Why Research Matters

Grady Miller
NC State University
def: formal work undertaken systematically to increase knowledge
What Does the Future Hold for Athletic Turf?

- Increased need for fields
- Increased attention to safety and liability
- Greater conservation expectations
- More outsourcing for management practices
- More training for turf managers
- Greater use of technology (equipment, computers, etc.)
Range of estimates of the rate of return to public agricultural research in the United States

Number of studies with estimate in range

Source: USDA, ERS, using data from Huffman and Evenson, 2006.
Flows of research costs and benefits over time

Poorly trained or bad attitudes will further test!
Discovery vs Validation

— Most of the turf research is directed towards validating performance.
  • Performance compared to industry standards.
— Of course discovery (new uses, rates, products, etc) may happen along the way.
NCSU Variety Evaluation Program

Establishment rate Data: Tifway (Plugged) 7 Weeks After Planting
Establishment rate Data:
Northbridge (Plugged)
7 Weeks After Planting
• Pest Control: product, rate, non-target safety
• Application method, timing
• Grass, cultivar
  – Establishment
  – Mowing
  – Irrigation
• Grass, cultivar
• Hardness threshold
• Construction material and techniques

• What happens when?
New Pesticide to Market

• Estimated cost of discovery, development and registration to bring a new pesticide active ingredient to the marketplace exceeds $180 million, not including any capital costs.

• Time frame: 8-10 years
  – On average 1 in 70,000 go forward from screening phase.
  – On average 1 in 2 make it through an application for registration
  – Only 1 in 139,000 molecules synthesized will ever make it to market.
We usually start with a question.

3. Find x.

Here it is

Simplicity

The simplest solutions are often the cleverest
They are also usually wrong
We hope it ends with SIMPLE answers!
Where am I coming from?

My Historical Perspective

- Rohm & Haas
- Developing a new STAM M4 rice herbicide
- Learned by doing
- You can conduct research too!
Experimental Approach

1. Hypothesis
2. Experimental design
3. Experimental execution
4. Statistical analysis
5. Interpretation
Hypothesis!

In Swedish coffee houses they grind each bean individually for every cup of coffee they sell.

Or maybe it was Ethiopia.

And it might have been tea and not coffee.

Or Missouri.

Knowledge is power, dude.
Variation

• Do you want variation? Sometimes!
• Use variation in experimental units to your advantage.
• Incorporate with experimental design.
Experimental Execution
Collect data
What data is important?
The Problems Associated with Evaluating Color

chroma or saturation
value or brightness
Rub-off Test Examples
Purpose of Statistics

- Using objective criteria to **aid in decision making** in the face of uncertainty
- Statistics can control the rate of making an incorrect decision
- It is not the “final answer”
# Mean Separation

## Overseeding + Colorant Treatments

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Mean Quality</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.4</td>
<td>12# seed + paint</td>
</tr>
<tr>
<td>B</td>
<td>6.9</td>
<td>12# seed, no paint</td>
</tr>
<tr>
<td>B</td>
<td>6.9</td>
<td>8# seed + paint</td>
</tr>
<tr>
<td>C</td>
<td>5.7</td>
<td>8# seed, no paint</td>
</tr>
<tr>
<td>D</td>
<td>5.0</td>
<td>4# seed + paint</td>
</tr>
<tr>
<td>E</td>
<td>4.1</td>
<td>4# seed, no paint</td>
</tr>
<tr>
<td>E</td>
<td>4.0</td>
<td>0 seed + paint</td>
</tr>
<tr>
<td>F</td>
<td>2.4</td>
<td>0 seed, no paint</td>
</tr>
</tbody>
</table>

*Means with same letter not different (P=0.05) using LSD test*
Researchers at North Carolina State University found that Holganix decreased the need for prodiamine, a crabgrass herbicide. Dr. Neidermyer reports that Holganix combined with 33% less prodiamine produced results equal to those treated at the full-label rate (1.5 lbs per 1,000 sq ft).
Interpretation: Same results do not apply to every situation

– Environmental differences
– Different application
– Different margin of safety
If you can’t explain it simply, you don’t understand it well enough.

– Albert Einstein

Extension!
Common University Efforts in Turfgrass Research?

- Maintain turf/field quality with fewer inputs (water, fertilizer, chemicals, labor)
  - Develop and evaluate new grasses/cultivars
  - Evaluate new chemicals and turf care products
  - Evaluate new fertilizer formulations/programs
  - Evaluate new technologies and management strategies to allow greater water conservation

Who develops “Protocols”? 
Funding

• Federal
• State
• Companies
• Individuals
• Non-funded?

The Center for Turfgrass Environmental Research and Education (CENTERERE) at North Carolina State University was formed in, funded at $600,000 annually. The funds were generated from a mutual agreement by the turfgrass industry and the North Carolina Legislature. Turfgrass industry leaders agreed to a self-imposed tax: and the industry further agreed not to oppose a sales tax on seed and fertilizer (which were heretofore exempt from sales tax) if the State Legislature agreed to allocate a small portion of those tax revenues to turfgrass research and education. At the time of bill ratification, fiscal research estimated that the legislation would add approximately $12 million annually to the North Carolina General Fund. In return, $600,000 was allocated to NCSU for turfgrass research. Because of budget cuts, the $600,000 has been decreased to $540,000 in 2010 and is threatened by additional cuts in FY 2011-12 and beyond.
Funding: What we could do versus the limitations.
www.TurfFiles.ncsu.edu
ONE OF THE TOP TURFGRASS WEBSITES IN THE NATION
Over 500,000 pageviews in 2012

“Cutting Edge” Technology & Science
A Porous Convection Model for Grass Patterns

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ABSTRACT: Spatial ecological patterns are usually ascribed to Turing-type reaction-diffusion or scale-dependent feedback processes, but morphologically indistinguishable patterns can be produced by instabilities in fluid flow. We present a new hypothesis that suggests that fluid convection and chill damage to plants could form vegetation patterns with wavelengths 10–2 times the plant height. Previous hypotheses for small-scale vegetation pattern formation relied on a Turing process driven by competition for water, which is thought to occur in large vegetation patterns. Predictions of the new hypothesis were consistent with properties of natural grass patterns in North Carolina, contradicting the Turing hypothesis. These results indicate that similarities in pattern morphology should not be interpreted as implying similarities in the pattern-forming processes, that small-wavelength vegetation patterns may arise from mechanisms that are distinct from those generating long-wavelength vegetation patterns, and that fluid instabilities should be recognized as a cause of ecological patterns.

Keywords: ecological patterns, thermal convection, soil moisture, chill damage.
## Comparison of athletic field paint application methods

**Grady Miller**  
**Aug 11, 2010**

There are two primary paint formulations used in application of paints (lines or logos) to athletic fields: aerosol and bulk paint. The aerosol paint may be applied as a line using a “striping” and the bulk paint using roller, paint brush, or pressurized sprayer. The pressurized sprayer is most commonly used with either low pressure (from CO2 tanks or compressed air) or high pressure (often called an airless sprayer). The benefits of aerosol paint compared to bulk paint are convenience and less need of cleanup after use. The downside is all the spent cans that are discarded and end up in a landfill and high paint cost. Other than clean-up, the downside to bulk paint is the significant cost of the application machine. A new product on the market (Starliner) provides a new alternative to each of these methods. It uses paint from a sealed cardboard box and the relatively inexpensive application machine uses an electric motor to pressurize the system to deliver the paint. A relative cost comparison of the three different application methods is below:

<table>
<thead>
<tr>
<th>Paint type</th>
<th>Linear ft.</th>
<th>$/unit</th>
<th>Cost</th>
<th>Associated equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1000 linear ft.</td>
<td>Soccer small</td>
</tr>
<tr>
<td>Aerosol (18 oz.)</td>
<td>180/can</td>
<td>$4.46</td>
<td>$25</td>
<td>$45</td>
</tr>
<tr>
<td>Starliner electric</td>
<td>1250/box</td>
<td>$39.75</td>
<td>$32</td>
<td>$57</td>
</tr>
<tr>
<td></td>
<td>2000/box</td>
<td></td>
<td>$20</td>
<td>$36</td>
</tr>
<tr>
<td>Airless sprayer</td>
<td>1900/gal.</td>
<td>$14.50</td>
<td>$8</td>
<td>$14</td>
</tr>
</tbody>
</table>

Note:
Starliner has 2 speed options. This changes painted area per box of paint.
All products can be bought in bulk to reduce price.
No such thing as a bad question
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