

# Troubleshooting Drip/Micro For Avocados

**Stuart Styles**  
**[itrc.org](http://itrc.org)**

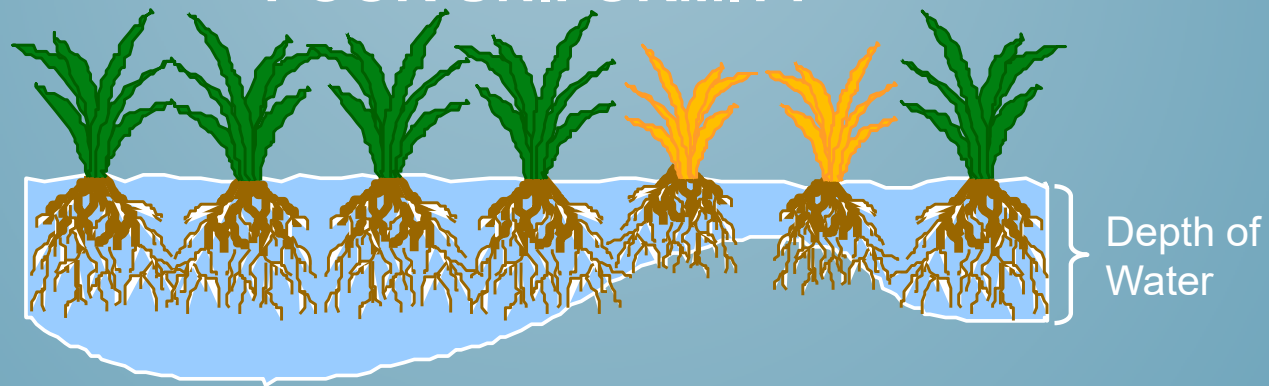
# SUMMARY

1. *Irrigation Performance Assessment*
2. *Preventative Maintenance for Drip*
3. *Water Quality/Salinity Issues*
4. *Fertigation*

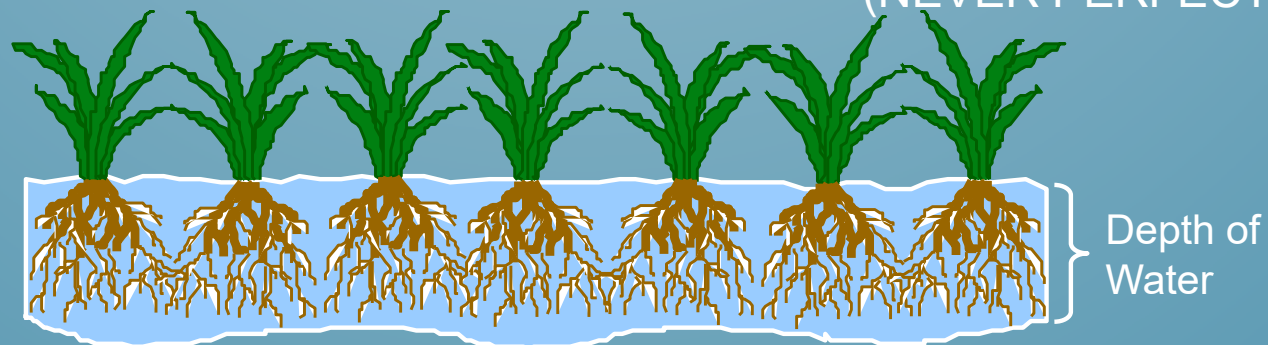
# Uniformity of the Irrigation System

*How evenly is water applied to individual plants throughout the field?*

## POOR UNIFORMITY



## GOOD UNIFORMITY (NEVER PERFECT)



# Uniformity of the Irrigation System

By the way – where do you

- Put soil moisture sensors?
- Measure fertility/take leaf samples?



# ET/Weather Stations

- Need at least one full station
- Need additional precipitation and temperature stations
- Current Companies (not complete):

Climate Minder: [www.climateminder.com](http://www.climateminder.com)

Ranch Systems: <http://www.ranchsystems.com/ssite/index.shtml>

PureSense: <http://www.puresense.com/> (Now, owned by Jain)

GroPoint: [http://www.esica.com/products\\_gropoint\\_wireless.php](http://www.esica.com/products_gropoint_wireless.php)

Hortau: <http://www.hortau.com/en/home/>

Adcon: [http://www.mccrometer.com/products/product\\_mccrometerconnect.asp](http://www.mccrometer.com/products/product_mccrometerconnect.asp)

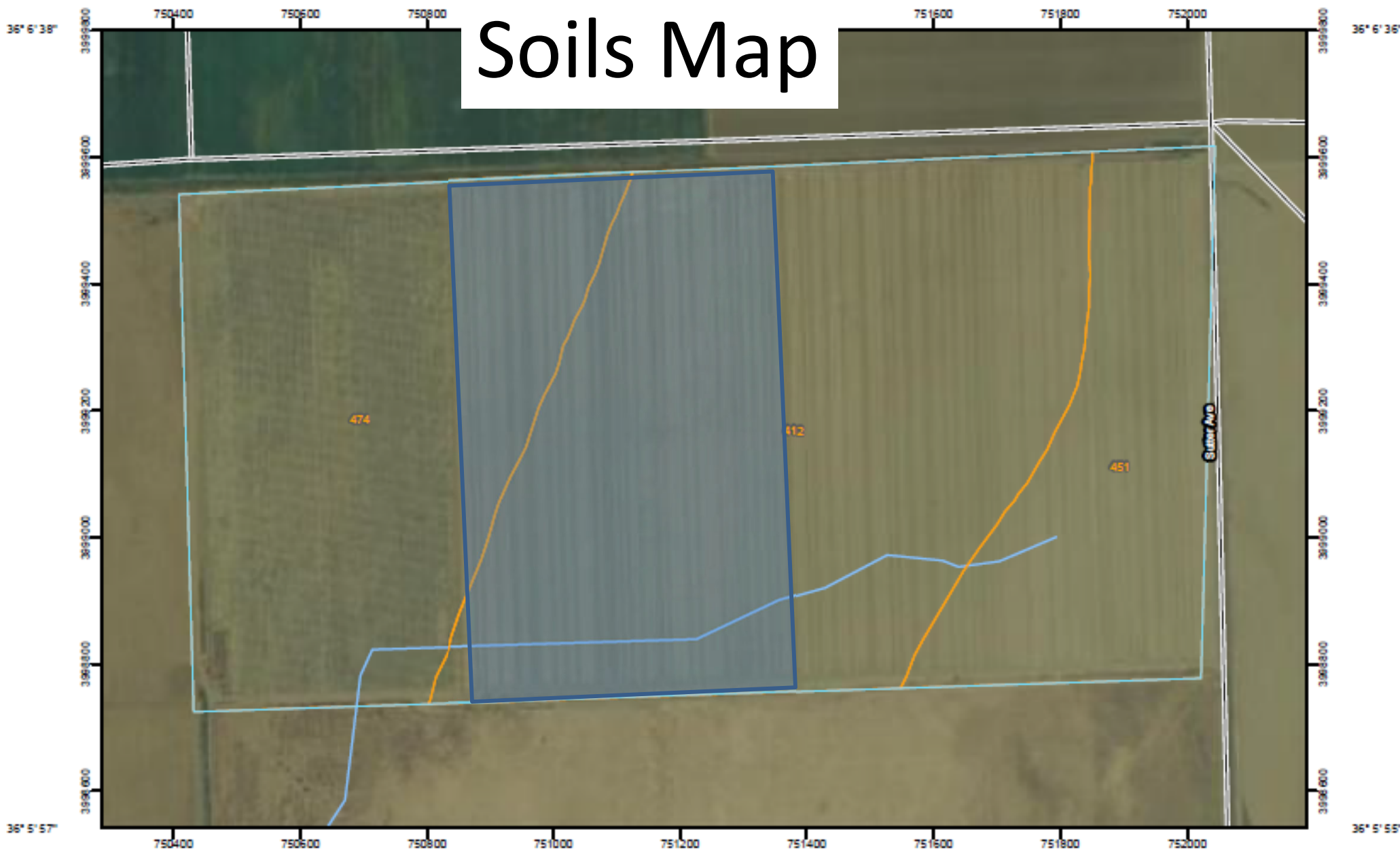
# Irrigation System Evaluations Example

Nichols Farms  
Johnny Starling/Joe Perez

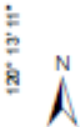




# Soils Map



Map Scale: 1:9,020 if printed on A size (8.5" x 11") sheet.





# PC Emitter Evaluated

## PC DRIPPER

ON-LINE PRESSURE-COMPENSATING,  
CONTINUOUSLY SELF-CLEANING DRIPPER



### TECHNICAL INFORMATION

- Recommended filtration: 130 micron / 120 mesh.
- Filtration method: TurboNet™ lat
- To be inserted
- Injected dripper, very low CV.
- UV resistant. Resistant to standard nutrients used in agriculture.
- PC on-line drippers meet ISO 9261 Standards with production certified by the Israel Standards Institute (SII).

Minimum pressure 7psi

See  
the  
instructions.

### DRIPPERS TECHNICAL DATA

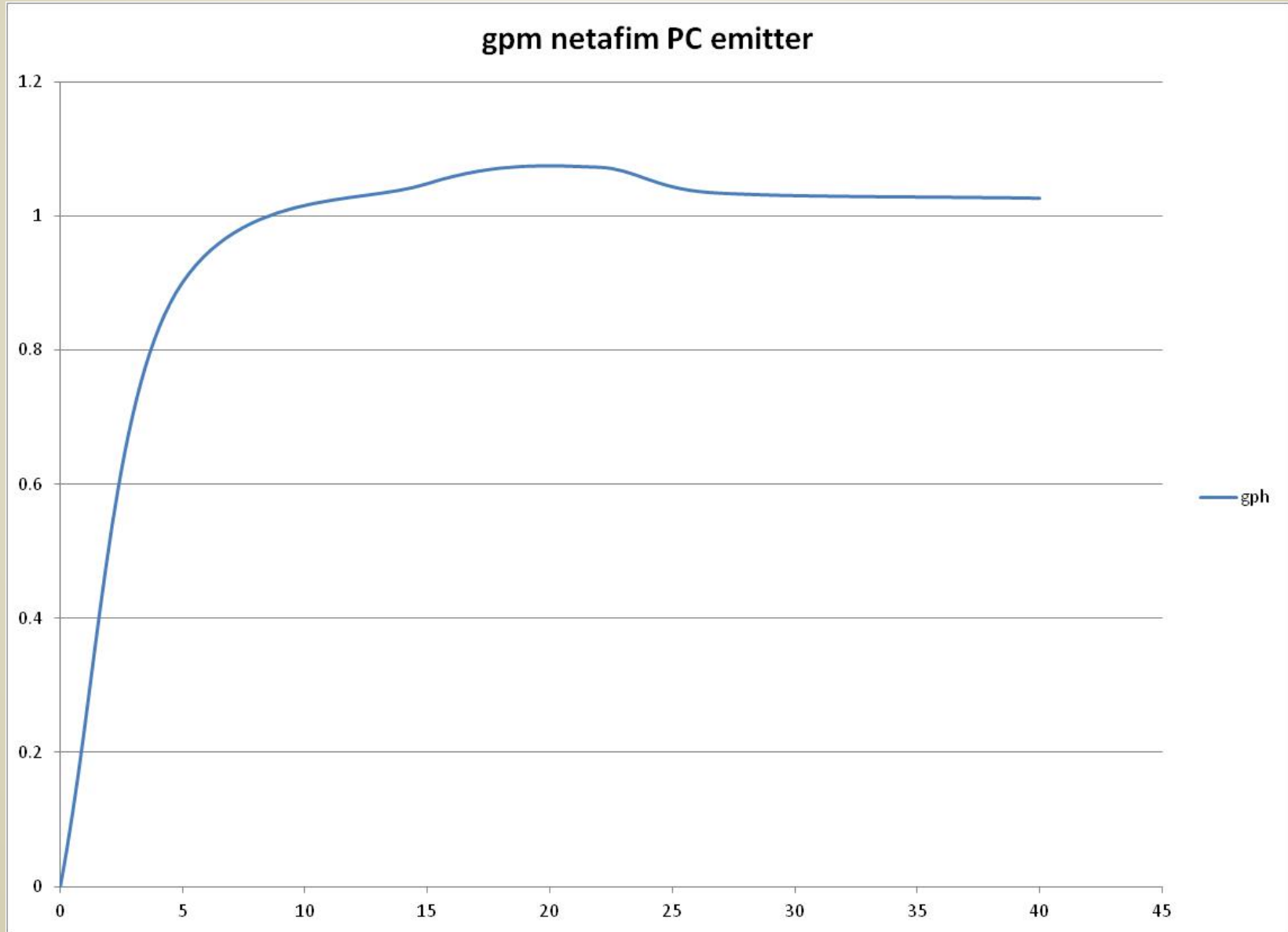
PC drippers

FLOW RATE (L/H)	WORKING PRESSURE RANGE (BAR)	WATER PASSAGE DIMENSIONS WIDTH-DEPTH-LENGTH (MM)	FILTRATION AREA (MM <sup>2</sup> )	CONSTANT K	EXPOONENT X	BASE CODE COLOR	CAP COLOR CODE
2.0	0.5 - 4.0	1.17 x 1.07 x 61	2.0	2.0	0	Red	Black
4.0	0.5 - 4.0	1.32 x 1.40 x 60	2.0	4.0	0	Black	Black
8.5	0.5 - 4.0	1.60 x 1.60 x 17	2.0	8.5	0	Green	Black

\*Within working pressure range

# PC Emitter Evaluated

Flow Rate (gph)



Pressure (PSI)

# Results Year 1

## DRIP/MICRO EVALUATION: RESULTS

GLOBAL SYSTEM DULQ .....  
(Low Quarter Infiltrated / Average Infiltrated)



DISTRIBUTION UNIFORMITY PROBLEMS -  
PERCENT OF TOTAL NON-UNIFORMITY DUE TO EACH PROBLEM:

Pressure differences ..... 53%

Difference between manifold inlet pressures: 1 psi

Difference between hose inlet pressures: 2 psi

Maximum pressure difference within a hose: 13 psi

Other causes of flow variation ..... 47%

# Results – Year 2

## DRIP/MICRO EVALUATION: RESULTS

GLOBAL SYSTEM DULQ .....  
(Low Quarter Infiltrated / Average Infiltrated)



DISTRIBUTION UNIFORMITY PROBLEMS -  
PERCENT OF TOTAL NON-UNIFORMITY DUE TO EACH PROBLEM:

Pressure differences ..... 26%

Difference between hose inlet pressures: 17 psi

Maximum pressure difference within a hose: 20 psi

Other causes of flow variation ..... 73%

Unequal Drainage ..... 1%

# Results – Year 3

## DRIP/MICRO EVALUATION: RESULTS

GLOBAL SYSTEM DULQ .....  
(Low Quarter Infiltrated / Average Infiltrated)

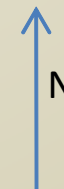
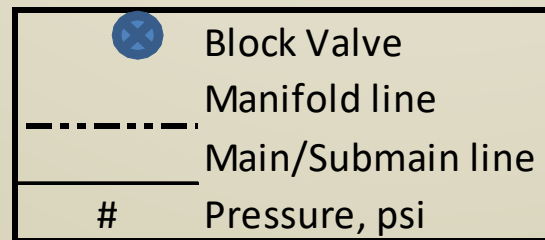
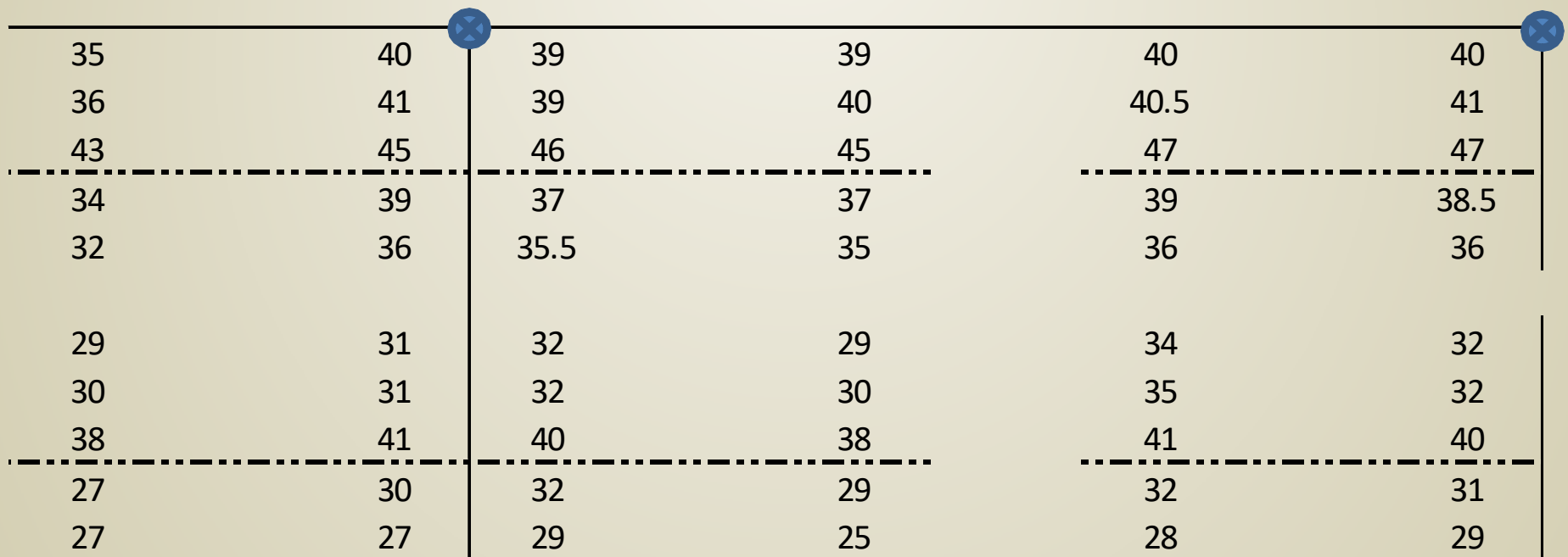


DISTRIBUTION UNIFORMITY PROBLEMS -  
PERCENT OF TOTAL NON-UNIFORMITY DUE TO EACH PROBLEM:

Pressure differences .....	16%
Difference between hose inlet pressures across the field:	9 psi
Maximum pressure difference within a hose:	13 psi
Other causes of flow variation .....	84%
Unequal Spacing .....	0%
Unequal Drainage .....	0%

# Pressure Distribution

## Pressure (psi) Differences along Laterals





# Measuring volumes



**ITRC**

**Cal Poly**

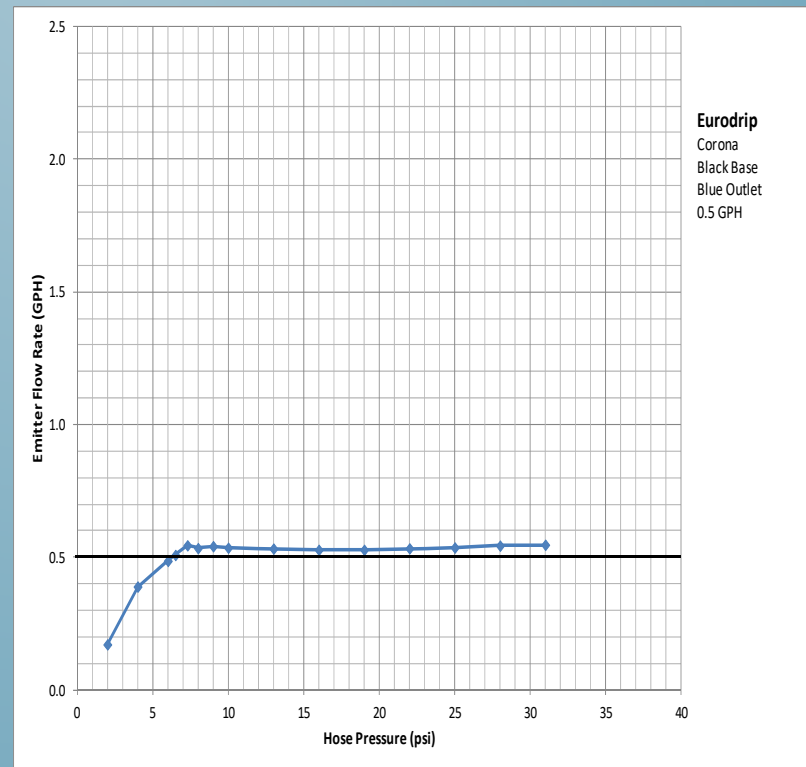
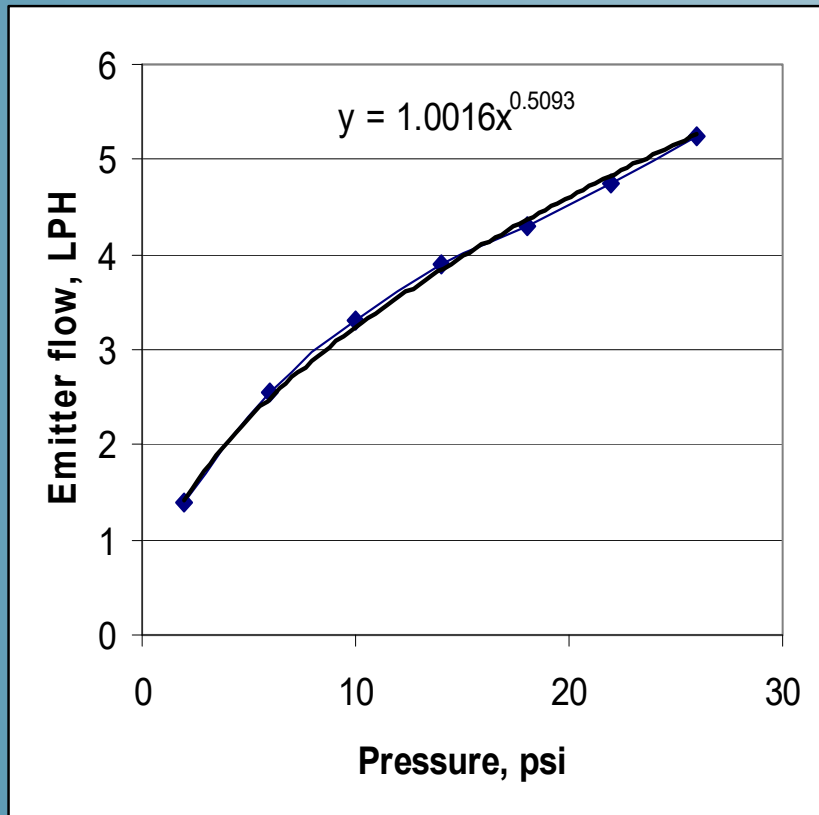


# Components

# Pressure Differences

## Non-PC emitters

## PC emitters



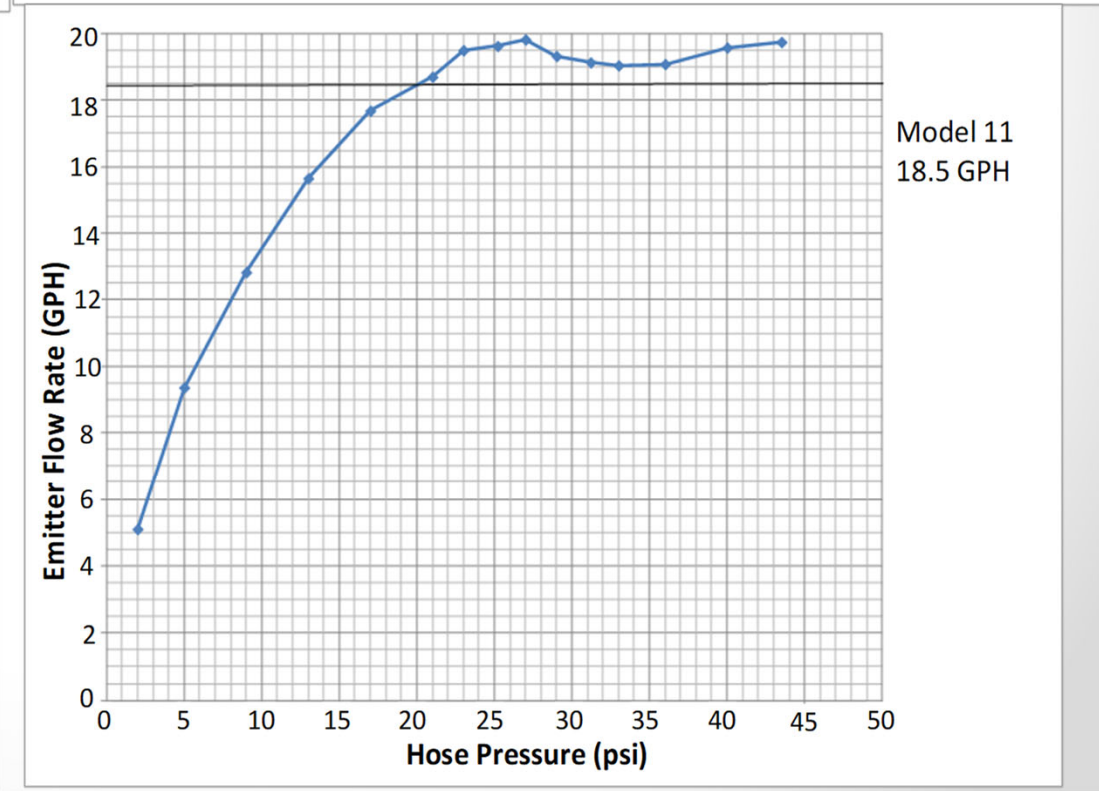
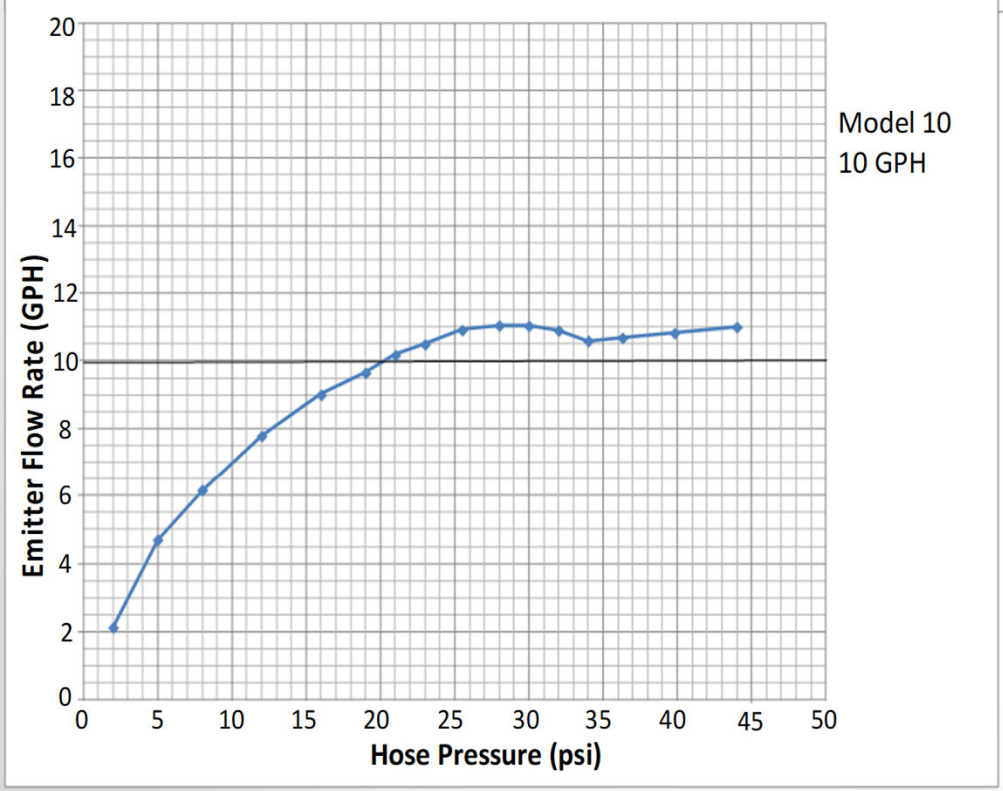
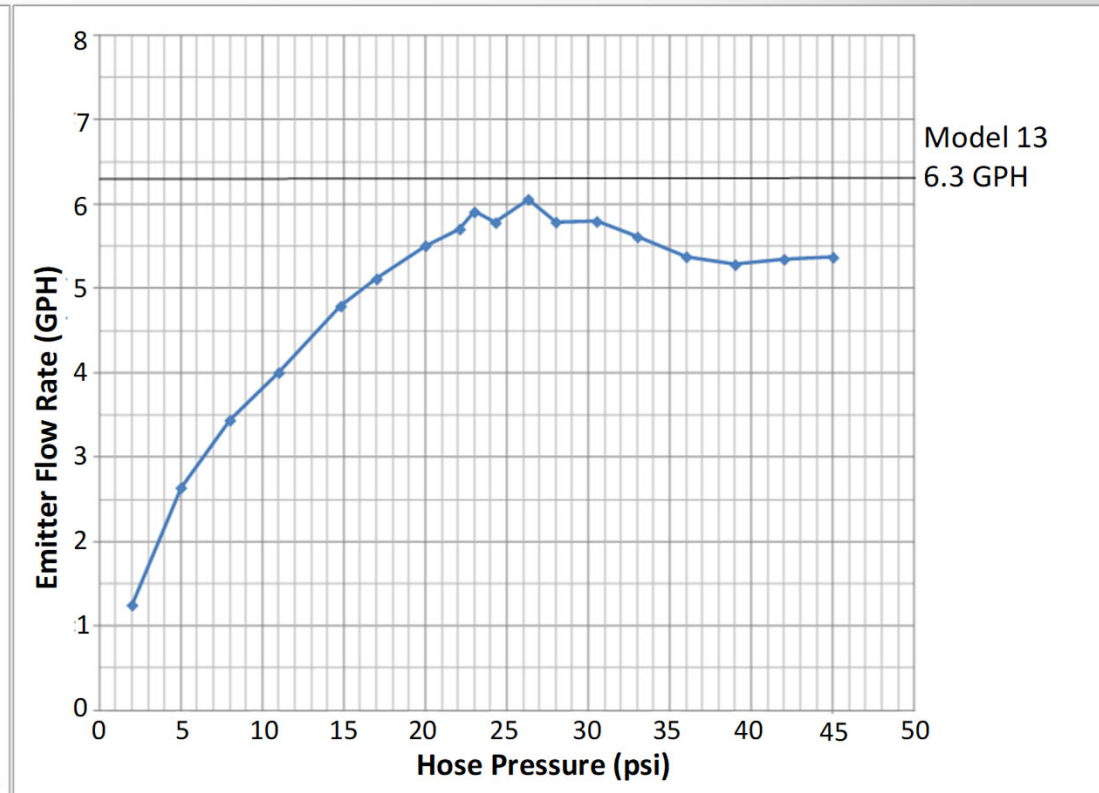
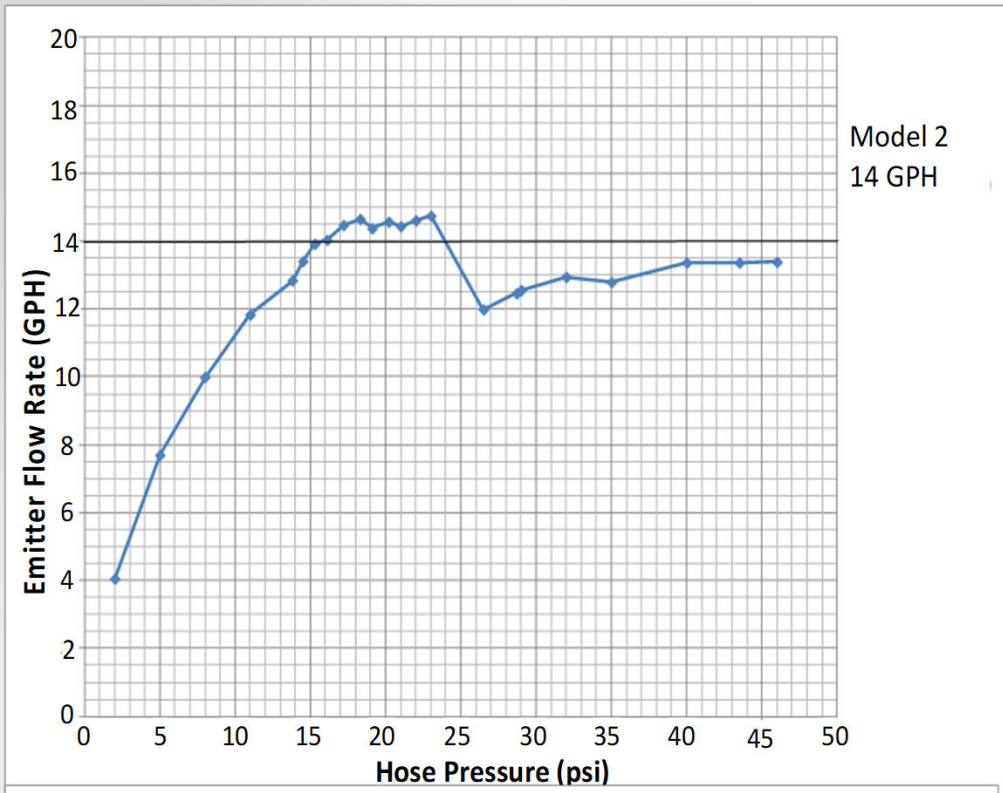
Eurodrip  
Corona  
Black Base  
Blue Outlet  
0.5 GPH



# How about PC microsprayers?

They aren't nearly as good as the low flow PC emitters.

- High pressure requirements.
- Varying flows with pressure changes.
- Often the flow isn't the published – **nominal** - flow.







**Pressure gauges must be of high quality and of the proper range.  
We test our gauges frequently.  
Ideally, use only one gauge for all pressure measurements.**



# Solutions to Pressure Differences

- *Down a hose – Too late*
- *Between hoses*
  - *Pre-set pressure regulators*
  - *Remove hose screen washers*
- *Between blocks*
  - *Adjust pressure regulators*
  - *Install pressure regulators*







# Preventative Maintenance

# Preventative

#1 - FLUSH HOSES  
REGULARLY



**Flushing minimizes the amount of chemical needed.**

# #2 - Chemical Injection

- *Dosages*
- *Frequency*
- *Location*
- *Other items*

# Chemical Injection (Plugging)

## *Dosages*

*Avoid very large dosages – such as pulling up a trailer and dumping in 3 months of fertilizer - there can be plugging problems.*



# Chemical Injection

## *Frequency*

- *At least once/week allows you to match demands.*
- *Proportional and continuous are nice, but sometimes become complicated.*

# Plugging Prevention

- Chemicals
  - Chlorine (*PLUS acid*)
  - Various Polymers
    - For organics?
    - For iron, manganese?
  - Aeration
  - $SO_2$
  - Magnets????
  - Magic????

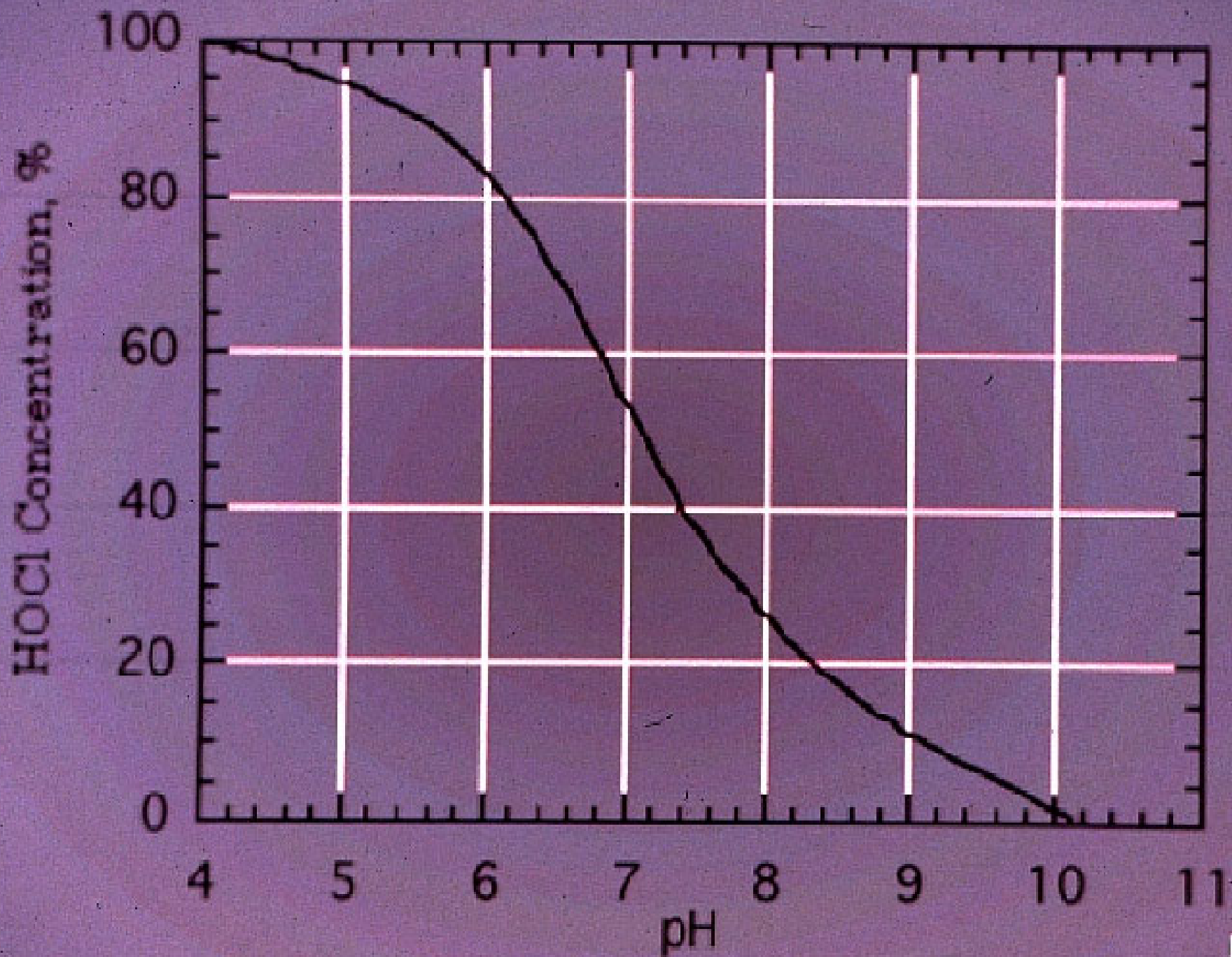


# How often should chlorine be injected?

- As often as necessary.
  - In other words, it depends on the water quality. In some systems chlorine must be injected continuously. In other systems, once a week is fine.
  - *Check the ends of hoses to see if the maintenance program is fine.*

# Chlorine

- **0.5 - 5 ppm**
  - **Bactericide**
  - **Oxidizer of iron**
- **100 - 1000 ppm**
  - **Oxidizes organic materials**
  - **Kills plants**



ITAC

Cal Poly



# Lowering pH Sulphuric Acid



## Ácido Sulfúrico

**VERDEGAAL BROTHERS, INC.**  
13555 S. 11th Ave. / Hanford, CA 93230 / Ph. (559) 582-9205  
www.verdegalbrothers.com Email: verdegal@verdegalbrothers.com

**ANÁLISIS GARANTIZADO**

Azufre total Derivado de Ácido Sulfúrico	31%	
Ácido Sulfúrico (H <sub>2</sub> SO <sub>4</sub> )	93%	
15.4 libras por galón		

**¡PELIGRO!**  
El ácido sulfúrico puede causar quemaduras graves y puede ser fatal si se ingiere.  
Los contenidos cubren las siguientes bajas presiones expuestas de gas hidrógeno.  
\*Manténgalo al resguardo del calor, chispas y flamas.

**PRECAUCIÓN**

\* Antes de empezar a trabajar con ácido sulfúrico, se tendrá que poner ropa protectora incluyendo guantes para químicos o ceras, mascar, guantes de hule y zapatos. Si se están manejando grandes cantidades de ácido sulfúrico se recomienda ropa protectora completa incluyendo pantalones y chaqueta.

\* Manténgase siempre en una zona con ventilación efectiva. Donde la exposición por aire puede exceder las concentraciones permitidas por aire. Un lavado que tiene buena protección biológica en un interior, se recomienda un respirador purificador de aire de presión negativa con cartuchos que sean apropiados por NIOSH/MSHA contra el polvo y bromos.

\* Lavarse minuciosamente después de manejar ácido sulfúrico y antes de comer, beber o fumar. No coma o fume si usted se encuentra con ácido sulfúrico.

**PREMIEROS AUXILIOS**

**CONTACTO CON LA PIEL:** Si se cae el ácido o se cae en la piel o en un ojo, inmediatamente enjuague con bastante agua por 15 minutos. Si se cae en los ojos, inmediatamente enjuague y levante los párpados y levante los párpados para ayudar a la zona donde se aplicó el ácido. Quitarse la ropa en la cual se cayó el ácido, mientras que se encuentra en el baño de emergencias.

**INHALACIÓN:** Alejar la persona afectada. Si no pudo la respiración, sacar respiración artificial. Si persona muestra dificultad para respirar, administrar oxígeno. Si inhalación por vía bucal, pueden provocar irritación de la garganta. Si sistema respiratorio superior muestra dificultad para la respiración.

**INGESTIÓN:** No dar grandes cantidades de agua a la persona. NO INDUCIR EL VÓMITO. La ingestión puede provocar irritación y quemaduras con la boca, garganta y pecho en los ojos.

**CUALQUIER ACCIDENTE QUE IMPULSAR LA EXPOSICIÓN DE ÁCIDO A LOS TEGOS HUMANOS REQUIERE DE ATENCIÓN INMEDIATA.**

**MANEJAMIENTO**

Use ropa protectora y equipo según se indica.

\* No sea que la arena en los ojos, que se disuelva en la piel o ropa. El ácido sulfúrico puede provocar quemaduras graves o irritación de la piel que quemó o irritación.

\* No enjuague agua al ácido sulfúrico. Cuando se está despidiendo, siempre enjuague el ácido al agua cuidadosamente mientras lentamente está agitando la mezcla.

\* El ácido sulfúrico no es inflamable pero gas hidrógeno inflamable y explosivo puede ser generado dentro de las tuberías de metal y durante el almacenamiento. Antes de efectuar conexiones de tubo de transferencia. Si se requiere el tubo de gas que está expuesto, debe de asegurarse el tapón y sellarse a una distancia segura hasta que sea el tubo. Consulte el procedimiento con cuidado.

\* Quite los recipientes y escape con bastante agua. Neutralice con ácido al menor espacio de tiempo si es posible. Se requiere ventilación apropiada cuando se está empujando cerca de agua debajo o que se forma gas de hidrógeno de carbono por la mezcla.

\* Demasiado vapores se deberán manejar con un plan predefinido de cumplimiento de cumplimiento y neutralización con ácido.

\* Mantenga la zona libre de otros materiales. El ácido concentrado puede incendiar materiales combustibles o corrosivos. El ácido y mostacho líquido puede formar concentraciones explosivas de hidrógeno.

\* Cuando el ácido sulfúrico en una zona, también, los vapores de ácido se crean los vapores del polvo del tubo y donde se encuentran niveles de combustión y de sulfuro reactivos. Los vapores se deberán almacenar en una posición neutral. Además, se prohíbe el fumar en la zona de almacenamiento.

## Sulfuric Acid

**VERDEGAAL BROTHERS, INC.**  
13555 S. 11th Ave. / Hanford, CA 93230 / Ph. (559) 582-9205  
www.verdegalbrothers.com Email: verdegal@verdegalbrothers.com

**MINIMUM GUARANTEED ANALYSIS**

Sulfur (S) Derived from Sulfuric acid	31%	
Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> )	93%	
15.4 pounds per gallon		

**! DANGER!**  
Sulfuric acid can cause severe burns and is fatal if inhaled.  
\* Under pressure, explosion or rupture may occur.  
\* Keep away from heat, sparks and flames.

**PRECAUTIONS**

\* Before you begin to work with sulfuric acid, you must put on protective clothing including gloves, goggles or a face shield, hard hat, rubber boots and apron. If large quantities are being handled, full protective clothing including pants and jacket is recommended.

\* Handle only in an area with effective ventilation. Where airborne vapors may exceed permissible air concentrations, you must wear respiratory protection. As a minimum, it requires pressure air purifying respirator with cartridges that are NIOSH/MSHA approved against dust and mist is recommended.

\* Wash thoroughly after handling and before eating, drinking or smoking. Do not eat or drink in work areas where sulfuric acid is present.

**FIRST AID**

**SKIN OR EYE CONTACT:** Immediately flush with plenty of water for at least 15 minutes. If acid splattered or poured on skin or eyes, remove clothing and shoes. Remove clothing on which acid has been splashed while under shower. Inhalation: Remove individual to fresh air. If breathing has stopped, give artificial respiration. If difficulty in breathing occurs, administer oxygen. When fumes or mist are inhaled, remove person to the upper respiratory system. Give large amounts of water or milk. DO NOT INDUCE VOMITING. Ingestion can cause irritation and corrosive burns to the mouth, throat and stomach and can be fatal if swallowed.

**ANY ACCIDENT INVOLVING ACID EXPOSURE TO HUMAN TISSUE REQUIRES IMMEDIATE MEDICAL ATTENTION.**

**HANDLING**

\* Wear protective clothing and equipment as outlined above.

\* Do not get in eyes, on skin or on clothing. Sulfuric acid can cause severe burns or skin irritation, corrosion, tissue damage and blindness.

\* Do not add acid water to sulfuric acid. When diluting, always add acid to water cautiously while slowly agitating the mixture.

\* Sulfuric acid is not flammable but flammable and explosive hydrogen gas can be generated traces metal drums and storage tanks. Before making pipe connections, the cap should be being inserted perpendicular to the ground. Open slowly. If the sound of escaping gas is heard, STOP! unsewing the cap and move a safe distance away until the sound ceases. Continue the procedure with caution.

\* Dilute small spills or leaks with plenty of water. Neutralize with acid such as soda ash or lime. Adequate ventilation is required when acids such is used because carbon dioxide gas is formed by the mixture.

\* Major spills must be handled with a predetermined plan. Containment and neutralization with what is recommended.

\* Keep the area clear of other materials. Concentrated acid can ignite combustible materials on contact. Acid plus oxidizer can also form explosive concentrations of hydrogen.

\* Store sulfuric acid in a cool, well-ventilated area where the fumes are prevented from possible physical damage and are away from combustibles and reactive chemicals. Containers should be stored in an upright position. Draining is prohibited in the storage area as well.



# Plugging Prevention

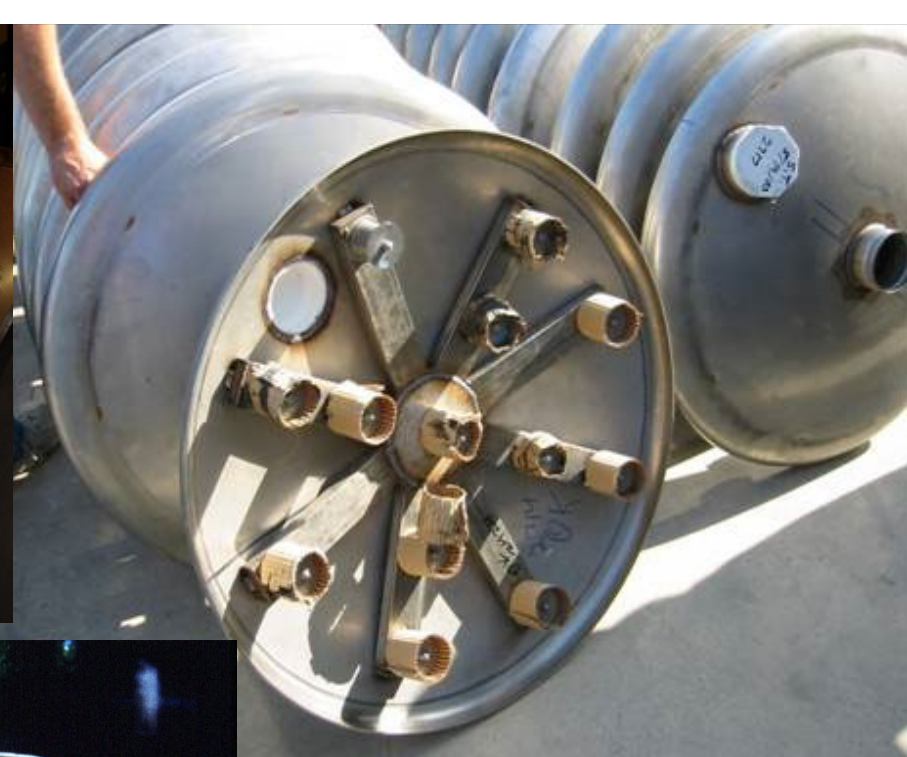
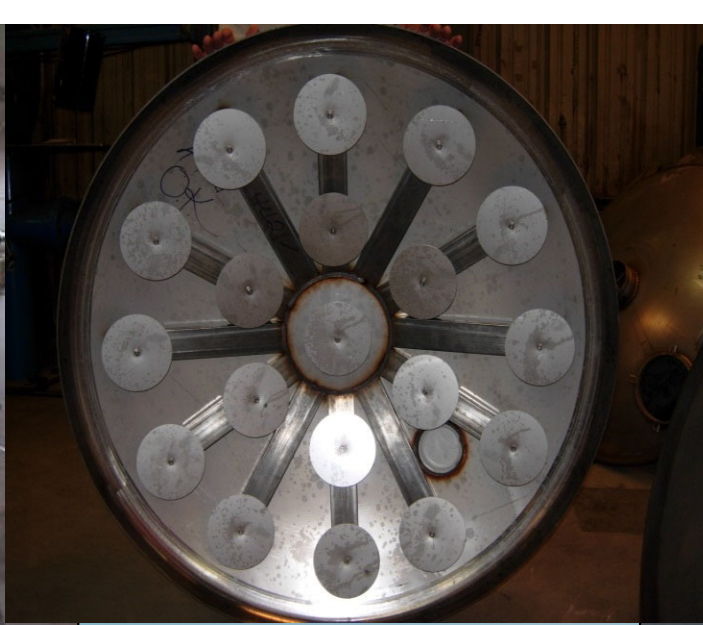
*#3 - Filtration*

*#3 - Filtration*

*#3 - Filtration*







# Media filter underdrains

Good underdrain: Little media goes out during large flow backflush.

**Table 9. Characteristics of the media filter tanks**

Feature	Characteristic	Measured Values for Different Tanks						Relative Importance*
		Arkal	Flow-Guard	Lakos	Lakos New	Waterman Wand	Waterman Dome	
Valve	Friction during filtration with #16 silica media @250 GPM, psi	2.3	0.8	0.9		2.2	2.1	2.5
	Friction during backflush with #16 silica media @200 GPM, psi	5.0	3.0	2.8		11.5	11.5	5
	Pressure required to open, psi	13.0	5.0	6.0		5.0	6.0	5
	Valve closure time at 22-25 psi, sec.	13.0	7.0	9.0		4.0	5.0	6
System	Total friction loss during filtration @250 GPM when clean	4.3	2.2	2.5			3.6	3
	Total friction loss during filtration @200 GPM when clean	6.0	3.5	3.0			13.0	5
Sand Removal	Mass of sand (grams) in 2 minutes @250 GPM	0.2	48.6		18.5	0.0	2.2	10
	Mass of sand (grams) in 2 minutes @200 GPM	0.0	0.7		0.7	0.0	0.1	
Underdrain	Horizontal area (sq. cm.) served by each pod or wand unit	214	613	446		117	214	6
	Coefficient of variation of the horizontal area served per pod/wand unit	0.24	0.14	0.31		0.75	0.17	8
	% of the horizontal area that is covered by pods or wands	9	3	7		32	12	8
	Mean slot width, mm.	0.33	0.23		0.27	0.19	0.29	
	Std. Deviation of slot widths, mm.	0.036	0.029		0.036	0.026	Not meas.	5
	Total slot open area, sq. Cm.	200	184		261	343	108	5
Summary	<b>Total best ratings</b>	1	7	5		8	4	
	<b>Total worst ratings</b>	6	3	1		3	4	

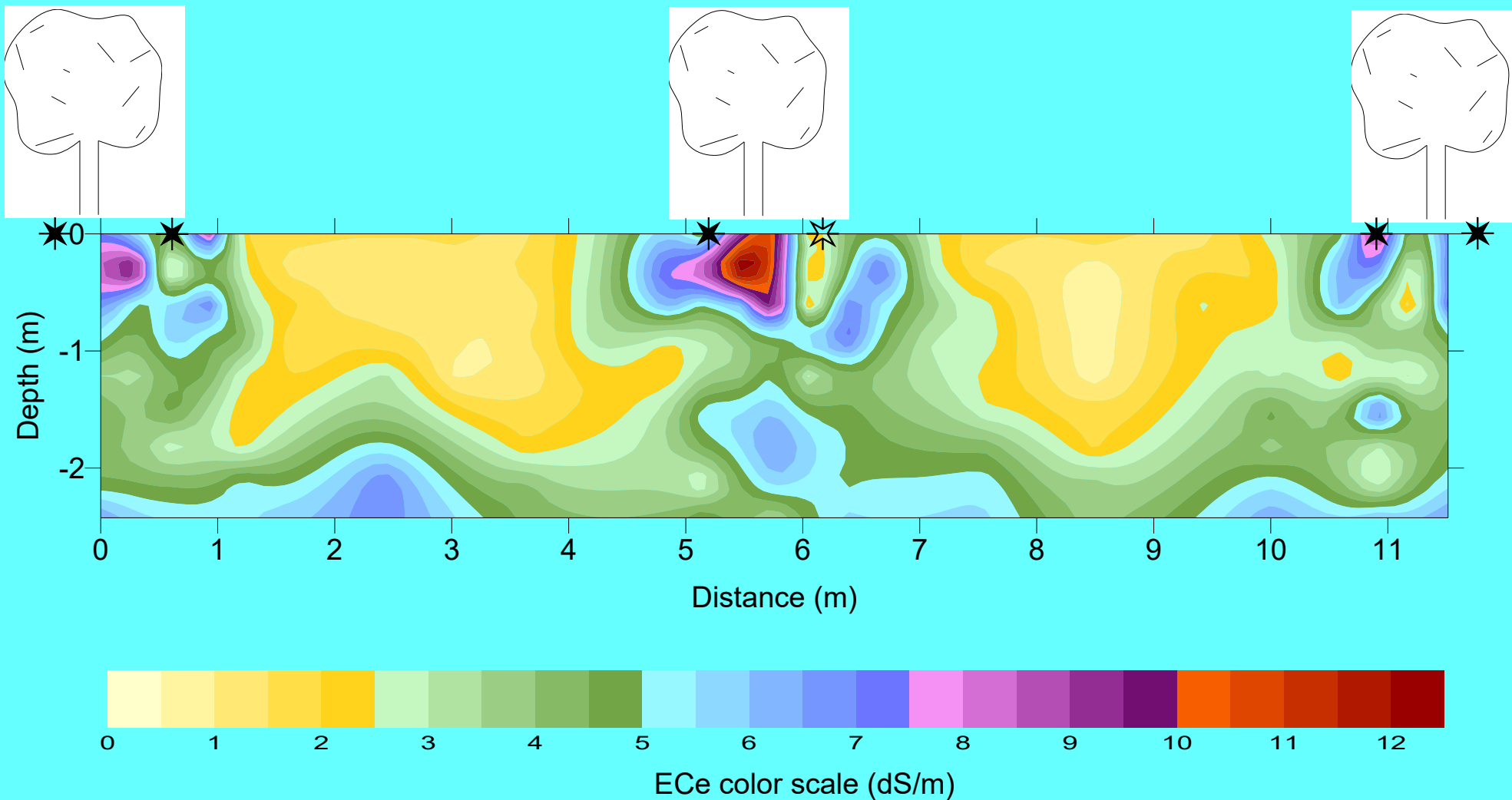
\*The greater the Relative Importance value, the more important this characteristic is.



# Challenges with Water Quality and Salinity

# Research - Long term salinity buildup on the West Side of the San Joaquin Valley

## DRIP irrigation



# Impact of Salinity with Different Salts



20 dS/m NaCl



20 dS/m KSO4



10 dS/m NaCl



10 dS/m KSO4



5 dS/m NaCl



5 dS/m KSO4



0 dS/m NaCl added



0 dS/m KSO4 added

**Key Point:**  
**Chloride salts are BAD**

# Reiter Brothers Matthews Ranch Well Water + Amendments – November 19, 2008

## General Irrigation Suitability Analysis


















Test Description	Result			Graphical Results Presentation				
	mg/L	%	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
<b>Cations</b>								
Calcium	157	36	430	**				
Magnesium	44	16	120	**				
Potassium	9	1	24	**				
Sodium	238	47	650					
<b>Anions</b>								
Carbonate	< 10	0	0					
Bicarbonate	280	21	760	**				
Sulfate	500	48	1400	**				
Chloride	230	30	630					
Nitrate	< 0.4	0	0					
Fluoride	0.3	0	0.8					
<b>Minor Elements</b>								
Boron	0.60		1.6					
Copper	0.020		0.054					
Iron	0.26		0.71					
Manganese	0.020		0.054					
Zinc	< 0.02		0.00					
<b>Other</b>								
pH	7.2		units					
E. C.	1970		umhos/cm					
SAR	4.3		mg/L					
<b>Crop Suitability</b>								
No Amendments	Poor							
With Amendments	Poor							
<b>Amendments</b>								
Gypsum Requirement	0.4		Tons/AF	Do not apply if Sulfuric Acid amendment is applied. Or 39 oz/1000Gal of urea Sulfuric Acid (15/49).				
Sulfuric Acid (98%)	16		oz/1000Gal					
Leaching Requirement	16		%					

## Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
			Slight	Moderate	Severe
<b>Chemical</b>					
Manganese	0.02	mg/L			
Iron	0.26	mg/L			
TDS by Summation	1460	mg/L			
<b>No Amendments</b>					
pH	7.2	units			
Alkalinity	230	mg/L			
Total Hardness	573	mg/L			
<b>With Amendments</b>					
Alkalinity	230				
Total Hardness	573	mg/L			
pH	5.4 - 6.7	units			

Good Problem Indicates physical conditions and/or phenological and amendment requirements.  
Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

### Avocado Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
<b>Cations</b>									
Calcium	97	4.8	33	260	**				
Magnesium	40	3.3	22	110	**				
Potassium	6	0.15	1	16	**				
Sodium	146	6.4	43	400					
<b>Anions</b>									
Carbonate	< 10	0	0	0					
Bicarbonate	80	1.3	9	220	**				
Sulfate	478	10	68	1300	**				
Chloride	117	3.3	23	320					
Nitrate	1.2	0.019	0	3					
Nitrate Nitrogen	0.3			0.8					
Fluoride	0.7	0.037	0	2					
<b>Minor Elements</b>									
Boron	0.50			1.4					
Copper	0.080			220					
Iron	0.24			650					
Manganese	< 0.01			0.00					
Zinc	0.030			82					
TDS by Summation	966			2600					
<b>Other</b>									
pH	7.5			units					
E. C.	1.38			dS/m					
SAR	3.1								
<b>Crop Suitability</b>									
No Amendments	Fairly		Good						
With Amendments	Fairly		Good						
<b>Amendments</b>									
Gypsum Requirement	0.0			Tons/AF					
Sulfuric Acid (98%)	4.9			oz/1000Gal	Or 12 oz/1000Gal of urea Sulfuric Acid (15/49).				
Leaching Requirement	11			%					

Good  Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.



**KTS® is a clear, chloride-free solution with the highest potassium and sulfur content available on the market.**

**Both potassium and sulfur can be supplied in one highly soluble form — KTS.**

**KTS boosts resistance to environmental stress.**

### **Benefits of introducing KTS into your growing program:**

- KTS has proven to be a great addition to N and P starters, because it supplies both potassium and sulfur — nutrients that are often in short supply in cold soils where root growth is limited.
- KTS is an excellent source of potassium for chlorine sensitive crops.
- Sandy soils, where nutrient holding capacity is limited, may benefit from starter fertilizers containing KTS.
- KTS is a foliar fertilizer — an ideal product to supply potassium when crop demand is high.





# Adding Calcium Thiosulphate

## PRE CaTs APPLICATION

It is especially important to monitor growth and prevent the risk of frost damage by avoiding salt stress and preventing salt stress by ensuring the root zone is salt free and in a good operating condition in the soil.

## APPLYING CaTs

CaTs is a calcium thiosulphate product that is used to reduce the risk of frost damage by ensuring the root zone is salt free and in a good operating condition in the soil.

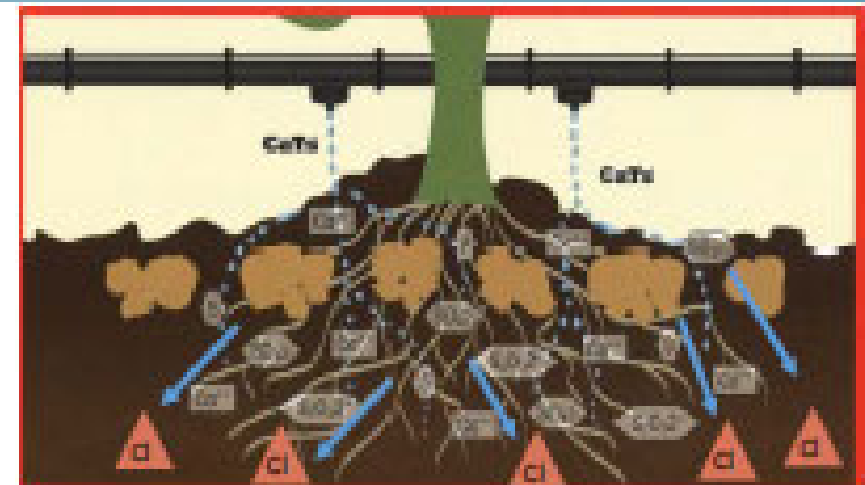
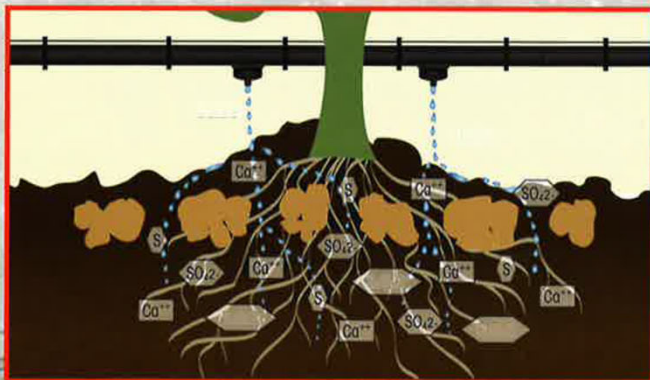
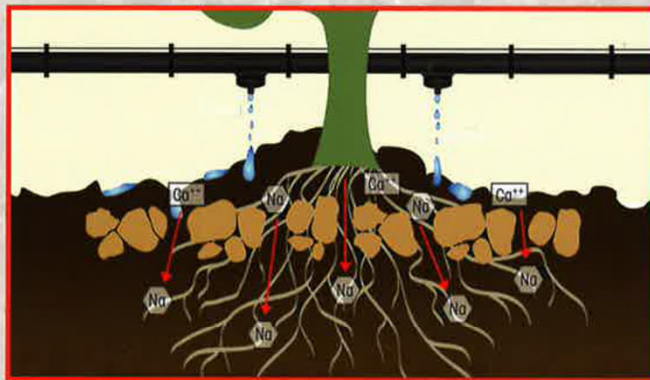
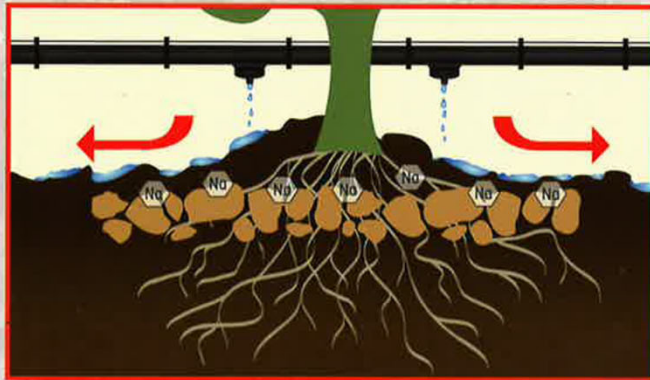
## POST APPLICATION

CaTs is a calcium thiosulphate product that is used to reduce the risk of frost damage by ensuring the root zone is salt free and in a good operating condition in the soil.

Calcium exchanges with Sodium

Thiosulphate “counters” the negative effect of chlorides

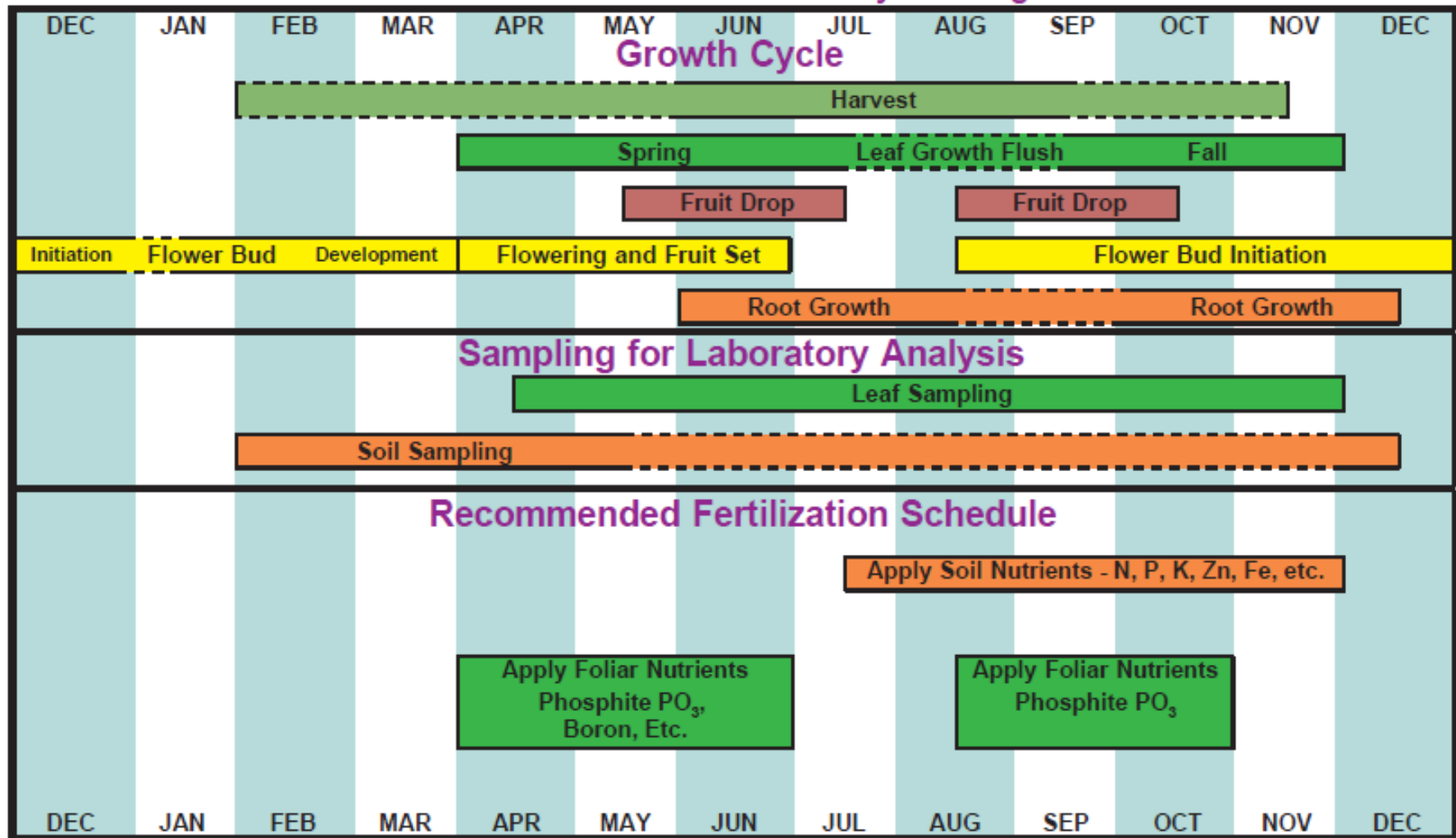
**Note: Works well in gypsiferous soils. Will cause pH to drop if soil is low in Calcium**





# AVOCADO TREES

Ventura and Santa Barbara County Growing Area



-- Indicates transition or less intensive periods.



# Summary - Basic maintenance ideas for a good irrigation system:

1. Good DU
2. Good filtration and hose flushing.
3. Inject fertilizers upstream of filter.
4. Continuous water treatment for PREVENTION of many problems.
5. Occasional “reclamation” of salts if needed.
6. End of season “winterizing” of system.

End