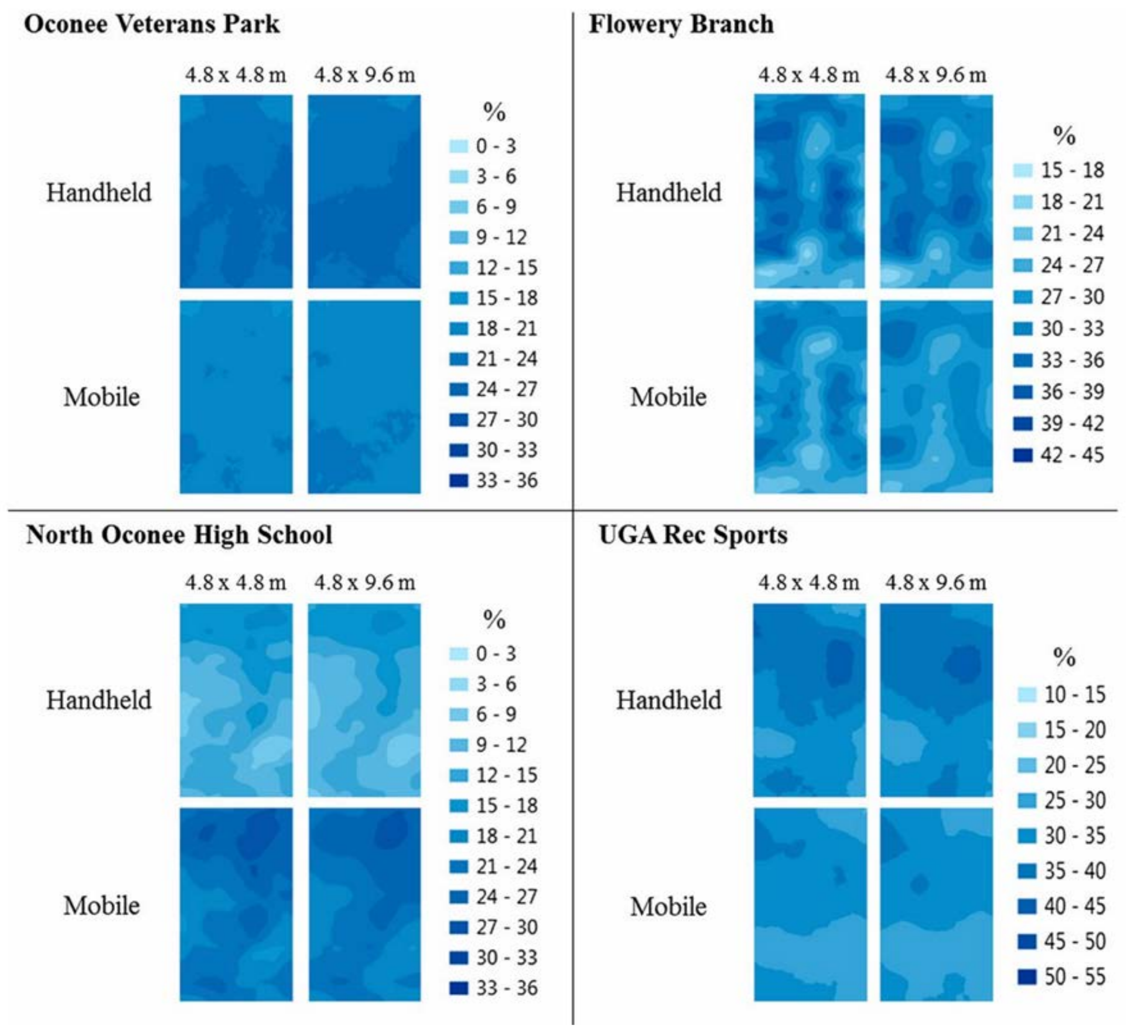


Straw, C. M., Grubbs, R. A., Tucker, K. A., & Henry, G. M. (2016). Handheld versus mobile data acquisitions for spatial analysis of natural turfgrass sports fields. *HortScience*, *51*(9), 1176-1183.

Spatial Maps

- Volumetric Water Content (VWC)
  - %VWC used as a parameter for measuring soil moisture
- Similar patterns between handheld and mobile devices, but at different magnitudes.
- Data collected at 4.8 × 4.8 m and 4.8 × 9.6 m sampling grids did not differ greatly throughout the study on any field

Conclusion: Handheld VWC meters can effectively demonstrate spatial trends in soil moisture, while perhaps not doing so at quite the same magnitude as mobile devices.

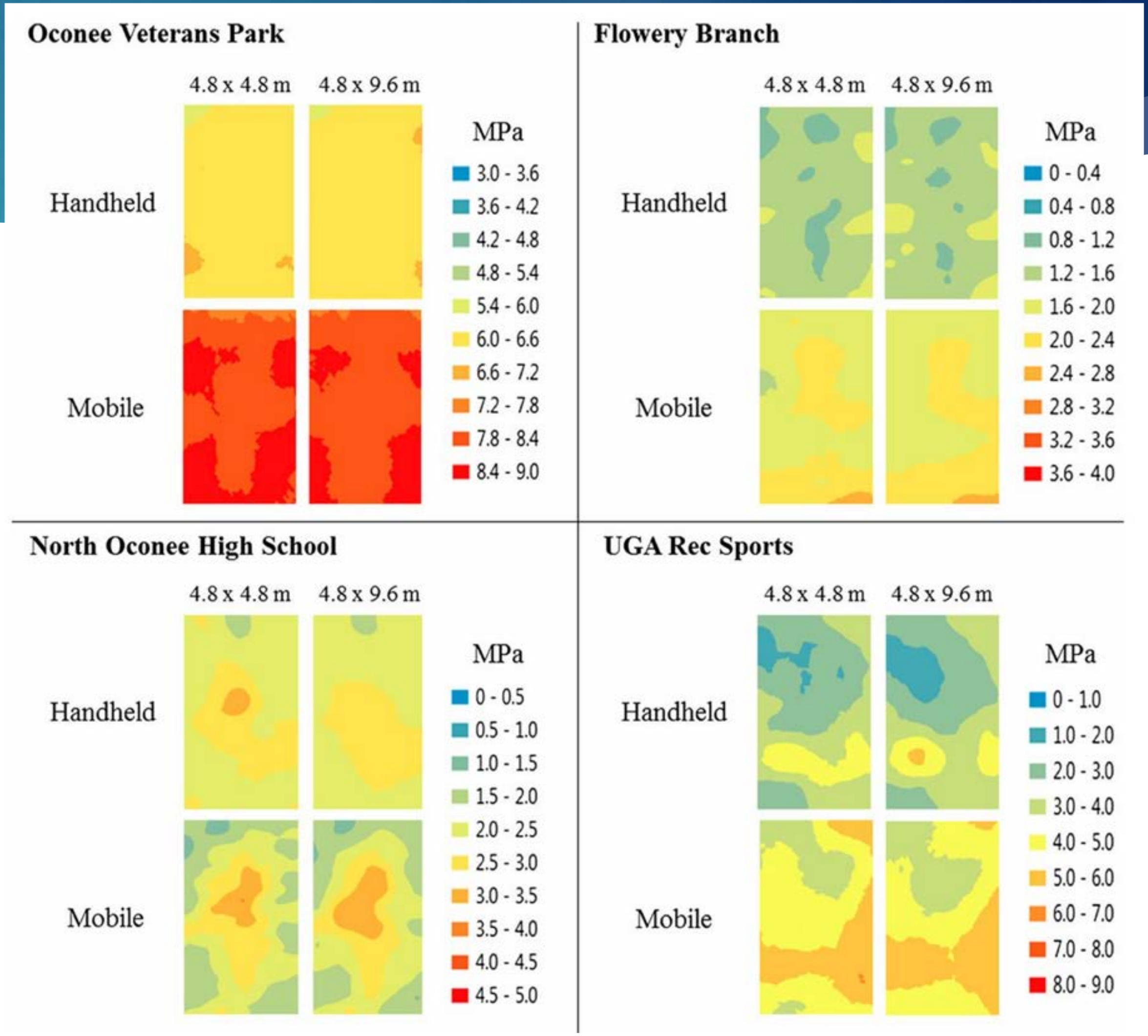


Straw, C. M., Grubbs, R. A., Tucker, K. A., & Henry, G. M. (2016). Handheld versus mobile data acquisitions for spatial analysis of natural turfgrass sports fields. *HortScience*, *51*(9), 1176-1183.

Spatial Maps

- Penetration Resistance (MPa)
- Data collected at 4.8 × 4.8 m and 4.8 × 9.6 m sampling grids did not differ greatly throughout the study on any field

Conclusion:
Results for penetration resistance were more erratic and presented with less consistency between mobile and handheld sensor devices with mobile devices perhaps being more accurate. This should be a consideration by turf managers attempting to map spatial variability of this particular property.



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Designing an IPM Program for Turfgrass Systems

3. Survey Pests at the Site

- Two comprehensive scoutings per year for weeds
- Less comprehensive scoutings and general observation notes should be made throughout the summer to evaluate effectiveness of spring treatments and turfgrass performance
- Utilize employees

Late Winter/Early Spring (Feb – Apr)	Late Summer/Early Fall (Aug – Oct)
Evaluate efficacy of winter weed control	Evaluate efficacy of summer weed control
Summer weeds are young and easier to control than in the late summer or fall	Both summer and winter weeds may be present at this time to allow for thorough identification
Good time to evaluate for site modification before primary growing season	Winter weeds are young and easier to control than in the spring.

Designing an IPM Program for Turfgrass Systems
3. Survey Pests at the Site

Pest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fall Armyworms								T	T	T	T	
White Grubs				A	A	A	T	T	S	S		
Chinch Bugs			S	S	S	T	T	T	T	S	S	
Mole Crickets			S	S	T	T	T	S	S	S	S	
Bermudagrass Mites			S	T	T	T	T	T	T	S		

Designing an IPM Program for Turfgrass Systems

3. Survey Pests at the Site

- Disease scouting can be trickier, as preventative control methods (cultural and chemical) are often most effective
- Important to track environmental conditions AND site history

Large Patch

Take-All Root Rot

Gray Leaf Spot

Pythium Blight

Large Patch *Rhizoctonia solani*	Take-All Root Rot *Gaeumannomyces graminis var. graminis*	Gray Leaf Spot *Pyricularia grisea*	Pythium Blight *Pythium spp.*
High fall N applications	Excessive shade	Hot, humid conditions	Warm, humid conditions
Excess moisture, poor drainage	Herbicide injury	Shade	Prolonged overcast periods
Soil temps between 50 and 70 F	Nutrient imbalances	N-deficient areas	Restricted air movement
Shade	Soil compaction	St. Augustinegrass	Tarping/Covering
Poor drainage	Temperature extremes		Poor drainage
Excess thatch	Environmental stress		Excess thatch
Symptoms: most visible in spring	Symptoms: spring and fall, but can appear in summer under extreme stress	Symptoms: Appear in the summer under hot, humid conditions	Symptoms: Appear in warm, humid periods starting in the spring
Treatment: spring and fall, but preventative fall applications tend to be more effective	Treatment: spring and fall	Treatment: summer, if severe. N to stimulate growth. Mow frequently.	Treatment: Preventative treatments during prolonged warm, humid periods are most effective. History of disease also important.

Designing an IPM Program for Turfgrass Systems
4. Set Action Thresholds

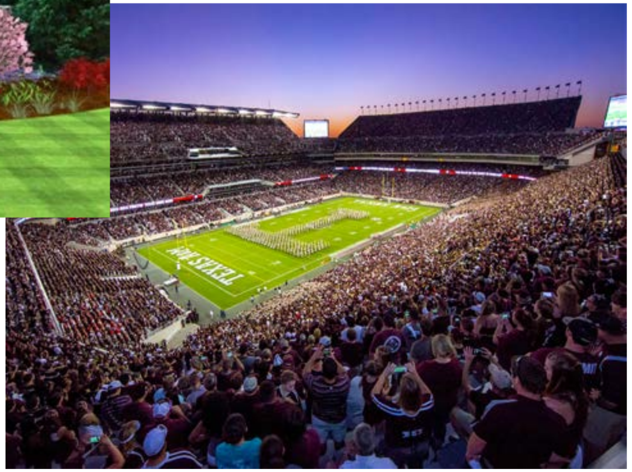
5 Primary Considerations

1. Economics
2. Health and Safety Concerns
3. Aesthetic Concerns
4. Public Opinion
5. Legal Concerns

Designing an IPM Program for Turfgrass Systems

4. Set Action Thresholds

Low Thresholds



High Thresholds

Designing an IPM Program for Turfgrass Systems

4. Set Action Thresholds

- Parks and school grounds where kids actively play will present a unique challenge
- Pests can be a safety concern
  - Tripping hazards
  - Insect allergies
  - Ticks and fleas
- Action threshold should be low, while threshold for pesticide use should be high
  - Exhaust cultural, mechanical, and natural control methods *first*
  - Keep pesticide use to a minimum and use products with a lower risk factor

Designing an IPM Program for Turfgrass Systems

5. Decide whether control measures are appropriate

Mechanical Control	Biological Control	Chemical Control
• Erecting Barriers • Using Traps • Hand-pulling or physical removal • Sanitation • Mowing (fire ants, mites, select weeds)	Introduction of protection of “natural enemies” • Conservation: avoiding use of pesticides that kill natural predators • Augmentation: release of natural enemies (predators, parasites, pathogens)	Use of chemical pesticides (based on action threshold) • Herbicides • Fungicides • Insecticides • Nematicides

Inside Look #3: On-going Research for New Mechanical Control Methods

Fraze mowing as part of an integrated approach to managing annual bluegrass (*Poa annua)*

Dr. Jim Brosnan (University of Tennessee) and Dr. Bryan Unruh (University of Florida)

Research question: *Is fraze mowing a viable option for reducing seed populations in turfgrass stands with heavy existing Poa annua populations?*

- Bermudagrass and zoysiagrass
- Fraze mowing implemented using a Koro Topmaker (KTM 1200, Campey Imants, Rocky Mount, NC) affixed to the power-take off (PTO) assembly of a tractor
- Three mowing timings (May, June, July)
- Three mowing depths: 0, 1.5 and 3 cm

Inside Look #3: On-going Research for New Mechanical Control Methods

Inside Look #3: On-going Research for New Mechanical Control Methods

- Recovery of the turfgrass species in fraze-mowed plots is being assessed using digital image analysis

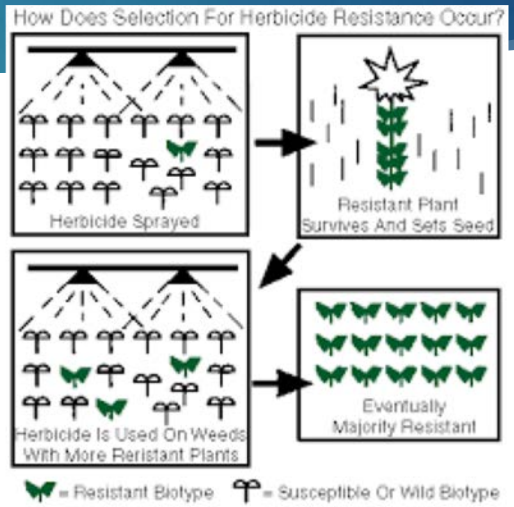
- The number of annual bluegrass plants in each plot will be quantified at each winter and spring using a 25 x 25 cm grid placed in five locations at the center of each plot.

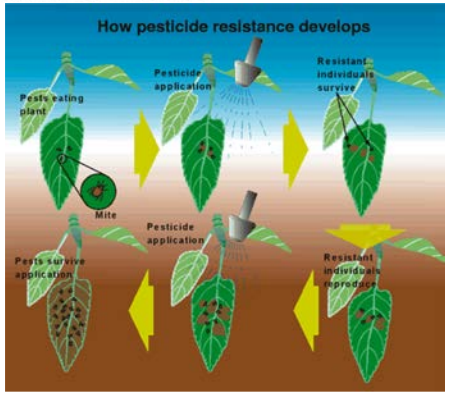
Similar published research available now:

Green, T. O., Kravchenko, A., Rogers, J. N., & Vargas, J. M. (2019). Annual Bluegrass: Emergence of Viable Seed in Various Putting Green Sites and Soil Removal Depths. *HortTechnology*, *1*(aop), 1-5.

A Quick Reminder: Pesticide Resistance

- Repeated use of pesticides with the same site/mode of action will select for resistant pests.
- These uncontrolled pests will reproduce, leading to an increased prevalence of resistance within a local population.
- That population can move off-site independently, on equipment or even on athletic attire, shoes, etc.





A Quick Reminder: Pesticide Resistance

Tips for Preventing Pesticide Resistance

- Implement IPM to reduce the need for pesticides, and improve efficiency of pesticide programs
- Rotate modes of action – not just active ingredients – and do so frequently.
  - Some weeds can develop resistance in just 2 years when a product is used heavily
- Apply products at the appropriate times to improve efficacy
- *Always follow label stipulations regarding use and applications rates*

Questions?