Results of a Survey of Well Water Used in Tobacco Greenhouses in Georgia

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Introduction

- High alkalinity resulting from excessive carbonates, bicarbonates and hydroxides in the well water used for float production of tobacco transplants have been determined to reduce the growth of seedlings in NC, SC, and VA.

- In these areas acidification of the water is routine and required.

Introduction

- No survey of the tobacco producing area of Georgia had been conducted to determine the variation of alkalinity across the area.

- Recommendations had been based on individual well water samples.

Materials & Methods

- Prior to the 2009 seedling production season Extension Agents were offered an opportunity to submit well water samples from tobacco greenhouse transplant producers.

- A pre-prepared laboratory form was provided (billing, sample analysis variables, reporting)

COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCE

Soil, Plant & Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9105

Phone: (706) 542-5350
Fax: (706) 369-5734

Tobacco Greenhouse Well Water Alkalinity Sampling Program

Research Sample Submission Form

Date Submitted: _____ Date Received: _____ Lab Number (s): _____
SOIL LAB USE ONLY

W18 – Well Water Alkalinity / Bicarbonate

Sample Type: _____ Number of Samples Submitted: _____
(Categories listed below)

Sample I.D. Numbers: **(Use Grower Initials + Number of His Wells. Ex.(JHT3)**
(Numbering System must be Simplified and Consecutive (Example, 1,2,3 or A, B, C etc.)

Return Results To: (complete mailing address)

Name: _____

Department Name: _____

Building Name: _____ Room # _____

(If off campus) City State Zip

Phone: _____ Fax: _____

Email Address: _____

Account Name: **On File**

Account No / Purchase Order No: **On File**

Bill To: (if address different from Return to)

Name: **On File**

Address: _____

City State Zip

Disposition of Sample after Analysis:

☐ Discard ☐ Hold for Pickup ☐ Return
(If samples are returned you might be billed for shipping charges)

Email results to: jmmoore@uga.edu

Tests Requested

Soil		Plant		Water		Environmental Waste	
☐ S1	Routine Test [1]	☐ P1	Mineral Analysis [4]	☐ W1	Mineral Analysis [3]	☐ SC1	Total Mineral [5]
☐ S1A	pH Only	☐ P2	Mineral Analysis Only[3] *(excludes N, S)*	☐ W1A	Mineral w/acid digestion-ICP	☐ SC3	NO_3-N
☐ S2	Routine + Heavy Metals					☐ SC4	NH_4-N
☐ S3	Boron			☐ W3	Anions (Chloride, Fluoride, Phosphate, Sulfate, Nitrate)	☐ SC5	Moisture
☐ S4	Soluble Salts	☐ P3	Carbon + Nitrogen +Sulfur			☐ SC6	Arsenic
☐ S5	Mechanical Test					☐ SC7	Selenium
☐ S6	Organic Matter		Any Single Element (in P3)	☐ W4	Any Single Anion (in W3)	☐ SC8	As + Se
☐ S7	NO_3-N	☐ P4	☐ C ☐ N ☐ S		☐ Cl ☐ F ☐ PO_4	☐ SC9	Mercury
☐ S8	NH_4-N				☐ So_4 ☐ NO_3	☐ SC15	Carbon + Nitrogen + Sulfur
☐ S11	Greenhouse & Nursery [2]	☐ P5	Any 2 Elements (in P3) ☐ C ☐ N ☐ S	☐ W5	Any 2 Anions (in W3)		
☐ S19	Carbon + Nitrogen + Sulfur				☐ Cl ☐ F ☐ PO_4 ☐ So_4 ☐ NO_3	☐ SC16	Any Single Element (in SC15) ☐ C ☐ N ☐ S
☐ S20	Any Single Element (in S19) ☐ C ☐ N ☐ S			☐ W6	NO_3-N		
				☐ W8	NH_4-N	☐ SC17	Any 2 Elements (in SC15) ☐ C ☐ N ☐ S
☐ S21	Any 2 Elements (in S19) ☐ C ☐ N ☐ S			☐ W9	Lead		
☐ Other:		☐ Other:		☐ Other:		☐ Other:	

1. Routine Test: pH, P, K, Ca, Mg, Zn, Mn (reported in pounds per acre.)
2. Greenhouse Test: for mixes which include soil, sand, peat, pine bark, vermiculite, etc, P, K, C, Ca, Mg, NH_4 NO_3, (reported in PPM), soluble salt (reported in mmhos) *THIS TEST CANNOT BE RUN ON A REGULAR SOIL SAMPLE*
3. Mineral Analysis: P, K, Ca, Mg, Fe, Al, B, Cu, Zn, Na, Cr, Cd, Ni, Mo.
4. Mineral Analysis: P, K, Ca, Mg, Fe, Al, B, Cu, Zn, Na, Cr, Cd, Ni, Mo, N, S.
5. Total Mineral (Hot Acid Digestion): P, K, Ca, Mg, Mn, Fe, Al, B, Cu, Zn, Na, Pb, Cr, Cd, Ni, Mo.

Revised C: 09/23/2004 Amuta Littlejohn

Materials & Methods

- A standard sampling protocol was followed
  - Flush water line before collecting water at the well
  - Collect & cap a sample bottle of water.
  - Complete a sample identification sheet
  - Ship immediately to the UGA Soil, Plant and Water Laboratory for analysis
  - Results of analyses were reported to County Agents and after conffering with the Ext. Tobacco Specialist growers were informed.

Materials & Methods

- Sample Analysis
  - pH
  - Alkalinity - ppm
  - Conductivity - µS/cm

Materials & Methods

- Determine need for acid and the required amount using the Purdue/NCSU Acid Addition Calculator

PURDUE UNIVERSITY/NORTH CAROLINA STATE UNIVERSITY GREENHOUSE MEDIA LAB ACID ADDITION CALCULATOR TO CONTROL ALKALINITY IN IRRIGATION WATER

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Questions or problems:
pah@hort.purdue.edu or FAX(317)494-0391 ATTN:Hammer
or Doug_Bailey@.ncsu.edu or FAX (919) 515-7747 ATTN:Bailey

INPUT ALKALINITY VALUES

VIEW RESULTS

PRINT RESULTS

PRECAUTIONS

END

Version 3.1
4/2/1996

RETURN

PURDUE UNIVERSITY/NORTH CAROLINA STATE UNIVERSITY
GREENHOUSE MEDIA LAB ACID ADDITION CALCULATOR

Name: RG3

Street:

City/State/Zip: Coffee County

Laboratory ID #:

Client ID of sample: RG3

Date: 17-Jan-10

Phone Number:

FAX Number:

This spreadsheet provides the recommendations for the amount of acid to add to irrigation water in order to modify the pH and alkalinity levels. In addition, the spreadsheet calculates the amount of added phosphorus and nitrogen that the corresponding acids will provide, plus an economic comparison of each acid.

Your Sample Information

The pH of your sample:	7.51
The alkalinity of your sample:	129.8
Target alkalinity or pH : (pH must be below 7.2)	6.25

Calculated information for your sample

Alkalinity before acid addition

	meq:	2.59
pH = 7.51	ppm of HCO_3:	158.3
	ppm of $CaCO_3$:	129.8

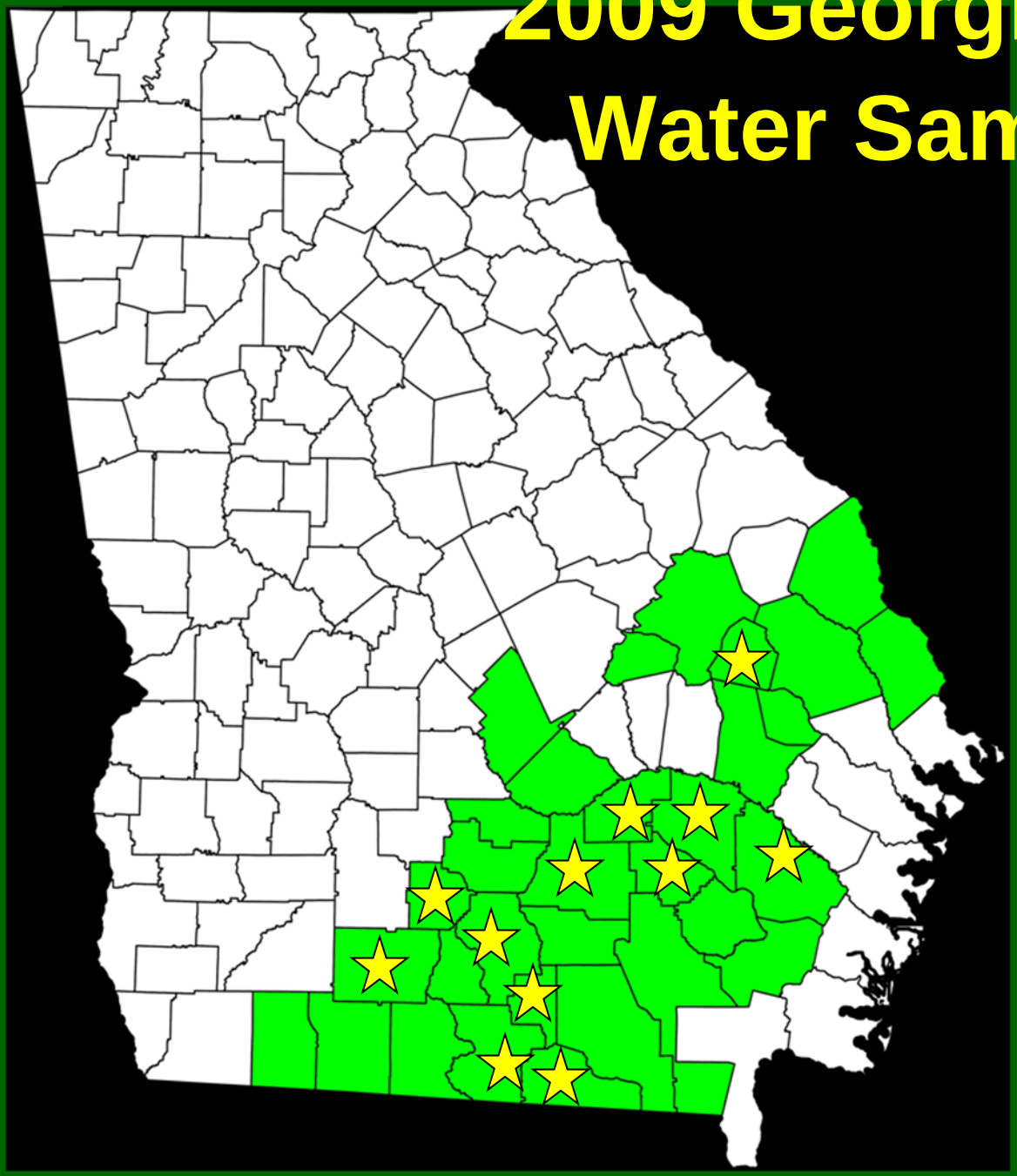
Alkalinity after acid addition

	meq:	1.21
pH = 6.25	ppm of HCO_3:	73.9
	ppm of $CaCO_3$:	60.7

Alternative Acids to Add to Irrigation Water

Acids / Amounts	Phosphoric Acid (75%)	Phosphoric Acid (85%)	Sulfuric Acid (35%)	Sulfuric Acid (93%)	Nitric Acid (61.4%)	Nitric Acid (67%)
For Small Volumes						
ml per liter	0.108	0.089	0.154	0.039	0.104	0.093
fl. oz. per gallon	0.014	0.011	0.020	0.005	0.013	0.012
ml per gallon	0.409	0.336	0.583	0.146	0.392	0.351
For a 1:100 Injector						
fl. oz. per gallon (conc.)	1.38	1.14	1.97	0.49	1.32	1.19
ml per gallon (conc.)	40.93	33.59	58.32	14.62	39.18	35.14
For a 1:128 Injector						
fl. oz. per gallon (conc.)	1.77	1.45	2.52	0.63	1.70	1.52
ml per gallon (conc.)	52.39	42.99	74.65	18.71	50.15	44.97
For a 1:200 Injector						
fl. oz. per gallon (conc.)	2.77	2.27	3.94	0.99	2.65	2.38
ml per gallon (conc.)	81.86	67.17	116.64	29.24	78.36	70.27

2009 Georgia Well Water Samples



				ppm		µS/cm
Date	Lab	Sample	pH	Alkalinity	CO_2	Conductivity
Appling County, James Clark						
01/13/09	2847	BC1	7.92	123.4	2.97	248.0
03/03/09	3597	BC1	6.54	48.0	27.69	585.0
01/13/09	2848	DT1	7.94	146.5	3.36	298.0
01/13/09	2849	DT2	7.88	153.9	4.06	302.0
01/13/09	2850	JRT1	7.20	20.4	2.58	75.6
01/28/09	3068	JRT2	6.20	22.4	28.24	118.0
01/13/09	2851	JT1	7.72	134.8	5.14	297.0
01/13/09	2852	JT2	6.18	8.8	11.64	138.6
01/13/09	2853	SW1	7.84	104.5	3.02	288.0
02/04/09	3157	SW2	6.14	17.4	25.20	146.0
Berrien County, Tim Flanders						
01/30/09	3092	DH1	5.40	6.3	50.08	14.5
01/30/09	3093	MD1	7.49	114.0	7.38	205.0
01/30/09	3094	MD2	7.85	108.1	3.05	190.7
Candler County, David Spaid						
02/02/09	3130	JD1	7.50	109.8	6.95	187.0
02/02/09	3131	JD2	6.95	103.2	23.16	207.0

Coffee County, Eddie McGriff						
01/12/09	2797	CC1	7.55	112.6	6.35	408.0
01/12/09	2799	CC2	7.72	152.4	5.81	345.0
01/12/09	2838	CC3	7.01	68.1	13.30	424.0
01/21/09	2999	DM1	5.45	5.6	39.38	118.0
01/21/09	3000	MS1	7.07	148.8	25.33	308.0
01/16/09	2912	NH1	7.73	115.6	4.31	301.0
01/12/09	2798	RG3	7.51	129.8	8.02	325.0
01/12/09	2836	RR1	6.77	45.8	15.57	107.9
01/12/09	2837	RR2	7.68	175.6	7.34	263.0
01/21/09	2998	RR3	6.57	30.4	16.39	98.0
01/16/09	2913	TA1	7.69	111.2	4.54	267.0
Colquitt County, Glenn Beard						
03/12/09	3779	AF1	7.83	103.9	3.07	238.0
03/12/09	3782	RW1	7.78	110.9	3.68	332.0
Echols County, Justin Shealey						
03/03/09	3599	SC1	7.73	95.9	3.57	219.0
Jeff Davis County, Tim Varnedore						
01/14/09	2888	JW1	7.00	153.9	30.78	315.0
01/21/09	2996	JW1-B	6.92	172.3	41.43	643.0
01/14/09	2889	KW1	5.89	15.8	40.66	201.0

Lanier County, Elvin Andrews						
01/12/09	2834	LI1	4.81	<5.0	0.00	79.6
01/12/09	2835	LI2	7.82	108.2	3.28	256.0
Lowndes County, Jake Price/Calvin Willis						
01/28/09	3066	FW1	7.48	103.2	6.83	70.6
01/28/09	3067	FW2	7.36	98.9	8.64	73.6
Pierce County						
01/21/09	2997	CB6	7.57	132.0	7.11	375.0
01/21/09	2994	JD1	7.59	106.2	5.46	220.0
01/21/09	2991	MF2	7.90	130.1	3.28	313.0
01/21/09	2995	RB4	4.85	5.8	164.14	657.0
01/21/09	2993	RB5B	4.92	9.9	238.53	652.0
01/21/09	2992	RC3	7.66	100.1	4.38	217.0
Tift County, Brian Tankersley						
03/12/09	3780	GR1	7.64	146.6	6.71	284.0
03/12/09	3781	RM1	7.84	132.9	3.84	266.0
Wayne County, Randy Franks						
01/13/09	2815	FB1	7.79	128.2	4.16	286.0
03/03/09	3598	FB5	7.88	84.9	2.24	191.0

Desirable range for selected water analysis determinations of transplant production.

Determination	Desirable range	units
pH	6.2 - 6.8	--
Soluble salts	0 - 75	mhos x 10^{-5}/cm
Alkalinity* as $CaCO_3$	0 - 100	mg/l or ppm
Total carbonates* (TC)	0 - 2	meq

Source: T. David Reed, Float Greenhouse Tobacco: Transplant Production Guide

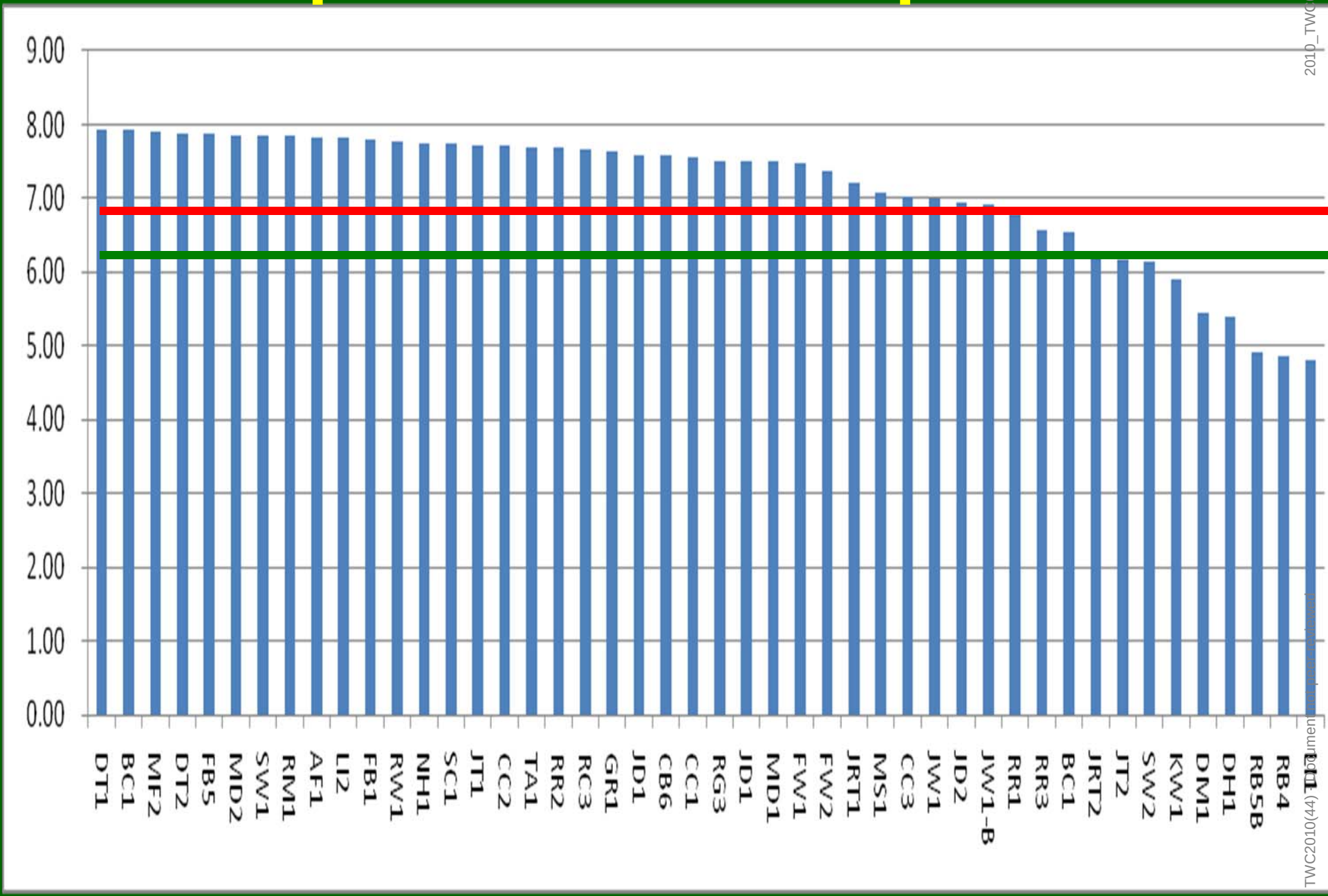
	Total	
Alkalinity	Carbonates	Corrective Action
(ppm or mg/l)	(meq)	
100- 200	2 - 4	neutralize with fertilizer selection (Peters Excel 15-5-15)
200 +	4 +	neutralize with addition of acid

Source: T. David Reed, Float Greenhouse Tobacco: Transplant Production Guide

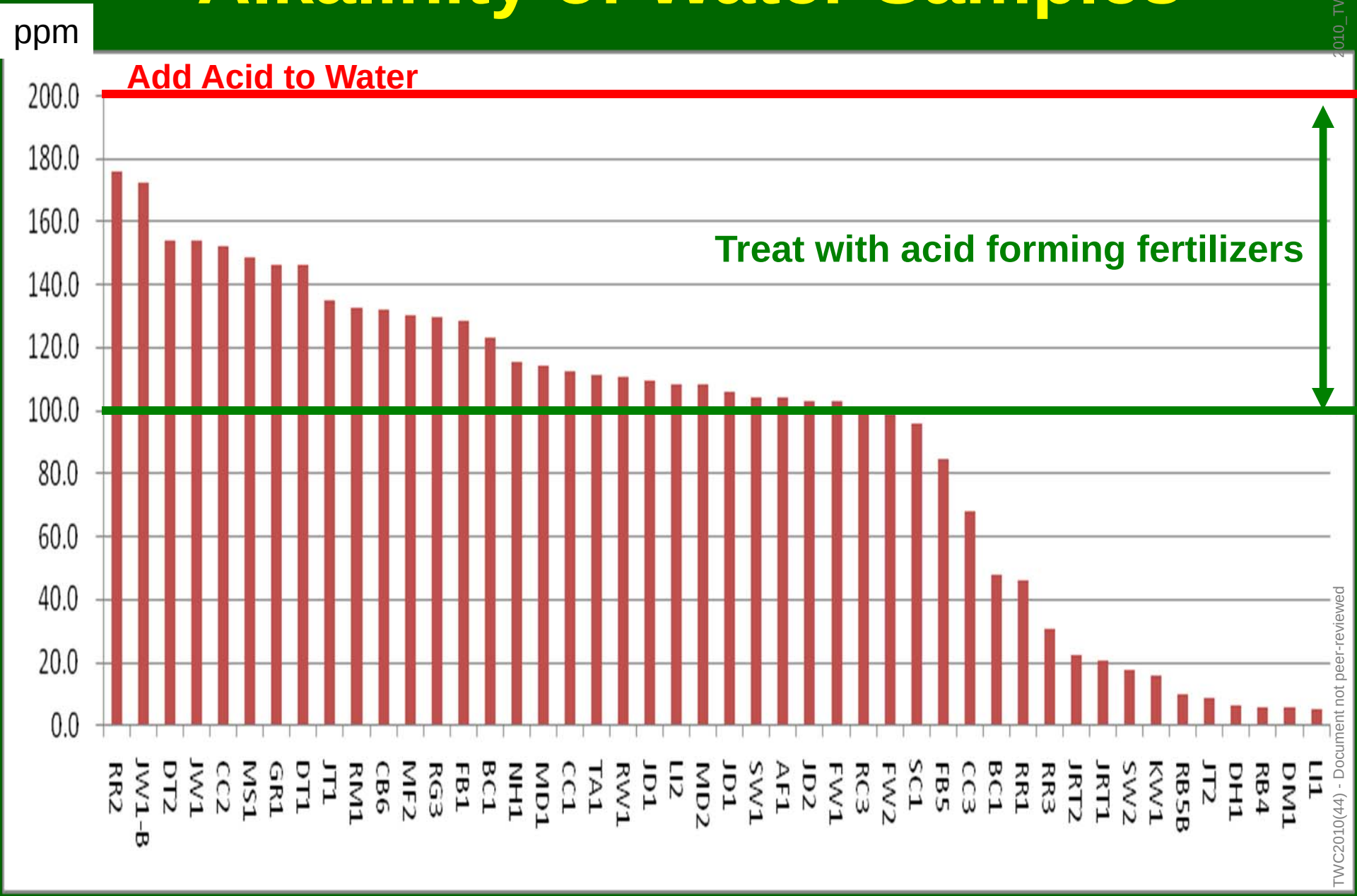
Results & Discussion

- 12 counties
- 46 Samples – 28 - moderate alkalinity
- pH = 4.81 7.94
- Alkalinity = 5 175 ppm
- Conductivity = 14.5 657 µS/cm

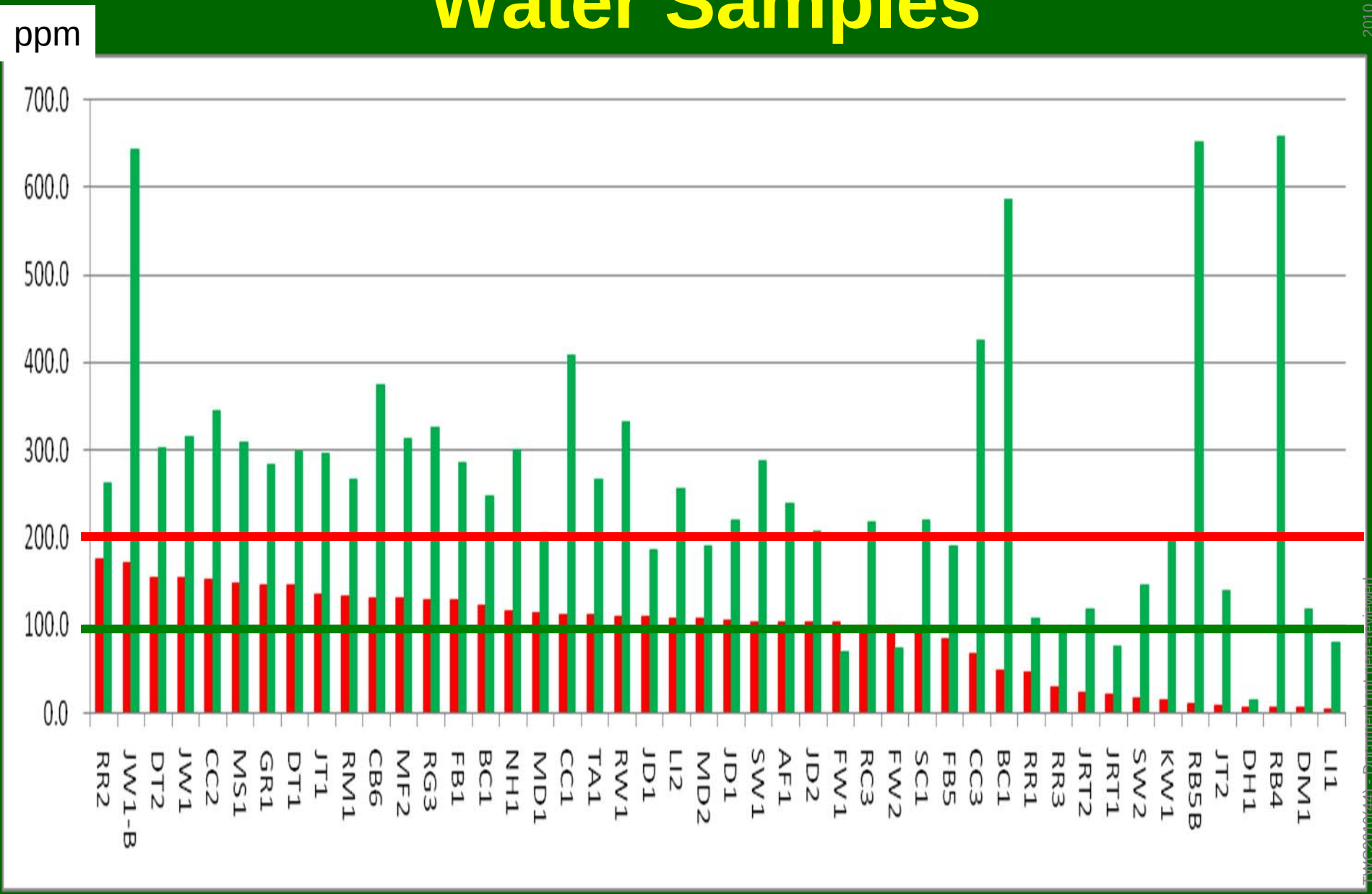
pH of Water Samples



Alkalinity of Water Samples



Alkalinity & Conductivity of Water Samples



Conclusion

- **Results indicate a moderate level of bicarbonate in Georgia Water and little need to acidify the water as it is used.**

- **Acidic fertilizers (20-10-20, 20-20-20) should adequately offset the existing alkalinity.**

Acknowledgements

- David Reed, VA Tech
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- Georgia tobacco growers participating