History of Rapid Blight in the Southwest US

Temporal Variation in Soil Salinity and Sodium

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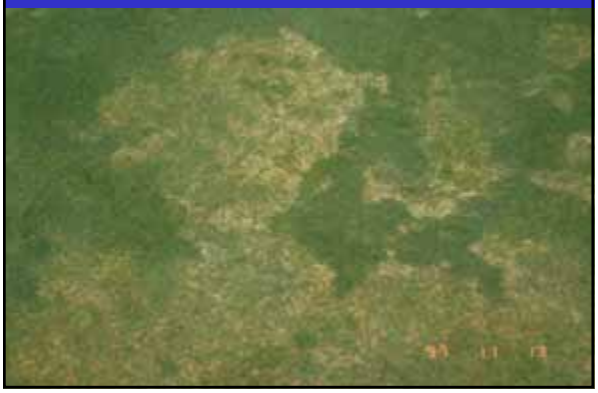
http://www.apsnet.org/online/feature/rapid/

First Observation of Rapid Blight, Poa annua
December 12, 1995 - Santa Ana Country Club
David Zahrte, CGCS, Superintendent

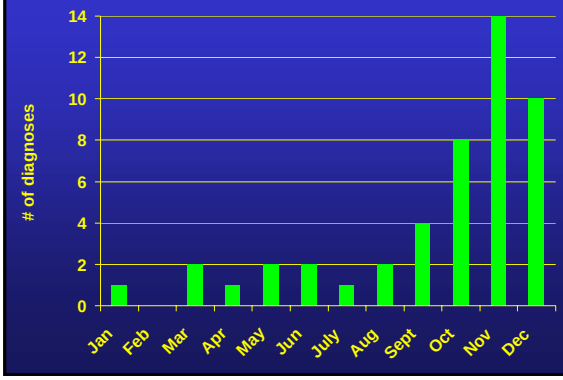
November 13, 1997 - Santa Ana, Poa annua



Poa annua

- Single-celled
- Holocarpic
- Tentatively identified as a chytridiomycete fungus – WRONG!

Timing of attack on poa greens
Predominantly 4th Quarter of the year



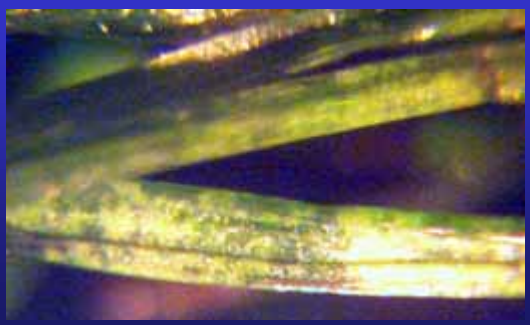
November 5, 1999 - Estrella Mountain Ranch
Poa Trivialis, Mick Twito, Superintendent

Poa trivialis overseeded bermuda, Arizona

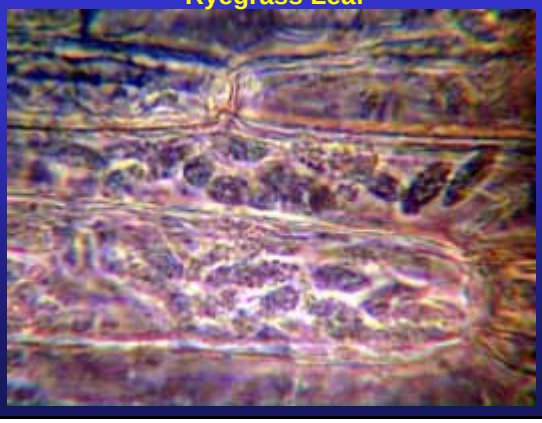
Ryegrass overseeded bermuda

Ryegrass overseeded bermuda, Arizona

Ryegrass Leaf Symptoms



Ryegrass Leaf

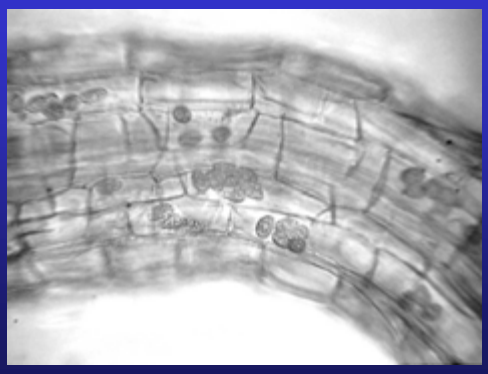


December 20, 2000
Tommy Witt and Randall Glover
Poa trivialis overseeded bermuda
Cassique Golf Course
Kiawah Island, South Carolina

- First East Coast diagnosis
- Dr. Bruce Martin Contacted
- Dr. Mary Olsen and Dr. Frank Wong join the quest shortly thereafter
- The project gets “legs”
- The rest is history

November 25, 2002 Penn A4 bentgrass
Hillcrest Country Club, Los Angeles
Reed Yenny, CGCS

Penn A4 bentgrass, Southern California



Koch’s Postulates

- Disease continues to spread from diseased to healthy plants within sample plugs in the laboratory – not good enough.
- Attempts to isolate the pathogen on water agar, PDA, media etc. failed
- Attempts to isolate the pathogen on standard chytrid media by Jim Adaskaveg, UC Riverside, failed

Koch’s Postulates Continued

- Steve Alderman, USDA, has reproduced the disease by seeding poa trivialis into soil from samples that were previously killed by the pathogen – close but no cigar.
- In 2003 Mary Olsen, U of A, nails the ID as Labyrinthula and completes Koch’s postulates – wins steak dinner.

Diagnosed in 10 states (and the UK)

Temporal Variation

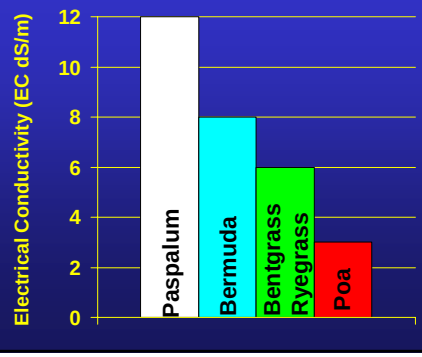
Managing Soil Sodium

- Rainfall patterns
- Irrigation volumes
- Water quality
- Soil texture and drainage
- Soil amendments

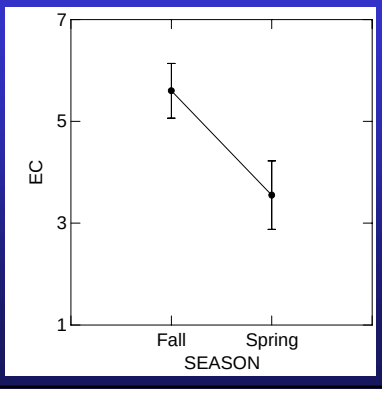
Martin, Olsen and Wong

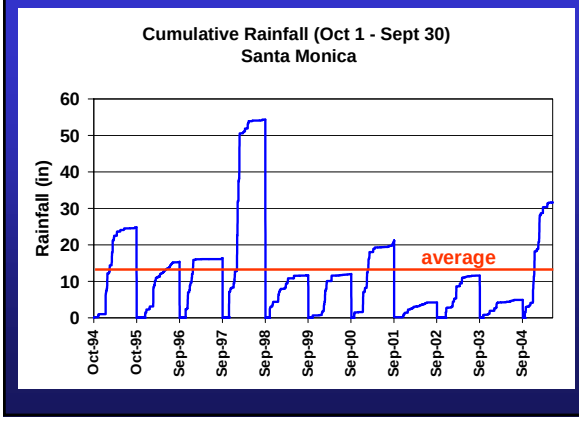
- Sodium (Na) is a critical element for pathogenesis
- Estimated sodium threshold for rapid blight is 114 ppm or higher in sandy soil
- Soil salinity threshold is 2 dS/m or higher
- Potassium may reduce disease severity

Turfgrass Tolerance to Soil Salinity (dS/m)



Soil EC (dS/m) through the seasons



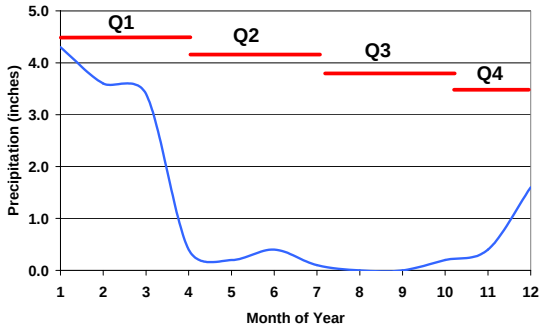


CASE Studies

Bad Water
Death Valley
285 ft below sea level

HCO3	96 ppm
RSC	0
SAR	92
TDS	37,632 ppm
Na	11,973 ppm
Cl	20,833 ppm
B	55 ppm

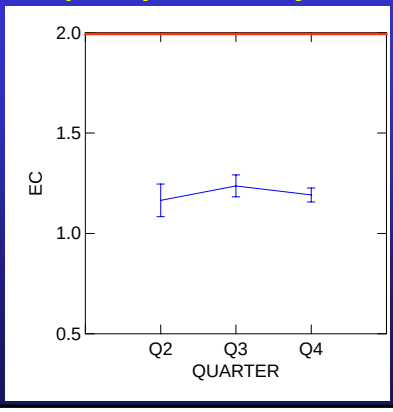
Southern California Rainfall



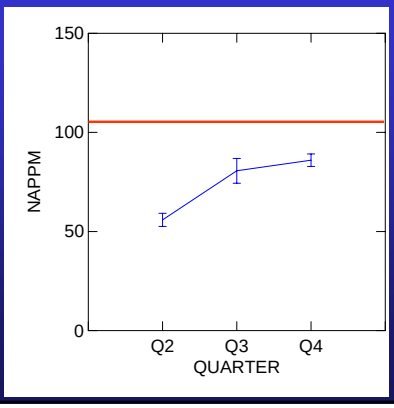
Irrigation Water Quality Comparisons

	No Restriction	Friendly Hills	Santa Ana	CAP	Silverleaf Recycled
EC dS/m	<0.8	0.6	0.6	1.0	1.4
TDS pppm	<525	378	380	640	867
pH	6.5 – 7.8	8.1	8.4	8.0	7.0
SAR	<3.0	0.9	9.1	2.4	3.8
HCO3 ppm	<50	266	184		189
Na ppm	<100	30	117	93	150
RSC meq/l	<1.0	0.0	2.7		0.0
B ppm	<0.5	0.1	0.2		0.3
Cl ppm	<90	45	71	86	187
NO3 ppm	<8.0	3.6	0.5	0.2	18

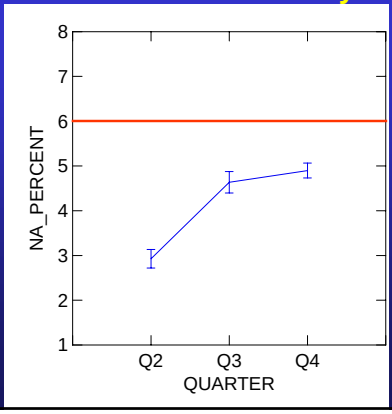
EC (dS/m) at Friendly Hills



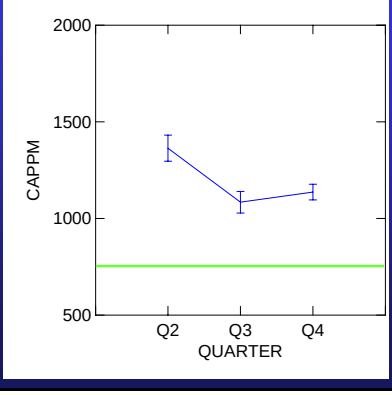
Sodium at Friendly Hills



Percent Sodium at Friendly Hills



Calcium at Friendly Hills



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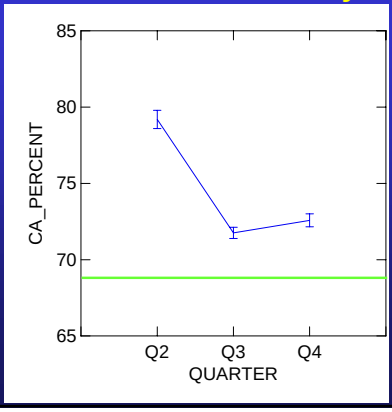
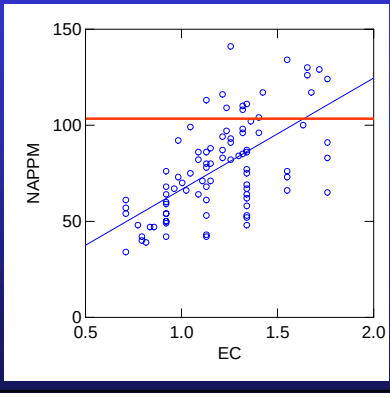


Sodium vs. EC at Friendly Hills



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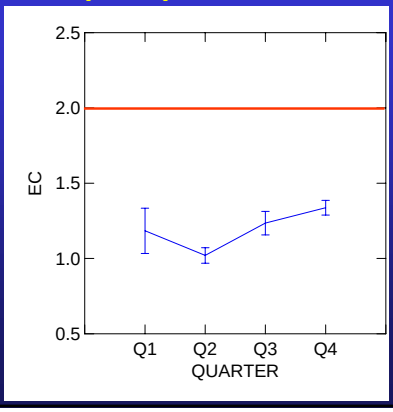

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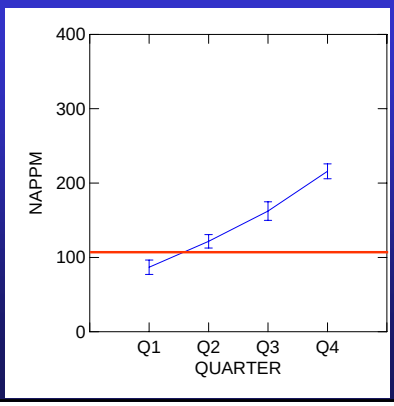

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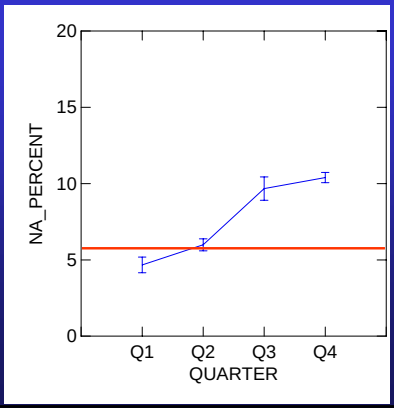

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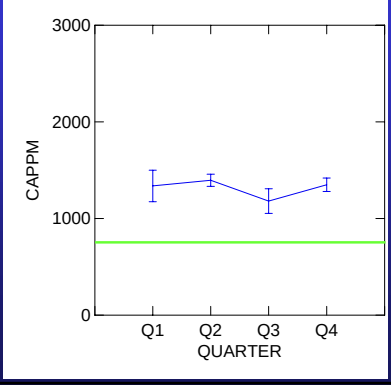

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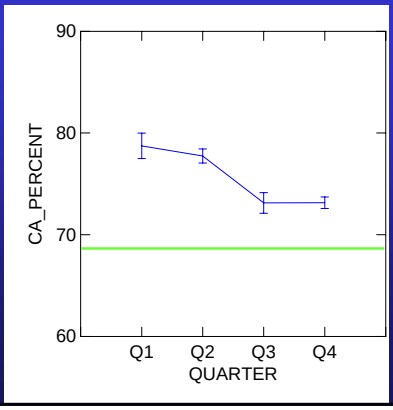
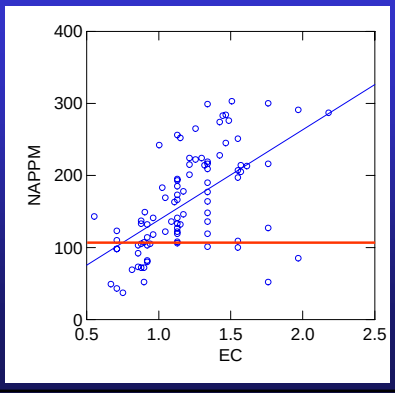
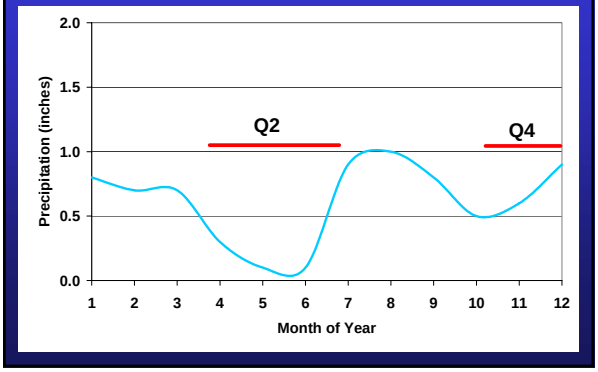


EC vs Sodium at Santa Ana



Phoenix, Arizona Rainfall



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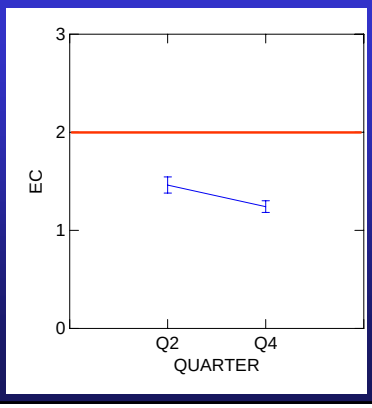
Average EC for Arizona Greens



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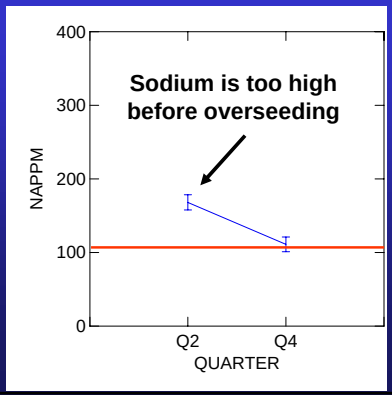
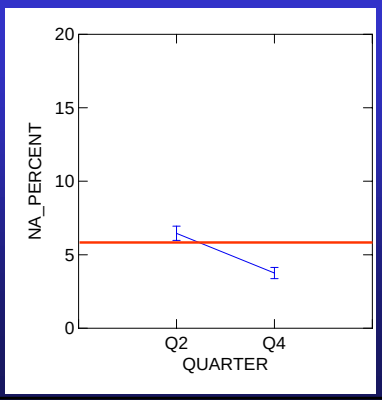
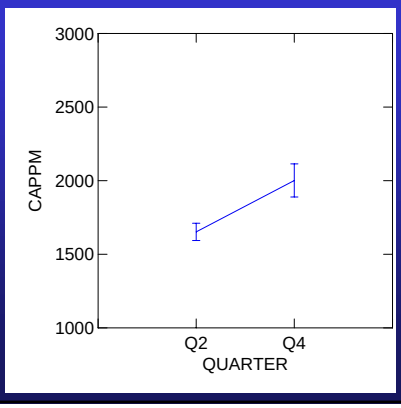


Average Percent Sodium Arizona Greens



Average Calcium for Arizona Greens



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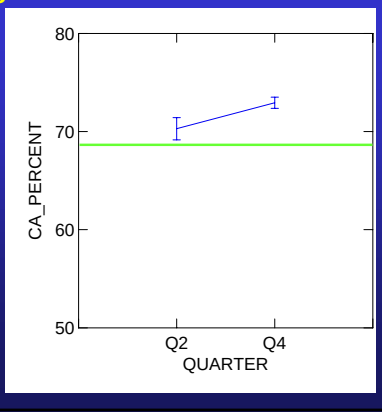
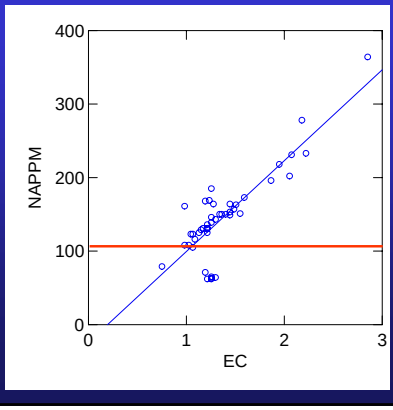


Sodium vs. EC for Arizona Greens



EC meters for field measurement of soil salinity

Calcium to Manage Sodium

- Gypsum: $CaSO_4*2H_2O$ (23% Ca)
  - 10 lbs/1000 sq ft monthly and leach
- Calcium chloride: $CaCl_2$ (36% Ca)
  - Fairways only so far
  - 100 – 200 lbs/acre, 5 – 6 applications
- Pounds on the ground!

Using Calcium to Displace Sodium

- Reported Na ppm – 110 ppm = excess Na ppm
- Excess Na ppm * 0.04 = lbs Ca needed per 1000 sq ft
- Lbs Ca/ 0.23 = $CaSO_4$ requirement
- Lbs Ca/ 0.36 = $CaCl_2$ requirement

Using Calcium to Displace Sodium: Precautions

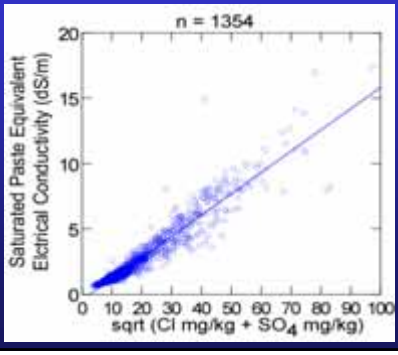
- Do not apply more than 10 lbs $CaSO_4$ per 1000 sq ft per application to greens.
- Allow minimum of 14 days between applications – 28 days if high rates used
- Do not apply more than 200 lbs $CaCl_2$ per acre to fairways per application per month

EC meters measure SO4-S and Cl

- Electrical conductivity is related to soil salinity
- The main anions that are measured are sulfate and chloride
- Calcium amendments add to the soil pool of sulfate and chloride – select wisely.

Soil Electrical Conductivity vs. Cl and SO4-S

Multiple r^2=0.92



Soil Electrical Conductivity vs. Cl and SO4 -S

$$EC\ (dS/m) = 0.16 \times \sqrt{SO_4 \frac{mg}{kg} + Cl \frac{mg}{kg}} - 0.44$$

r^2 = 0.92 p<0.001

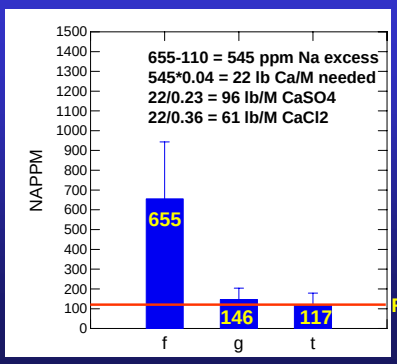
Chloride and Sulfur Damage Threshold

	EC dS/m	Cl mg/kg	SO4 mg/kg	Cl + SO4 mg/kg
Poa	3	185	265	462
Ryegrass	6	787	935	1620
Bermuda	8	1411	1607	2783

Realistic Guideline ~50% of Damage Threshold

	EC dS/m	Cl mg/kg	SO4 mg/kg	Cl + SO4 mg/kg
Poa	2	90	130	200
Ryegrass	4	400	460	800
Bermuda	6	700	800	1300

Sodium in Arizona Golf Course Soils



Rapid Blight

Sodium Applied in Irrigation Water

(100 ppm Na in water) * 2.72 = 272 Na/A ft

272 lb Na/A ft * 5 acre ft/A = 1360 lbs Na/acre

Estimated Accumulation of Sodium in Soil

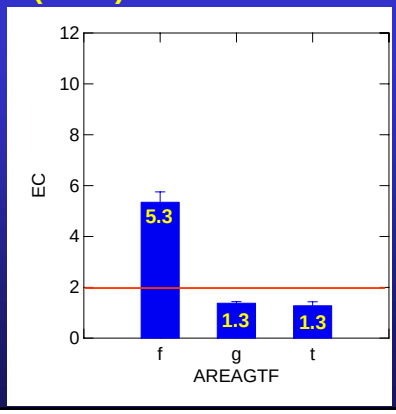
0.5 * 1360 lbs/A = 680 ppm Na increase/year

680 ppm Na – 110 = 570 ppm excess Na

570 ppm Na excess * 0.04 = 23 lb Ca/M required

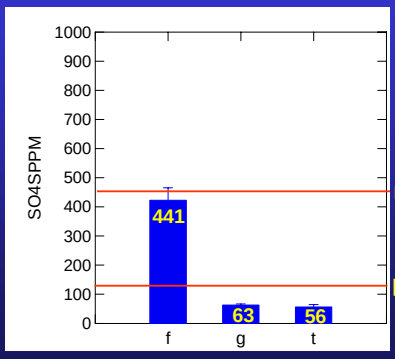
(22 lb Ca/M)/0.23 = 100 lbs gypsum/M (~2 tons/acre)

EC (dS/m) in Arizona Golf Course Soils



Rapid Blight

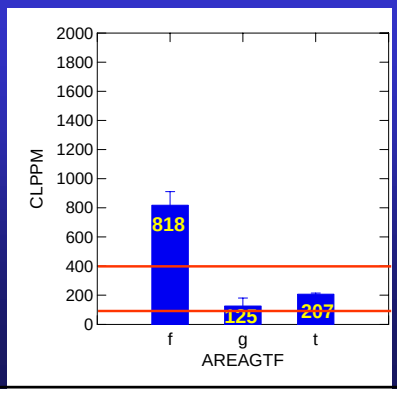
SO4-S in Arizona Golf Course Soils



rye

poa

Cl in Arizona Golf Course Soils



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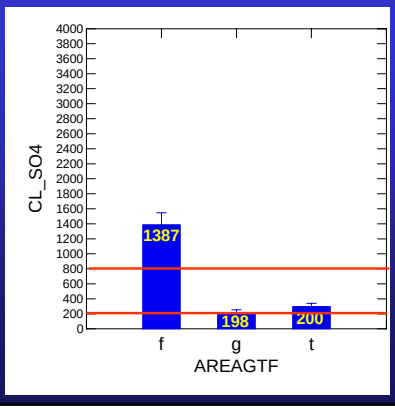
Cl + SO4-S in Arizona Golf Course Soils



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poa

Arizona Rapid Blight Management

- Preliminary data suggests that salts have been managed effectively
- Sodium may be the weak link
- Summer calcium applications and leaching will be needed to move sodium out of the soil
- Increased leaching is needed to move sulfur and chloride out of the root zone

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