SFMA SPORTS FIELD MANAGEMENT ASSOCIATION

Soil Testing Interpretation and Application

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Simplifying Soil Tests

TRAVIS SHADDOX

Who am I?

- Lawn care
- Landscape Maintenance
- Golf Course
- Sport Turf
- Fertilizer Sales
- Assistant Professor – UF & UK
- Semi-Retired
- Turfgrass Epistemology YouTube/Podcast

Outline

- Risk Factors
- Types of Soil Tests
- pH, Salinity, Sodicity, OM, P, etc.

Risk

Risk Factor

- Anything that increases the probability of unacceptable turfgrass.
- Correlational and not necessarily causal.

Risk Factors for Turfgrass Quality

Don’t soil test unless you have a good reason!

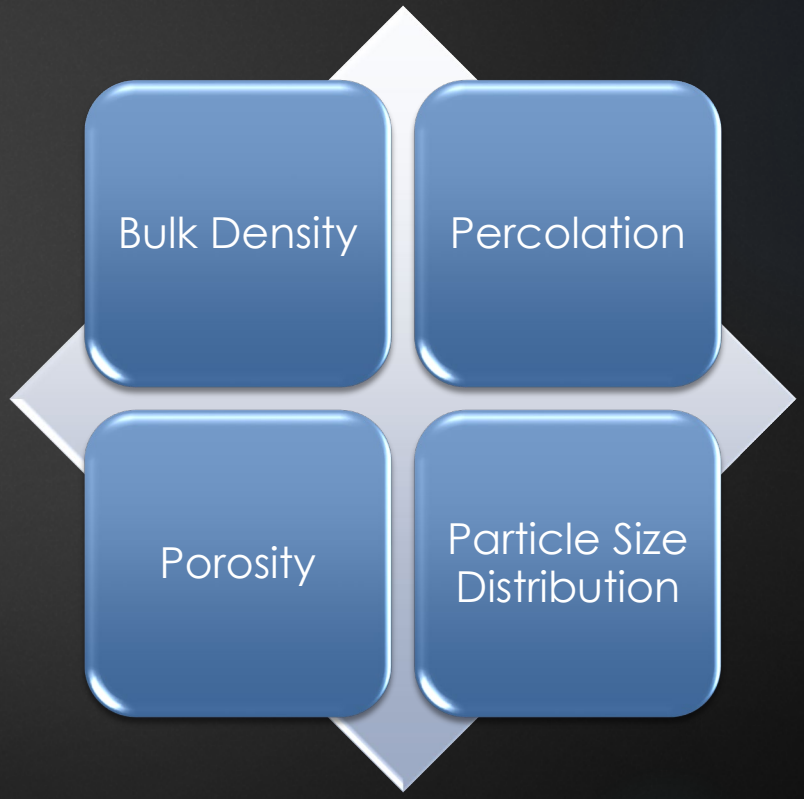
If your turfgrass is acceptable and you have no pre-existing conditions, then you probably don't have a good reason.

Types of Soil Tests

Types of Soil Tests

Chemical

Physical



Bulletin *of the* Green Section *of the* U. S. Golf Association

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A MONTHLY PERIODICAL TO PROMOTE THE BETTERMENT OF GOLF COURSES

CONTENTS

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in the autumn rather than assuming a yellowish dead appearance. This also adds color to the grounds in the fall when other plants are dead.

Rather than to plant the harmful common barberry which is known to cause the loss of so many million dollars from black stem rust, country clubs are asked to plant the Japanese barberry, which in the end will prove far more satisfactory and beautiful than the common barberry.

Methods of Applying Ammonium Sulfate or Ammonium Phosphate

By O. B. Fitts

There are three methods available for applying ammonium sulfate or ammonium phosphate, and each gives splendid results when properly employed.

1. The first method is to mix the fertilizer thoroughly with compost. Topdress with this mixture, brush the material well down into the turf, and then follow immediately with a thorough watering. By this method both ammonium sulfate and ammonium phosphate have been applied on plots at the Arlington Turf Garden at the rate of 6½ pounds per 1,000 square feet of surface every month during the growing season without the slightest indication of burning, and the results of each application have been excellent. It is, of course, very rarely necessary to make such a heavy application. In fact, it is advised that applications of not more than 5 pounds per 1,000 square feet be used in the cool weather of spring and fall, and not more than 2 pounds in the very hot summer weather. However, in case it is necessary to use heavier applications, it can be done by this method without burning the grass. The fertilizer is absorbed by the compost as it goes into solution when water is applied, and there is very little chance of its sticking to the foliage and burning if sufficient water is employed.

2. Either fertilizer may be applied satisfactorily in the form of a solution provided extreme care is taken to water it in well. Even if a weak solution is left on the grass it becomes stronger as the water evaporates and may then cause burning.

3. Another method is to apply ammonium phosphate or ammonium sulfate in the crystal form, either alone or with just sufficient sand to facilitate uniform distribution. This method, like that of the solution, requires extreme care in watering the fertilizer in, as the sand has very little absorbing capacity and the fertilizers, as they go into solution, may burn the foliage.

Results of the three methods of applying ammonium sulfate or ammonium phosphate, as here described and as conducted in experiments at the Arlington Turf Garden, have indicated throughout the past three years that better and more lasting effects have been obtained from mixing the fertilizers with compost than from either of the other methods. It is the safest method of the three and should be used on golf courses in preference to any of the other methods. However, if it is not convenient to use this method, either of the other methods may be used if extreme care is taken to see that the fertilizers are thoroughly watered into the turf.

Soil analyses.—These are of practically no value. No one living can tell what they mean.

Don’t guess. Soil test.

(so we can guess for you)

REPORT NUMBER
F115-049B

A & L Southern Agricultural Laboratories, LLC.

1199 W. Newport Center Drive • Deerfield Beach, FL 33442
(954)972-3255 • FAX (954)972-7885 • email: Lgriff6250@aol.com

"Get The Soil Right"

GROWER: NONE GIVEN

SAMPLES SUBMITTED BY: TRISTAN R

PO No:

DATE RECEIVED: 4/24/2012

DATE REPORTED:

SEND TO: HARRELL'S, INC

P O BOX 807
LAKELAND, FL 33802-

Copy TO:

SOIL ANALYSIS REPORT

LAB NUMBER / SAMPLE ID	ORGANIC MATTER %	ENR lbs./A	P1 WEAK BRAY ****ppm	P2 STRONG BRAY****ppm	POTASSIUM ***** ppm	MAGNESIUM *** ppm	CALCIUM *** ppm	SODIUM *** ppm	SOIL pH
0147	+ 9.9	242 VH	9 VL	21 L	70 VH	78 VH	2193 VH	27 L	6.9 H
gumbo limbo	ALUMINUM ppm	HCO3-P ppm	HYDROGEN meq/100g	C.E.C. meq/100g	PERCENT BASE SATURATION (COMPUTED)				
					% K	% Mg	% Ca	% Na	% H
			0.3	12.2	1.5	5.3	89.8	1.0	2.5
	NO3-N ppm	SULFUR ppm	ZINC ppm	MANGANESE ppm	IRON ppm	COPPER ppm	BORON ppm	BUFFER pH	SOLUBLE SALTS mmhos/cm
		206 H	0.1 VL	1 VL	1 L	0.1 L	0.8 M		1.1 H
	CHLORIDE ppm	MOLYBDENUM ppm	WATER SOL Pw ppm	TOTAL N ppm	NH4 ppm	TEXTURE ANALYSIS SAND	SILT	CLAY	CLASSIFICATION

LAB NUMBER / SAMPLE ID	ORGANIC MATTER %	ENR lbs./A	P1 WEAK BRAY ****ppm	P2 STRONG BRAY****ppm	POTASSIUM ***** ppm	MAGNESIUM *** ppm	CALCIUM *** ppm	SODIUM *** ppm	SOIL pH
0148	+ 9.9	242 VH	36 M	118 VH	187 VH	110 VH	2537 VH	21 L	6.9 H
Pinwheel jasmine	ALUMINUM ppm	HCO3-P ppm	HYDROGEN meq/100g	C.E.C. meq/100g	PERCENT BASE SATURATION (COMPUTED)				
					% K	% Mg	% Ca	% Na	% H
			0.2	14.4	3.3	6.4	88.3	0.6	1.4
	NO3-N ppm	SULFUR ppm	ZINC ppm	MANGANESE ppm	IRON ppm	COPPER ppm	BORON ppm	BUFFER pH	SOLUBLE SALTS mmhos/cm
		253 H	0.1 VL	4 L	1 L	0.1 L	0.8 M		1.56 VH
	CHLORIDE ppm	MOLYBDENUM ppm	WATER SOL Pw ppm	TOTAL N ppm	NH4 ppm	TEXTURE ANALYSIS SAND	SILT	CLAY	CLASSIFICATION

CODE TO RATING – Very Low (VL) – Low (L) – Medium (M) – Very High (VH)
*ENR – Estimated Nitrogen Release
***MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM.
****MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
*****MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

A & L SOUTHERN AGRICULTURAL LABORATORIES LLC.

By Lynn P. Griffith, Jr. - Lab Manager

Course Name	1/0/1900
Date	2/28/2018
Sample ID	
Superintendent	

Category	Target Range			Actual Data	Remarks
pH	6.2	to	6.7	6.8	High
Organic Matter	0.5	to	1.8	1	Good
CEC	5	to	10	5.8	Good
Saturation Index	30	to	45	33	Good
Soil Reserve	**Target Range**			**Actual Data**	**Remarks**
Nitrate N - ppm	10	to	25	5	Low
Phosphorous - ppm	20	to	29	17	Low
Potassium - ppm	93	to	113	17	Low
Magnesium - ppm	69	to	89	20	Low
Calcium - ppm	575	to	750	1106	High
Sulfur - ppm	8	to	14	6	Low
Zinc - ppm	3.4	to	7.9	4.8	Good
Manganese - ppm	20	to	50	0.8	Low
Copper - ppm	1.2	to	3	0.6	Low
Iron - ppm	10	to	50	43.4	Good
Boron - ppm	1.2	to	2.5	0.1	Low
Soil pH and Buffer					
pH	6.2	to	6.7	6.8	High
Buffer pH				7.5	
Carbonates and Salts					
Excess Carbonates	5	to	25	0	Low
Soluble Salts	0.01	to	2.9	0.14	Good
Na - ppm	0		9	14	High
Base Saturation					
%Potassium	2	to	5	0.8	Low
%Magnesium	10	to	15	2.9	Low
%Calcium	65	to	75	95.3	High
%Sodium	1	to	2	1	Good
%Hydrogen				0	
Critical Ratio's					
Ca:K Ratio	13	to	1	65.1	High
Ca:Mg Ratio	8	to	1	55.3	High
Mg:K Ratio	1.5	to	1	1.2	Low

CATEGORY	meq/ltr			
EC - (mmhos/cm)	0.7			
Saturation Index	33.25			
SOIL SOLUTION	**meq/ltr**	**ppm**	**ppm %**	**ANIONS**
Sodium	1.13	25.99	5.5%	
Calcium	3.88	93.12	19.8%	
Magnesium	0.55	6.875	1.5%	
Potassium	0.54	21.06	4.5%	
Amonium Nitrogen	0.50	8.52	1.8%	
Nitrate Nitrogen	0.77	47.77	10.2%	
Phosphorous	0.03	1.65	0.4%	
Bicarbonate	2.87	178.17	38.0%	67%
Sulfate	0.72	34.58	7.4%	13%
Chloride	1.45	51.41	11.0%	19%
Boron		0.01	0.0%	
ELEMENT	**DATA**	**% PBS**	**IDEAL**	**REMARKS**
SAR	0.76			
%Sodium	1.13	19%	10%	High
%Calcium	3.88	64%	53%	High
%Magnesium	0.55	9%	22%	Low
%Potassium	0.54	9%	15%	Low
GUIDELINES				**REMARKS**
Ca:Na (Ideal 5:1)	3.4	To	1	Low
Na (< 1.5)	1.13			Low
Ca+Mg > HCO3	Ca+Mg	HCO3		
Actual----->	4.43	2.87		Ideal
Na>Cl	Na	Cl		
Actual----->	1.13	1.45		High
NO3:NH4 (Ideal 3:1)	5.6	To	1	High
K>N (Minimum 1.3:1)	0.5	To	1	Low

Sampling Depth

Sampling Depth

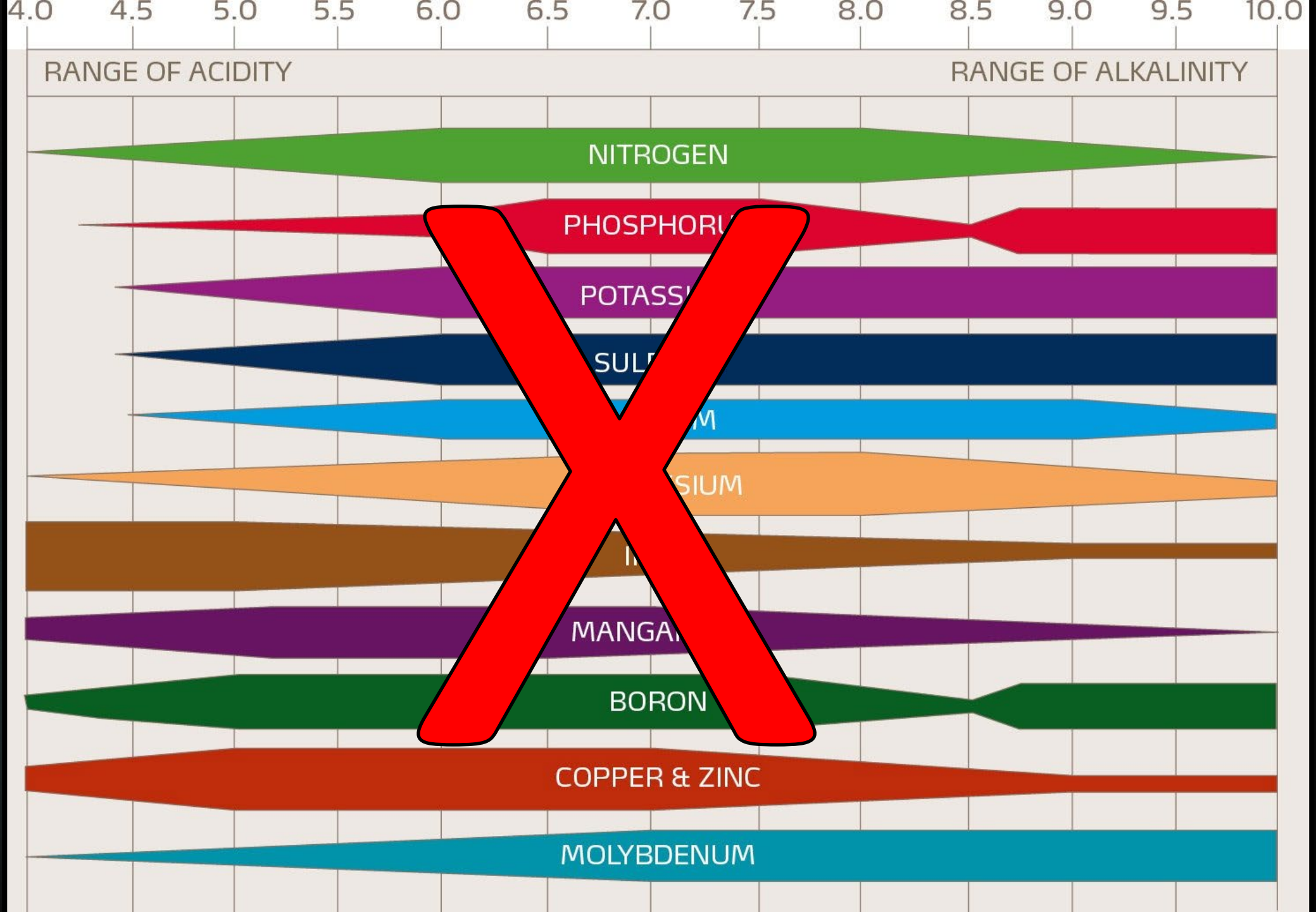
Depth	Mehlich-3 Phosphorus
Inches	ppm
0-1	205
0-2	138
0-3	74

Unpublished data, D.J. Soldat.

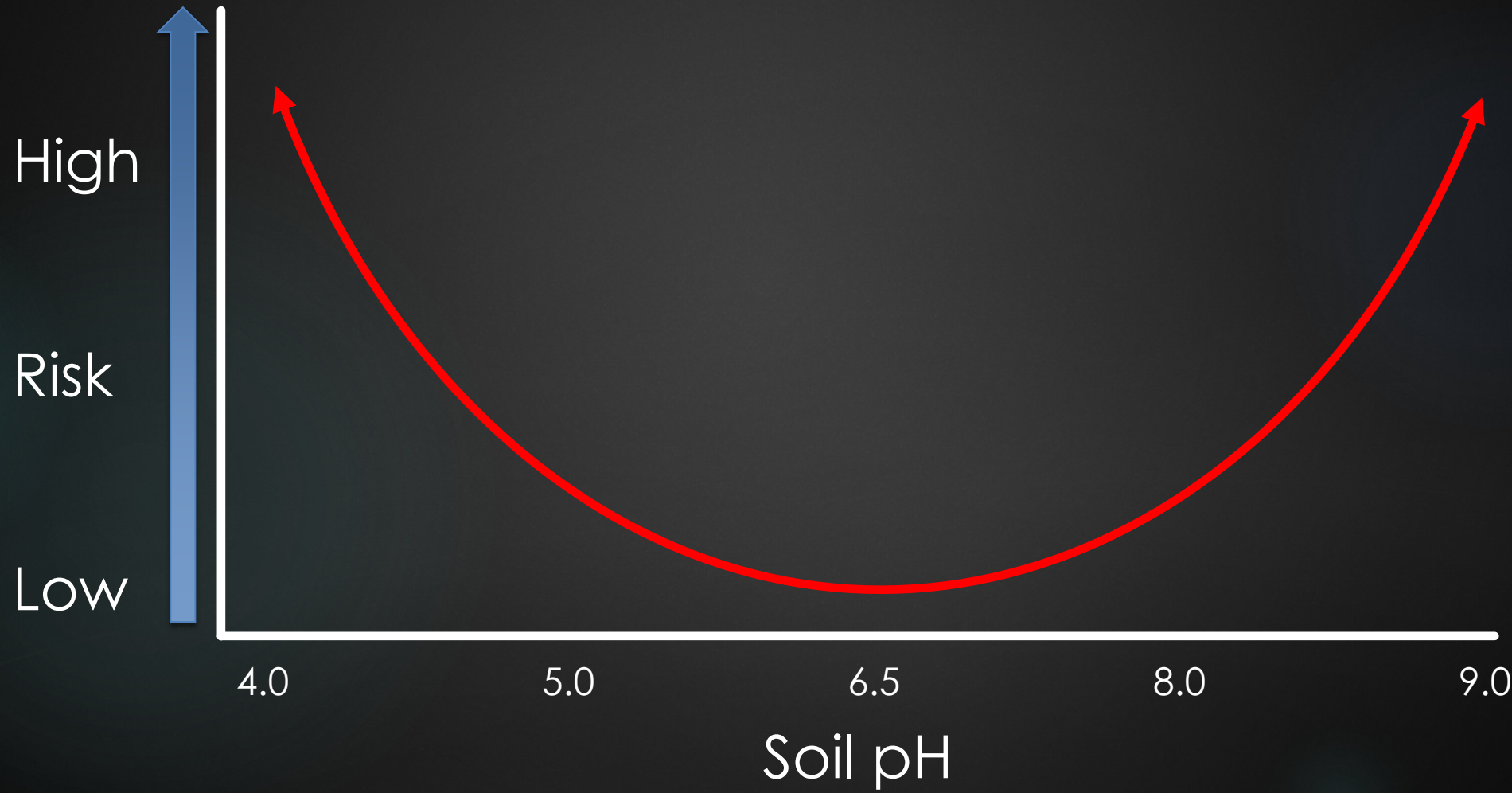
Sampling Depth

- Probably the greatest source of error.
- Sample the same depth every time.
- Ideally, 6-inches because correlations and calibrations were also conducted at 6-inches.
- Welding a stop at 6-inches on the probe will force it to stop at 6-inches more consistently.

pH


4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
RANGE OF ACIDITY
RANGE OF ALKALINITY
NITROGEN
PHOSPHORU
POTASS
SUL
M
SIUM
I
MANGA
BORON
COPPER & ZINC
MOLYBDENUM

Risk of Soil pH Affecting Turfgrass Performance



Bulletin *of the* Green Section *of the* U. S. Golf Association

Vol. I. Washington, D. C., March 23, 1921 No. 3

A MONTHLY PERIODICAL TO PROMOTE THE BETTERMENT OF GOLF COURSES

ISSUED BY THE GREEN COMMITTEE OF THE UNITED STATES GOLF ASSOCIATION

CONTENTS

Address all communications to W. B. Lydenberg, Executive Acting Secretary, P. O. Box 676, Eleventh Station, Washington, D. C.

The Green Committee is anxious that as many clubs as are able to undertake this kind of investigation engage in the work. It will be glad to give detailed plans to follow and will secure all the necessary grasses or seeds. Beyond this there is full opportunity to test out, if desired, all the ideas that club members are sure to suggest. In this way, the fellow who believes that lime will cure all grass ills, as well as the one who thinks that orchard grass will make good putting greens, can be satisfied and no harm done to the course. But, much more important, some things that will greatly improve the turf on each course will pretty surely be discovered. Please consider this matter prayerfully and realize that your club can, by this means, help itself as well as the other clubs, nearly every one of which will be able to contribute something new of value to you. Let us all get after these puzzling grass problems on an adequate basis and cut out the foolish and wasteful practices that still prevail.

The Use and Abuse of Lime

C. V. Piper and R. A. Oakley

There is still room for difference in opinion regarding the desirability of using lime on golf courses, but the weight of the present evidence is that, as good or better results are secured without lime as by its use, certainly so in the case of bents and fescues and probably so in the case of most other turf grasses.

The vast amount of agricultural literature dealing with the use of lime, and some enticing rhetorical statements such as "lime sweetens the soil," have conspired to lead many people to believe that lime is a corrective for all the ills of soil and of turf. It is this belief that leads many misguided victims to scatter lime on their half bare lawns every spring with the simple faith that this will in some way insure a dense cover of green velvet sward. Year after year they do the same thing, with exactly the same results as if they had not used the lime—a course lawn of crab grass in summer and a cover of ghastly gray-brown dead turf in winter. But their faith never seems to weaken; and indeed against such faith no reason can prevail.

The facts regarding the effects of lime on soils and crops are fairly well ascertained, but there is less agreement on the theoretical explanations of the facts. There are four very definite effects of lime:

1. Lime tends to improve the texture of clay soils by making them more crumbly. This can easily be demonstrated with small samples of soil; but it must not be forgotten that an application of one ton of lime per acre is only two-fifths of an ounce to a square foot. Of course a spoonful of lime does not go far in changing the texture of a cubic foot of soil.

2. Lime, being alkaline, tends to make the soil likewise. If the soil has an acid reaction, a sufficient amount of lime will make it neutral, while more will make it alkaline. The amount of lime needed to make one acre of soil neutral is called its *lime requirement*. The lime requirement of some soils is as much as 10 tons per acre.

3. Lime has a very pronounced effect in stimulating the growth of alfalfa and clover. Indeed, on many soils these plants can not be successfully grown without the use of lime. To a less degree this is true of other crop plants. The effect is probably due both to the lime itself as plant food and to the changed reaction of the soil.

pH BMPs

- Don’t worry about pH unless the turfgrass is unacceptable or you have a pre-existing condition.
- Risk increases as soil pH increases or decreases from ~neutral.

Salinity

Salinity vs. Turf Quality

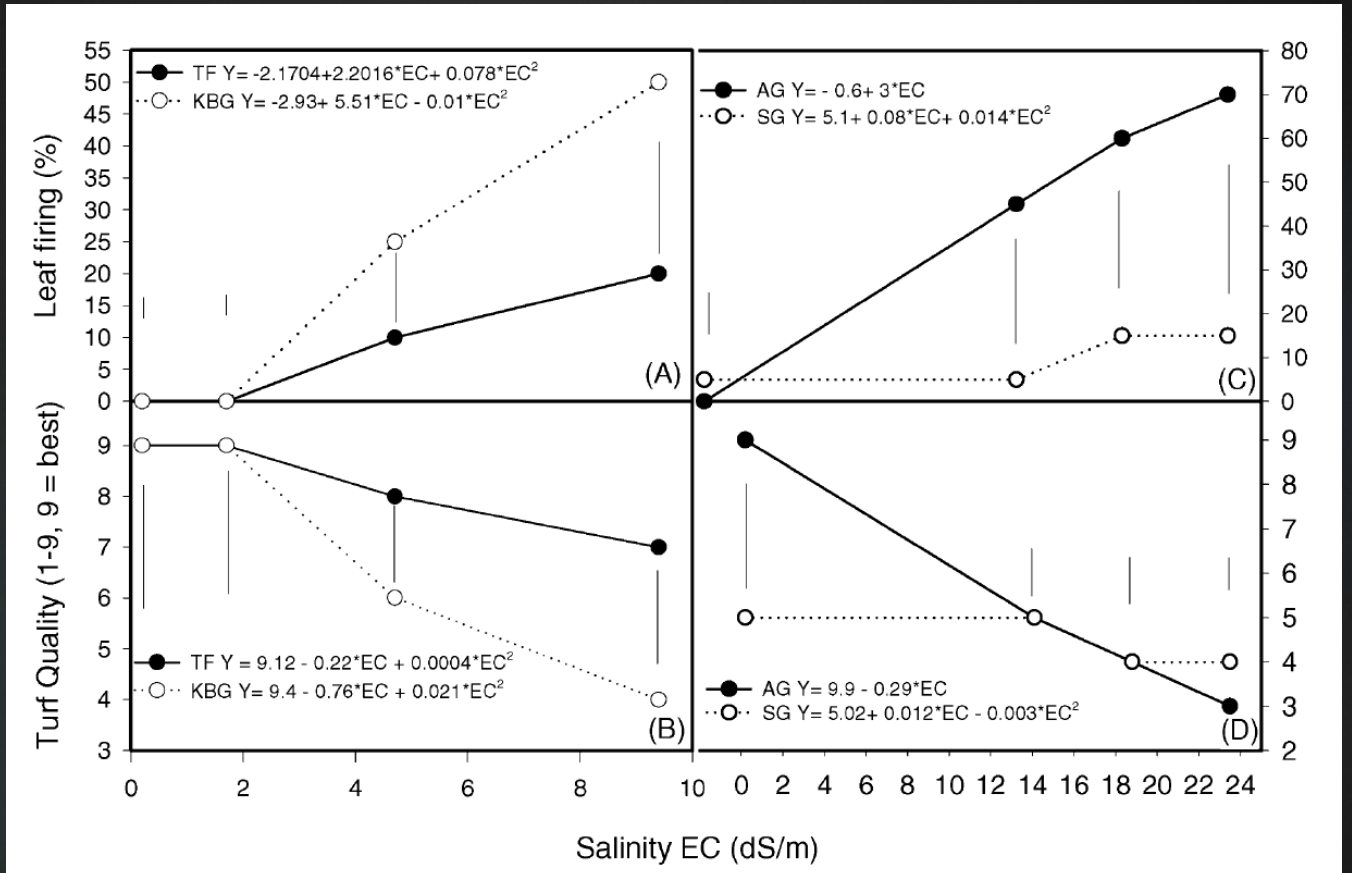


Fig. 2. Left panel: turf quality and leaf firing of tall fescue (TF) and Kentucky bluegrass (KBG) irrigated with saline solution at 0.2, 1.7, 4.7, and 9.4 dS m^{-1}. Left panel: turf quality and leaf firing of alkaligrass (AG) and saltgrass (SG) irrigated with saline solution at 0.2, 14.1, 18.8, and 23.5 dS m^{-1}. Vertical bars indicate least significant difference ($P = 0.05$) between species within a given salinity level.

Agr. Water Manage. 2004 66: 97–111

Salinity BMPs

- Don’t worry about salinity unless the turfgrass is unacceptable or you have a pre-existing condition.
- Salinity > 2-4 dS/m increases risk.

Organic Matter

Organic Matter BMPs

- We have no evidence-based ranges.
- Don’t worry about OM on a soil test.
- Use to document changes over time.

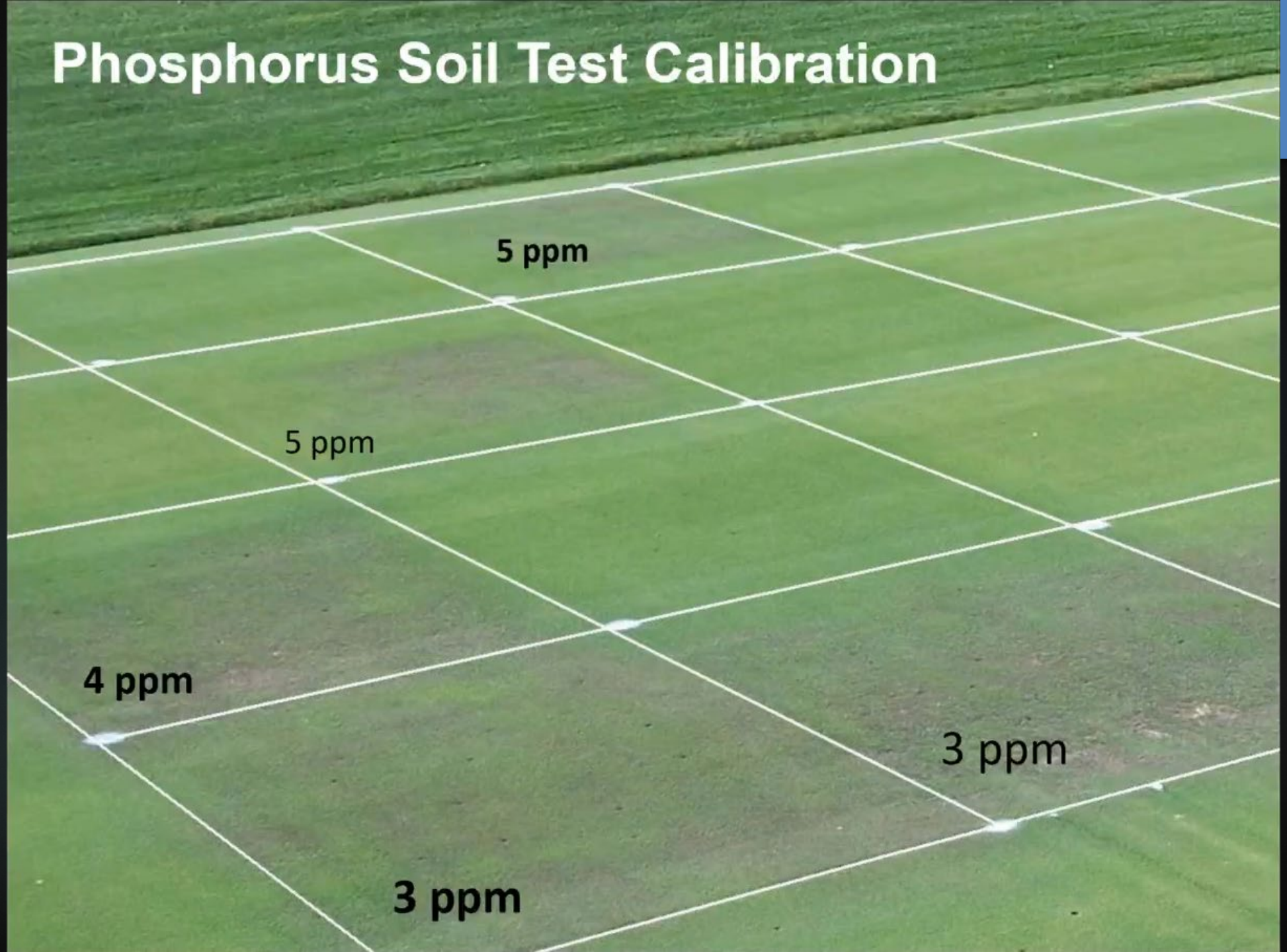
Cation Exchange Capacity

Cation Exchange Capacity BMPs

- Don't worry about CEC unless the turfgrass is unacceptable.
- CEC may provide evidence about how nutrients should be applied. For example, turfgrass on low CEC soils may benefit from low rates and more frequent applications.
- It is good to know CEC to be aware of the likelihood of cation deficiencies but adjusting CEC up or down can be expensive and unnecessary.

Phosphorus

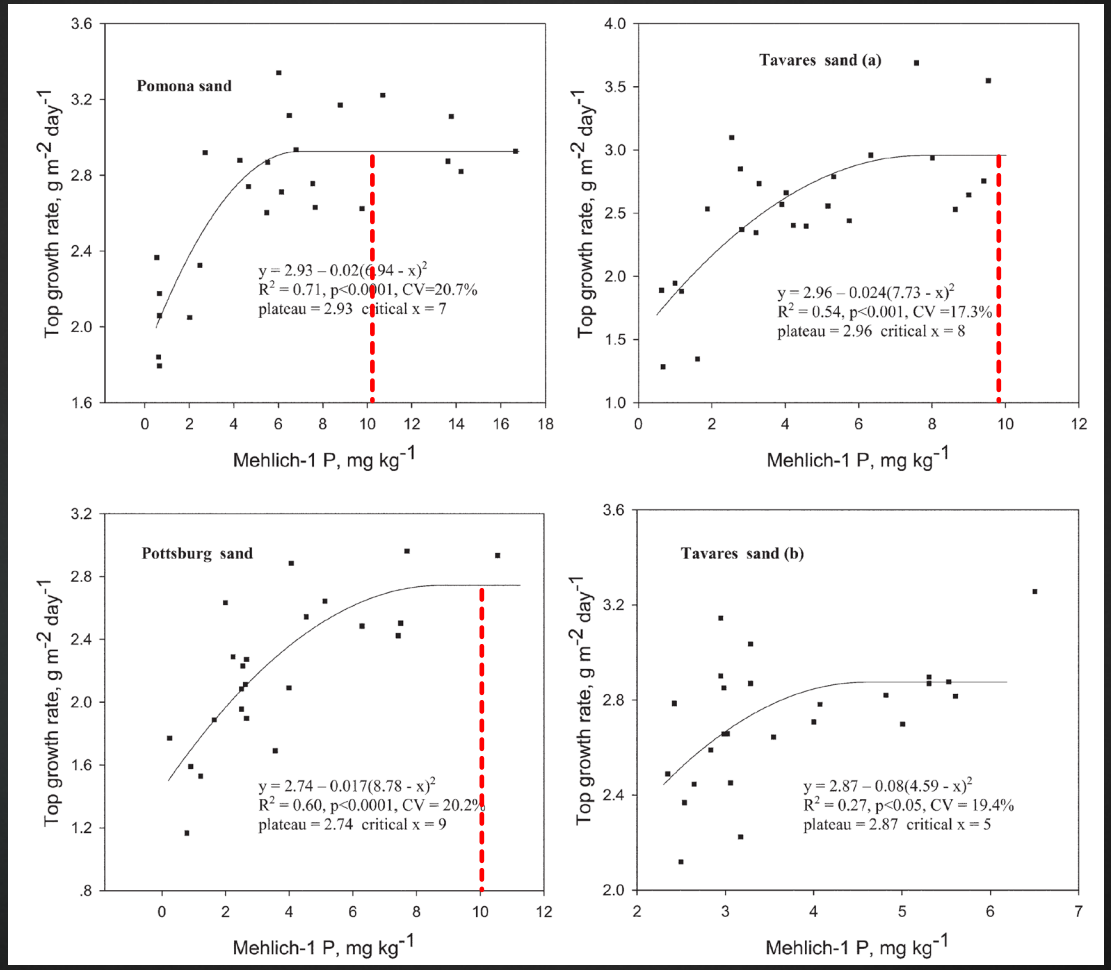
Credit: D.J. Soldat



Credit: D.J. Soldat

St. Augustinegrass

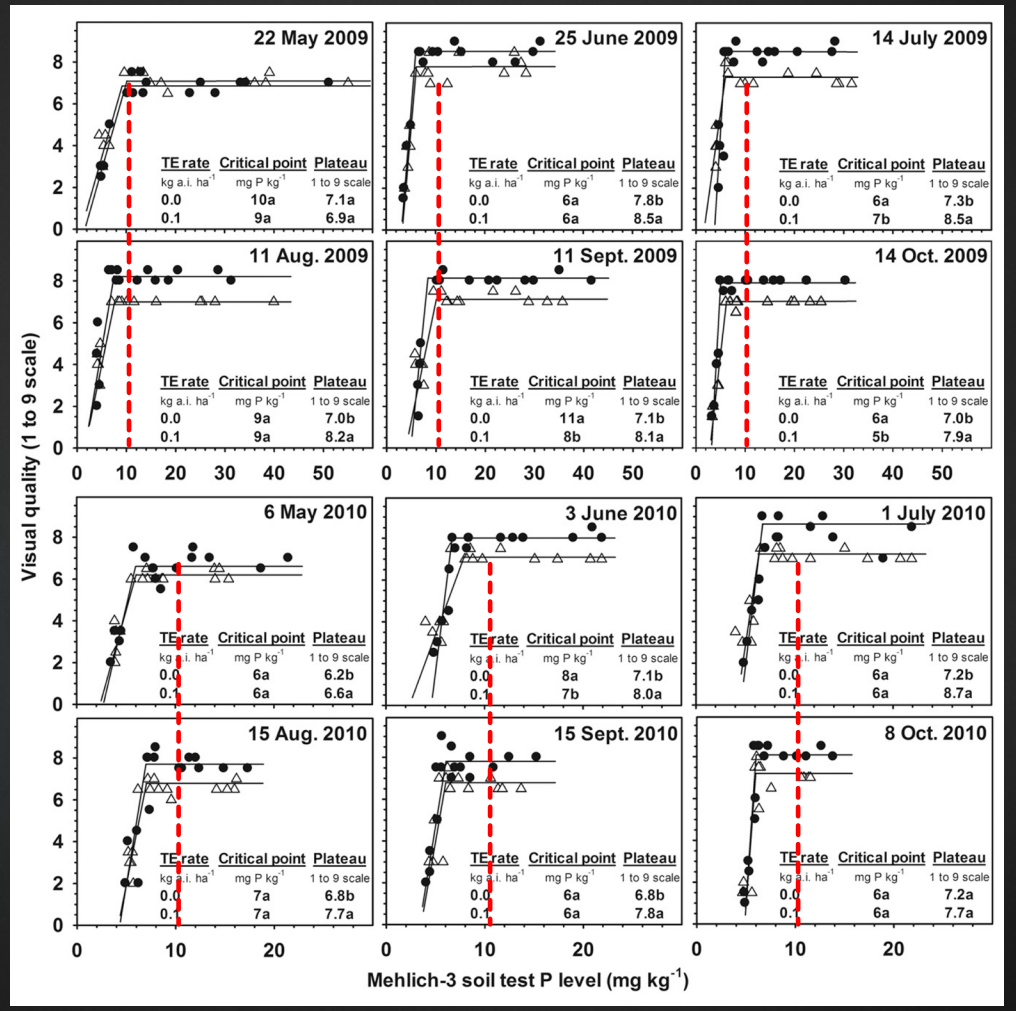
Soil P Critical Level = 10 ppm



Crop Sci. 2008 48:1178-1186.

Bentgrass

Soil P Critical Level = 10 ppm



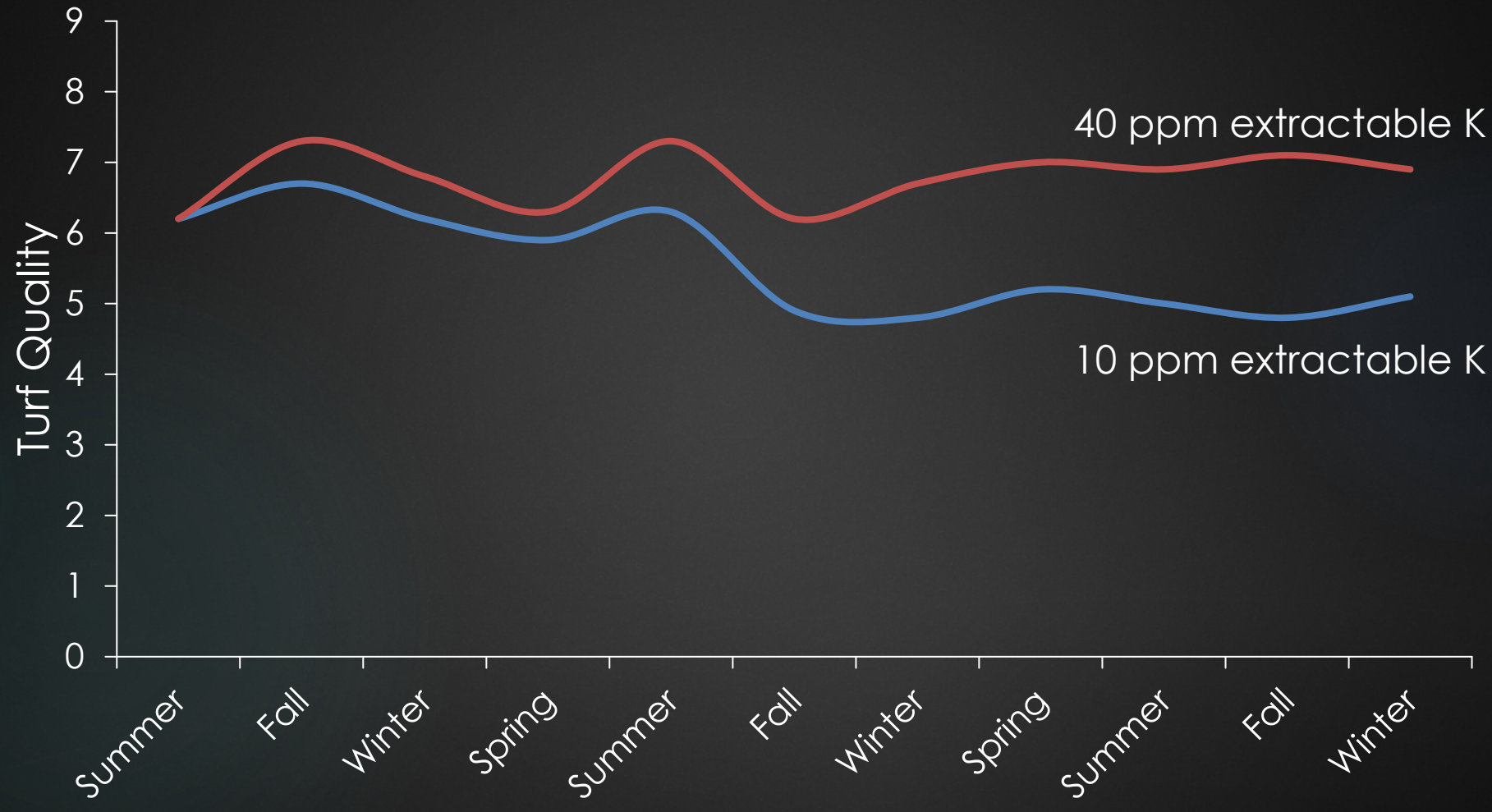
Crop Sci. 2012 52:1385-1392.

Phosphorus BMPs

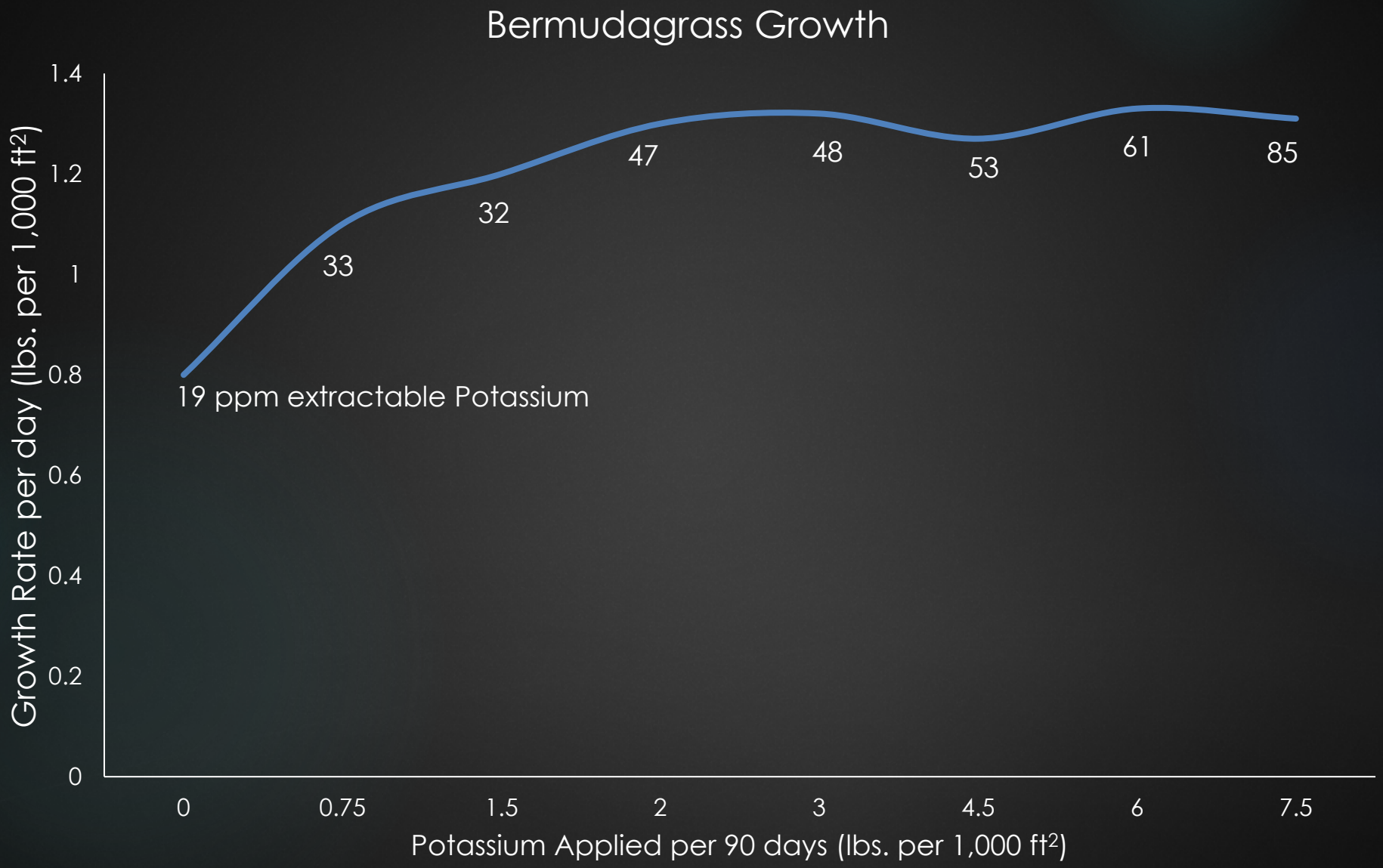
- Don’t worry about phosphorus unless the turfgrass is unacceptable or you have a pre-existing condition.
- Mehlich-3 P < 10-20 increases risk.
- Phosphorus deficiencies are normally rapidly alleviated.

Potassium

Bermudagrass Response to Potassium

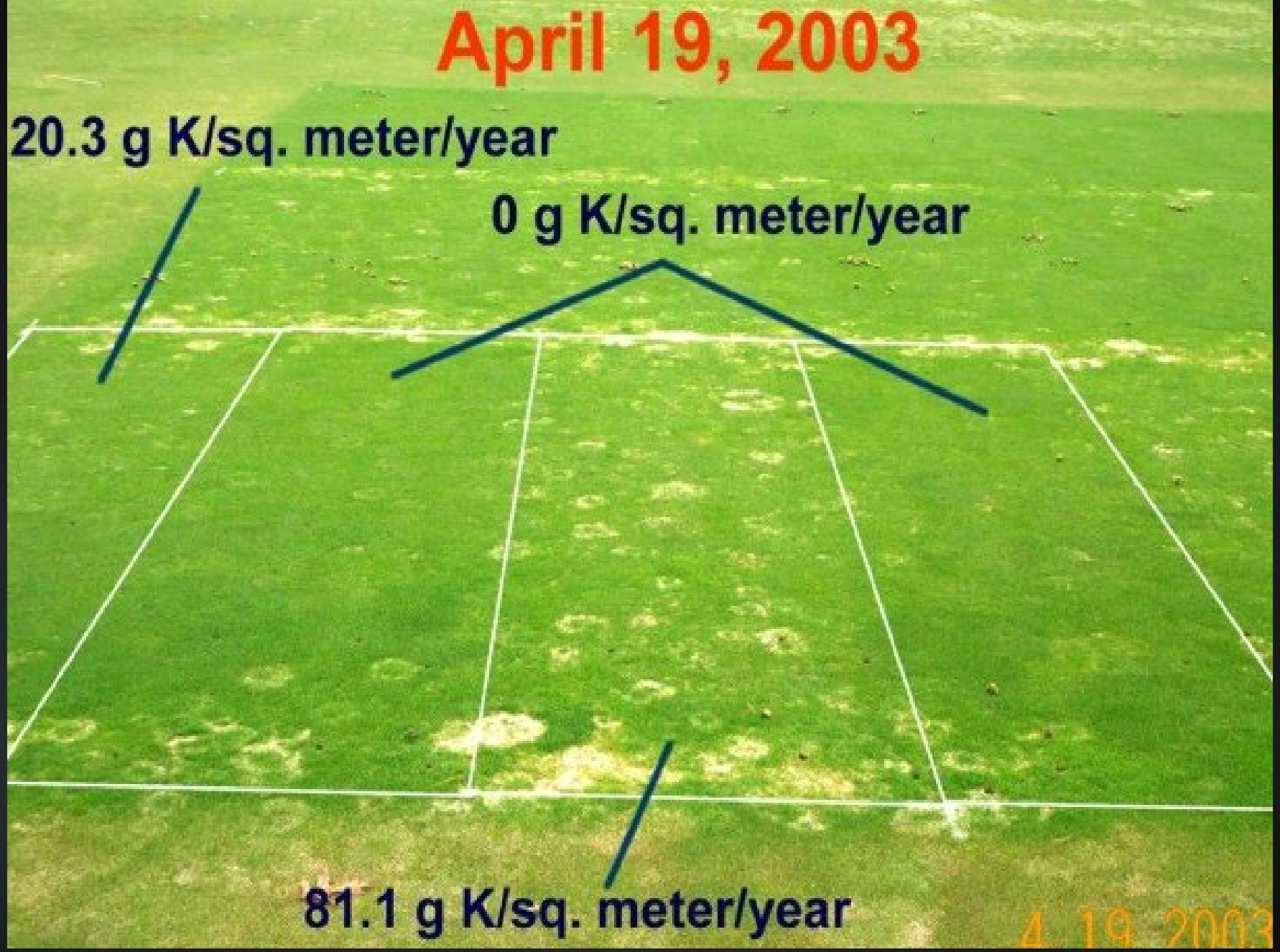


Snyder and Cisar, 2000.

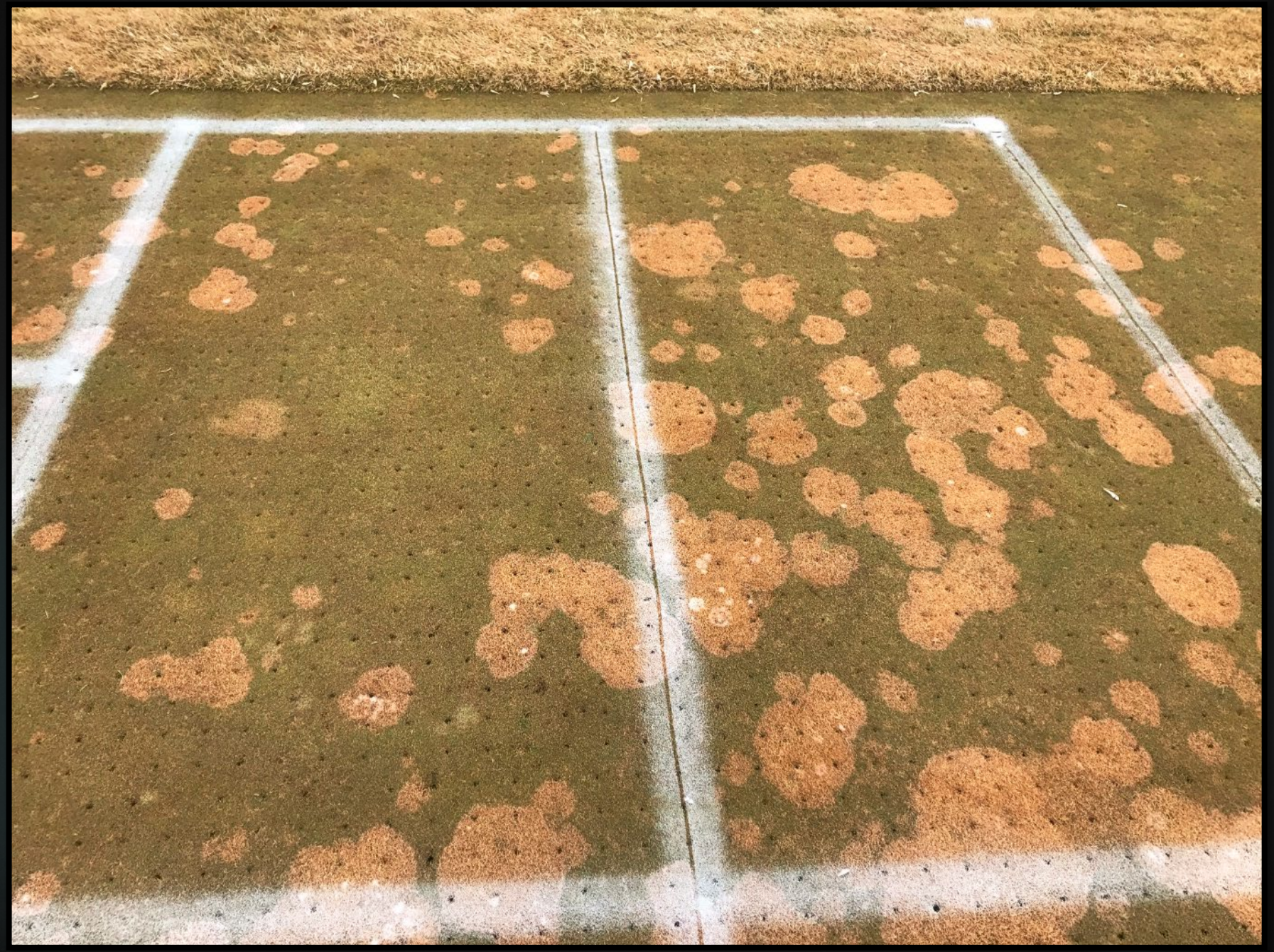


Crop Sci. 2002 42:507-512.

Can you apply K with every fertilization to ensure you are never deficient?



Credit: D.J. Soldat



Credit: D.J. Soldat

Potassium BMPs

- Don't worry about potassium unless the turfgrass is unacceptable or you have a pre-existing condition.
- Mehlich-3 K < 30 or > 50 ppm increases disease risk.
- Turfgrass almost never responds to applied potassium.

Magnesium and Sulfur

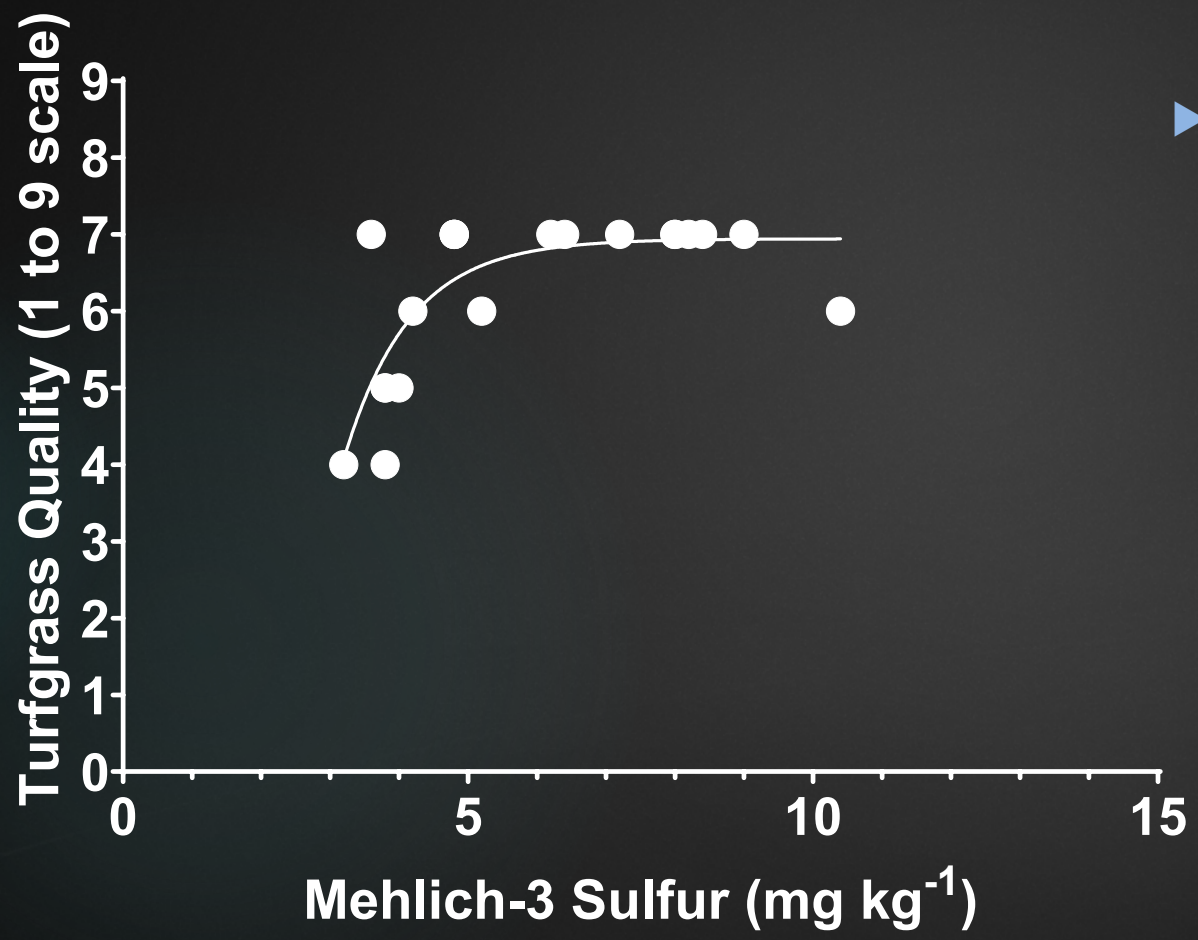
Magnesium

- Due to the lack of research, soil test magnesium values are not well established.
- It appears Mehlich-3 Mg levels ~20 ppm are adequate.

Agron. J. 1993 85:40-43


KBG
Lexington, KY
4/15/22
35 #/A of K as SOP
35 #/A of K as KCl

Sulfur



- Critical Minimum
  - Fall - 7.2 ppm
  - Spring - 4.2 ppm

Unpublished data, Shaddox.

Magnesium and Sulfur BMPs

- Don't worry about magnesium and sulfur unless the turfgrass is unacceptable or you have a pre-existing condition.
- Mehlich-3 Mg ~20 ppm may be adequate
- Mehlich-3 S ~7 ppm
- Turfgrass almost never responds to applied Mg.

Don’t soil test unless you have a good reason!

What is a good reason?

- Your turfgrass is unacceptable.
- You have a pre-existing condition.

General Soil Test Minimum Ranges

Element	
pH	>5 <8
OM	-
CEC	-
Salinity (ds/m)	<2-4
Mehlich-3 (ppm)	
P	20
K	>30 <50
Mg	20
S	7

Agr. Water Manage. 2004 66: 97–111
Crop Sci. 2008 48:1178-1186
Crop Sci. 2002 42:507-512
Agron. J. 1993 85:40-43

Category	Target Range			Actual Data	Remarks
pH	6.2	to	6.7	6.8	High
Organic Matter	0.5	to	1.8	1	Good
CEC	5	to	10	5.8	Good
Saturation Index	30	to	45	33	Good
Soil Reserve	**Target Range**			**Actual Data**	**Remarks**
Nitrate N - ppm	10	to	25	5	Low
Phosphorous - ppm	20	to	29	17	Low
Potassium - ppm	93	to	113	17	Low
Magnesium - ppm	69	to	89	20	Low
Calcium - ppm	575	to	750	1106	High
Sulfur - ppm	8	to	14	6	Low
Zinc - ppm	3.4	to	7.9	4.8	Good
Manganese - ppm	20	to	50	0.8	Low
Copper - ppm	1.2	to	3	0.6	Low
Iron - ppm	10	to	50	43.4	Good
Boron - ppm	1.2	to	2.5	0.1	Low
Soil pH and Buffer					
pH	6.2	to	6.7	6.8	High
Buffer pH				7.5	
Carbonates and Salts					
Excess Carbonates	5	to	25	0	Low
Soluble Salts	0.01	to	2.9	0.14	Good
Na - ppm	0		9	14	High
Base Saturation					
%Potassium	2	to	5	0.8	Low
%Magnesium	10	to	15	2.9	Low
%Calcium	65	to	75	95.3	High
%Sodium	1	to	2	1	Good
%Hydrogen				0	
Critical Ratio's					
Ca:K Ratio	13	to	1	65.1	High
Ca:Mg Ratio	8	to	1	55.3	High
Mg:K Ratio	1.5	to	1	1.2	Low

CATEGORY	meq/ltr			
EC - (mmhos/cm)	0.7			
Saturation Index	33.25			
SOIL SOLUTION	**meq/ltr**	**ppm**	**ppm %**	**ANIONS**
Sodium	1.13	25.99	5.5%	
Calcium	3.88	93.12	19.8%	
Magnesium	0.55	6.875	1.5%	
Potassium	0.54	21.06	4.5%	
Amonium Nitrogen	0.50	8.52	1.8%	
Nitrate Nitrogen	0.77	47.77	10.2%	
Phosphorous	0.03	1.65	0.4%	
Bicarbonate	2.87	178.17	38.0%	67%
Sulfate	0.72	34.58	7.4%	13%
Chloride	1.45	51.41	11.0%	19%
Boron		0.01	0.0%	
ELEMENT	**DATA**	**% PBS**	**IDEAL**	**REMARKS**
SAR	0.76			
%Sodium	1.13	19%	10%	High
%Calcium	3.88	64%	53%	High
%Magnesium	0.55	9%	22%	Low
%Potassium	0.54	9%	15%	Low
GUIDELINES				**REMARKS**
Ca:Na (Ideal 5:1)	3.4	To	1	Low
Na (< 1.5)	1.13			Low
Ca+Mg > HCO3	Ca+Mg	HCO3		
Actual----->	4.43	2.87		Ideal
Na>Cl	Na	Cl		
Actual----->	1.13	1.45		High
NO3:NH4 (Ideal 3:1)	5.6	To	1	High
K>N (Minimum 1.3:1)	0.5	To	1	Low