

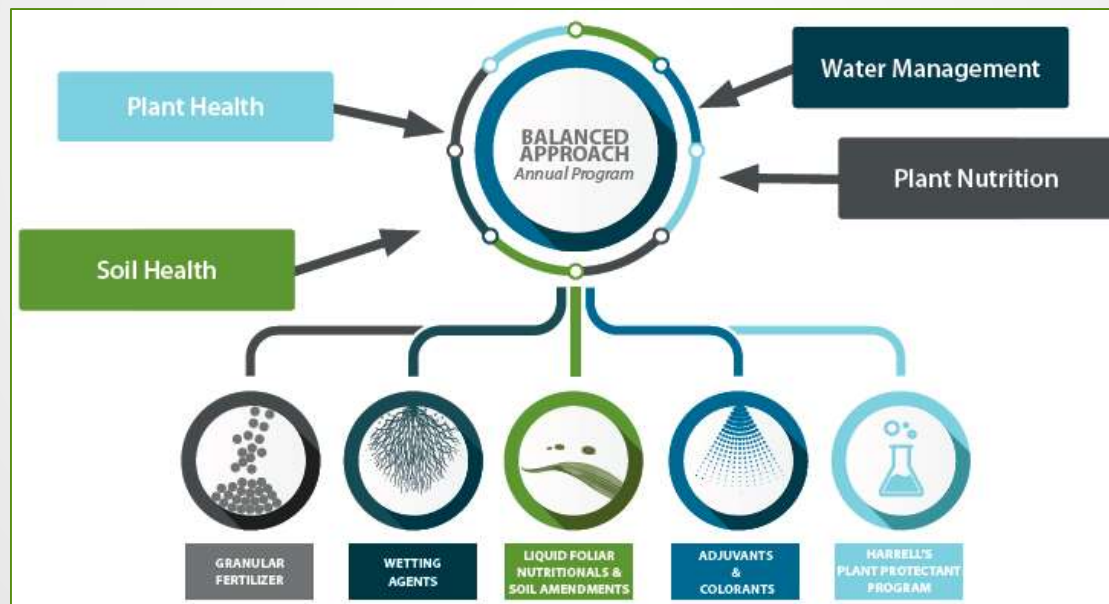
Balanced Approach Agronomic Management for Enhancing Plant Function

Jason Frank
Regional Director – FL
Harrell's LLC



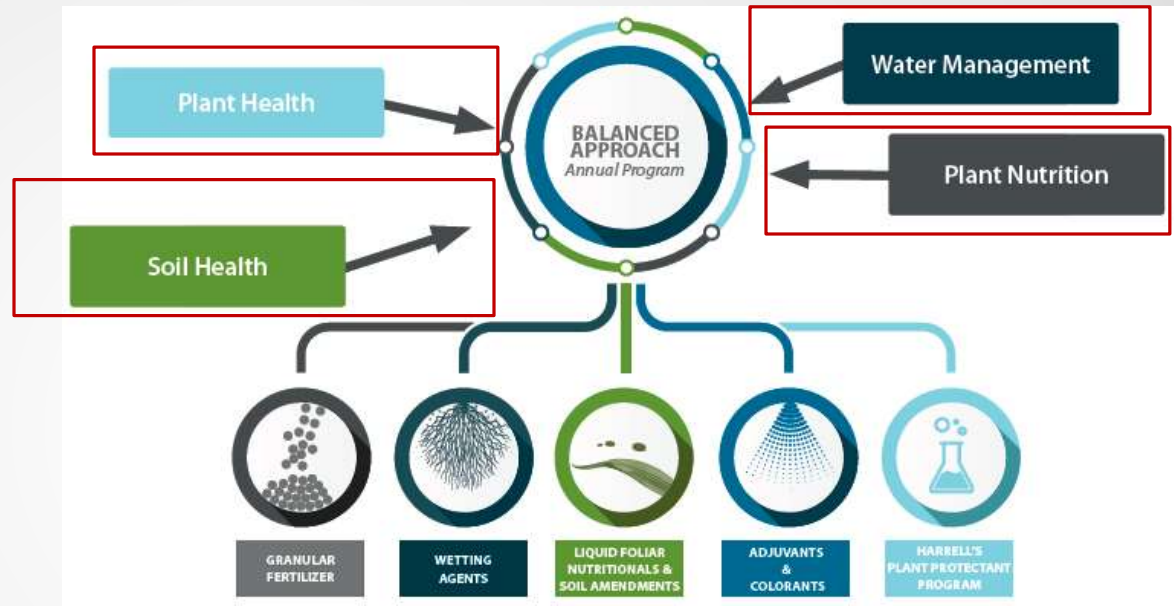
Harrell's Balanced Approach Concept

Scientifically supported, integrated and proactive utilization of agronomic resources for maximizing plant health and consistency during the growing season.



Agronomic Factors

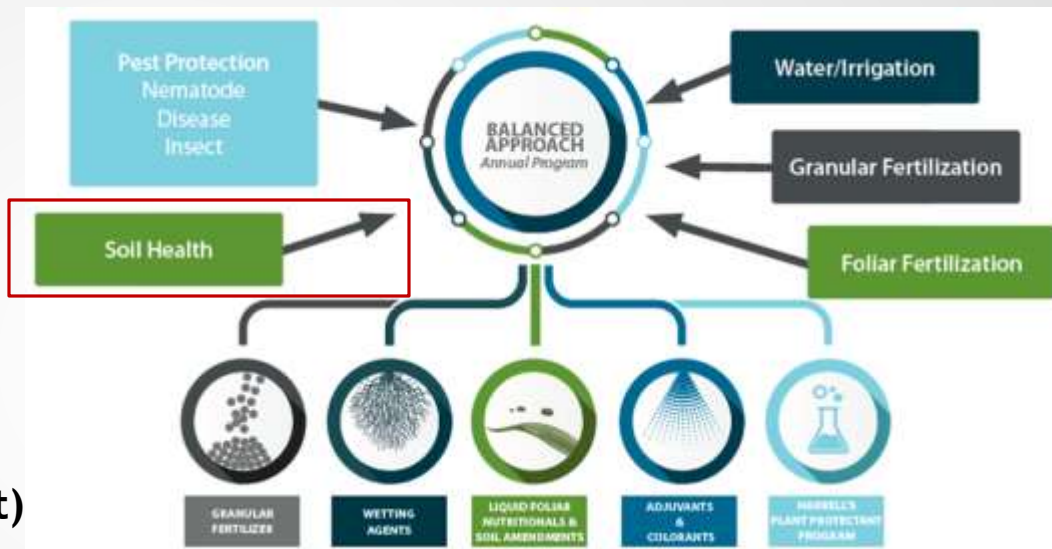
- **Soil Health**
 - pH
 - Nutrients
 - CEC
 - Salts
 - Bicarbonates
 - Organic matter management
- **Water Quality/Management**
 - pH
 - Sodium
 - Bicarbonates
 - Infiltration and distribution
 - Moisture management
- **Plant Nutrition**
 - Foliar inputs
 - Granular inputs
- **Plant Protection**
 - Plant health
 - Proactive fungicide program
 - Plant stress management
 - Nematodes
 - Assays
 - Management strategies
 - Insects
 - IPM
 - Proactive pest program



Agronomic Factors-Soil Health

- **Soil Health**

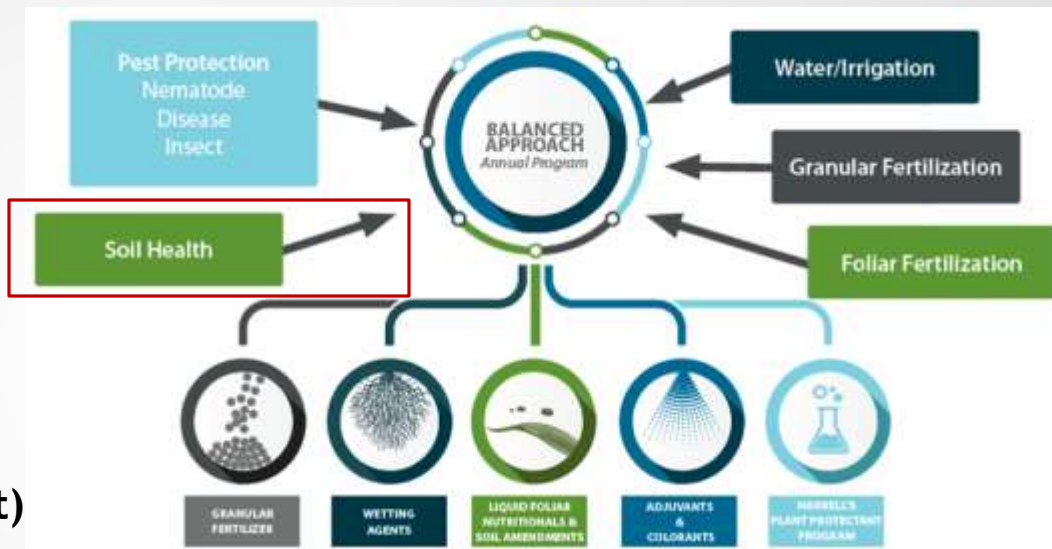
- pH
 - 5-5 - 6.5
- Nutrients
 - K, P, Ca, Mg, Fe, and Mn
- CEC
 - Ideally 2+
- Salts
 - Sodium <20 ppm (Paste)
 - Sodium <50 ppm (Soil-Test)
 - <2000 TDS (ppm)
 - 2-4 EC (dS/m)
- Bicarbonates
 - <50
- Organic matter management
 - <3%
 - Active organic carbon
 - Active Humic/Fulvic



Agronomic Factors-Soil Health

- **Soil Health**

- pH
 - 5-5 - 6.5
- Nutrients
 - K, P, Ca, Mg, Fe, and Mn
- CEC
 - Low (0-2)
- Salts
 - Sodium <20 ppm (Paste)
 - Sodium <50 ppm (Soil-Test)
 - <2000 TDS (ppm)
 - 2-4 EC (dS/m)
- Bicarbonates
 - <50
- Organic matter management
 - <3%
 - Active organic carbon
 - Active Humic/Fulvic





Soil Health - Flushing Programs

Water Management



Soil Health

Best Program	Product	Rate	Objective
	<i>Fleet</i>	5 oz/M	Vehicle
	<i>Soil Surge</i>	64 oz/A	Carbonates/pH
	<i>Cal Plus</i>	6 oz/M	Carbonates/pH/Na

Better Program	Product	Rate	Objective
	<i>Fleet</i>	5 oz/M	Vehicle
	<i>Soil Surge</i>	32 oz/A	Carbonates/pH
	<i>Cal Plus</i>	3 oz/M	Carbonates/pH/Na

Good Program	Product	Rate	Objective
	<i>Fleet</i>	5 oz/M	Vehicle
	<i>Soil Surge</i>	64 oz/A	Carbonates/pH
	<i>Salt Rx</i>	2 oz/M	Na Removal



Soil Health

Soil Health Organic Extracts





EarthMax

NON-PLANT FOOD INGREDIENTS

Derived From: Compost Extract

This product contains

4.2% Humic acid

6% Fulvic acid

28% Carbon

EarthMax also contains beneficial soil biology:

Multiple Strains of: Bacillus, Pseudomonas, and endo/ecto-mycorrhizal fungal spores



University of Florida

IFAS - Soil and Water Science Department
Microbiology Laboratory - Extension Service

NUMBER: SWS 2016- P190
DATE: JANUARY 12, 2017

FROM: ABID AL AGELY
2181 McCarty Hall A,
Gainesville, FL 32611-0290
Phone (352) 392 294 3144, Fax (352) 392 3399
aaag2@ufl.edu

TO: Raymond Snyder
Harrell's Growing Better Word
909 Lake Hollingsworth Dr
Lakeland, FL 33803

QTY	SAMPLE	FUNGI - CFU / 1 ML	BACTERIA - CFU / 1 ML
1	EarthMax - Foliar & Soil Additive	1.2 X 10 ⁵	4.9 x10 ⁷

Comments: Three replicates each five-ml subsample were used to create dilution of 10⁻³, 10⁻⁴, 10⁻⁵ for the fungi CFU test and 10⁻³, 10⁻⁴, 10⁻⁵ for the bacteria CFU test. Control for each test was assigned to check the background contamination. After one-week incubation at 26 °C, the result was 1.2 x10⁵ fungi CFU and 4.9 x 10⁷ CFU bacteria per one ml solution of EarthMax – Foliar & Soil Additive.

Please let us know if you have question or follow up request.

SAMPLES ANALYZED BY
ABID AL AGELY

SIGNATURE
abid

DATE
January 12, 2017

THANK YOU FOR CHOOSING BIOLOGICAL SERVICES

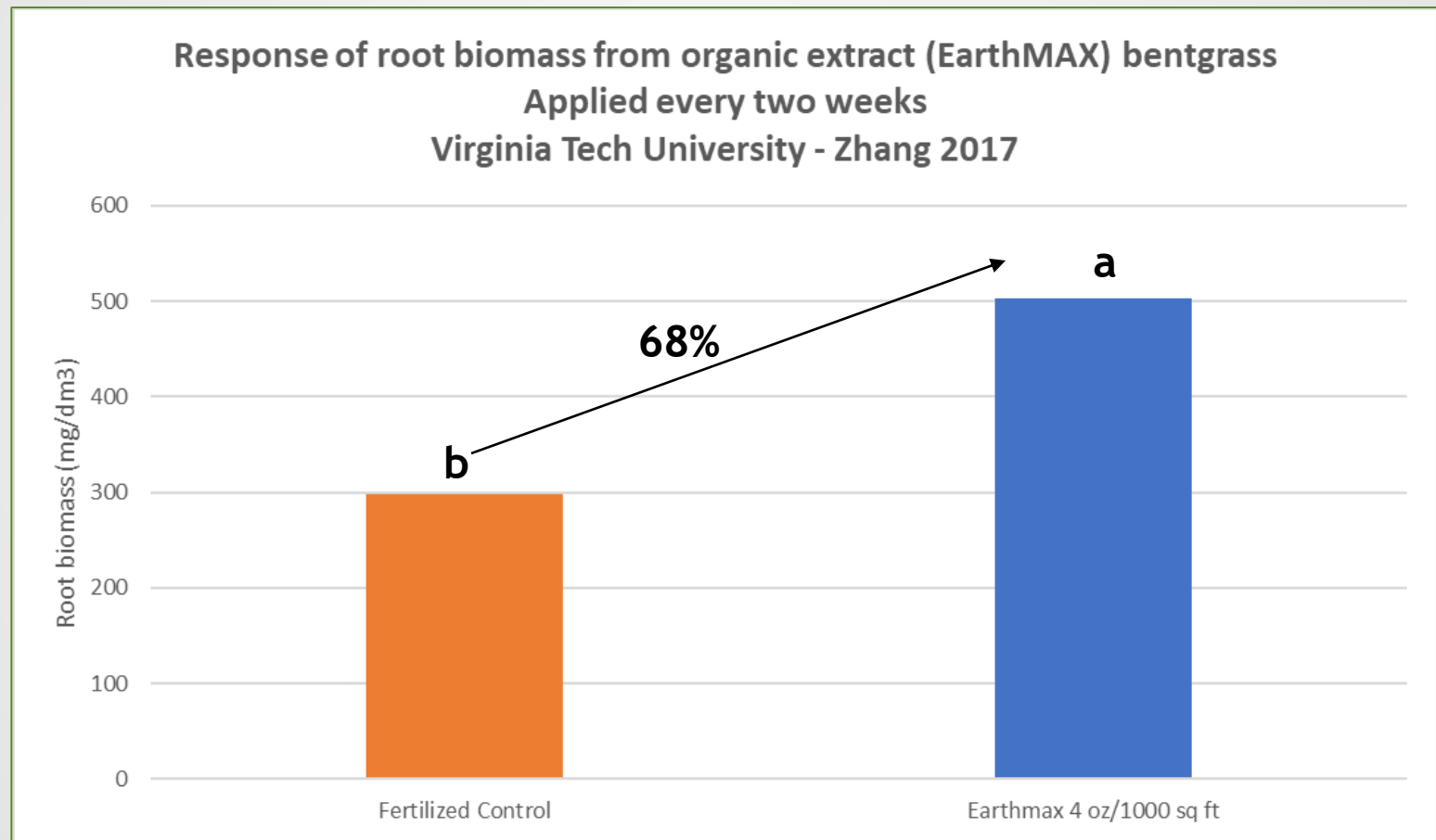
EarthMax

Fungi = $1.2 \times 10^5 = 120,000$ CFU's

Bacteria = $4.9 \times 10^7 = 49,000,000$ CFU's



EarthMAX – Virginia Tech 2017



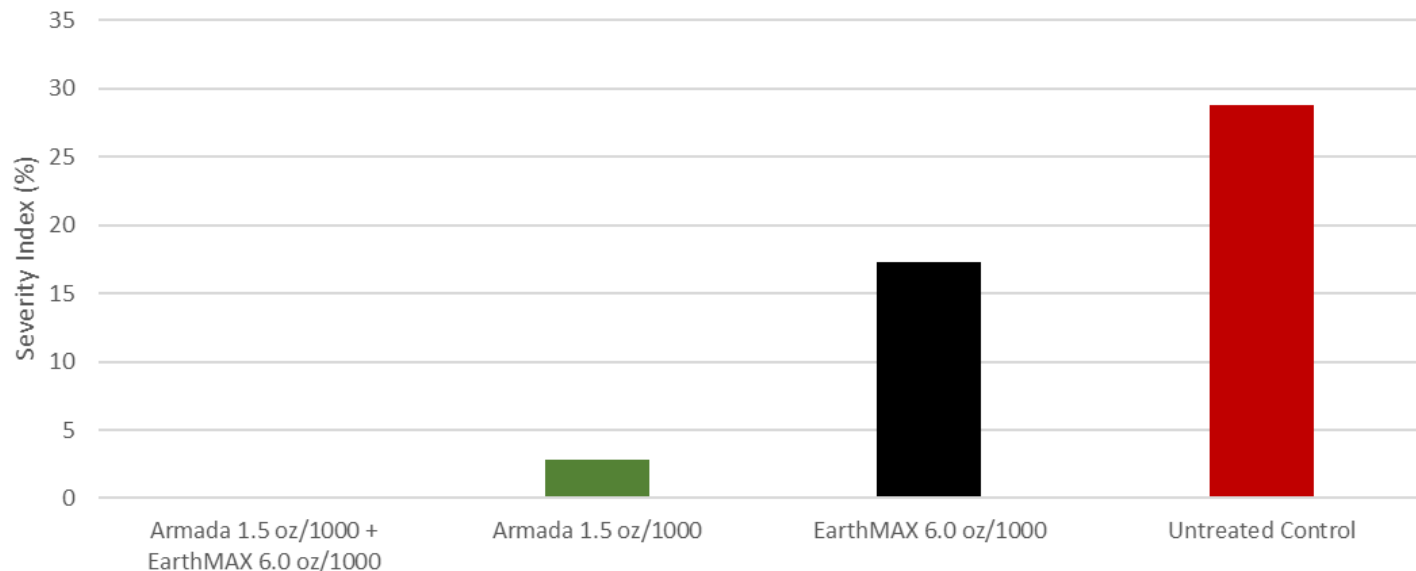
EarthMAX with Fungicides????

Effect of Harrell's EarthMAX* combined with Armada
on disease severity (brown patch) tall fescue

NCSU - Kerns

26 days after application

Summer 2017



*EarthMAX is an organic extract from humus applied as a foliar or soil additive to promote (or enhance) plant health. EarthMAX is not a pesticide and no pesticidal claims or properties are expressed or implied by its use in this study.

Agronomic Factors

Irrigation Water Quality

Water Management

Water Quality Affects:

1. Availability of nutrients
 - Fe
 - Mn
2. Infiltration of applied irrigation water
 - formation of Ca-Bicarbonate precipitates
3. Efficacy of applied products
 - Liquid fertilizers
 - Plant protectants



Agronomic Factors

Water Management

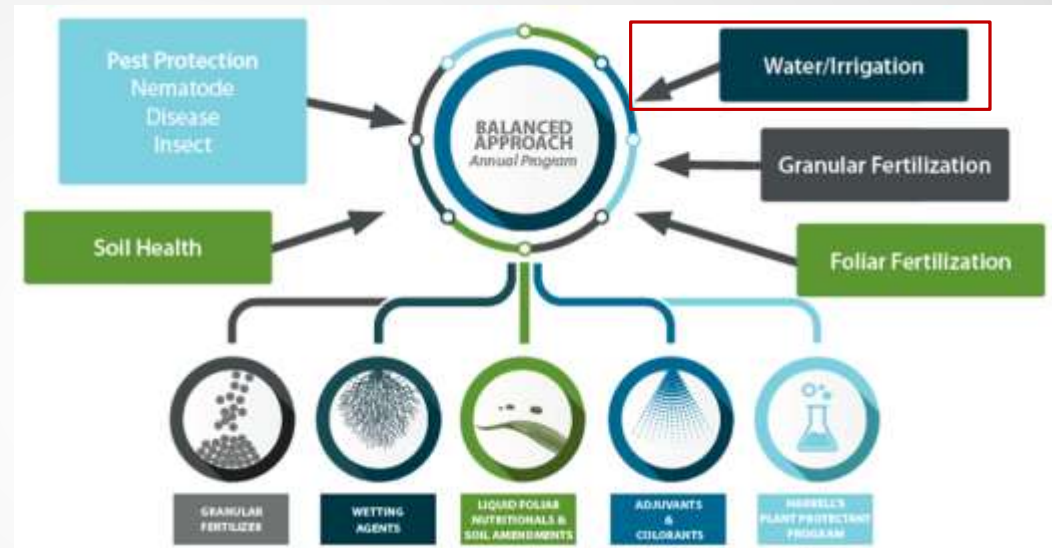
- **Water Quality**

- Ideal Values

- pH
 - 5.5-7
 - Sodium/TDS/EC
 - <200 Na
 - <150 TDS
 - <0.25 EC
 - Bicarbonates
 - ≤ 120

- **Water Management**

- Infiltration and distribution
 - Fleet
 - Moisture management
 - Symphony



Agronomic Factors

Water Management

Irrigation Water Quality

Desirable Irrigation Quality

pH - 5.5 - 7.0

Bicarbonates - 0-120 ppm

Sodium - <70 ppm

Use the tables on this page to assess the impact of irrigation water on plant quality

Table 1. Total quality factor classification guidelines for variable quality irrigation water based on Electrical Conductivity (EC) and Total Dissolved Solids (TDS)			
Variable Factor Class	EC (dS/m)	TDS (mg/L)	Desired Impact & Management Requirements
Low	<0.75	<100	Low salinity hazard. No management
Medium	0.75-1.50	100-1,000	Stress to plants is rare with regular or plant. Groundwater leaching is present with occasional salt. No management
High	1.5-3.0	1,000-2,000	Stress to plants with low response to salinity will likely occur. Apply stress response for leaching and no periodic use of low-salt water
Very High	>3.0	>2,000	Stress to plants with high response to salinity will occur. Use salt-tolerant plants. Use salt-tolerant plants. Use salt-tolerant plants. Use salt-tolerant plants.

Table 2. Soil tolerance of selected crop plants			
Soil Salinity Class	EC (dS/m)	Soil Salinity Class	EC (dS/m)
Low	<0.75	Medium	0.75-1.50
Medium	0.75-1.50	High	1.5-3.0
High	1.5-3.0	Very High	>3.0

Table 3. Specific ions in irrigation water			
Ion	Concentration (mg/L)	Ion	Concentration (mg/L)
Calcium	<100	Magnesium	<100
Sulfate	<100	Chloride	<100
Sodium	<100	Bicarbonate	<100

Table 4. Nutrient guidelines in irrigation water			
Nutrient	Concentration (mg/L)	Nutrient	Concentration (mg/L)
Nitrogen	<10	Phosphorus	<10
Potassium	<10	Sulfur	<10
Calcium	<10	Magnesium	<10

Table 5. Nutrient values in irrigation water			
Nutrient	Concentration (mg/L)	Nutrient	Concentration (mg/L)
Nitrogen	<10	Phosphorus	<10
Potassium	<10	Sulfur	<10
Calcium	<10	Magnesium	<10

TDS						
<150 Low						
150-500 Medium						
500-1500 High						
pH						
Desireable Range 5.5 to 7.0						
HCO3 (Bicarbonates)	EC (electroconductivity)		RSC (Residual Sodium Carbonate)		SAR (Sodium Adsorbtion Ratio)	
	<0.25	Low	<1.25	Generally safe for irrig.	0-10	Little Danger
	0.25-0.75	Medium	1.25 -2.5	Marginal	10-18	Possible Problems
	0.75-2.25	High	>2.5	Usually Unsuitable	18-24	Likely Problems
	>2.25	Very High			>24	Unsatisfactory
0-120	Low					
120-180	Moderate					
180-600	Severe					
>600	Very Severe					
Ca,Mg & Na reported as ppm			Respectfully Submitted,			
			Dennis Moseley			

Irrigation Water Quality



Water Management

Proactive



Reactive

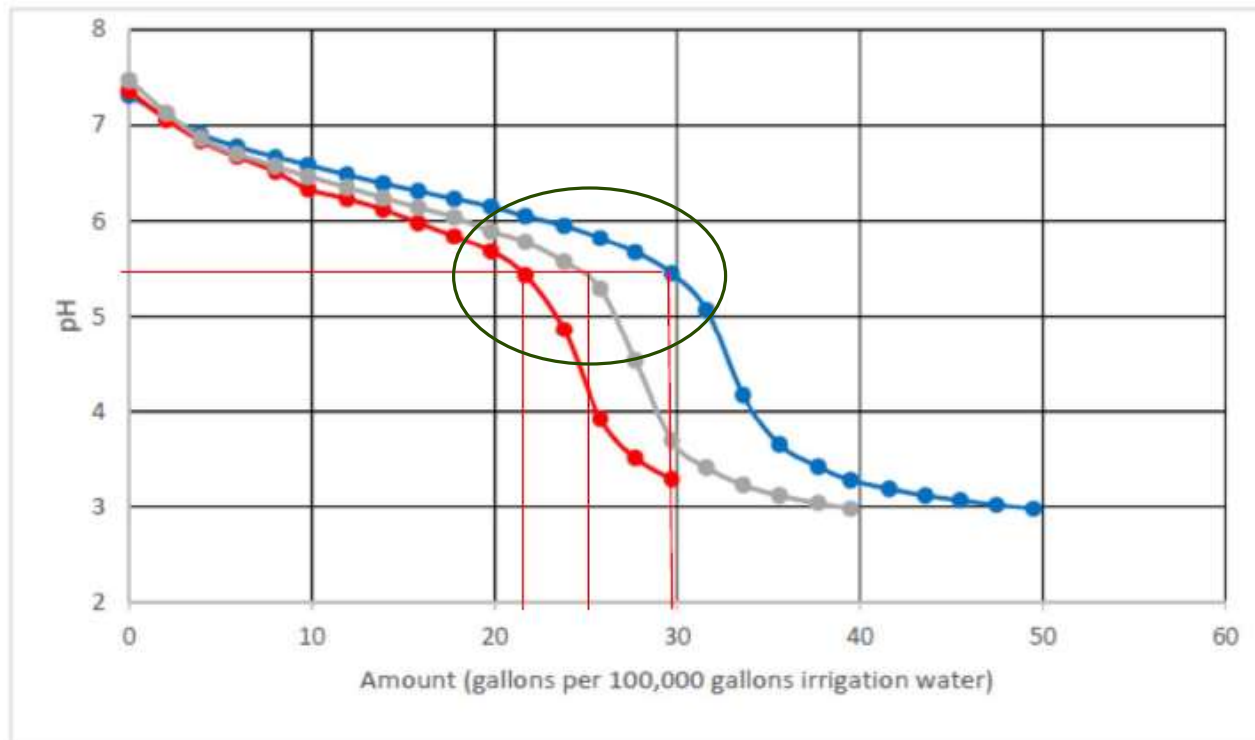


Irrigation Water Quality

Water Management

pH Adjustment of effluent irrigation water from the Red/Gold, Silver, and Blue Golf Courses at Trump Doral (Miami) with Hocking Neutralizer 15-0-0 Sample # HA14237001

June 16, 2015



Graphical representation of the pH resulting from addition of Neutralizer (gallons Neutralizer per 100,000 gallons irrigation water for the (left to right) Red/Gold, Silver, and Blue courses.

Agronomic Factors

Water Management

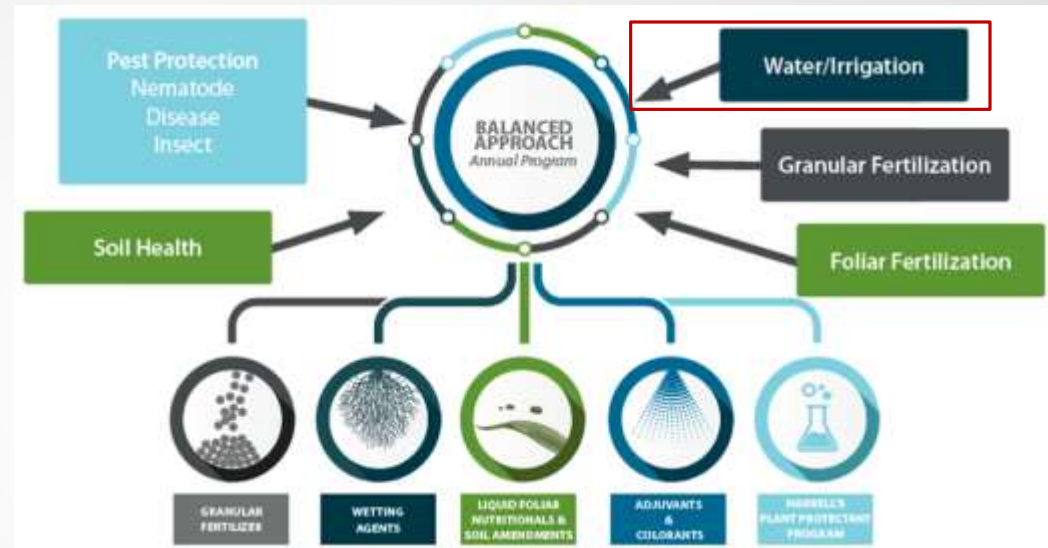
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- **Water Management**

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 - Fleet
 - Moisture management
 - Symphony

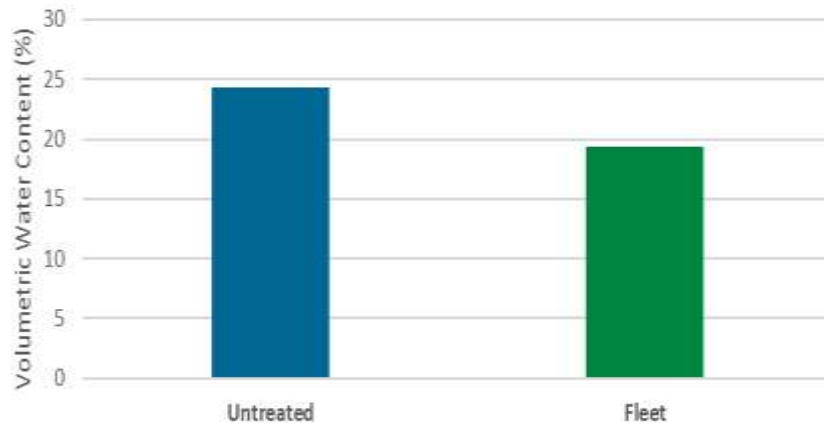




Water Management

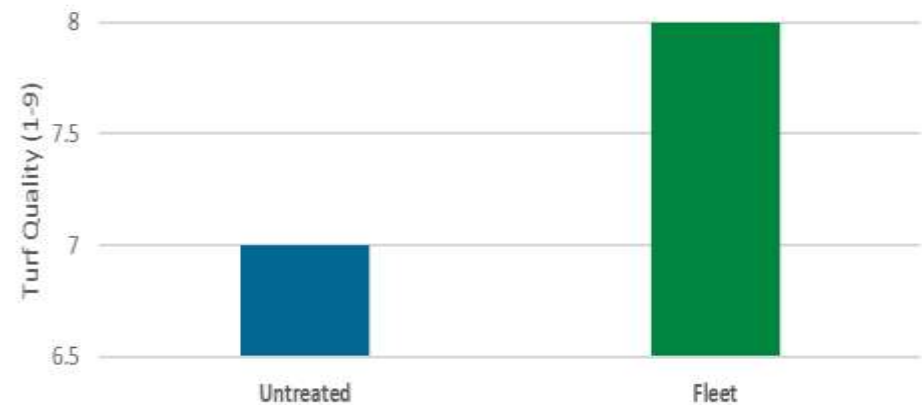
Water Management

Effect of Fleet on volumetric water content
Application rate 5 oz/1000 sq ft
14 days after application
Broward County, FL
Dr. Cisar - Summer 2017



11-Jul-17

Effect of Fleet on ultradwarf turf quality
Application rate 5 oz/1000 sq ft
30 days after application
Broward County, FL
Dr. Cisar - Summer 2017



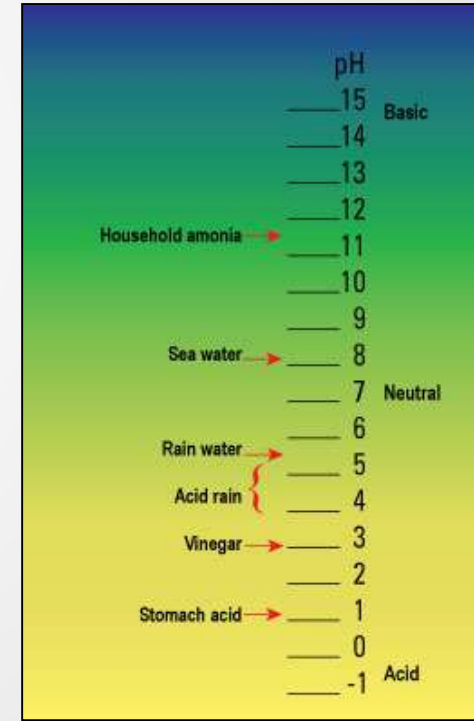
27-Jul-17

***Reduce volumetric water content - Increase soil oxygen**

Rainfall Natures Best!

- pH below 7 - approx.- 5.5
- Low presence of bicarbonates
- Contains a component of N - NH_4

Water Management

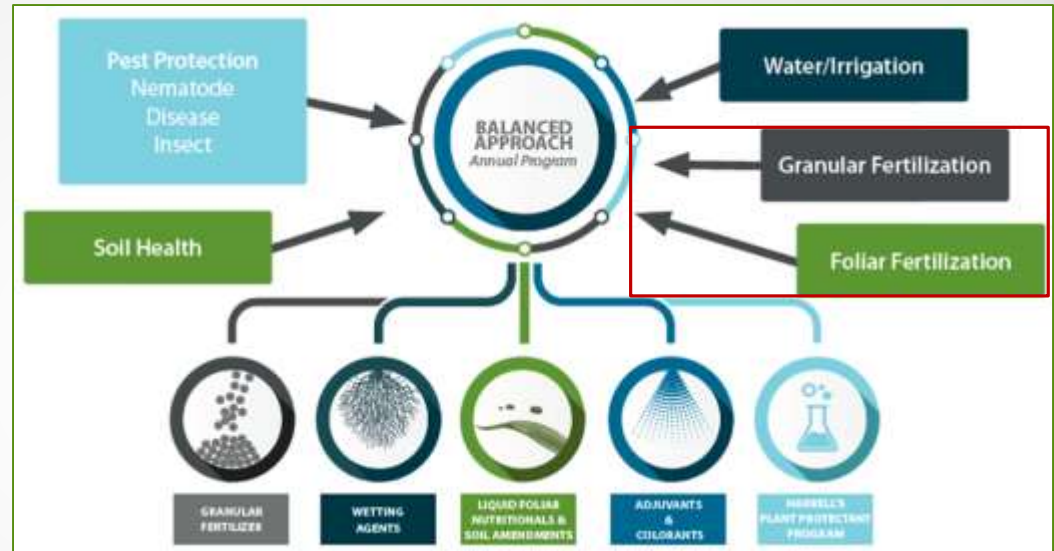


Agronomic Factors

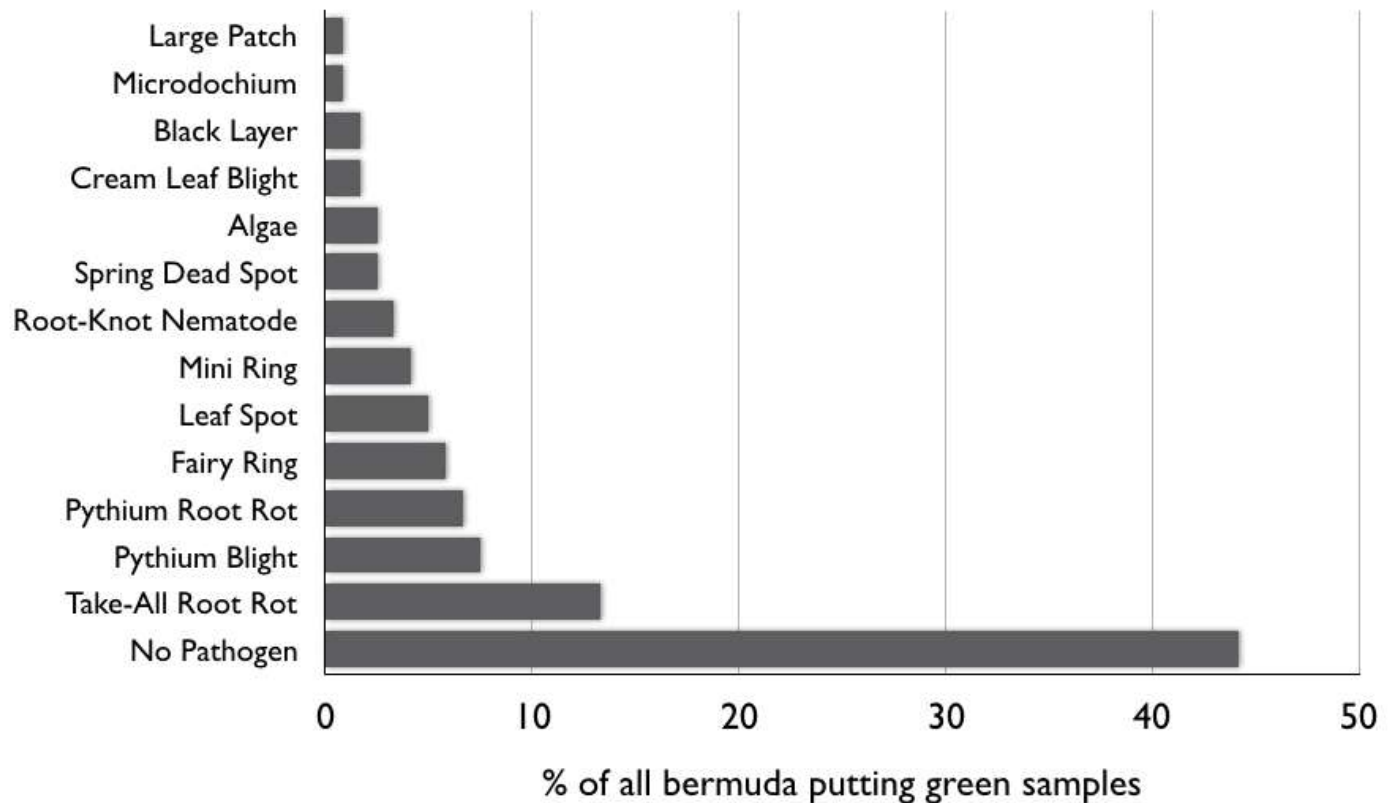
Plant Nutrition

- **Plant Nutrition**

- Foliar inputs
 - 50-75 %
 - N, P, K, Fe, and Mn
 - Protect/Chelated
 - Max foliar absorption
- Granular inputs
 - 25-50%
 - N, P, K, Fe, and Mn
 - Standard nutrient sources
 - Organic nutrient sources
 - Polyon K 0-0-50

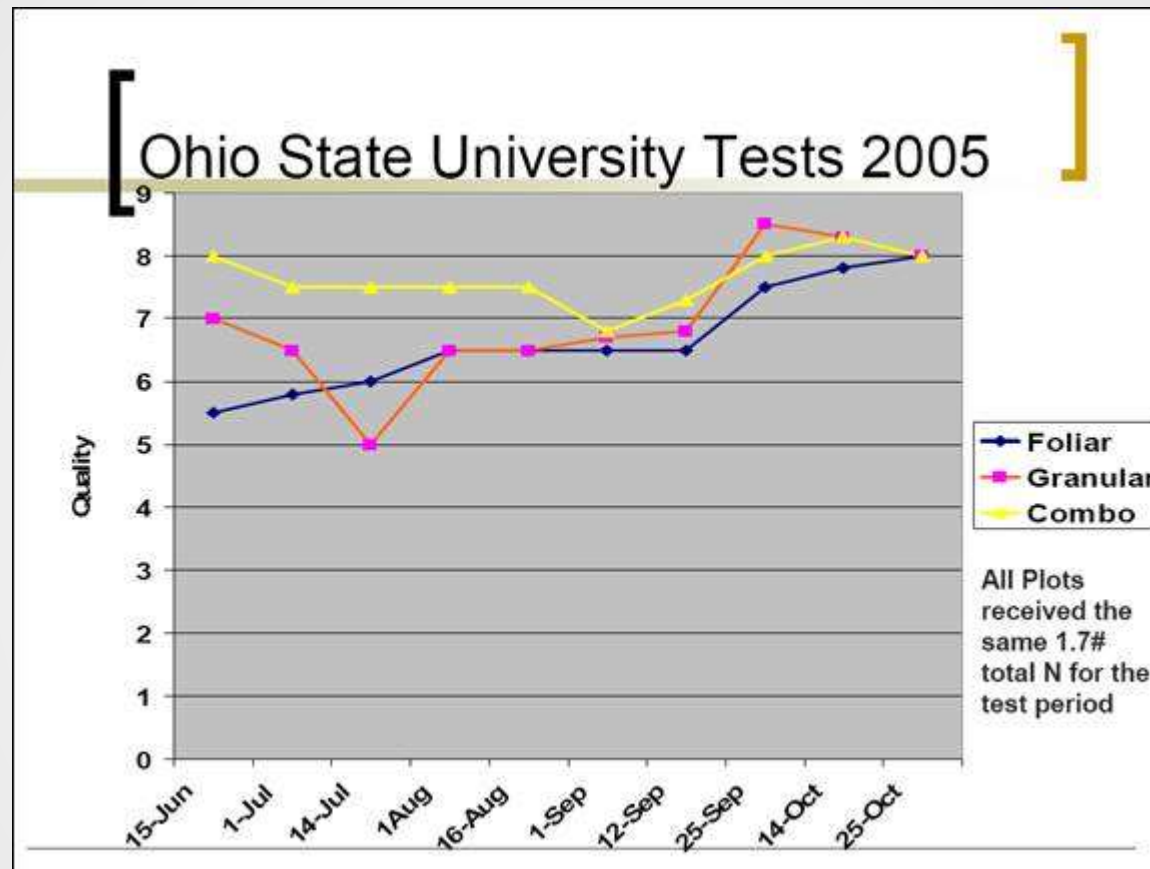


2018 Bermuda Putting Green Diagnoses



Plant Nutrition

Plant Nutrition



Totten, F.W., H. Liu, L.B. McCarty, and C.M. Baldwin. 2005b. Comparison of granular and liquid fertility on "TifEagle" bermudagrass. *Agronomy Abstracts*.



Product	Lbs./ Gal.	Suggested Rate (oz/1,000)	App. Rate Jugs/Tank	App. Rate (oz./1,000)	App. Rate (Gal/A)	N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Si
						Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Sulfur	Iron	Manganese	Zinc	Copper	Boron	Silica
Harrell's BioMAX 4-0-0 Biostimulant with Fe, Mn, SWE, and Fulvic Acid	10.34	3-6	0.00	0.00	0.00	0.0000	-	-	-	-	0.0000	0.0000	0.0000	-	-	-	-
Harrell's BioMAX 7-7-7 with Phosphate, Micros, SWE, and Fulvic Acid	10.68	3-6	0.50	2.00	0.68	0.0117	0.0117	0.0117	-	0.0003	-	0.0017	0.0001	0.0001	-	-	-
Harrell's BioMAX 12-0-6 with UMAXX with Fe, Mn, SWE, and Fulvic Acid	10.70	3-10	0.00	0.00	0.00	0.0000	-	0.0000	-	-	-	0.0000	0.0000	-	-	-	-
Harrell's Amino Pro V, 5-0-0, with 18 key plant-based amino acids in peptide form	9.84	1-4	0.00	0.00	0.00	0.0000	-	-	-	-	-	-	-	-	-	-	-
Harrell's MAX N30 Plus with UMAXX and SWE	10.68	4-12	0.00	0.00	0.00	0.0000	-	-	-	-	-	-	-	-	-	-	-
Harrell's MAX Nitrate Plus 6-0-0, 2% Mg 2% Fe 5% Mn	11.51	3-6	0.00	0.00	0.00	0.0000	-	-	-	0.0000	-	0.0000	0.0000	0.0000	-	-	-
Harrell's MAX 18-3-6 with UMAXX	10.30	3-7	1.00	4.00	1.36	0.0579	0.0097	0.0193	-	-	-	0.0003	-	-	-	-	-
Harrell's MAX Long Iron 15-0-0, 6% Fe with UMAXX	10.93	3-12	0.00	0.00	0.00	0.0000	-	-	-	-	0.0000	0.0000	-	-	-	-	-
Harrell's MAX 12-0-0, 6% Fe, 3% Mn with UMAXX	11.76	3-10	0.50	2.00	0.68	0.0221	-	-	-	2.00	0.0074	0.0110	0.0055	-	-	-	-
Harrell's MAX 12-0-12 with UMAXX and Potassium Acetate	10.18	3-10	0.00	0.00	0.00	0.0000	-	0.0000	-	-	-	-	-	-	-	-	-
Harrell's Title Phyte 0-0-30	13.34	2-4	0.50	2.00	0.68	-	-	0.0625	-	-	-	-	-	-	-	-	-
Harrell's MAX Potassium Silicate 0-2-12, 4.37% SiO ₂ , 2.33% Si	9.84	3-6	0.00	0.00	0.00	-	0.0000	0.0000	-	-	-	-	-	-	-	-	0.0000
Harrell's MAX Cal Plus 3-0-0, 10% Ca, 1% Mg, 3% B, 49% acid	11.20	2-4	0.00	0.00	0.00	0.0000	-	-	0.0000	0.0000	-	-	-	-	-	0.0000	-
Harrell's MAX Minors	10.34	3-6	0.00	0.00	0.00	-	-	-	-	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-
Harrell's MAX Non Staining Minors	11.00	3-6	0.00	0.00	0.00	-	-	-	-	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-
Harrell's BioMAX Root Enhancer 4% Fulvic Acid, 5% Fe	10.26	3-6	0.00	0.00	0.00	-	-	-	-	-	-	0.0000	-	-	-	-	-
Harrell's BioMAX SWE Seaplant Extract and Fulvic Acid	8.65	1-6	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-
Harrell's MAX Calcium 6-0-0, 8.25% Chelated Ca	11.22	3-6	0.00	0.00	0.00	0.0000	-	-	0.0000	-	-	-	-	-	-	-	-
Harrell's MAX with Fulvic Acid and Biologically Active 22% Carbon	8.40	3-6	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-
Harrell's MAX 0-0-5, 45% Organic Acid	10.10	1-4	0.00	0.00	0.00	-	-	0.0000	-	-	-	-	-	-	-	-	-
Harrell's MAX Phosphorous Plus 3-30-3	11.18	3-6	0.00	0.00	0.00	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-
Harrell's MAX Stress Release 0-0-25 with Potassium Acetate	10.68	3-6	0.00	0.00	0.00	-	-	0.0000	-	-	-	-	-	-	-	-	-
Harrell's MAX Potassium Plus Ca 4-0-8, 2.15% Ca with 1% Fulvic Acid	10.09	3-6	0.50	2.00	0.68	0.0063	-	0.0126	0.0034	-	-	-	-	-	-	-	-

N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B
0.0980	0.0213	0.1061	0.0034	0.0038	0.0274	0.0235	0.0196	0.0001	0.0000	0.0000

Enter products to achieve your desired amount of nutrients for your turf and your desired ratio of N:P:K.
Do not exceed .125 lbs of K per 1,000 sf.

Make sure that Fe and Mn are sufficient for superior color (>.015 lbs per 1,000 sf each)

Add products with Fe and Mn until red color goes away to ensure optimal color response. DO NOT EXCEED .025 lbs of Fe ON COOL SEASON TURF.

Total Nutrient Inputs per Season	1.7636	0.3841	1.9105	0.0610	0.0676	0.4933	0.4226	0.3527	0.0024	0.0000	0.0000
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Agronomic Factors

Plant Health

- **Plant Protection**

- Plant health

- **Proactive fungicide program**

- Fairy ring, leaf spot, pythium, Rhizoc, etc..

- **Plant stress management**

- Title Phyte
 - Fulvic Acid
 - Seaweed Extract
 - Organic Extract
 - Microbes

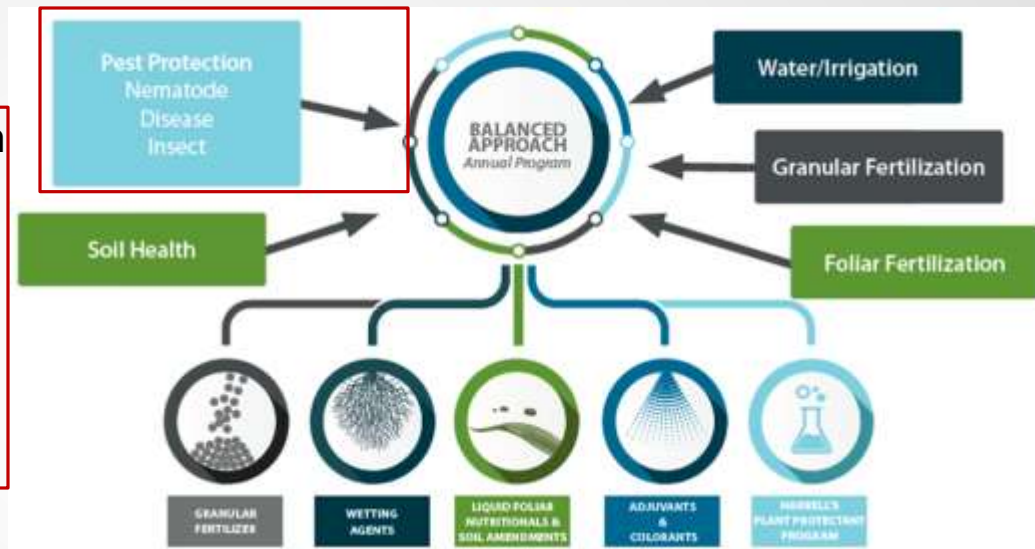
- **Nematodes**

- Assays

- Composite
 - Spot target

- **Management strategies**

- Control-Indemnify
 - Control/Suppress-Divanem
 - Suppress/Irritate-EarthMAX
 - University Studies (UF)



Proactive Fungicide Program

Pathogen Targets

- Fairy Ring
- Leaf Spot
- Pythium
- Microdochium
- Mini ring
- Other patches
- Decline

Annual UltraDwarf Fungicide & Plant Health Program

	Application 1	Application 2	Application 3	Application 4
January	Daconil or Secure Title Phyto** PAR* SG	Interface	Foie Subdue MAXX	Heritage Action Title Phyto**
February	Tartan	Daconil Signature	Title Phyto** PAR* SG	Daconil or Secure Heritage Action
March	Title Phyto** PAR* SG Tartan	Daconil Signature	Prostar	Title Phyto** PAR* SG
April	Lexicon	Daconil Velista	Mirage	Foie Subdue MAXX
May	Daconil Signature	Title Phyto** PAR* SG	Prostar	Honor
June	Daconil or Secure	Honor	Daconil Signature	Title Phyto** PAR* SG
July	Honor	Daconil or Secure Signature	Title Phyto** PAR* SG	Foie Subdue MAXX
August	Madalton	Daconil Velista	Title Phyto** PAR* SG	Bristaway
September	Title Phyto** PAR* SG	Mirage	Daconil or Secure Signature	Lexicon
October	Title Phyto** PAR* SG	Mirage	Daconil Signature	Foie Subdue MAXX
November	Title Phyto** PAR* SG Lexicon	Interface	Daconil or Secure Signature	Title Phyto** PAR* SG
December	Banol Fame C	Title Phyto** PAR* SG	Daconil Signature	Title Phyto** PAR* SG

Start SuperTulley Ring program first week of February and first week of March. Title Phyto** is a foliar K supplement which aids in plant health. The Harrell's products are not year older, and no parallel claim or competitive are registered or implied by their use in this program.



Title Phyte



GUARANTEED ANALYSIS

0-0-30

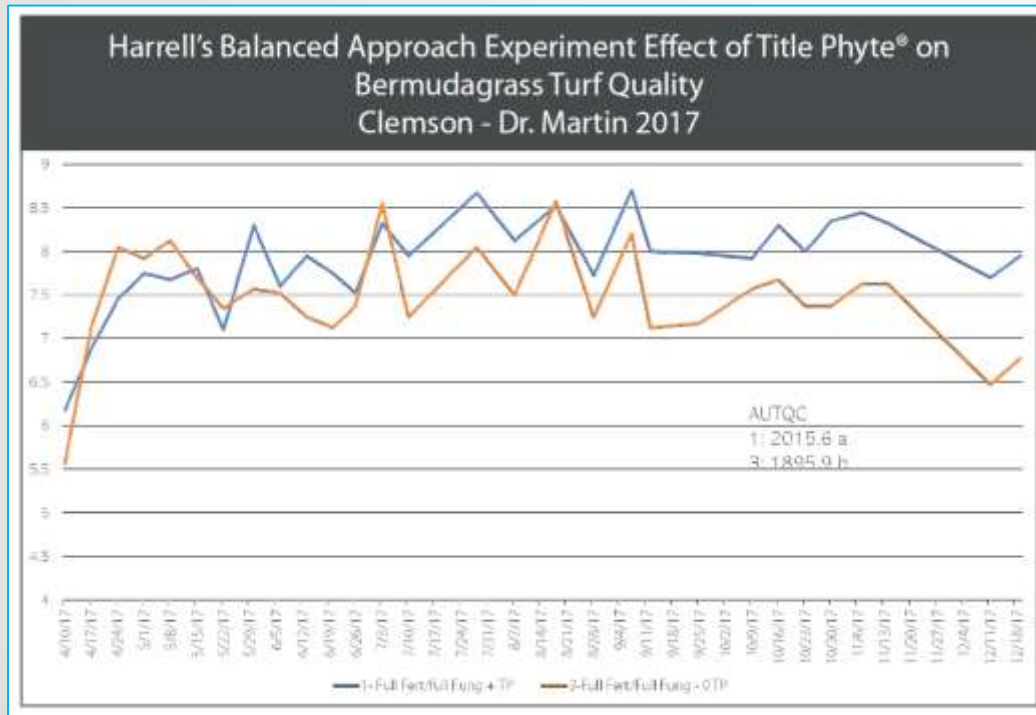
Soluble Potash (K_2O) 30.00%

Derived from: potassium phosphite

- A product obtained when phosphorus acid is neutralized with potassium hydroxide.

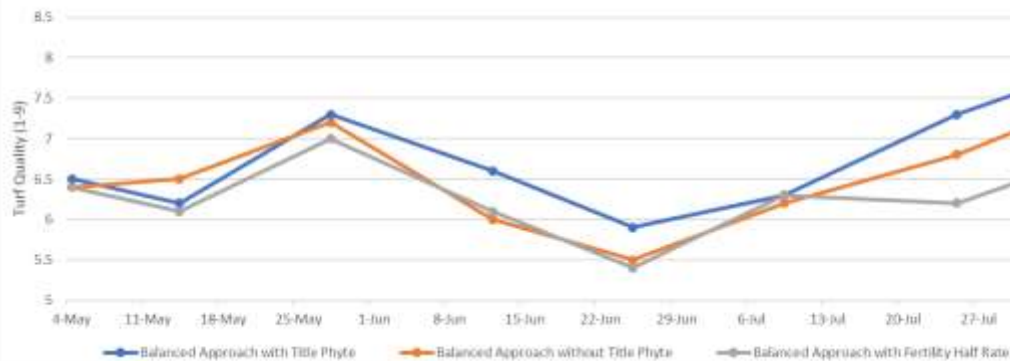
- Contains 4.77 Lbs/gallon of phosphorus acid

Balanced Approach Management Clemson Research 2017-2018



Balanced Approach Management NC State 2018 – Bentgrass

Effect of Harrell's Balanced Approach program on bentgrass turf quality
NCSU - Kerns 2018



NCSU Research Field Lab
07/17/18

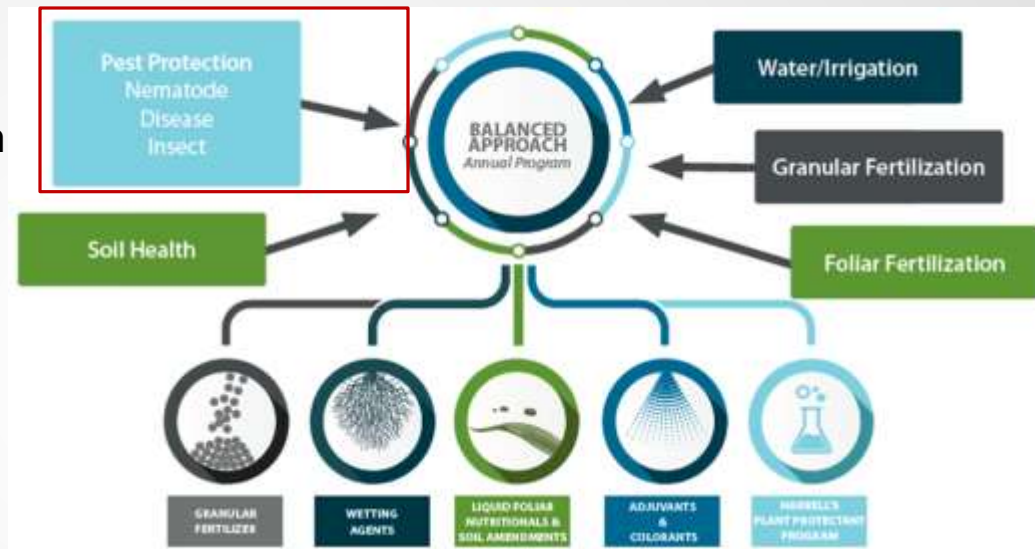


Agronomic Factors

Plant Health

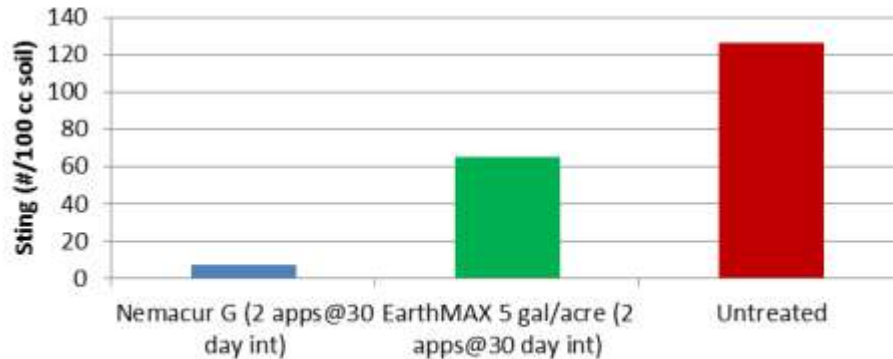
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 - Control-Indemnify
 - Control/Suppress-Divanem
 - Suppress/Irritate-EarthMAX
 - University Studies (UF)



Nematode Management

**Impact of increased organic constituents
in soil on sting nematode population**
Tequesta CC Celebration Bermudagrass Fairway
Initiated: 3-24-2015
Sample Date: 5-5-2015



Application	Month	Trt 1 Chemical	Trt 2 Chem+Soil	Trt 3 Soil	Trt 4 Control
1	Mar.	Indemnify+ Fleet	Indemnify + Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet
2	Apr.	Indemnify+ Fleet	Indemnify + Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet
3	May	Divanem + Velista + Acelepryn + Fleet	Divanem + Velista + Acelepryn + Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet
4	Jun.	Divanem + Velista + Acelepryn + Fleet	Divanem + Velista + Acelepryn + Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet
5	Jul.	Divanem + Velista + Acelepryn + Fleet	Divanem + Velista + Acelepryn + Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet
6	Aug.	Divanem + Velista + Acelepryn + Fleet	Divanem + Velista + Acelepryn + Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet
7	Sept.	Indemnify+ Fleet	Indemnify + Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet
8	Oct.	Indemnify+ Fleet	Indemnify + Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet + Earthax + Seaweed Extract + Root Enhancer	Fleet
		Product	Rate		
		Indemnify	17.1 oz/ac		
		Divanem	12 oz/ac		
		Velista	22 oz/ac		
		Acelepryn	8 oz/ac		
		Fleet (w/ Divanem)	2 gal/ac		
		Fleet (w/ Indemnify)	1 gal/ac		
		Earthmax	5 gal/ac		
		Seaweed Extract	1 gal/ac		
		Root Enhancer	1 gal/ac		

UF Nematode Research - Dr. Crow - Citra 2018



Untreated

BioStims Only

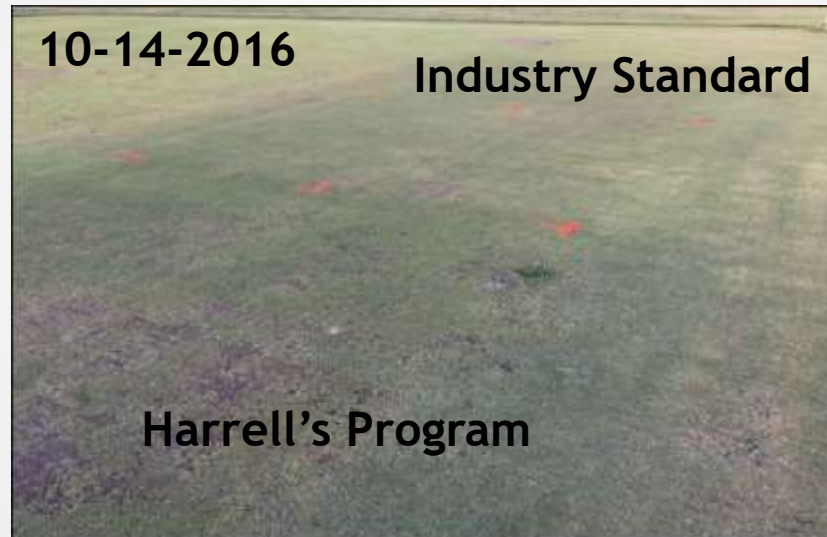


Nematicide+BioStims

Nematicide Only

All treatments included Fleet

**Harrell's Program Evaluation
University of Florida 2016-2017
Dr. Shaddox – Fort Lauderdale
10+ year old putting green
Study initiation**



Harrell's Program Evaluation

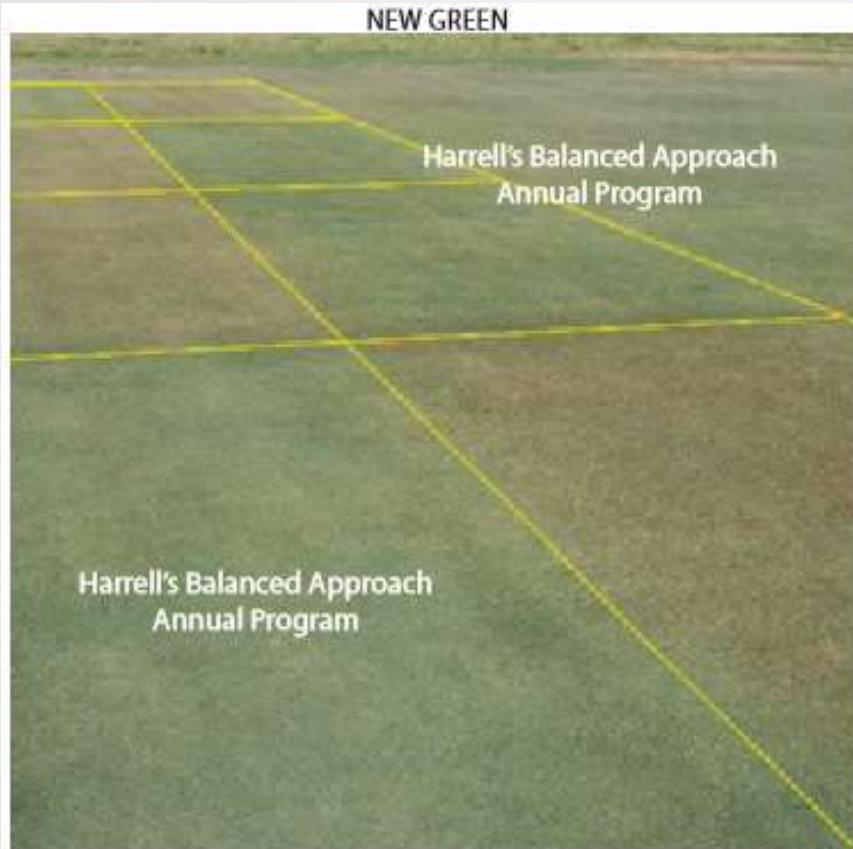
University of Florida 2016-2017

Dr. Shaddox - Fort Lauderdale



UF Research Summary

2016-2018



RESULTS	OLD GREEN	NEW GREEN	AVG.
Better Quality	12%	14%	13%
Longer Roots	16%	33%	25%
More Root Volume	23%	54%	39%
More Root Mass	59%	32%	46%

March 2018



★ Harrell's Research Locations
22 Trials

Thank You!

