

Drive Your Growth Rate

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Implications of Turfgrass Growth Manipulation

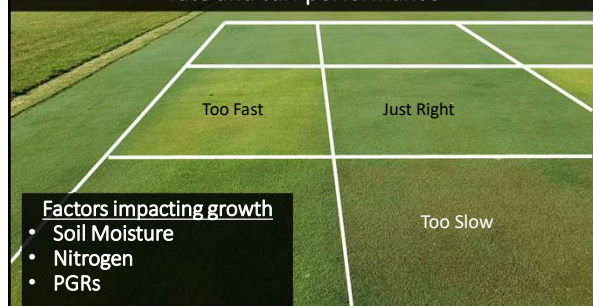
- Carbon Partitioning & Storage
- Nutrient & Pesticide Requirements
- Recuperative Potential
- Turfgrass Performance
- Playability



Photo courtesy Andrew McDaniel

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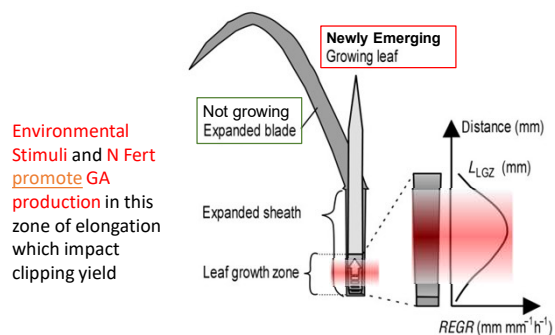
Turf managers are constantly trying to balance growth rate and turf performance



We need to define growth more precisely

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Hormone called gibberellin (GA) encourages leaf elongation rate (clipping yield)



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Various factors impact GA production

- Environmental conditions
 - Light quality
 - Water status
 - Temperature
- Mowing practices
- Nitrogen fertilization
- PGRs

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Absolute yield is most important but PGRs measured as relative growth suppression

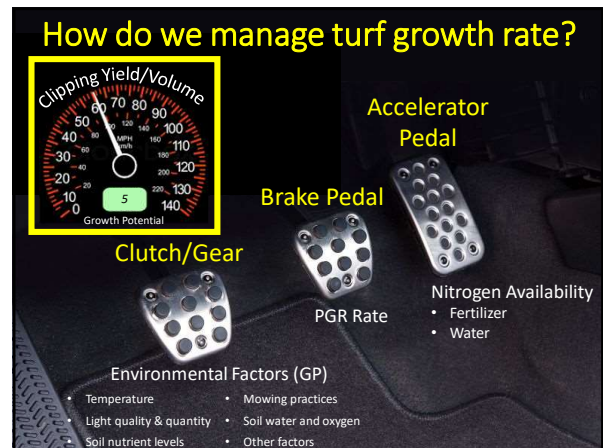
- You likely have growth rate goals
- PGR impact growth changes with growth rate



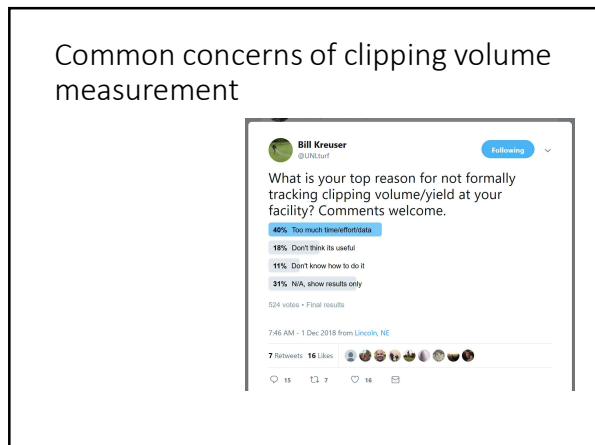
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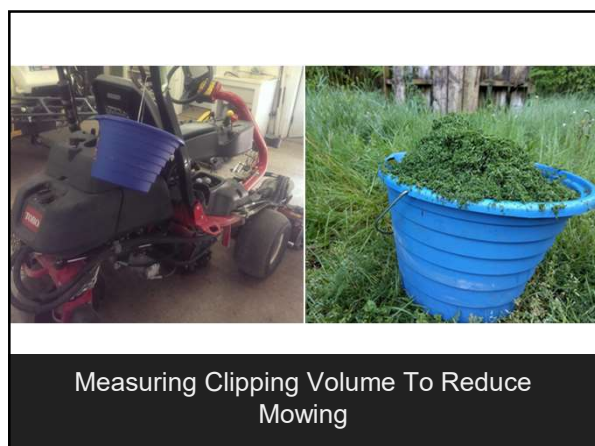
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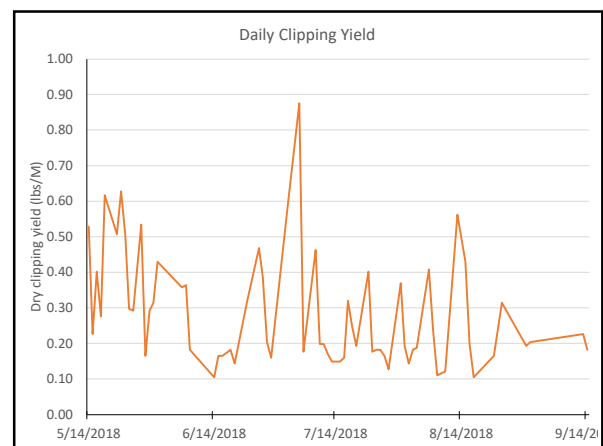
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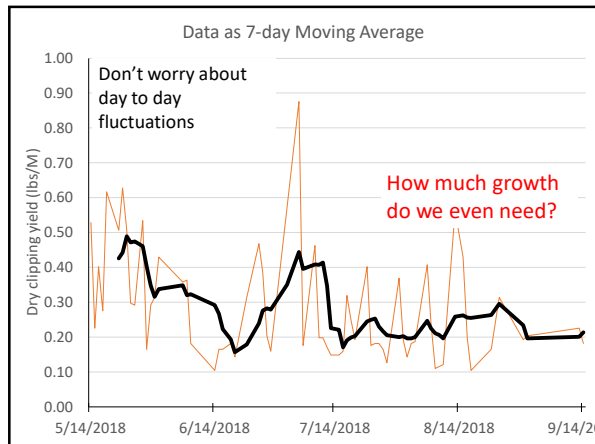
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Track Clipping Volume to Monitor N Availability

- What are the “optimum” growth rates for greens, tees, fairways, etc.?



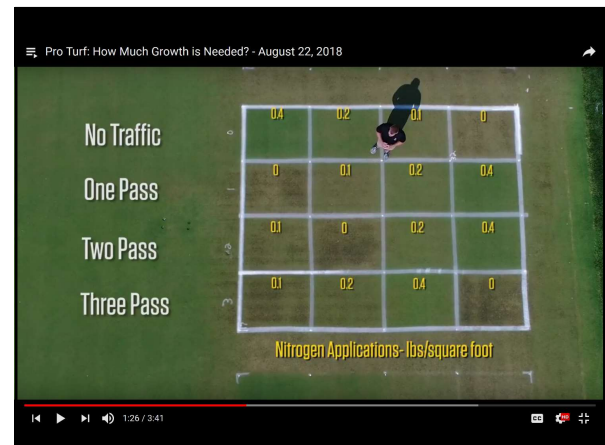
Photo courtesy Andrew McDaniel

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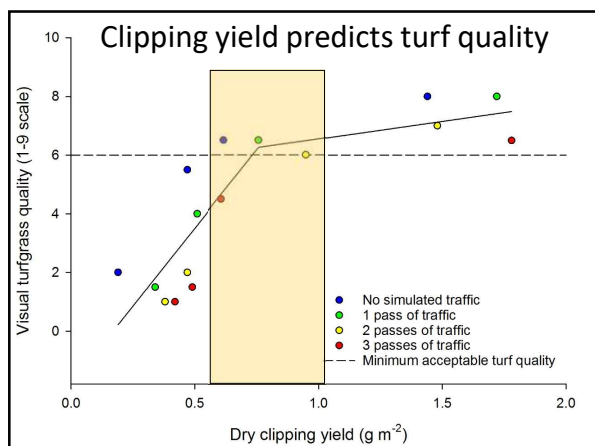
How much growth is required?



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How do we manage turf growth rate?



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Track Clipping Volume to Monitor N Availability

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Photo courtesy Andrew McDaniel

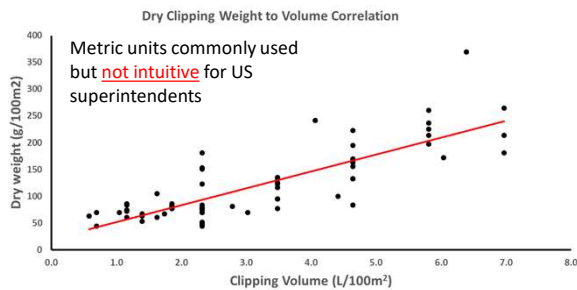
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How to Collect Clipping Volume



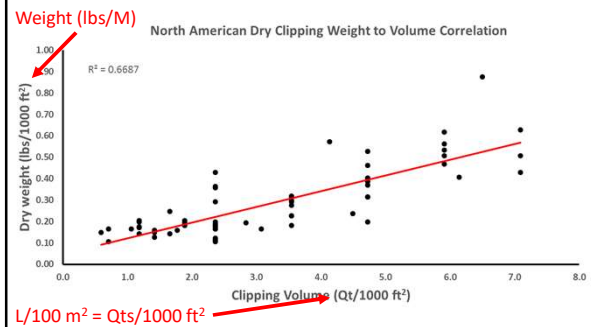
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Clipping volume linked to clipping weight

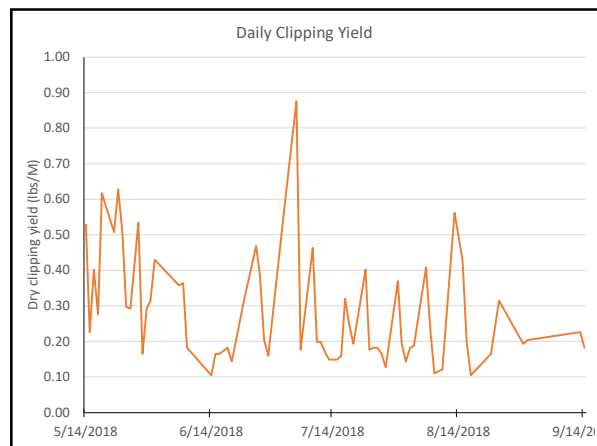


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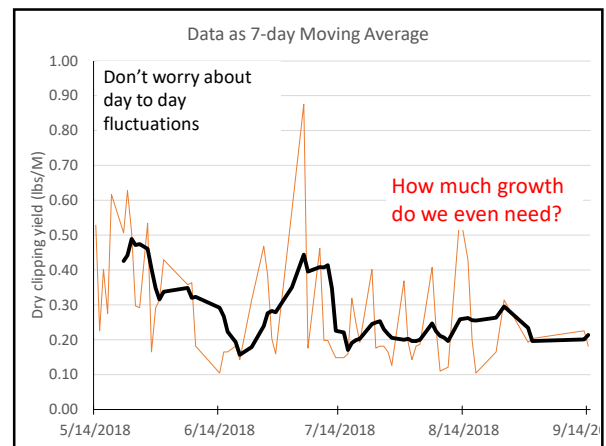
It's fine to use US Units (lbs/1000 ft²)



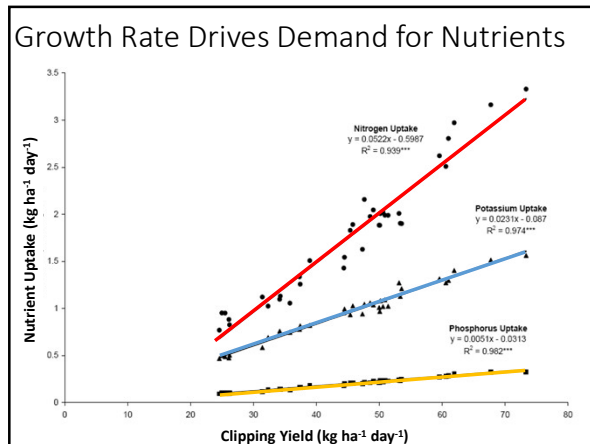
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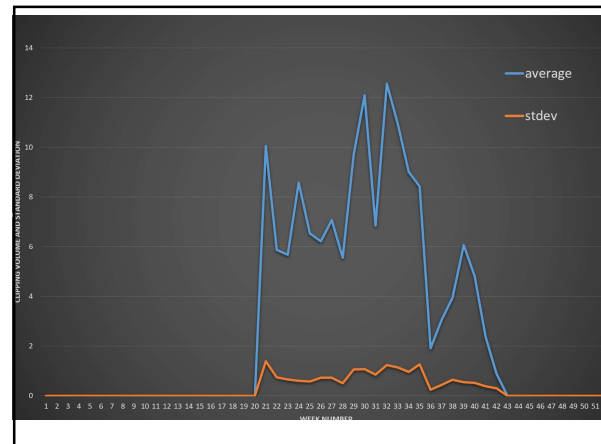
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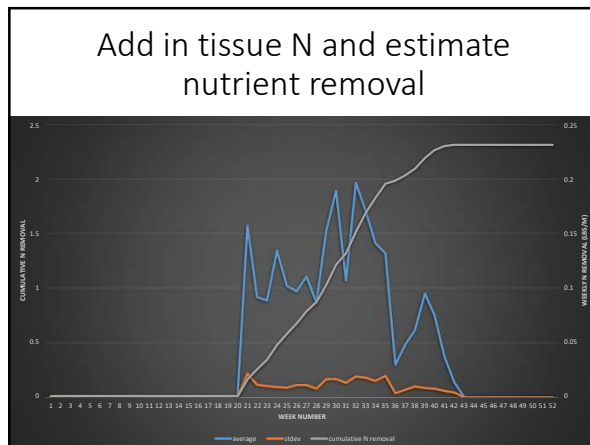
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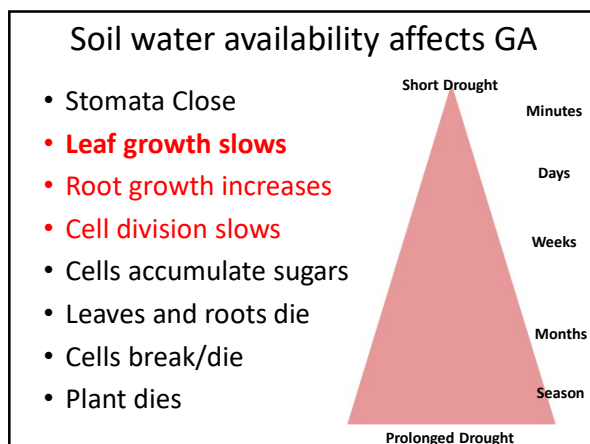
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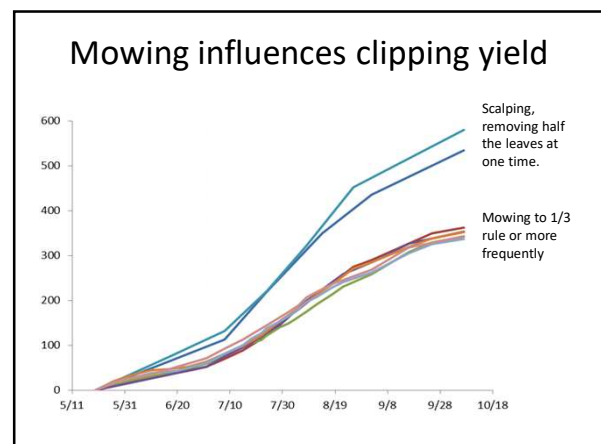
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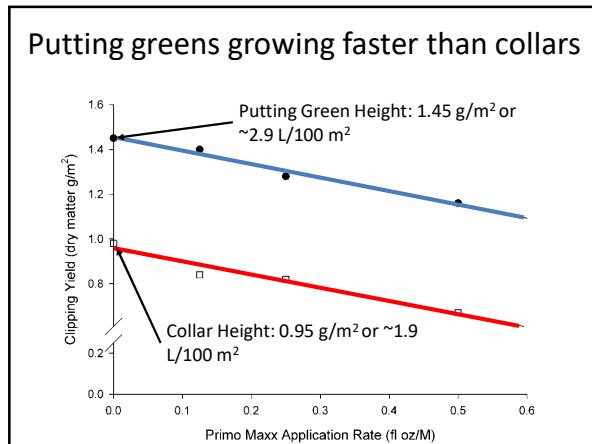
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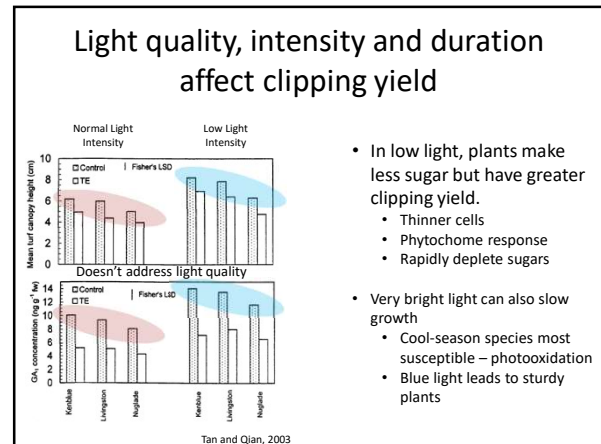
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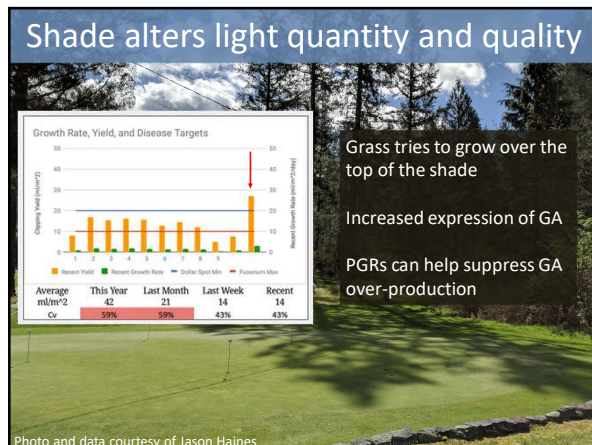
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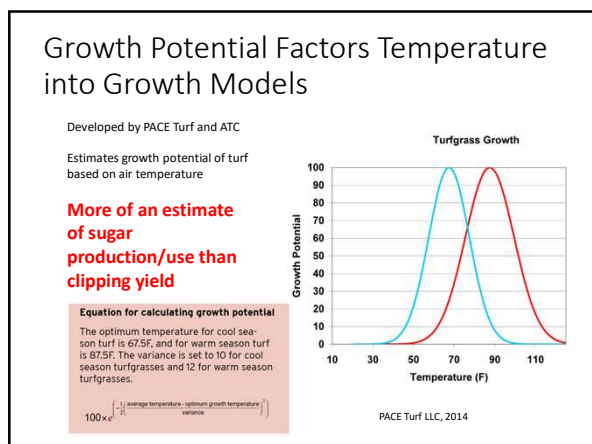
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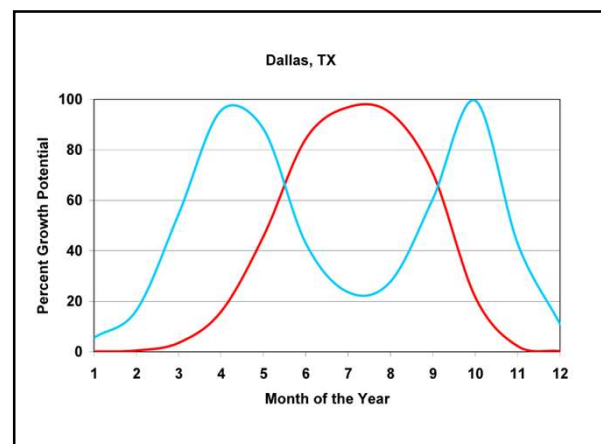
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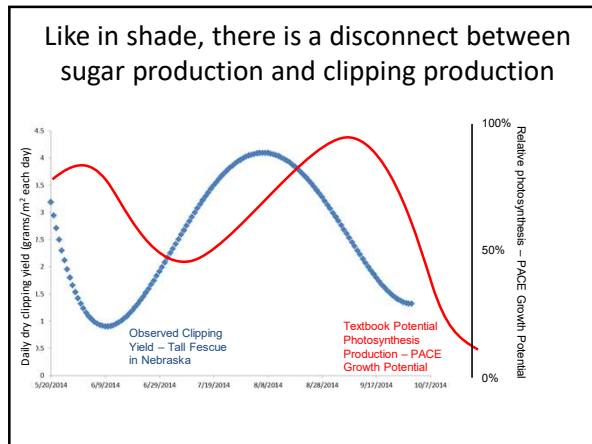
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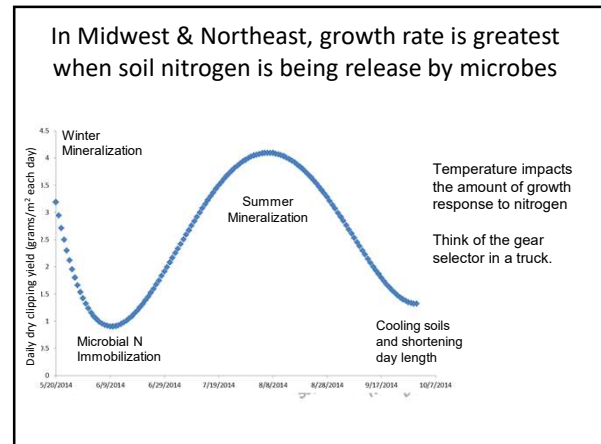
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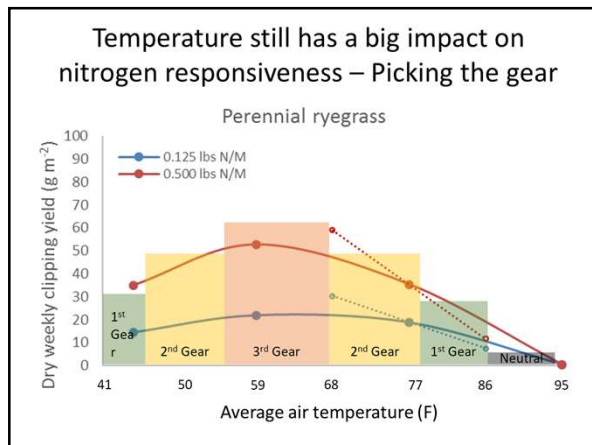
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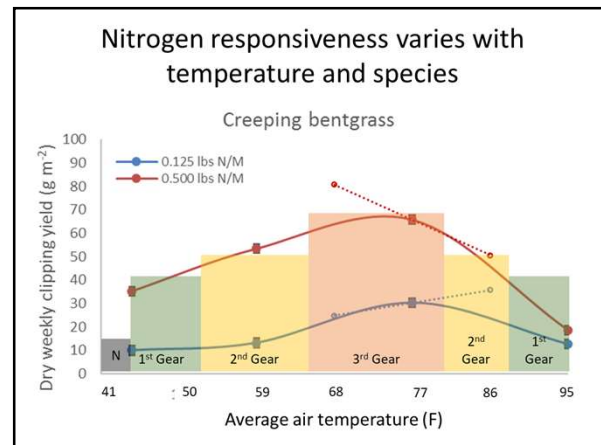
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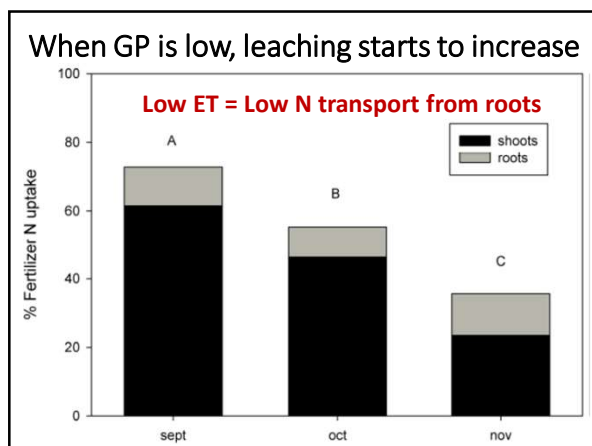
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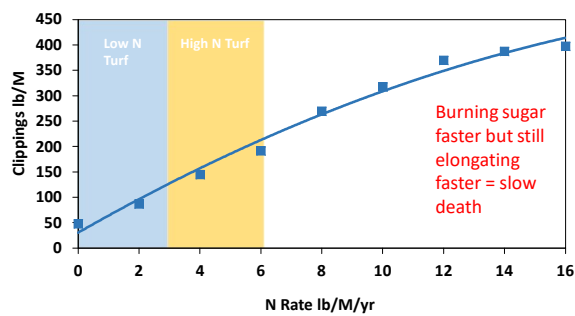


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Nitrogen Drives Growth Rate via Leaf Elongation – GA Production



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In-season Nitrogen Management

- Soluble fertilizer sources
 - Flexible application rate
 - Frequent applications
- Know that response will vary with temp and environment
 - Light needed to turn nitrogen into protein
- When temps are out of ideal range the risk of nutrient loss increases



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Precision Nitrogen Management

- Data capture and management – Clipping Volume



Spectrum.com

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Mounting a crop sensor to a mower to estimate N and water status



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2 Month Time Series



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Or mount a sensor to a Segway to estimate N and water status



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Or mount a sensor to a Segway to estimate N and water status



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Managing with the reflectance data

Normalized Difference Red Edge (NDRE) is a good indicator of nitrogen status

June 6th 2018

August 15th 2018



Mapping Color | NDRE Values

Extra N	<0.35
Standard N	0.35-0.40
Zero N	>0.40

Threshold values specific to your site!
(think TDR meter and wilt points)

Other factors to consider:

- Different species/cultivars
- Thin turf from disease, traffic, compaction, etc.
- Time of day during measurement

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Differentiating stresses

- Low N vs. drought vs. traffic/disease
- Testing NDRE over different N and water treatments
- Measuring reflectance from the sensor vs. measured plant chlorophyll
- Research on-going!



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How do we manage turf growth rate?



Accelerator Pedal

Brake Pedal

Clutch/Gear

PGR Rate

Nitrogen Availability

- Fertilizer
- Water
- Soil mineralization

Environmental Factors (GP)

- Temperature
- Light quality & quantity
- Soil nutrient levels
- Mowing practices
- Soil water and oxygen
- Other factors

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PGR application rate, air temperature, and mowing program impact PGR performance

- PGR Duration: Air temperature (GDD) and mowing practices

- PGR Intensity: Application rate*

*Applications that are more frequent than ideal will increase amount of suppression

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Comparing PGR Performance on cool-season greens

Active Ingredient	Common Name	Growth Suppression	Duration of Effect	Ideal GDD
Trinexapac-ethyl	Primo Maxx	20%	800 GDD	230 GDD
Pacllobutrazol	Trimmit	30-50%*	850-950 GDD*	280-310 GDD*
Flurprimidol	Cutless	20-30%*	600-800 GDD*	210-270 GDD*
Prohexadione-Ca	Anuew	25%	840 GDD	280 GDD
Flurprimidol + Trinexapac-ethyl	Legacy	20-35%*	810-910 GDD*	270-300 GDD*
Flurprimidol + Paclobutrazol + Trinexapac-ethyl	Musketeer	25-40%*	880 GDD	290 GDD

* Range from low to high application rate

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Fairways and rough are much more sensitive to PGRs than greens



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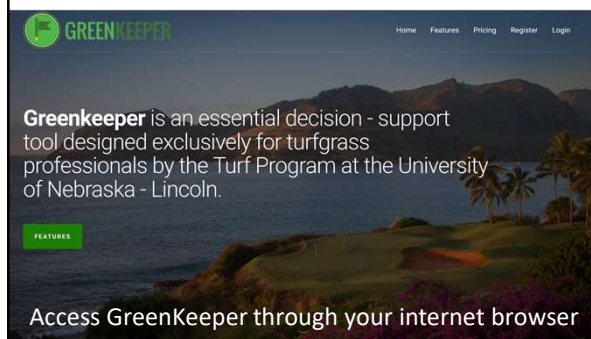
Bentgrass Fairway Models: Much longer intervals and more suppression than greens

Active Ingredient	Common Name	Growth Suppression	Ideal GDD
Trinexapac-ethyl	Primo Maxx	55-80%	350-380
Paclobutrazol	Trimmit	70-80%	480-640
Flurprimidol	Cutless	30-40%	380-410
Prohexadione-Ca	Anuew	60-75%	350-380
Flurprimidol + Trinexapac-ethyl	Legacy	40-70%	320-390
Flurprimidol + Paclobutrazol + Trinexapac-ethyl	Musketeer	55-70%	350-400

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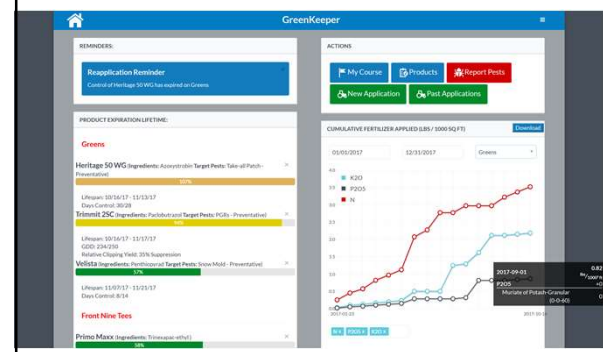
GreenKeeperApp.com

Decision-support tool to guide turf agronomics



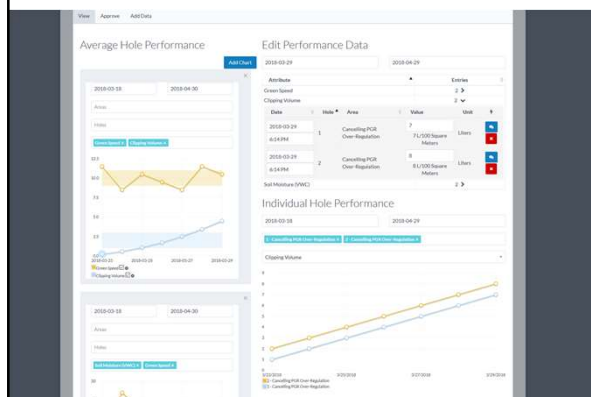
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GreenKeeper Homepage



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Performance Tracker for Course Data



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How do we manage turf growth rate?



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