Managing Rhizosphere pH In Container Production

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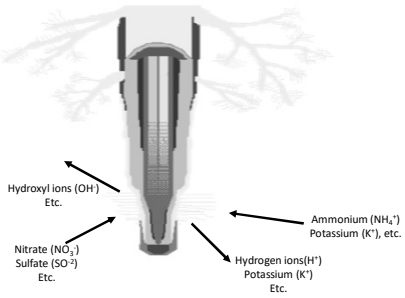
Why is rhizosphere pH important?



Nutrient Uptake
Influx/Efflux Processes and Selective

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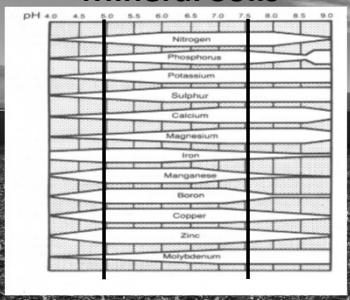
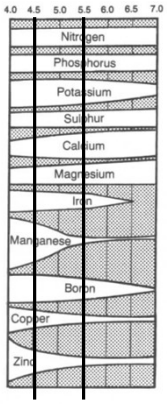
Nutrient Solubility Mineral Soils



*Mineral (Field) Soils
E. Truog U.S.D.A. Yearbook
1941-1947, p. 566-576.



Nutrient Solubility Container Media

***Soilless Media**

Handreck, K.A. and N.D. Black. 1999. Growing media for ornamental plants and turf. University of New South Wales Press.

Chelates and Their Chemical Properties

Chelates, chemical formula, molecular weight (M.W.), formation constants, and the pH range at which the chelate usually forms a stable complex with iron (Fe) (Bachman, 1993; Norvell, 1971).

			Formation constants				Fe-chelate pH stability range	
Chelate	**Formula**	**M.W.**	**Fe**	**Cu**	**Zn**	**Mn**	**Lower Limit**	**Upper Limit**
CDTA[1]	$C_{12}H_{22}O_6N_2$	346	29.4	22.2	19.6	17.7	4.0	7.0-7.5
DTPA[2]	$C_{14}H_{23}O_{10}N_3$	393	29.2	22.6	19.7	16.7	4.0	7.0-7.5
EDDHA[3]	$C_{18}H_{20}O_6N_2$	360	35.3	>24.9	17.8	--	4.0	9.0
EDTA[4]	$C_{10}H_{16}O_8N_2$	292	26.5	19.7	17.2	14.5	4.0	6.3
EGTA[5]	$C_{14}H_{20}O_{10}N_2$	380	21.9	18.6	13.8	13.2	4.0	5.2
HEDTA[6]	$C_{10}H_{18}O_7N_2$	278	20.8	18.2	15.2	11.5	4.8	6.7

[1]Cyclohexanediaminetetraacetic acid
[2]Diethylenetriaminepentaacetic acid
[3]Ethylenediaminedi-o-hydroxyphenylacetic acid
[4]Ethylenediaminetetraacetic acid
[5]Ethyleneglycol-bis(2-aminoethylether)tetraacetic acid
[6]Hydroxyethylethylenediaminetriacetic acid

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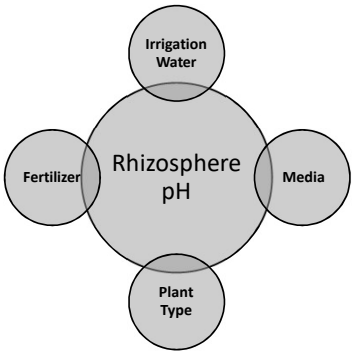
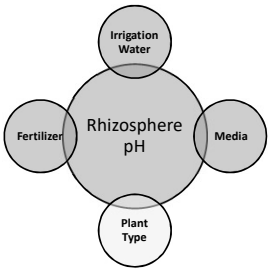
Variables Influencing pH



Variables Influencing pH



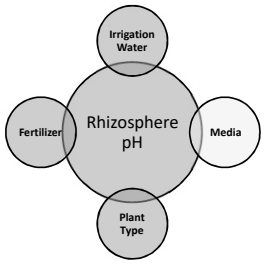
***Jeong, K.Y., P.V. Nelson, C.E. Niedziela Jr. and D.A. Dickey. 2016. Effect of plant species, fertilizer acidity/basicity, and fertilizer concentration on pH of soilless root substrate. HortScience 51(12):1596-1601**

Plant Type

<u>Decrease pH</u>
***Tomato**
***Dianthus**
***Sunflower**
***Kalanchoe**

<u>Increase pH</u>
***Marigold**
***Vinca**
***Zinnia**

Variables Influencing pH

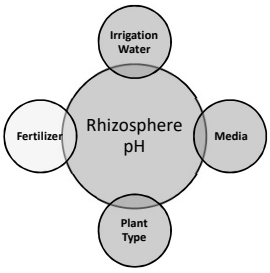


Substrates

Slightly acid – neutral pH
- *Coconut husks (6.0 – 7.0)
- *Hypnum Peats (4.0 -7.5)
- *Hardwood barks (> 7.0)
- *Softwood barks (6.0 – 7.0)
- *Rice hulls (~ 7.0)
- *Vermiculite (7.0 – 8.0)

Acidic pH
- *Sphagnum Peats (3.0 – 5.0)
- *Composts (variable)

Variables Influencing pH

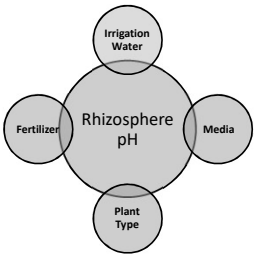


Fertilizer

Decrease pH
- *Ammonium-Nitrogen
- *Sulfur

Increase pH
- *Nitrate-Nitrogen
- *Lime
- *Dolomite

Variables Influencing pH



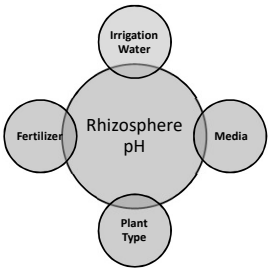
Irrigation Water

Increase pH
Alkalinity

Meq/L
1 meq/L = 50 ppm calcium carbonate = 61 ppm bicarbonate

0.0 - 1.0	low
1.0 - 3.6	acceptable
1.5 – 4.0	marginal
4.0 – 6.0	high
>6	very high

Alkalinity

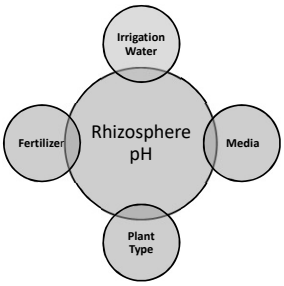


Alkalinity is the measure of the water's ability to increase pH (neutralize acids). This is through the carbonates (CO_3^{2-}) and bicarbonates (HCO_3^-)

Meq/L
1 meq/L = 50 ppm calcium carbonate = 61 ppm bicarbonate

0-1	low
1-3.6	acceptable
1.5-4	marginal
4-6	high
>6	very high

Variables Influencing pH



Irrigation Water

Acidifying Agents

***Sulfuric acid**
***Nitric acid**
***Citric acid**
***phosphoric acid**

***Acidic Fertilizers**

1. Reducing Water Alkalinity

- 1> How much water alkalinity do we remove?
- 2> Do we acidify year round or only during growing season?
- 3> Does acidification affect fertilizers?

2. Establishing dolomite rates for root media

- 1> How much dolomite should be added?
- 2> How long does the regulation of media pH from dolomite last?
- 3> Longevity of calcium carbonate vs. magnesium carbonate?

San Marcos Growers

Well Water

Alkalinity = 6.5 meq/L alkalinity
pH = 7.7
Magnesium = 36 ppm
Calcium = 147 ppm
EC = 1.20 dS/m

Plant Palette

Propagation material
CA Native
Australian/South African
Winter-dormant perennials
Summer-dormant perennials

Treatments

- Media Types

Acid media (Australian Mix)
Slightly acid media (Regular Mix)

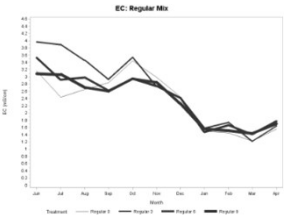
Dolomite Rates (lb/yd)

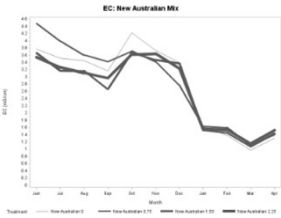
Australian Mix	Regular Mix
0.00	0.00
0.75	3.00
1.50	6.00
2.25	9.00

Monthly Pour-Thru

Measure
EC
pH
Calcium
Magnesium

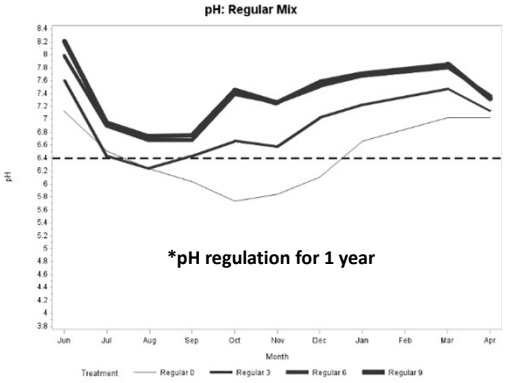
Electrical Conductivity

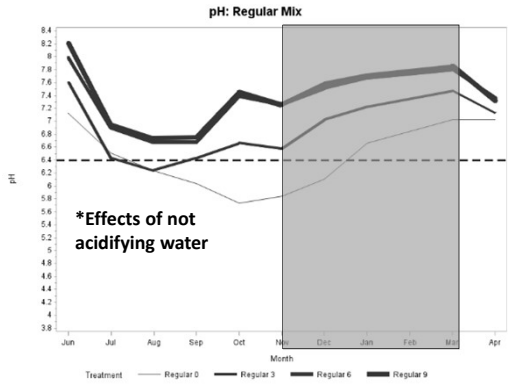


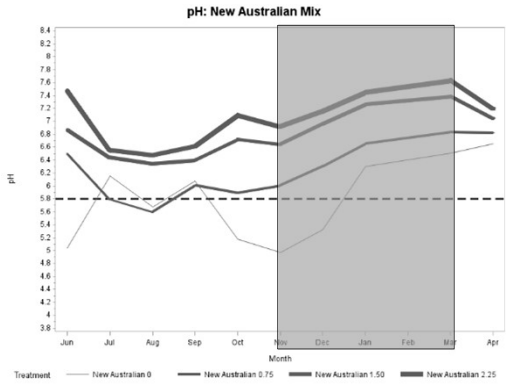


Fertilized through CRF added to media

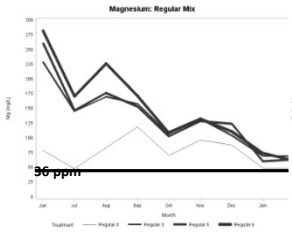
Keep Records

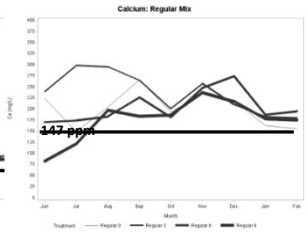






Magnesium and Calcium



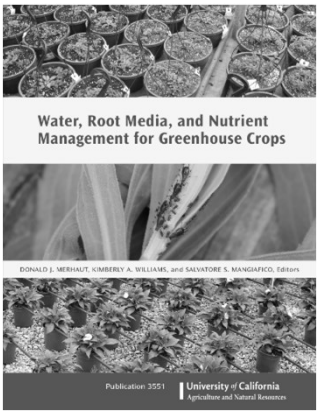


Conclusions

- 1> Dolomite AG65 pH regulation lasted a year
- 2> Acidifying water impacts media pour-thru pH
- 3> $MgCO_3$ breaks down faster than $CaCO_3$

??????????

- Acidify year round or seasonally? Depends on crop



Deal with Change

Mike Eliason,
Santa Barbara Fire Department
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SMG Staff

Laboratory Staff
Audrey Pong
Jennielynn Bazan
Joe Saharat