

University of Tennessee Center for Athletic Field Safety

Research and Science: Optimizing Player
Performance & Football Field Safety

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Outline

- Athletic Field Safety Facts
- Measuring Athletic Field Safety
- CAFS
- Bermudagrass Research



Importance

- Youth injuries (<14) cost the US public \$49,192,781,832 in 1997
- Emergency room visits (2004)
 - 116,000 – baseball
 - 186,000 – football



Importance

- 5.7% of high school football injuries were definitely related to field conditions, 15.2% were possibly related to field conditions

(Harper et al., 1984)

- 10% of lawsuits related to sports injuries claim that the athletic field was inadequately maintained

(Dougherty, 1988)



Importance

- 38 million children & adolescents

(NIH, 2009)

- 3.5 million children under 14 receive medical treatment for sports injuries

(Safe Kids, 2007)

- 50% of these injuries are preventable

(Brenner, 2007; Safe Kids, 2007)



What is playing quality?

Safety and Playability



DIFFERENT SPORTS



DIFFERENT SPECIFICATIONS





Player to Surface Interactions

Surface hardness,
consistency & reliability



Surface Hardness



Surface Hardness

- Ground Reaction Forces
 - The force exerted on an athlete by the surface upon impact

(Elftman, 1938; Nigg et al., 1984; Brosnan, 2007)



A man in a blue polo shirt and khaki cargo shorts is using a red penetrometer on a golf course green. He is bent over, holding the handle of the device with both hands. The device has a red base and a black vertical rod with a digital display attached. The background is a lush green golf course under bright sunlight.

Assessing Surface Hardness

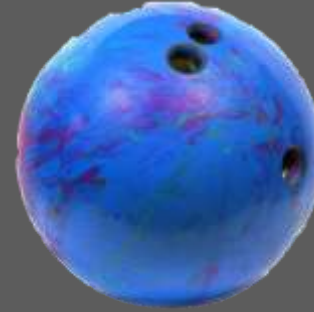
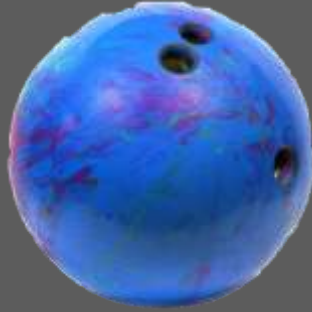
Clegg Impact Soil Tester

- Measures peak deceleration in G_{MAX}
 - 2.25 kg missile with embedded accelerometer
 - 45 cm drop through a guide tube

(Rogers III, 1988)



Clegg Impact Soil Tester



Consistency

- Data collected from 14 professional and college football games
- 78% of traffic is concentrated on 7% of the field
- Max. traffic concentration occurs at the 40 yd line
- 56 cleat marks ft^{-2}

The Problem

- The zone of traffic concentration
(Cockerham, 1989)
- Reduces turf cover
 - Increases surface hardness
 - Reduces traction
(Holmes and Bell, 1986)



Cady Traffic Simulator





Traction



Traction

Enable players to make necessary
movements

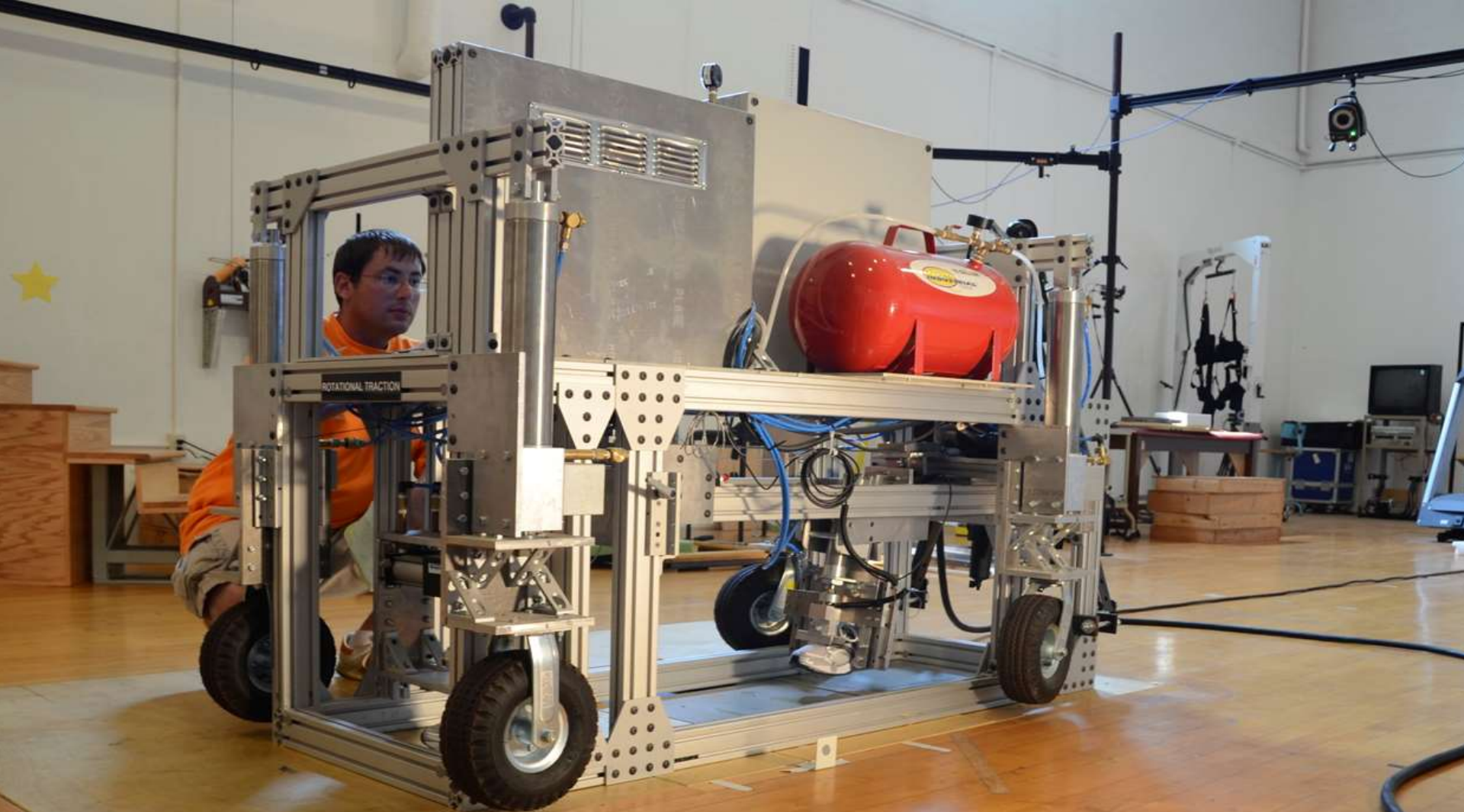
(Bell et al., 1985)



Traction



(Middour, 1992; Nigg and Yeadon, 1987; Wannop et al., 2010)



Assessing Traction

Tennessee Athletic Field Tester

- Simulates footstrike
- Measures the vertical and horizontal forces



Tennessee Athletic Field Tester

- Athlete weight
 - 45 lbs – 315 lbs
- Running
 - 1 m/s
- Contact distance
 - 230 mm



**Why is playing
quality so
important?**



Importance

- Poor playing quality of athletic fields can negatively impact player performance and safety

(Cockerham et al., 1993)



Surface Hardness



Consistency



Traction!



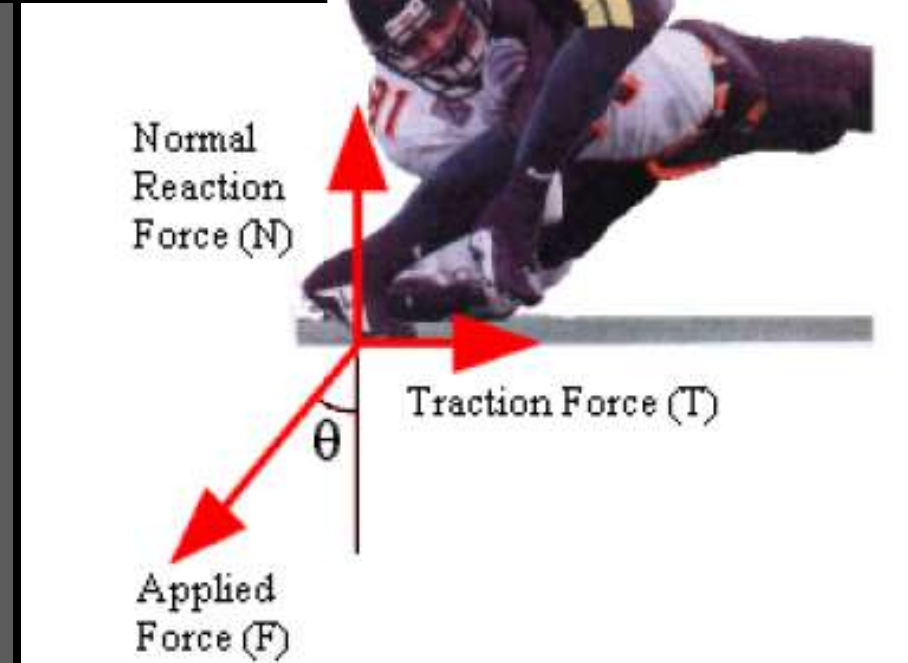
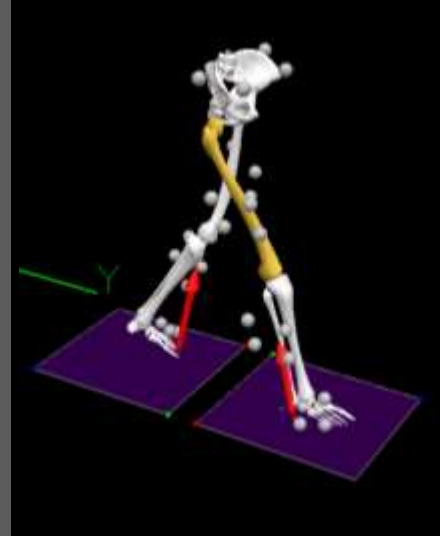
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Objectives:

- Determine safest playing surfaces possible
- Establish safer and higher performance optimums for players

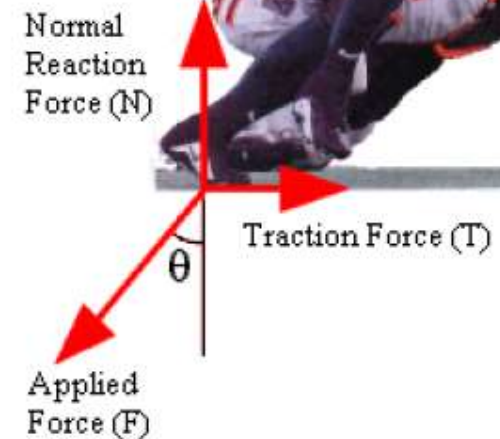
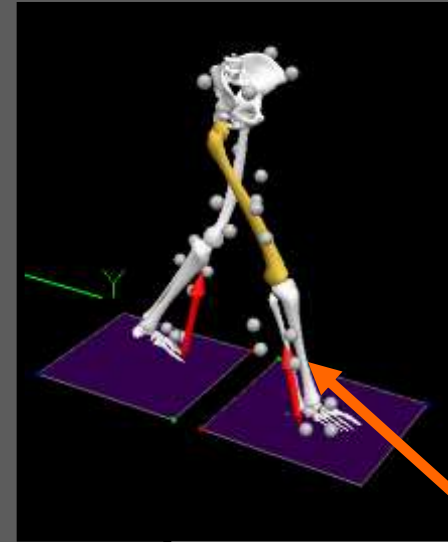


Determine athlete to surface interaction



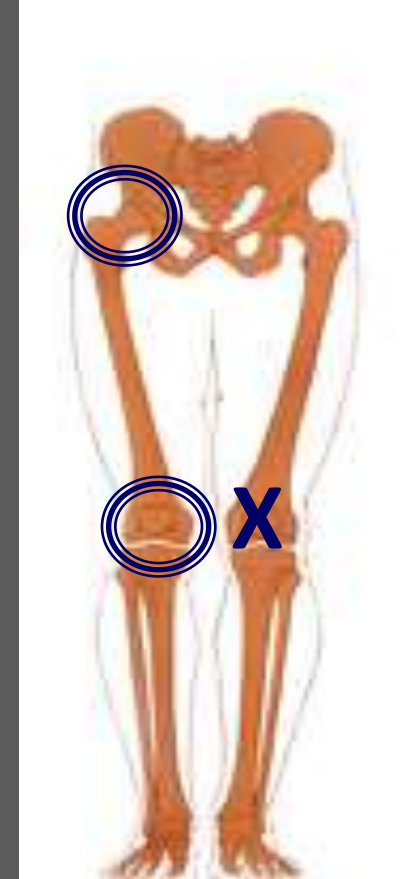
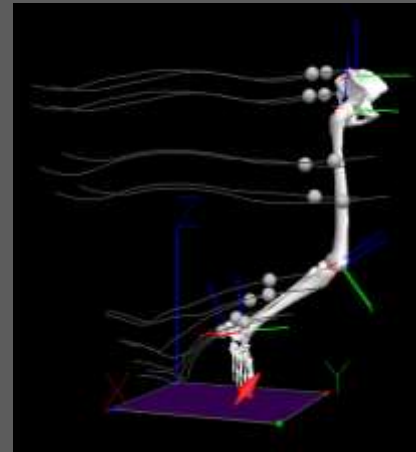
CAFS Sports Turf Research

- K-12 to Professional Fields
- Basic Management & Safety
- Field Performance
- Shock Attenuation



Athletic to Surface Interaction

- Surface Hardness
- Surface Traction
- Interaction between the two

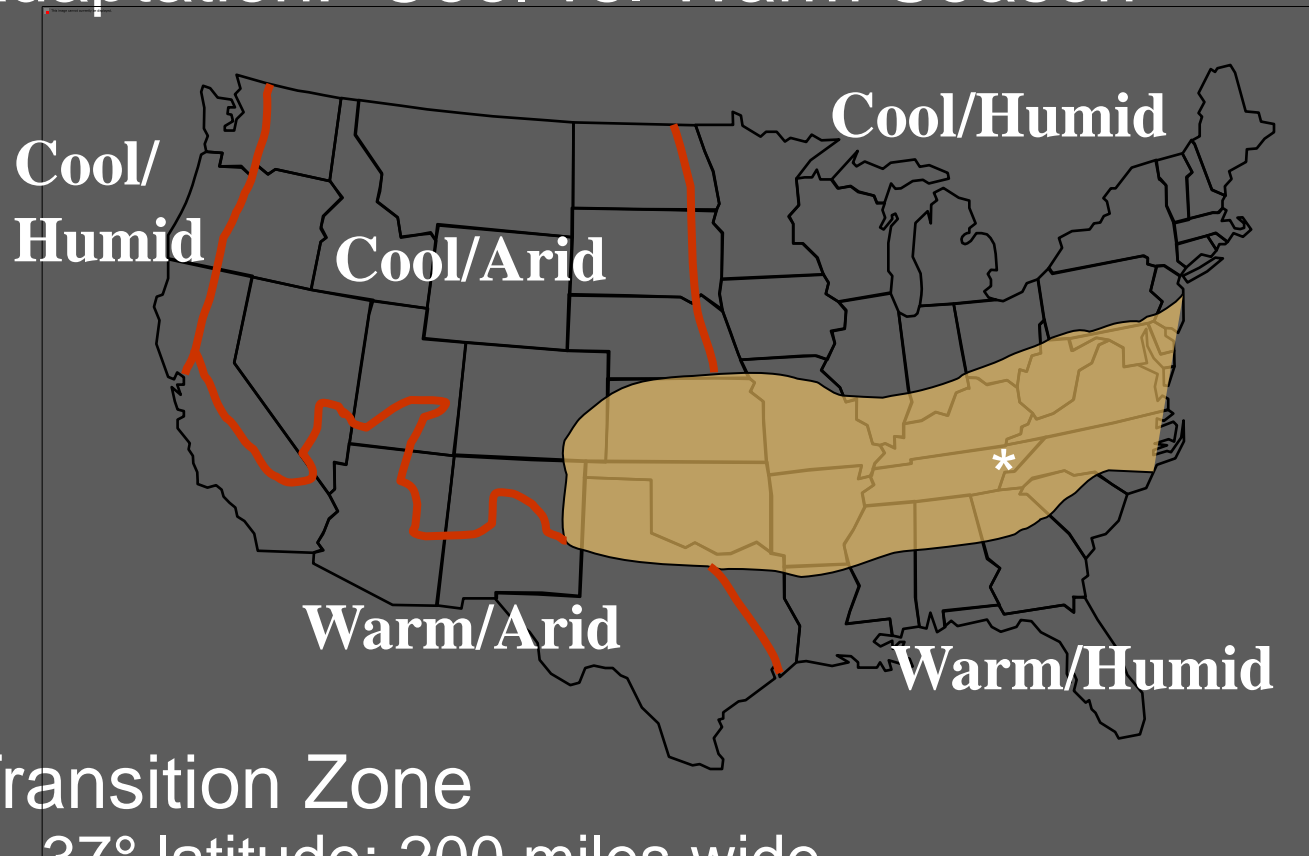


University of Tennessee Center for Athletic Field Safety - CAFS



Turf Climates in U.S.

- Adaptation: Cool vs. Warm Season



- Transition Zone
 - 37° latitude: 200 miles wide
 - Tall fescue
- Arid/Humid (cool and warm)





Ground Breaking
6-18-2010

Preparing the Varying Rootzones



Liners and Drainage





Center for Athletic Field Safety (CAFS)



Center for Athletic Field Safety (CAFS)



Project Name:
University of Tennessee
Turf Research Facility
Knoxville, TN

Rev	Date	Description	By

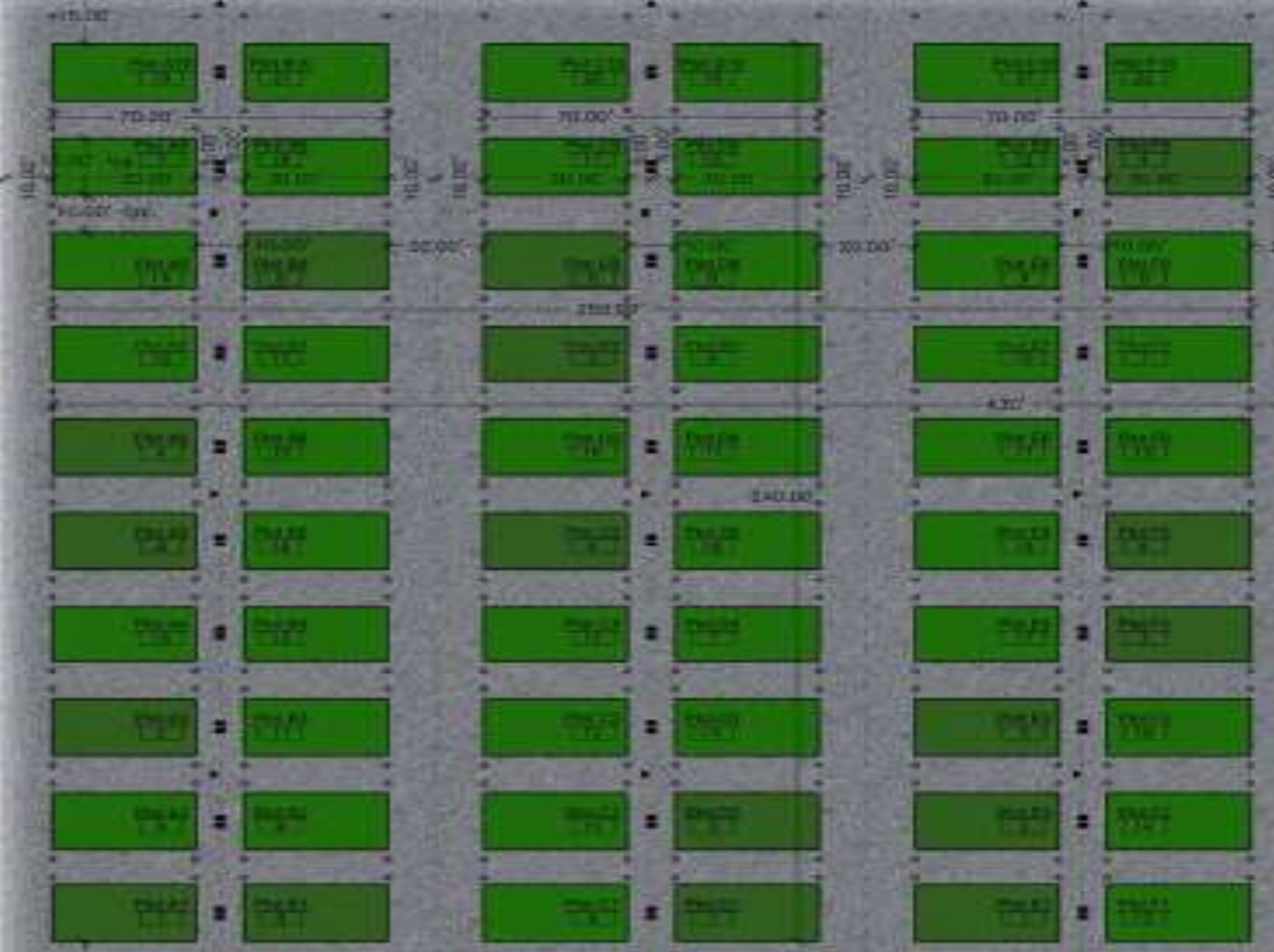
Sheet Title:
PLOT LAYOUT

Date:
Drawn By: CAB
Project No:
Scale:
Sheet Number:
A-1

Comparing Sports Turf Surfaces

- 72 Plots (150 ft²)
 - 12 Synthetic
 - 6 Natural Turfgrass (Sand Based)
 - Bermudagrass
 - Kentucky Bluegrass : Perennial Ryegrass Mixture
 - 6 Natural Turfgrass (Soil Based)
 - Bermudagrass
 - Kentucky Bluegrass : Perennial Ryegrass Mixture
- 10 year commitment

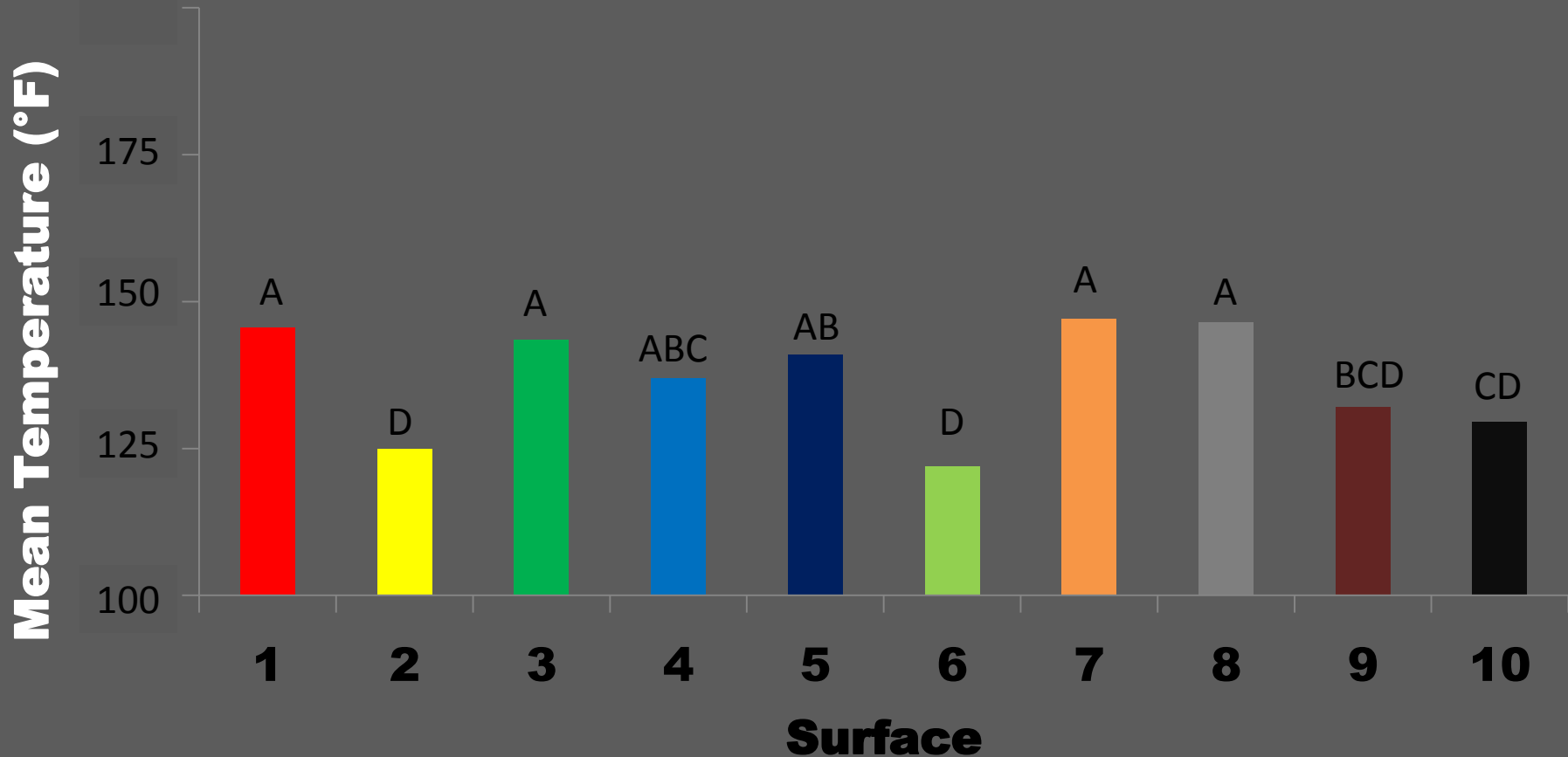




Developing a Model to Predict Synthetic Turfgrass Surface Temperature Using Atmospheric Conditions

A.W. Thoms, J.T. Brosnan, and J.C. Sorochan. University of Tennessee, Knoxville, TN. 37996

J.M. Zidek. ZedX Incorporated. Bellefonte, PA 16823



CONCLUSION

Atmospheric data can be used to model differences in synthetic turf surface temperature



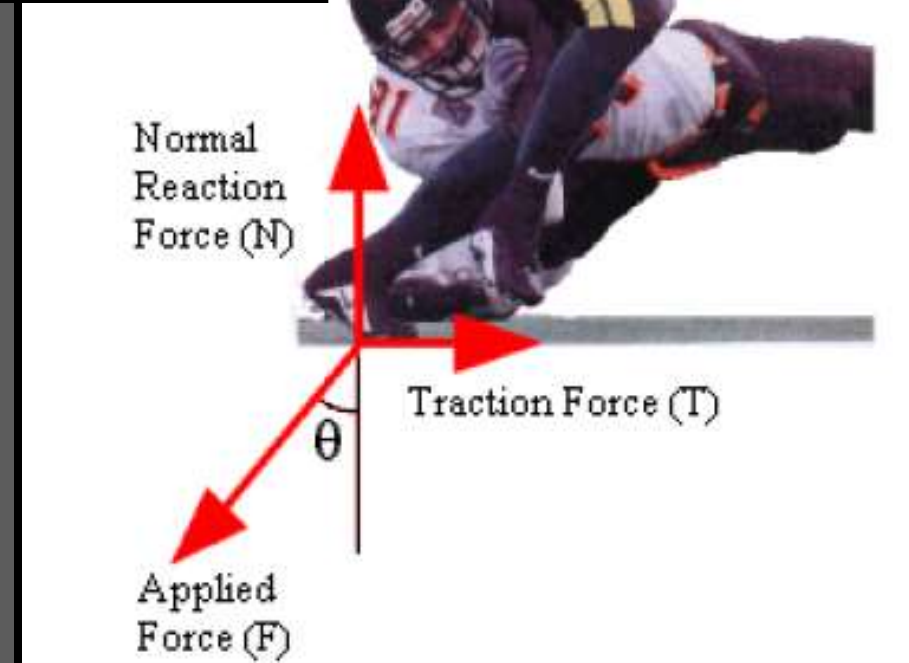
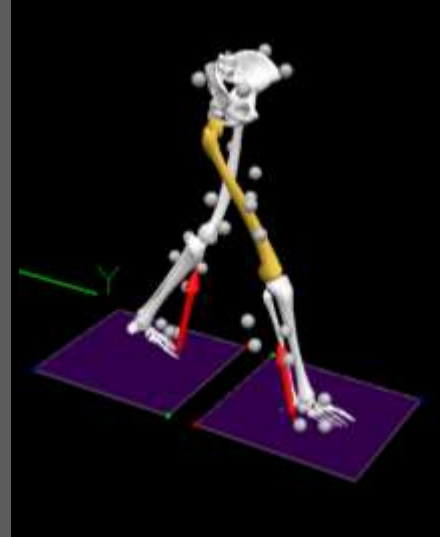
Athlete Safety & Performance Testing

8 – Combine Fields 50 yards x 5 yards

- 6 Synthetic Fields
- 2 Natural Turfgrass Fields (Sand Based)
 - Bermudagrass
 - Kentucky Bluegrass : Perennial Ryegrass Mixture
- Proving grounds for player safety and traction
 - Footwear
 - Different surfaces
 - Different conditions (wet and dry, etc.)



Determine athlete to surface interaction



TAFT – Tennessee Athletic Field Tester



TAFT – Tennessee Athletic Field Tester



TAFT – Tennessee Athletic Field Tester



TAFT – Tennessee Athletic Field Tester



Air Cylinder: 300 lbs Max

Load Cell: Compression only

Foot: Slide - 1 m/sec max
Measured loads: Horizontal
tension and compression
Vertical: Compression only

Cleat Type



VS

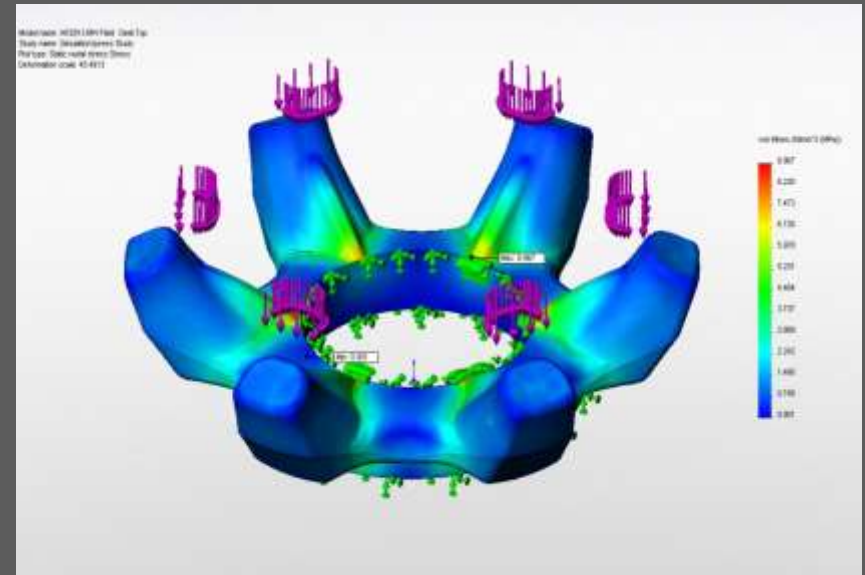
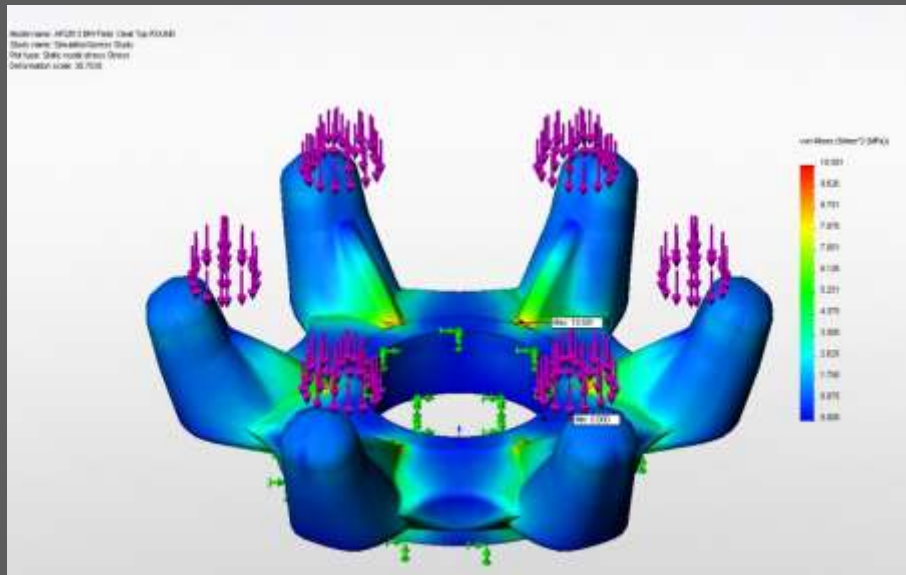


Kirk et al. (2006) – Proc of Int. Sports Eng. Assc.

Cleat Type

Cleat development for athlete safety and optimal traction

- Computer model of expected cleat Dynamics
- Field research with Tennessee Athletic Field Testers (TAFT)
- Human subject testing



Shoe companies now focusing on traction



Human Test Subjects for Performance and Safety



Human Test Subjects for Performance and Safety



Natural Turf Comparison



Mowing



Tennessee Mower



11/22/2003

Kentucky Mower



Alabama Mower



Current Research Studies



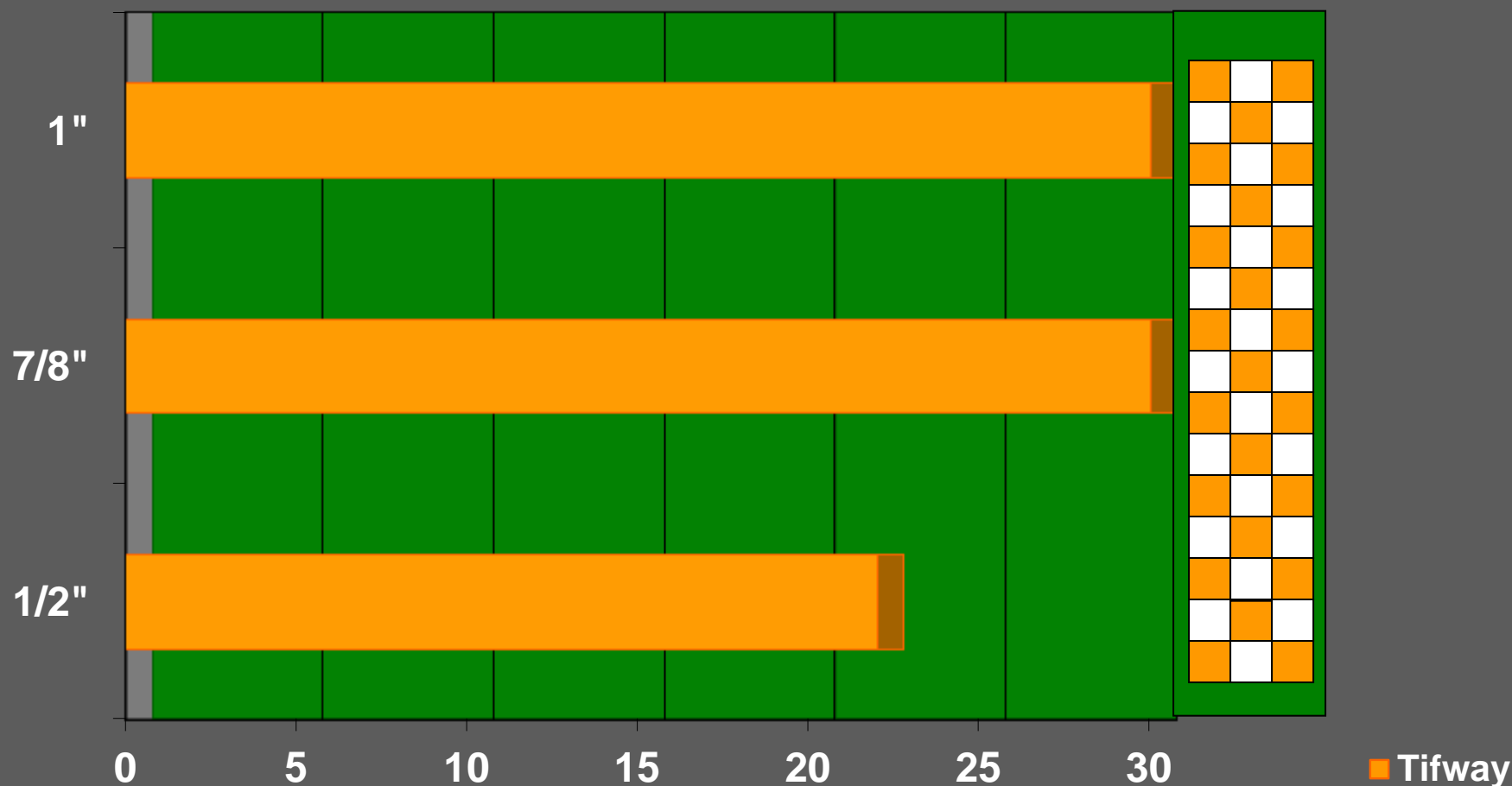
Bermudagrass Varieties with Grooming & Overseeding



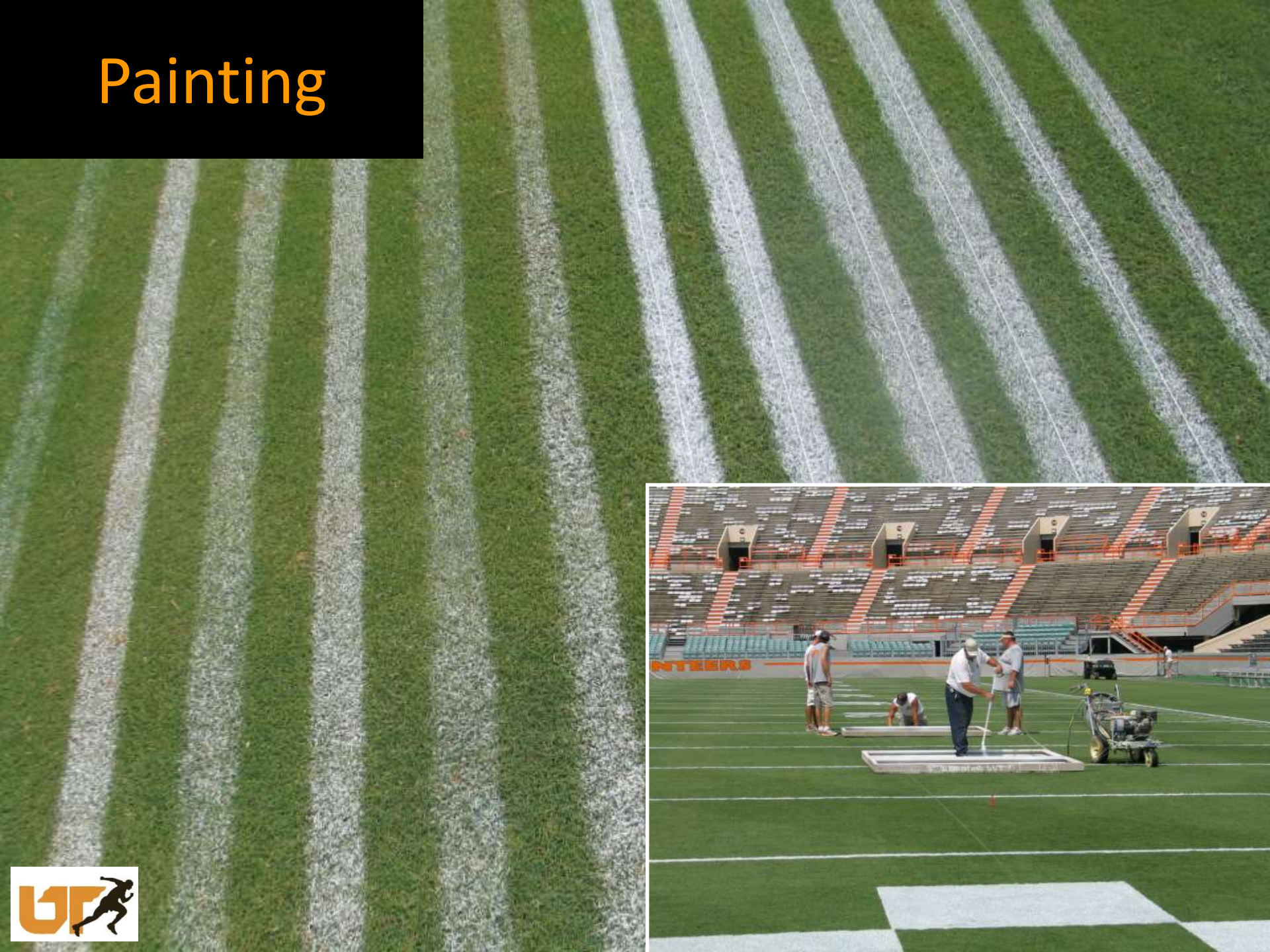
Mowing



Number of football games required for Tifway bermudagrass to achieve 75% turf cover for three mowing heights. Knoxville TN



Painting



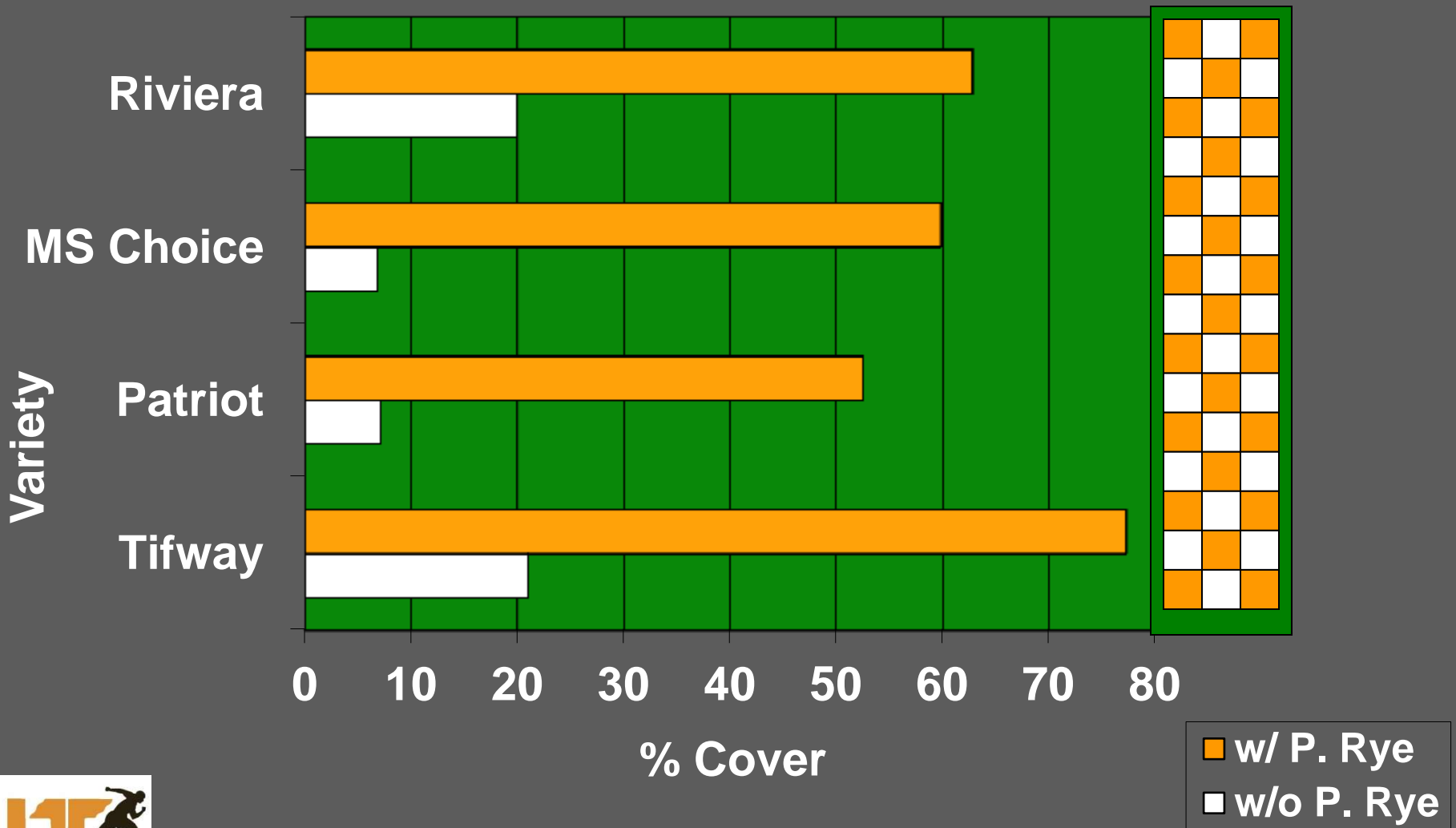
Variety Testing



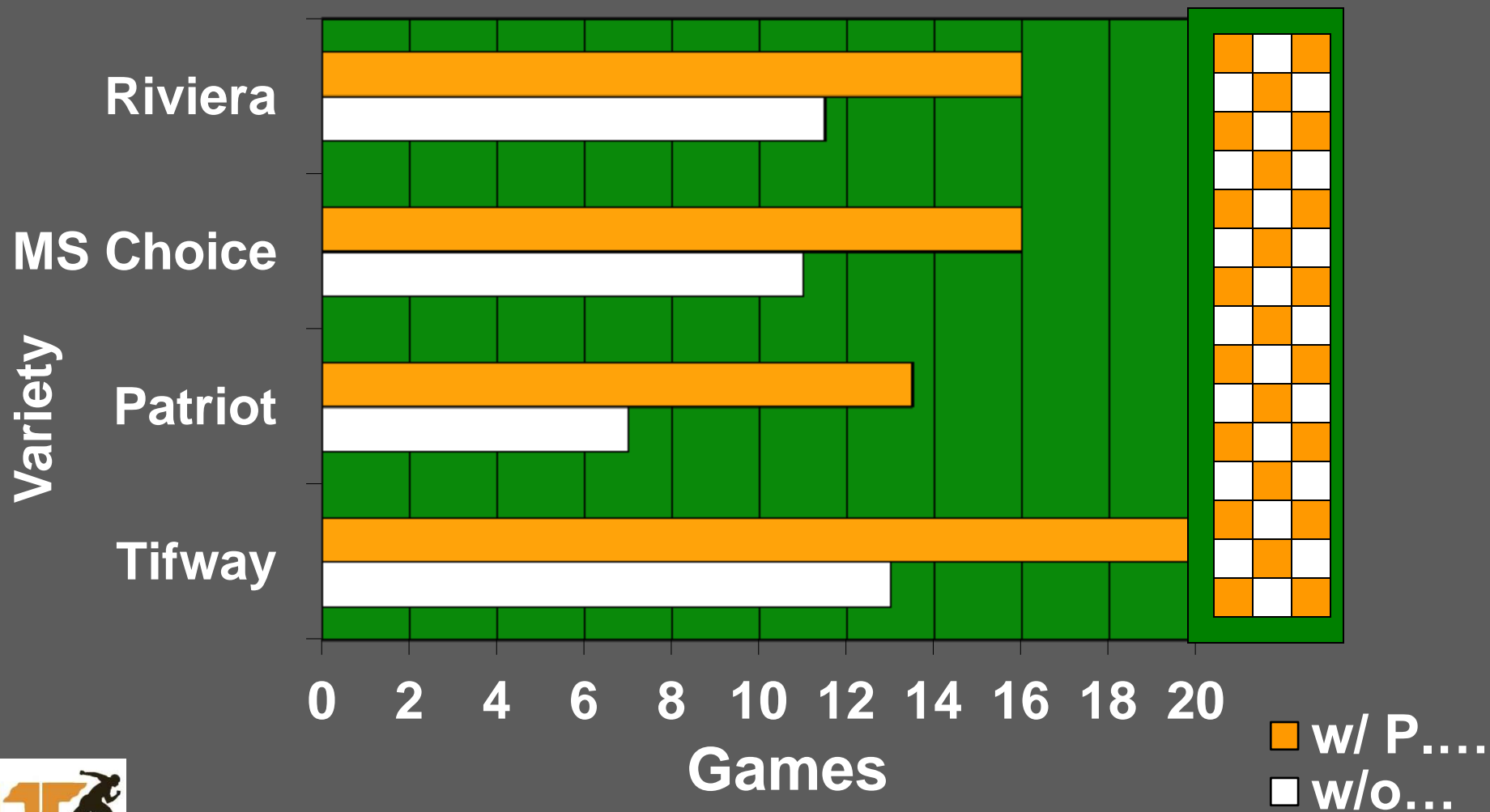
Overseeding Rates



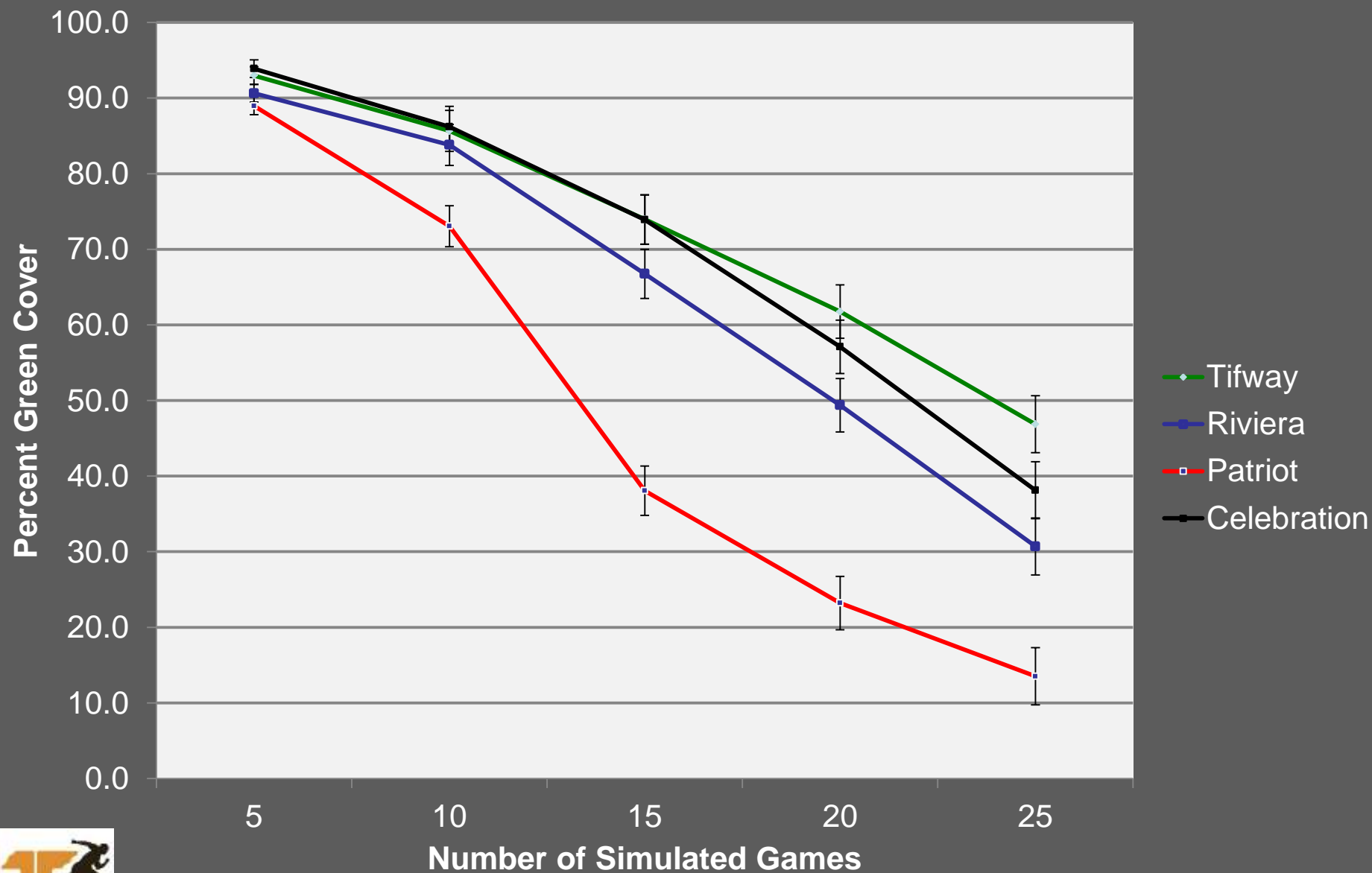
Percent turf cover for four bermudagrass varieties after 20 games



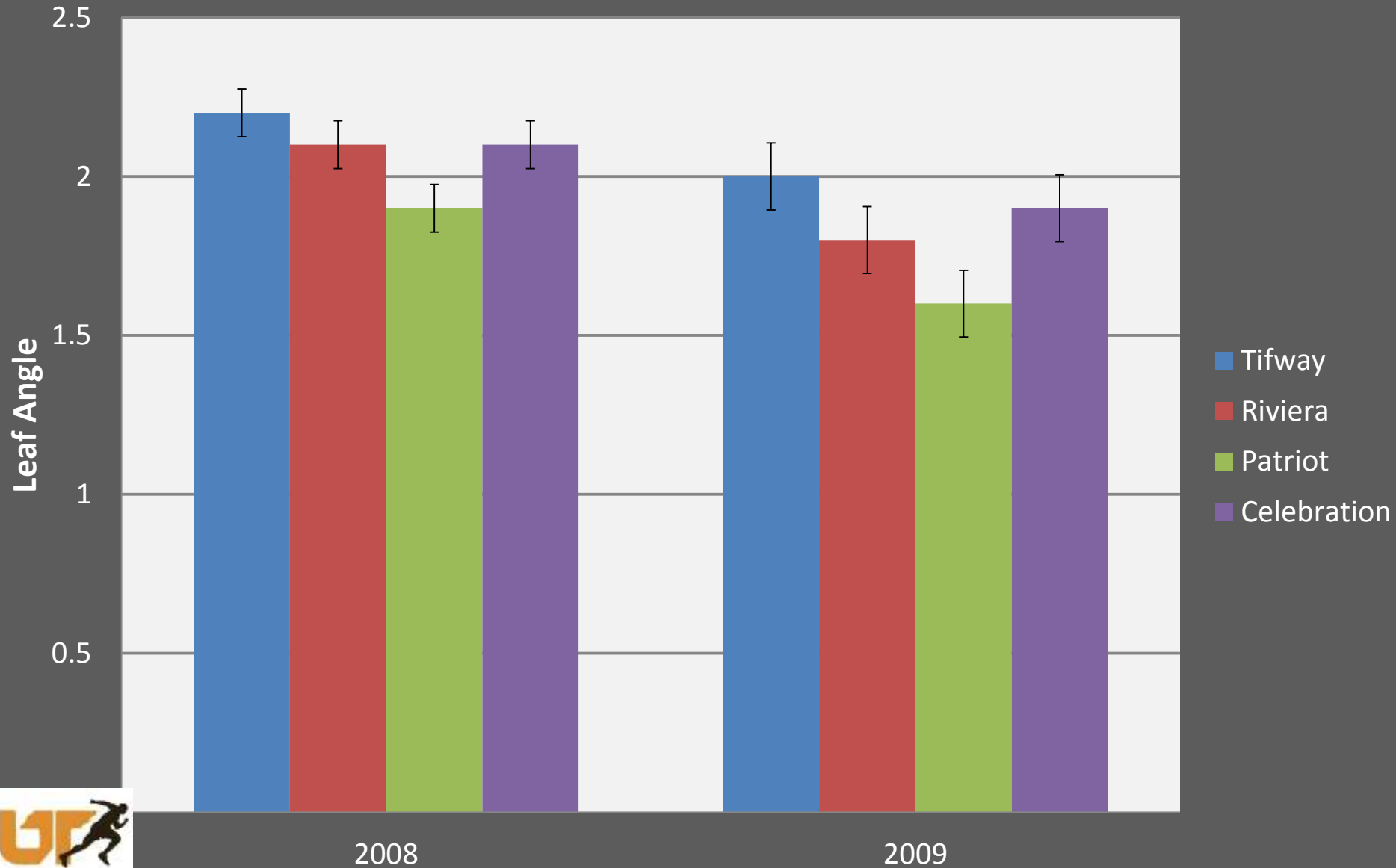
Number of football games required to achieve an acceptable 70-75% turf cover for bermudagrass varieties



Bermudagrass cultivars percent green cover after every five traffic events in 2008. Knoxville, TN



Leaf angle for cultivar in 2008 and 2009. Knoxville, TN



PGR and Traffic



Sports Turfs Species and Crumb Rubber Comparisons



Crumb Rubber Topdressing

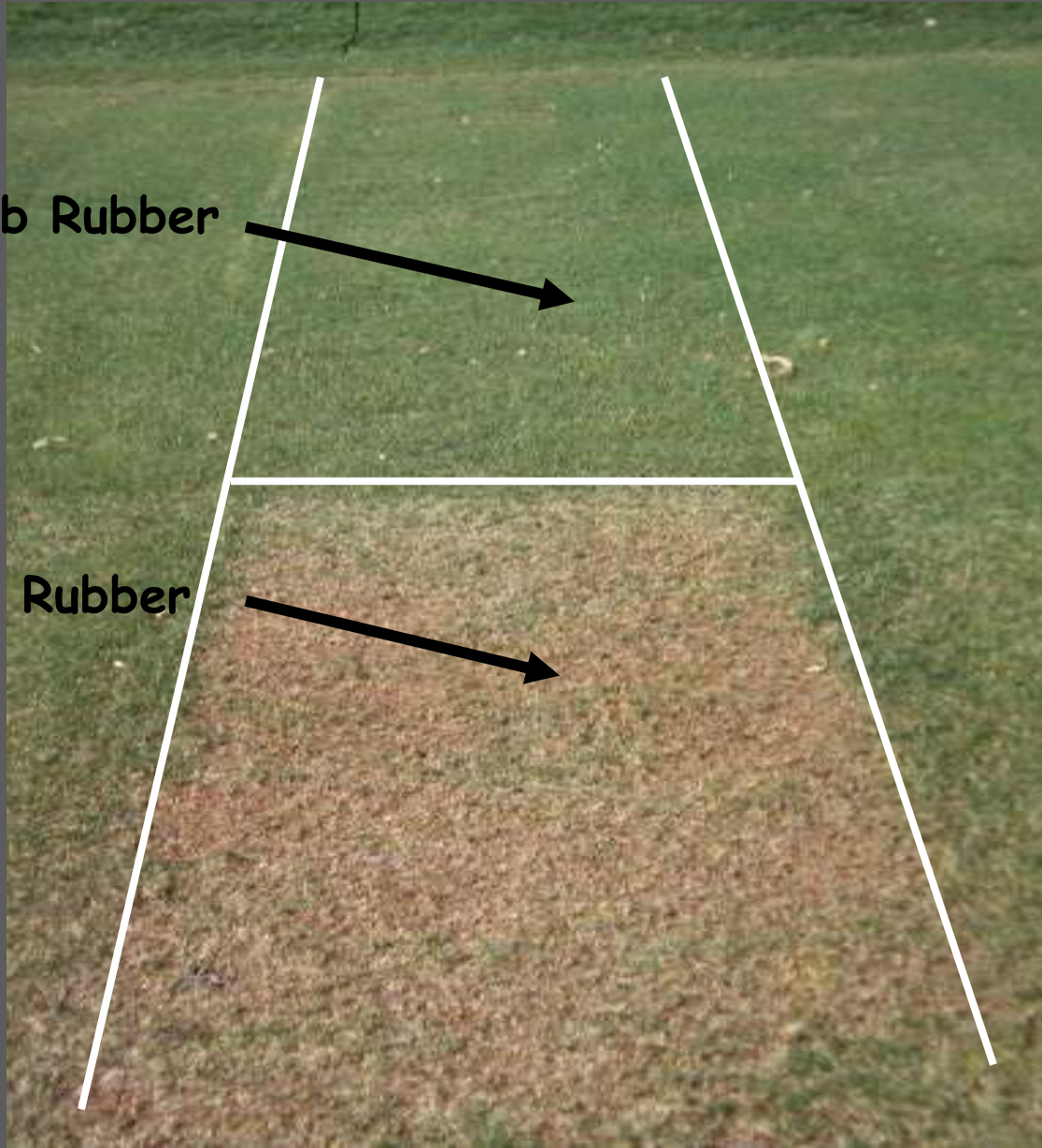


Crumb Rubber

0.75" Crumb Rubber



No Crumb Rubber



-Vanini et al
Mich St.





Sports Turfs Species and Crumb Rubber Comparison



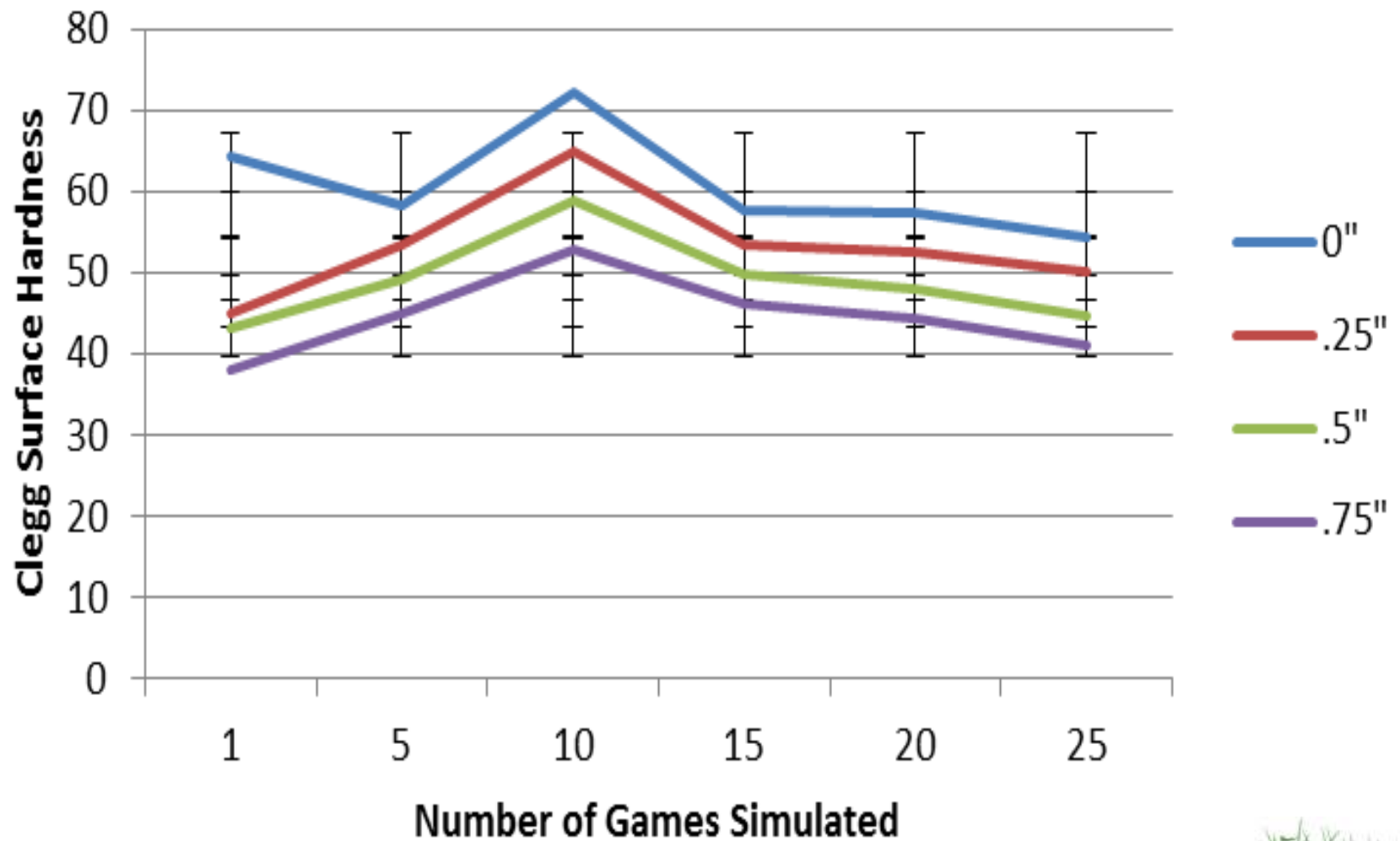
Sports Turfs Species and Crumb Rubber Comparisons



Results



Surface Hardness



A Comparison of a Control Plot

Start



End



A Comparison of 1/4in Rubber Plots

Start

End



A Comparison of 1/2in Rubber Plots

Start

End



A Comparison of 3/4in Rubber Plots

Start

End



Crumb Rubber Study after 25 games

0" CR

A photograph of a grass field with 0 inches of crumb rubber. The grass is dark green and appears somewhat sparse and uneven in color.

0.25" CR

A photograph of a grass field with 0.25 inches of crumb rubber. The grass is dark green and appears slightly more uniform in color compared to the 0" CR field.

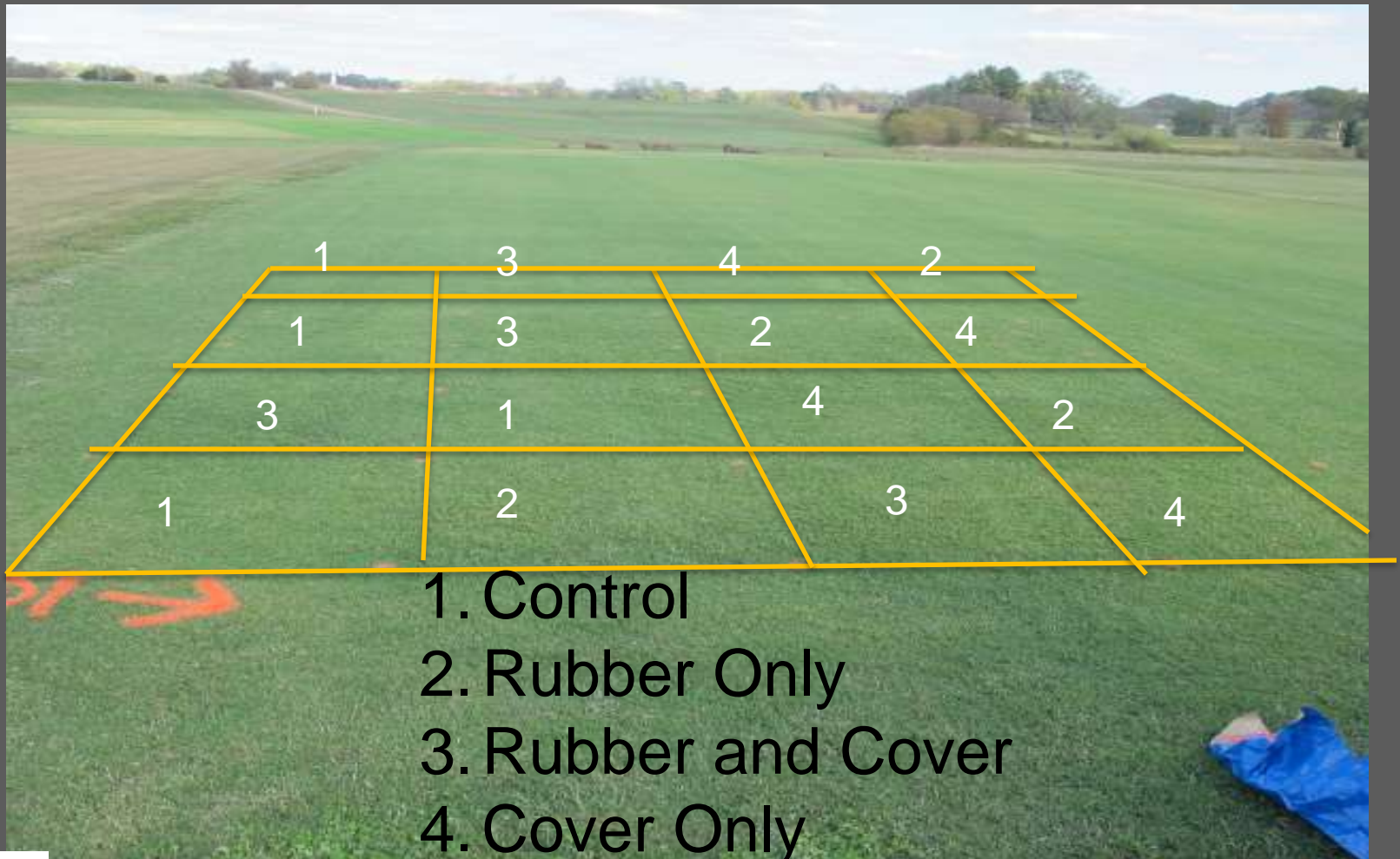
0.50" CR

A photograph of a grass field with 0.50 inches of crumb rubber. The grass is dark green and appears more uniform in color compared to the 0.25" CR field.

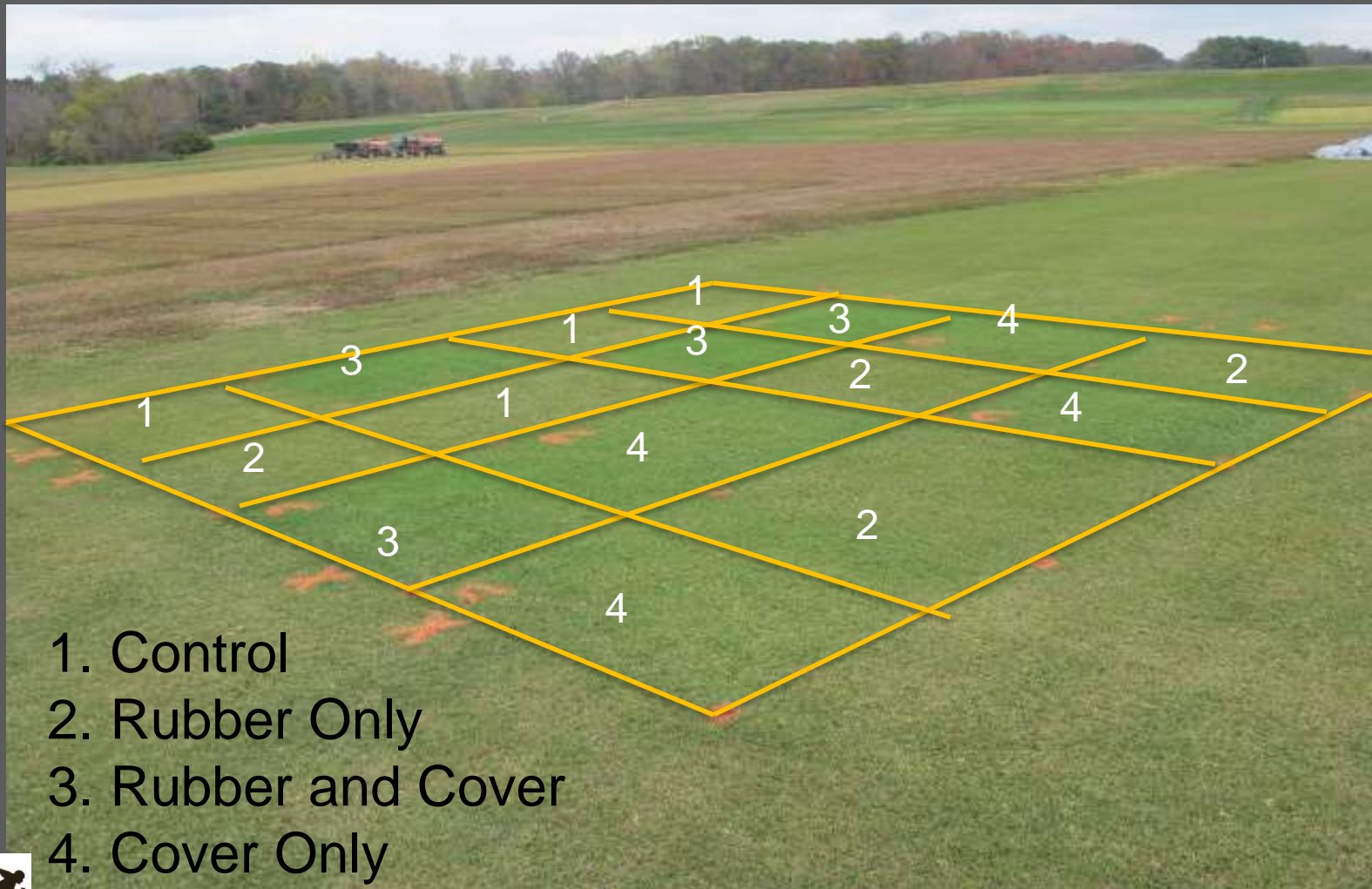
0.75" CR

A photograph of a grass field with 0.75 inches of crumb rubber. The grass is dark green and appears most uniform in color compared to the other three fields.

Cover Study October 21, 2011



Cover Study November 3, 2011



Cover Study November 22, 2011



Thank You



<http://www.turf.tennessee.edu>


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Write something about UT Center for Athletic Field Safety.

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UT Center for Athletic Field Safety


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UT Center for Athletic Field Safety



Drainage tile and Irrigation

13 new photos

222 Impressions · 2.25% Feedback

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👍 Drew Ellis, Jim Brosnan and 2 others like this.



Poa Annua Looks very professional. Look forward to moving in.
September 25 at 9:28pm · [Like](#) · [Flag](#)

Write a comment...



UT Center for Athletic Field Safety A few facts about the center:

1. The center has averaged about 8 dumptruck loads of gravel being delivered since the first of August.
2. There is over two miles of irrigation pipe to be installed in the next month.
3. Currently there is over a mile of drainage tile in the ground.

285 Impressions · 1.05% Feedback

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👍 Theresa Bayrer likes this.



Mike Richardson averaged 8 loads "per day", "per week", "per three days"??? I NEED MORE DETAIL!
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UT Center for Athletic Field Safety Sorry, that was an average of 8 loads of gravel a week.
December 2 at 12:55pm · [Like](#)

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The UT Center for Athletic Field Safety is being built as a place for the advancement of athletic field research and safety. There...

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