Fertigation Education For The San Joaquin Valley

Brought to you by:

California Department of Food and Agriculture (CDFA)

Fertilizer Research and Education Program (FREP)

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Fertigation Agenda

- Fertilizer Effects on Drinking Water – Kaomine Vang
- Nutrient Management Plan – Kaomine Vang
- Fertigation Equipment and Application – Bill Green

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What is Fertigation?

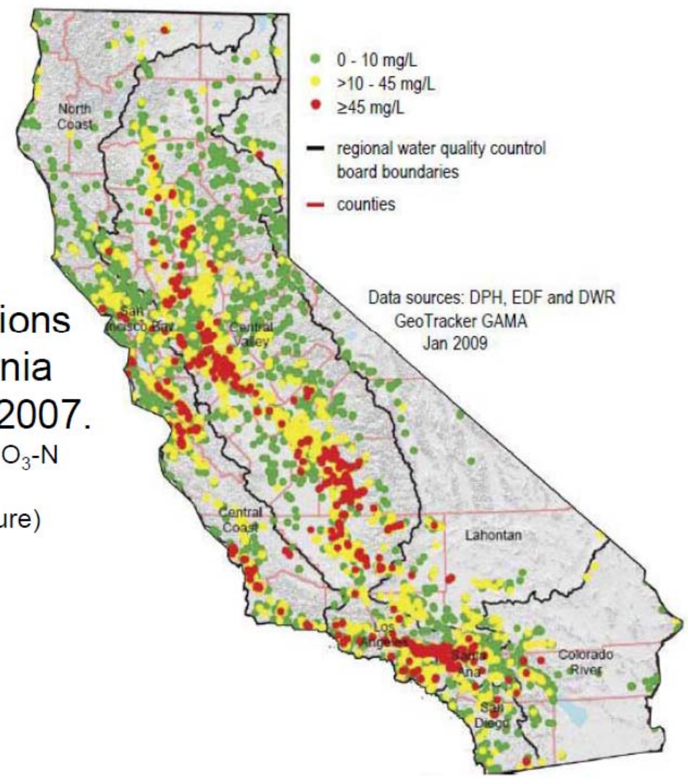
- Application of fertilizers, soil amendments and other water soluble chemicals through the irrigation system.

Effects on Drinking Water

- The major public concerns are the movement of nitrogen or especially nitrate (a highly soluble form of nitrogen which can easily move thru soil profile with water), and its accumulations in groundwater.

Effects on Drinking Water

Environmental concerns



Nitrate concentrations in various California wells measured in 2007.

44 mg/L NO_3 = 10 mg/L NO_3-N

(some from animal manure)

(Ekdahl and others, 2009)

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Effects on Drinking Water

- "Addressing Nitrates in California's Drinking Water" by UC Davis (2009)
- Major Public Concern about nitrate movement to ground water
- Collection of data from different agencies throughout the valley
- Nitrate issues is not new –
  - Researched for over 30 years

Effects on Drinking Water

- 250,000 residents in the San Joaquin Valley are affected by nitrates in drinking water.
- 95% of the San Joaquin Valley's residence are on well water.
- 1 in 10 wells effected

Effects on Drinking Water

- As more groundwater research is conducted and becoming public, farmers/growers are facing several challenges.
  - Justifying their practices and finding ways to mitigate or limit contamination.
  - How to address and assess these issues.
  - How to handle the possibility of regulatory change and the financial responsibility this will place on farmers/growers.

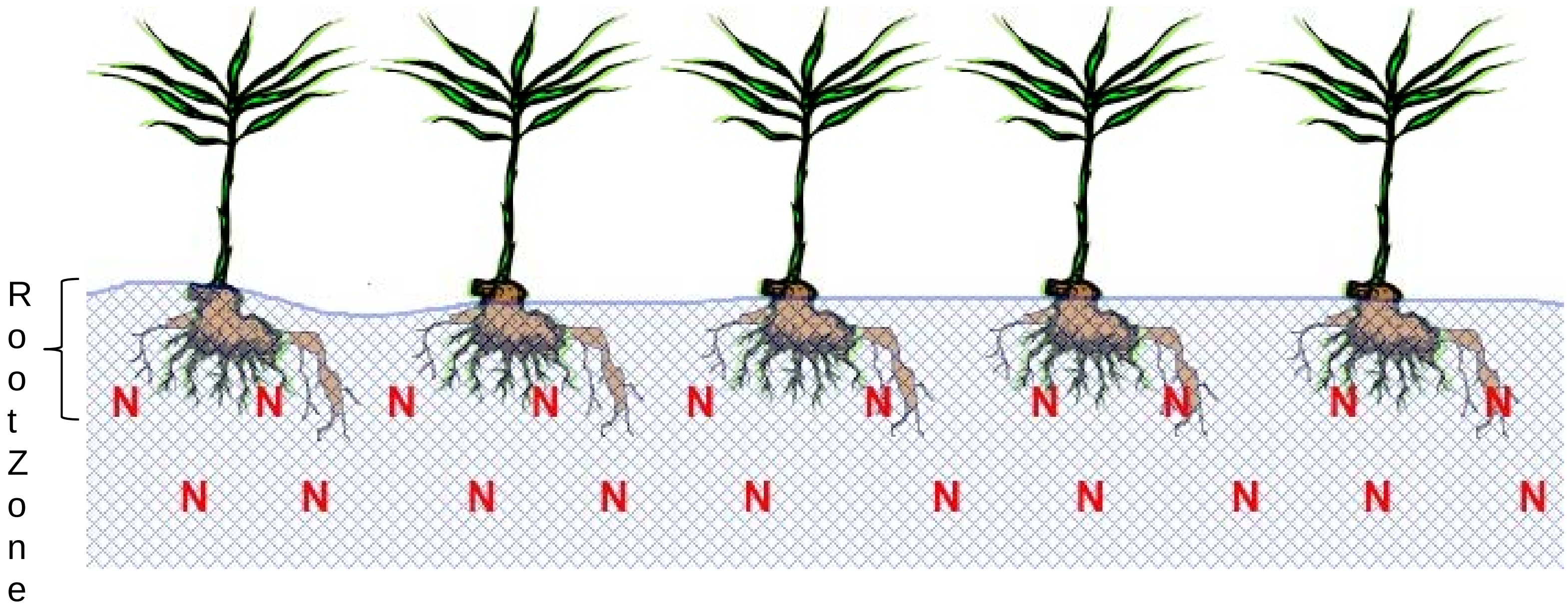
Prevention and Solutions

- *Nutrient and irrigation management* is a crucial key to utilize fertilizer effectively on farmlands. Growers may seek consultation from a specialist such as university or extension specialists, or certified crop advisors, agronomists, or soil scientists to properly manage their fertilizer program to maintain farm economic feasibility and minimize fertilizer loss.

Prevention and Solutions

- An essential prevention to the nitrate issue is to prevent water from moving beyond the root zone as a result of over irrigating.
- Over irrigation causes leaching of nitrates past the root zone and possibly into groundwater sources. To avoid leaching of nutrients, water budgets and irrigation scheduling can be used.

Preventions and Solutions- N leached past root zone, poor irrigation management



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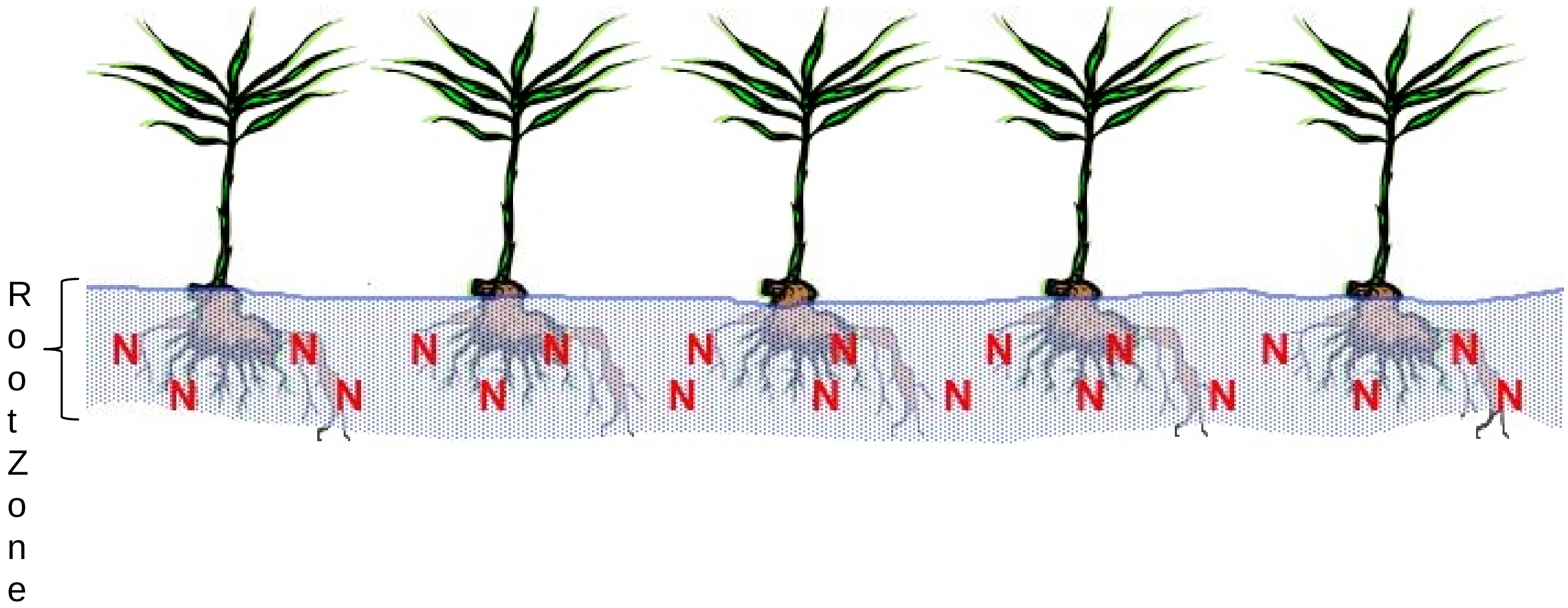
Preventions and Solutions- Good irrigation management, keep N in the root zone



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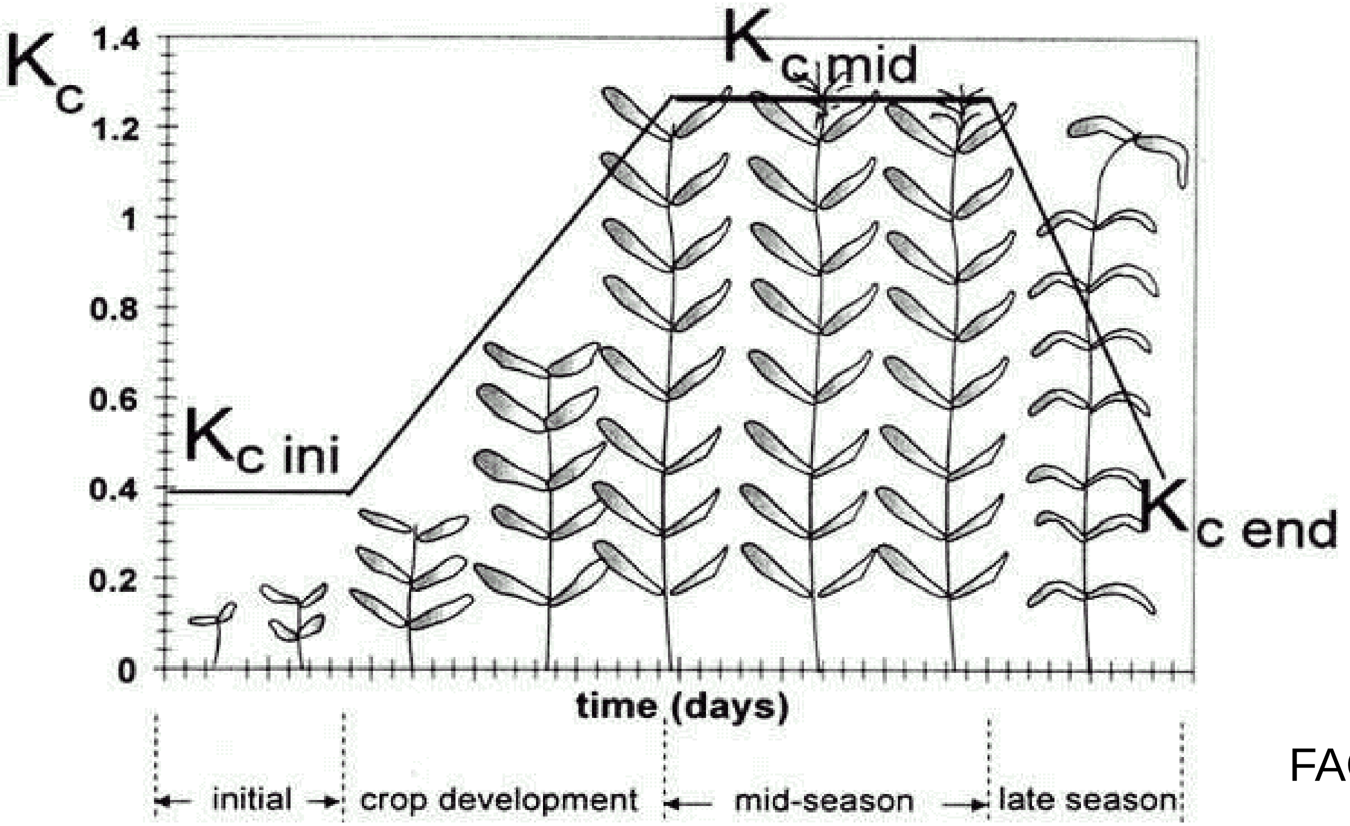
Crop evapotranspiration (ETc)=ETo*Kc

- Reference evapotranspiration (ETo)
- Crop coefficient (Kc)



FAO, 1999

CIMIS weather station

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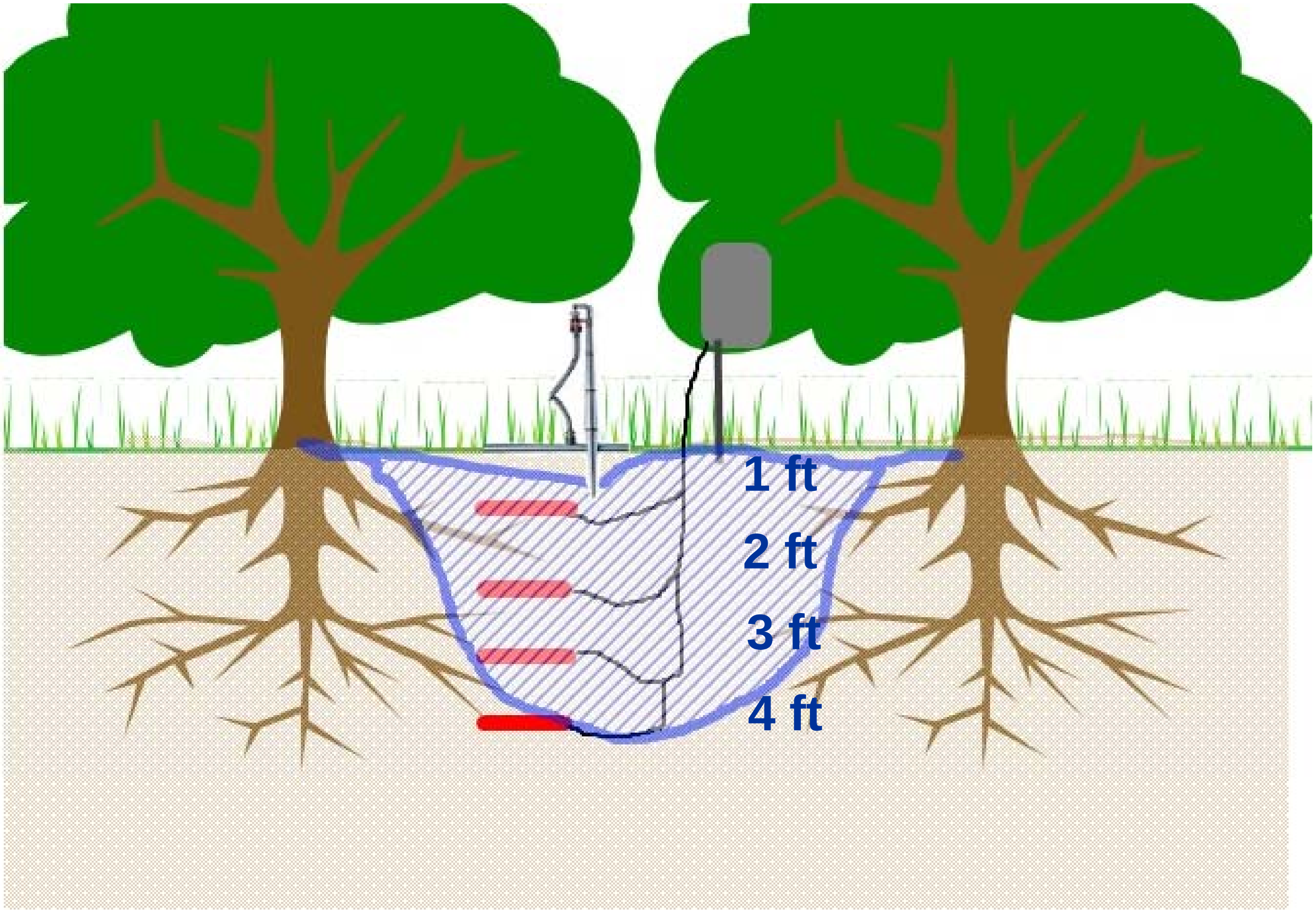
Soil moisture sensors



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Tools

- Irrigation Scheduling
  - WATERIGHT.org
  - Save water, energy, fertilizer
- Nutrient Guidelines
  - www.cdfa.ca.gov/is/frep
- Crop Manage
  - UC Davis

Nutrient Management Plan (NMP)

- Why do you need NMP?
  - Operational plan for applying fertilizer on a farm
  - A guide to monitoring and quantifying fertilizers inputs & outputs
  - Maximize fertilizer use efficiency (FUE) by crops
  - Save $$$
  - Protecting groundwater & (soil) quality

Nutrient Management Plan (NMP)

- Nutrient Budget
- A simple checklist as…

1. *Know Your Soil*
2. *Know Your Crop*
3. *Know Your Water*
4. *Know Your Fertilizer*

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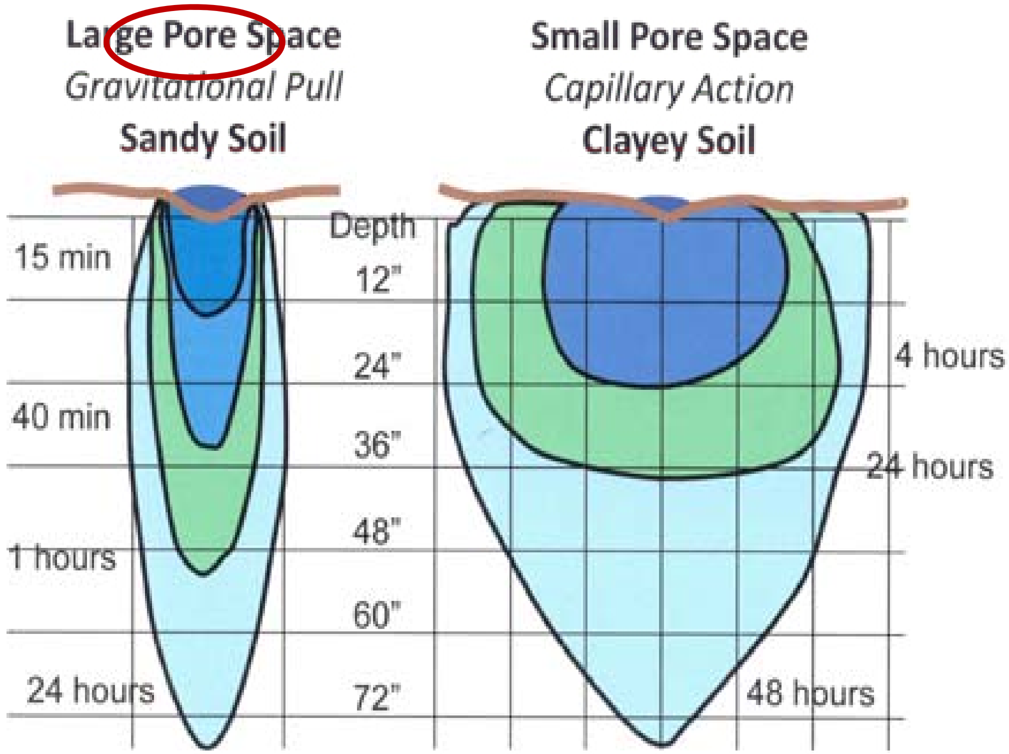
1. Know Your Soil



Water movement on various soil textures

- In sandy soils, water readily moves downward due to the force of gravity.
- In clayey soils, water slowly moves out in all direction by capillary action.

2. Know Your Crop

Whole Farm Nitrogen Balance[a]								
Field Name	Total N in Storage (PAN)	Total N Exported (e.g. leaching, denitrified)	N Imported (e.g. preplant)	Irrigation Nitrogen		Atm N in SJV	Total N Removed by Crops[b]	Field N Balance[c]
				Fert.	Manure			
Eggplant (north)	82 lbs/ac	0	50 lbs/ac	50 lbs/ac	10 lbs/acft	4 lbs/acyr	175 lbs/ac	**1.1**
Eggplant (south)	50 lbs/ac	0	50 lbs/ac	100 lbs/ac	10 lbs/acft	4 lbs/acyr	175 lbs/ac	**1.2**

- the ratio of **(total nitrogen in storage – total nitrogen exported + nitrogen imported + irrigation nitrogen + atmospheric nitrogen)/ (total nitrogen removed by crops)**
- A value larger than 1.0 would indicate a theoretical excess of the nutrient. <u>In practice, values between 1.0 and 1.5 are considered acceptable</u>

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3. Know Your Water

- Test irrigation water
- Free fertilizer (nitrate)
- Salinity level (crop tolerance), potential yield reduction

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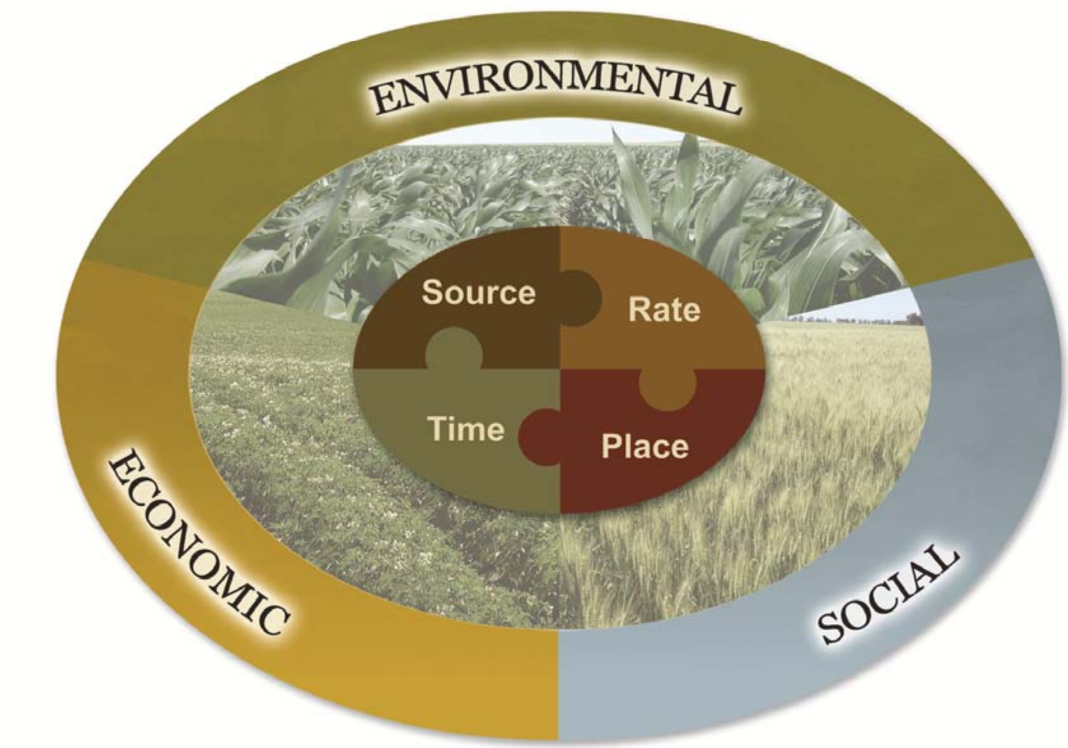
4. Know Your Fertilizer

- Common fertilizer types and sources
- Determine proper type, method of appli. , etc
- Calculate the need
- Seek technical consultations
  - Certified Crop Adviser (CCA)
  - Tech. sale rep. to obtain MSDS

4R Nutrient Stewardship Concept



1. Right Source: form/type (soil/foliar appli.)
2. Right Rate: crop nutrient requirement—split appli.
3. Right Place: root pattern, water movement
4. Right Time: crop physiology, soil environment

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Fertigation Equipment and Irrigation System Performance

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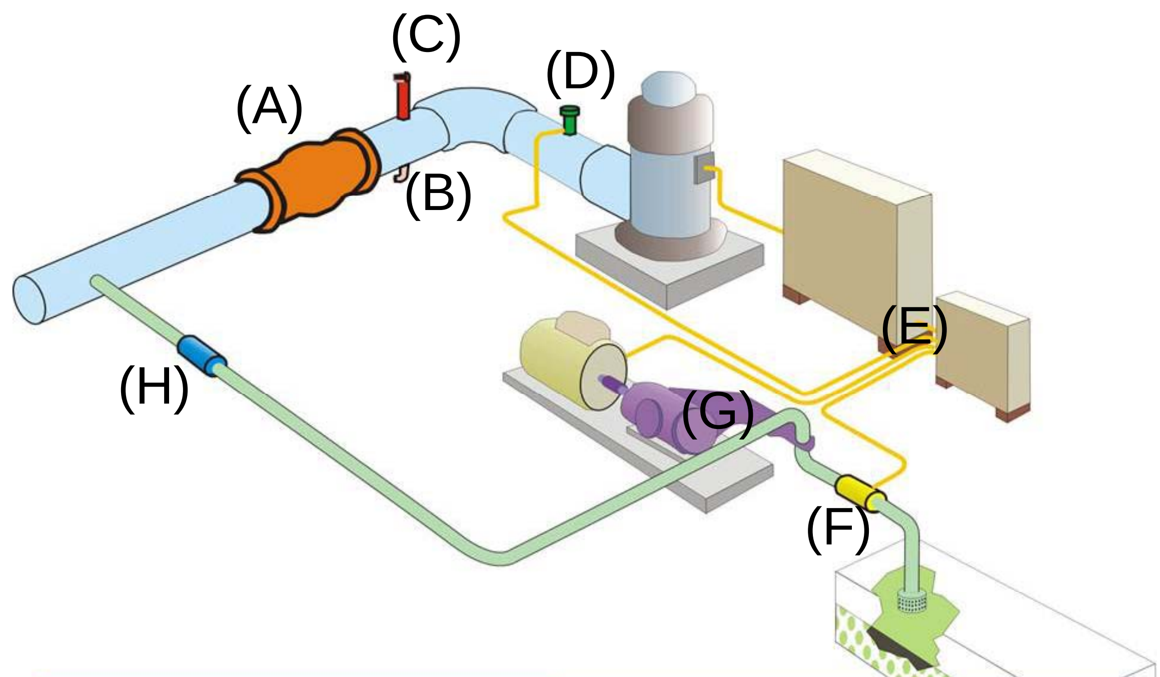
Complete Fertigation System Diagram

- The diagram at right shows all safety equipment installed. A good injection system should include backflow prevention, automated system shutdown in the event of a pressure or flow loss. In addition, shutting down the entire pump and irrigation system is possible.



(A) Mainline Single Check Valve	(E) Interlocking System Controls
(B) Low Pressure Drain	(F) Solenoid Operated Valve
(C) Air/Vacuum Relief Valve	(G) Chemical Injection Pump
(D) Pressure Switch	(H) Injection Line Check Valve

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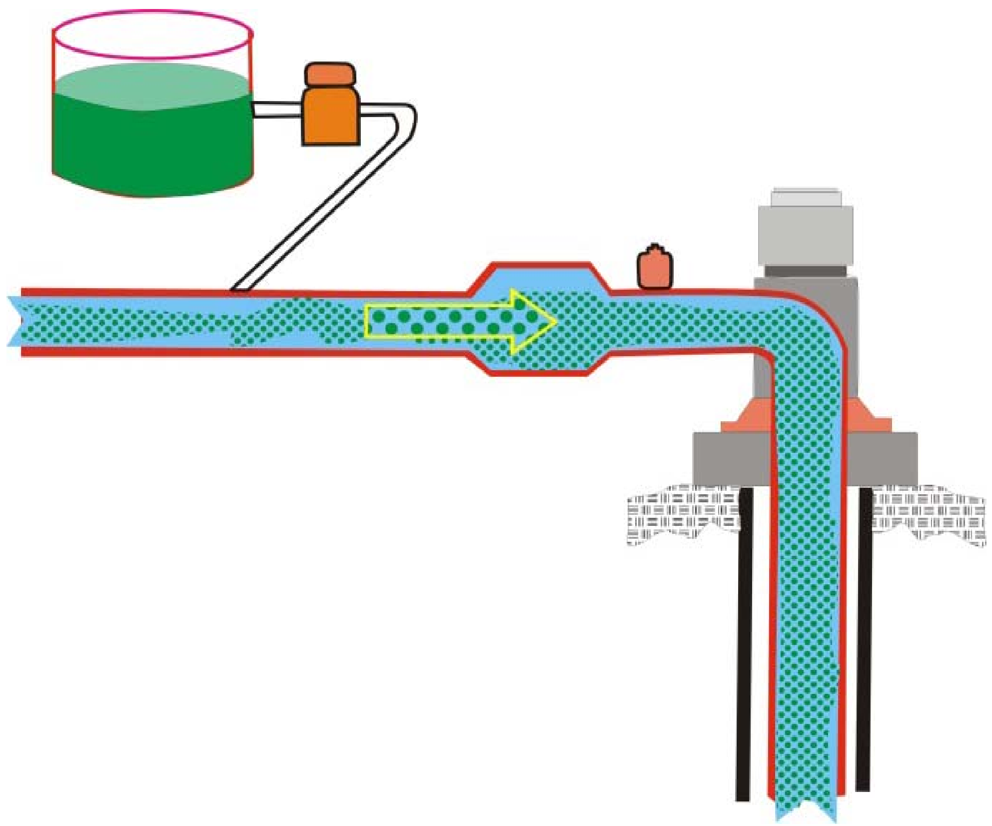
What do we need to accomplish for good Fertigation practices?

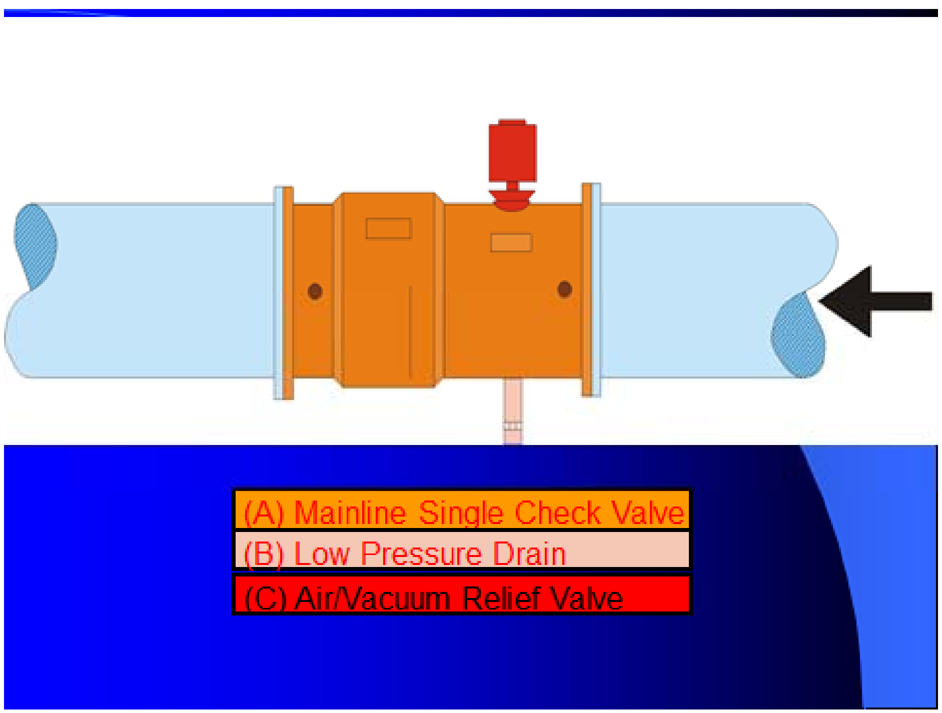
1. Protect the Water Source
2. Install automatic system shutdown controls
3. Keep pressurized irrigation system water from backflowing into fertilizer supply
4. Proper Irrigation System Performance

1. Protect the Water Source

- In the diagram at right, there is no backflow prevention. Injected fertilizer in the irrigation system discharge line could backflow into the water source if the pump shuts off or breaks.



Install a check valve



- This spring loaded check valve will close automatically if the irrigation system mainline water is interrupted. In addition, a Low Pressure Drain and Air/Vacuum Relief Valve give added protection to the single check valve.

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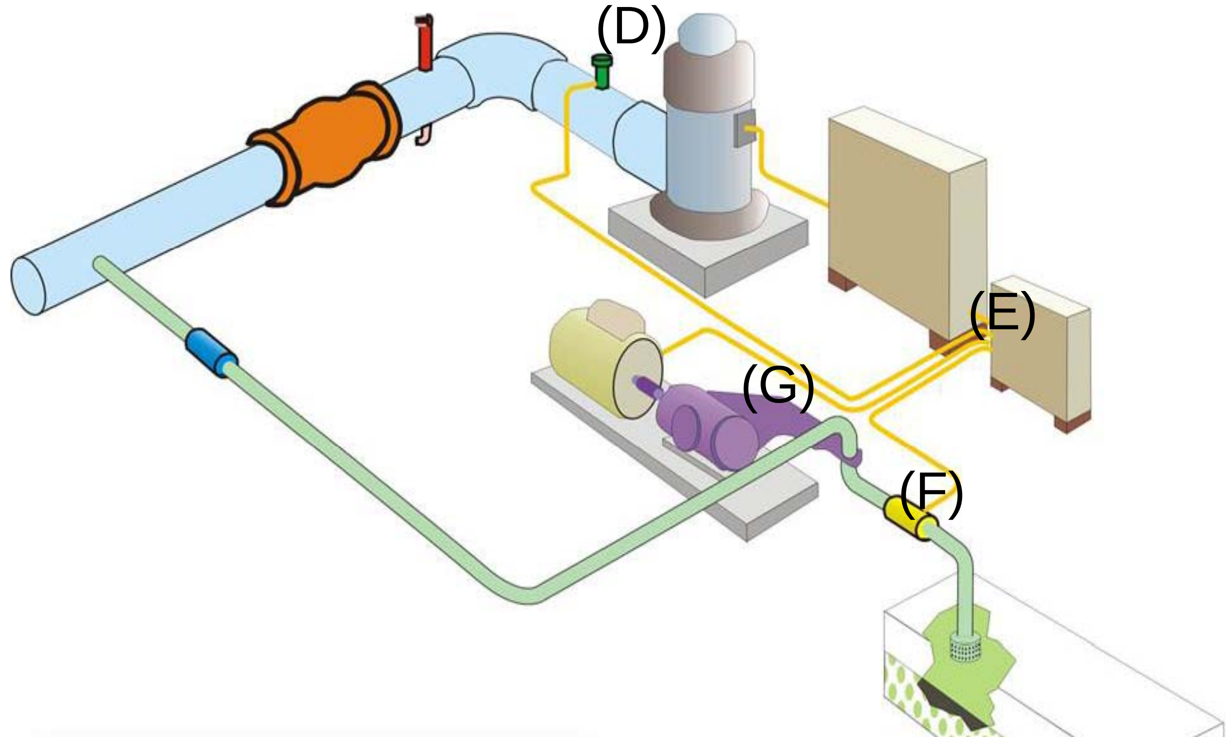
2. Install automatic system shut down controls

- A pressure switch connected to a "Normally closed" solenoid valve on the injection line will stop the injection of fertilizer if irrigation system requirements are not met. There is alternative safety equipment that can be installed.



(A) Mainline Single Check Valve	(E) Interlocking System Controls
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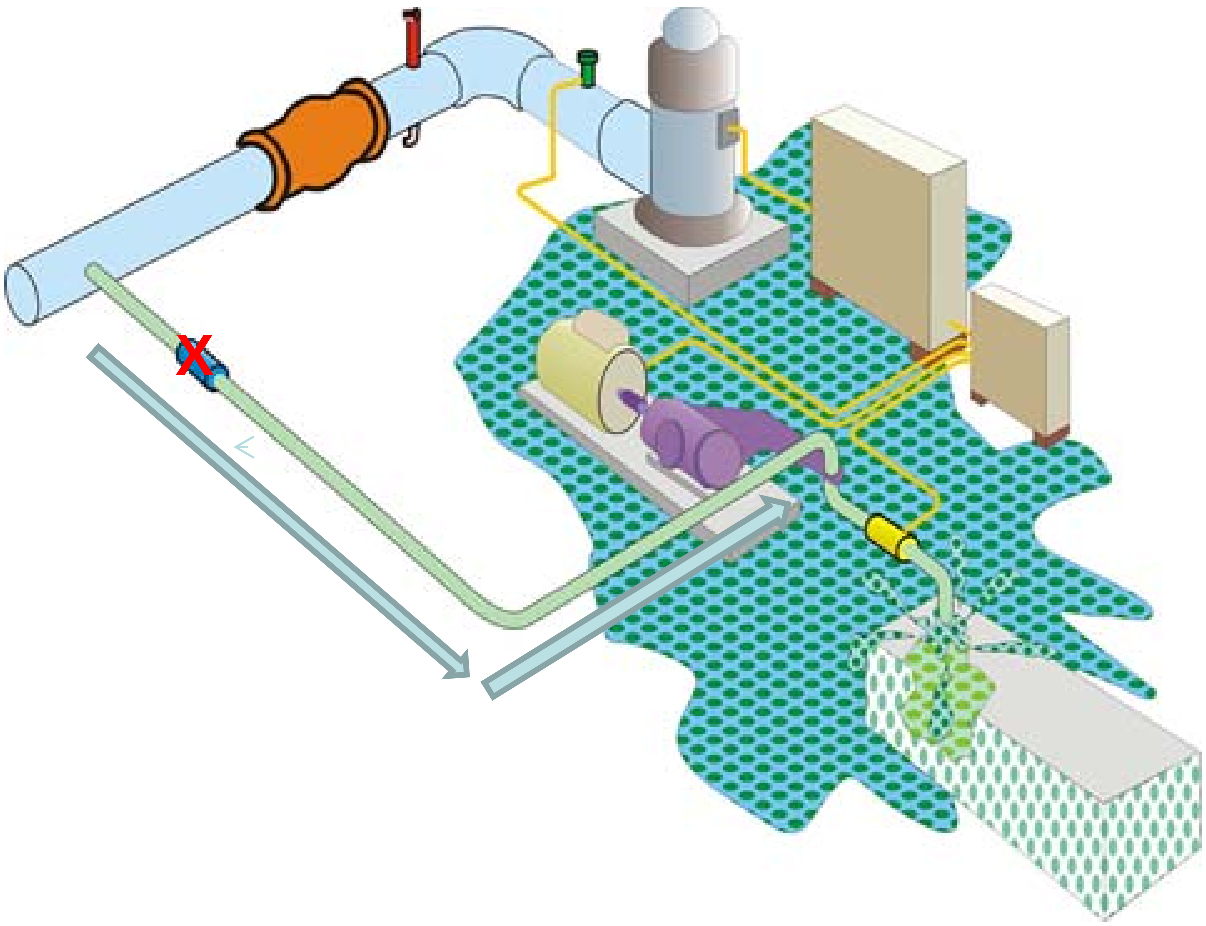
3. Prevent Backflow From Irrigation System to Fertilizer Supply Tank



- If the fertilizer injection shuts down for any reason, water pressure from the irrigation system could reverse flow direction and potentially cause a fertilizer spill.

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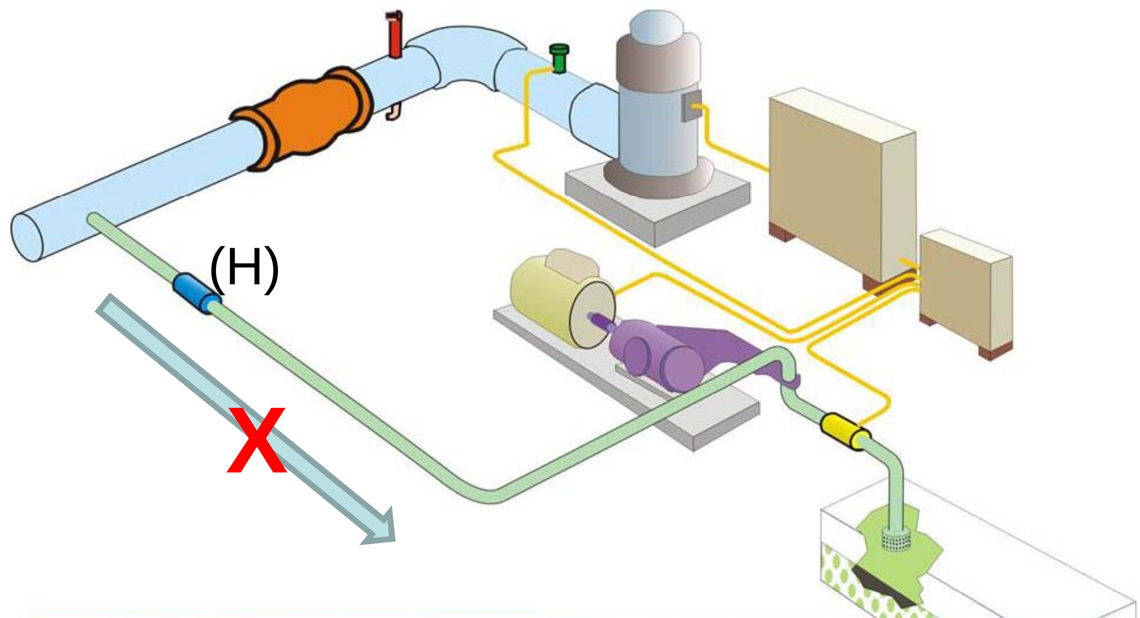
Injection Line Check Valve

- An Injection line check valve will keep reverse flow from the pressurized irrigation system from overflowing the fertilizer supply tank.



(A) Mainline Single Check Valve	(E) Interlocking System Controls
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Recap for equipment

1. Protect the Water Source
2. Install an automatic system shutdown controls
3. Keep pressurized irrigation system water from backflowing into fertilizer supply

4. Proper Irrigation System Performance

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Distribution Uniformity (DU)- "How evenly the water is applied to the target area"

- Every pressurized irrigation system should be designed, installed, and maintained with the goal of achieving good DU
- Good DU gives the system manager the potential to save water, fertilizer, and energy
- Once good DU is achieved, Irrigation, Fertigation, and Energy Efficiency can be the result

What are some of the reasons for poor DU

1. Poor irrigation system design
2. Elevation differences
3. Poor maintenance

   -Leaks

   -Plugged emitters

   -Pressure Valves not calibrated properly

   -Pump flow and pressure don't match system design

   -Poor filter maintenance or design

Get the irrigation system audited

Auditing the irrigation system to determine DUlq

Most Irrigation Systems audits use Distribution Uniformity of the low quarter DUlq

$$DUlq = \frac{\text{Average Minimum}}{\text{Average Total}} \times 100$$

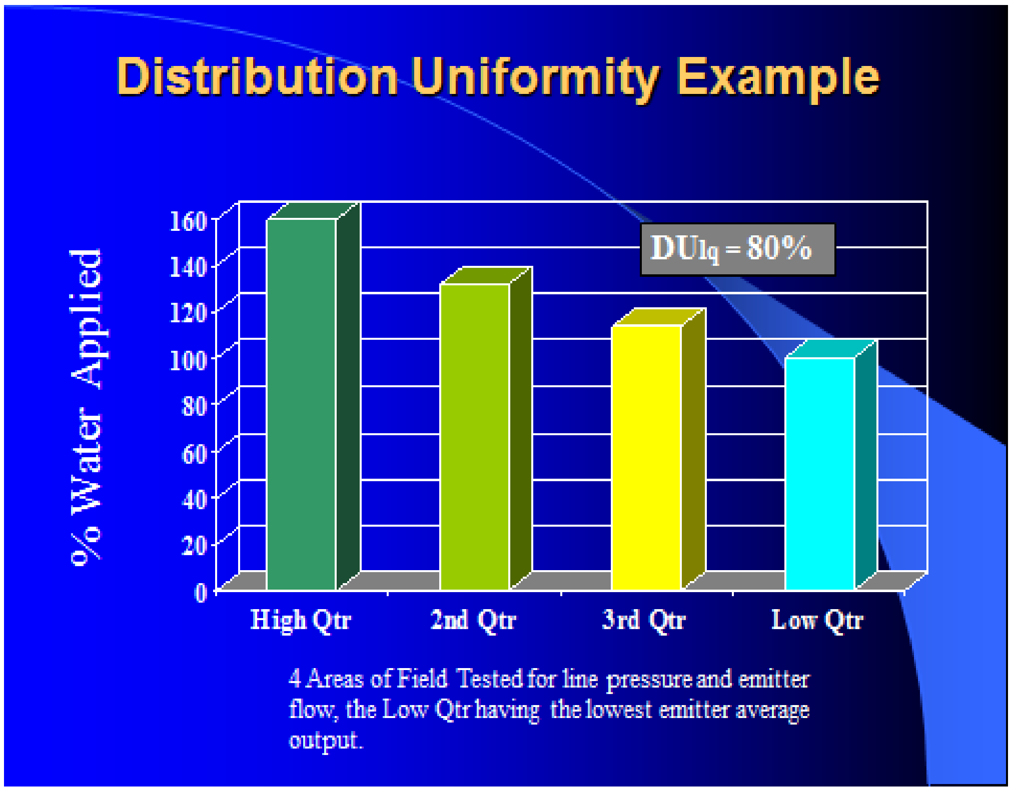
Where:

DUlq = Low Quarter Distribution Uniformity

Average Minimum = Average of lowest 25% of sample

Average Total = Average of total of remaining 75%

DUlq example



- The chart at left illustrates the importance of DU. With a Dulq of 80%, in order to achieve 100% of the required water in the Low Qtr, you would be applying 160% of the water in the High Qtr. 80%

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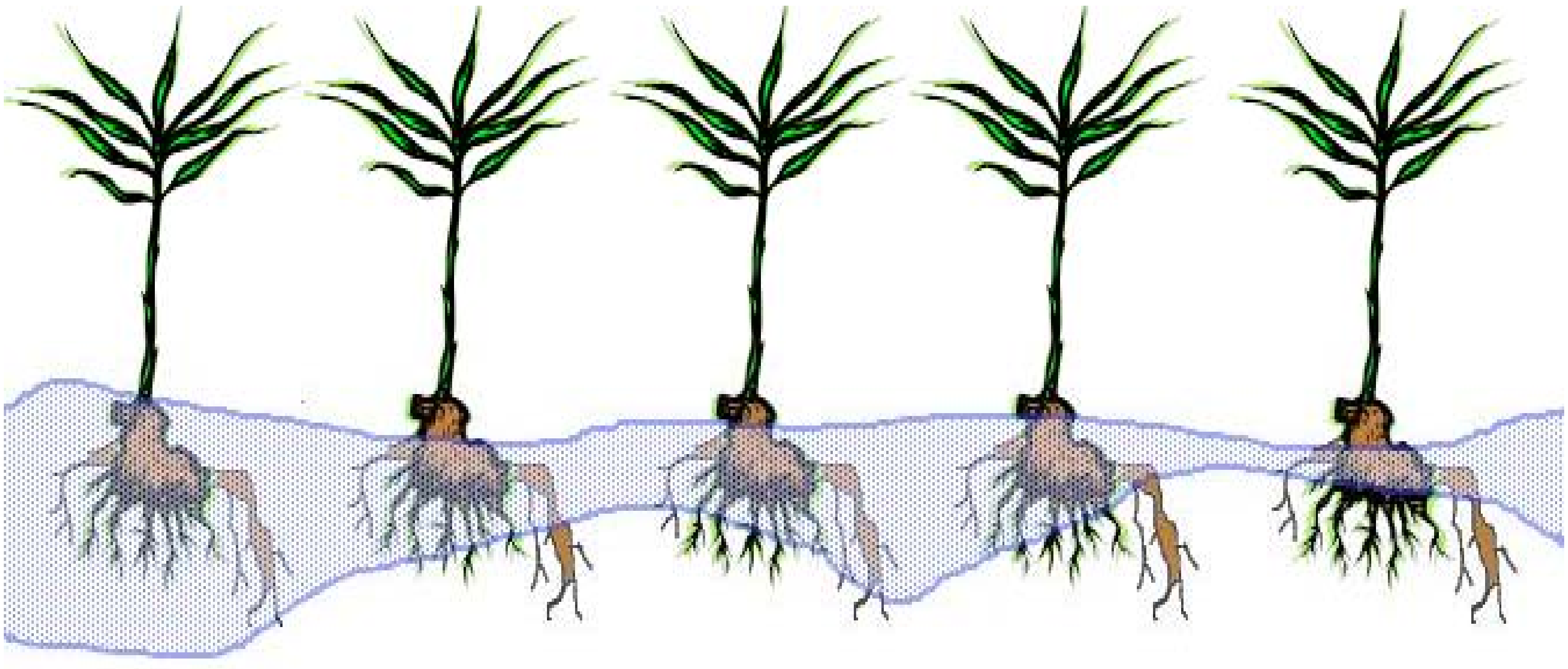
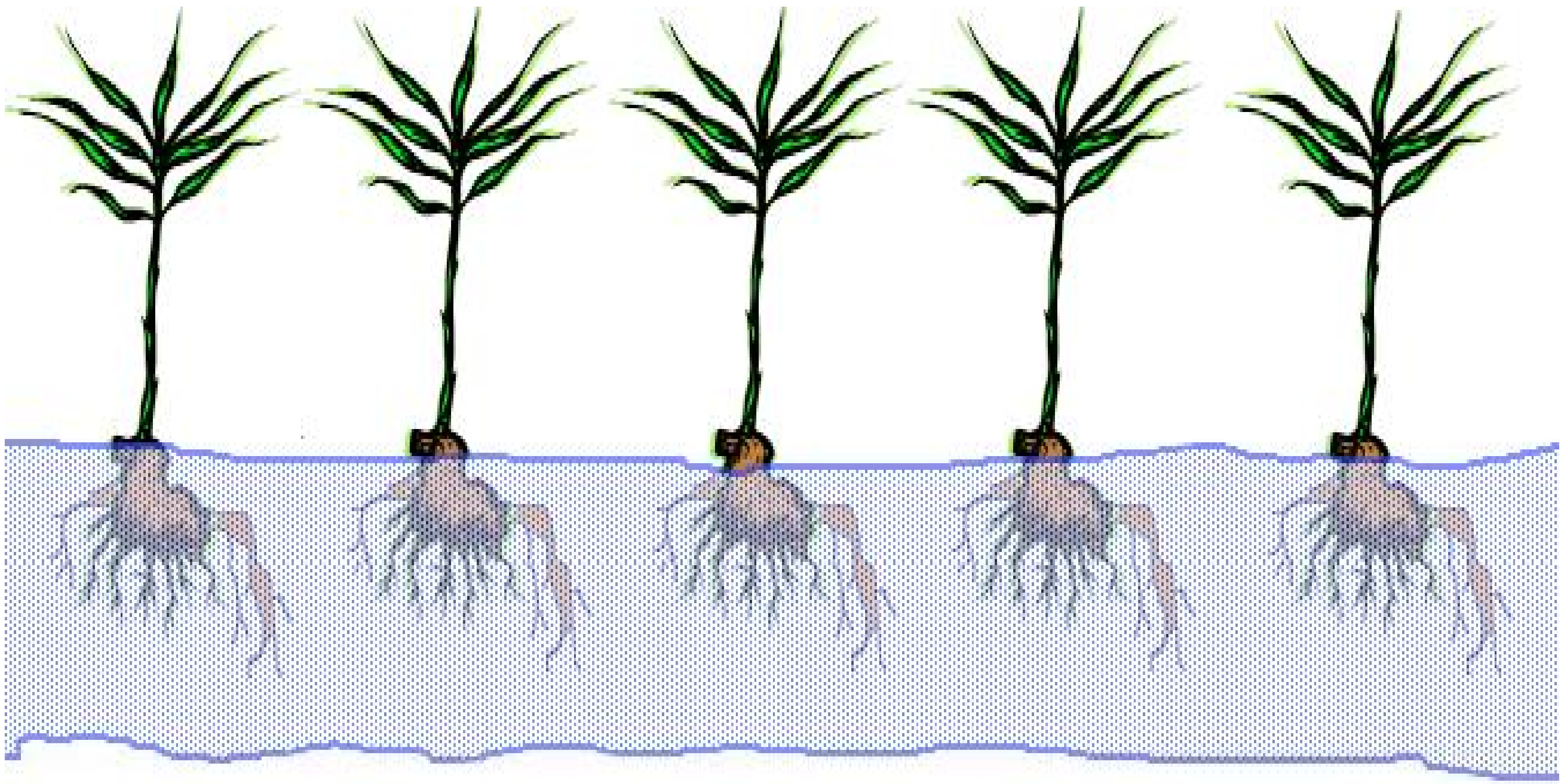
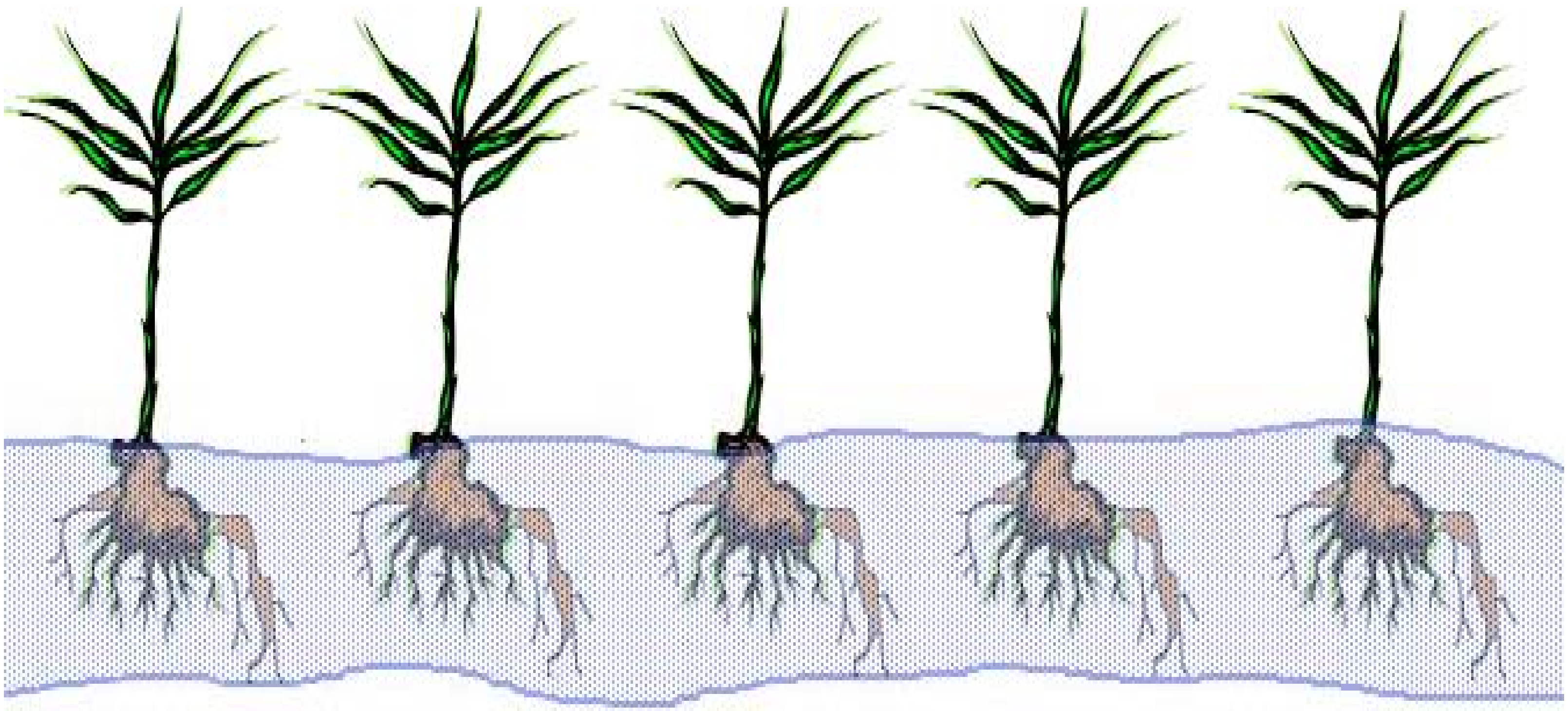
Poor DU, uneven irrigation and fertilizer application



Good DU, over irrigation, potential leaching of fertilizer



Good DU, good water and fertilizer management



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