Michigan Water Policy

•Report water use from all withdrawal – priority for withdrawals constructed prior to February 2006.

•Register new withdrawal constructed from February 2006 till present.

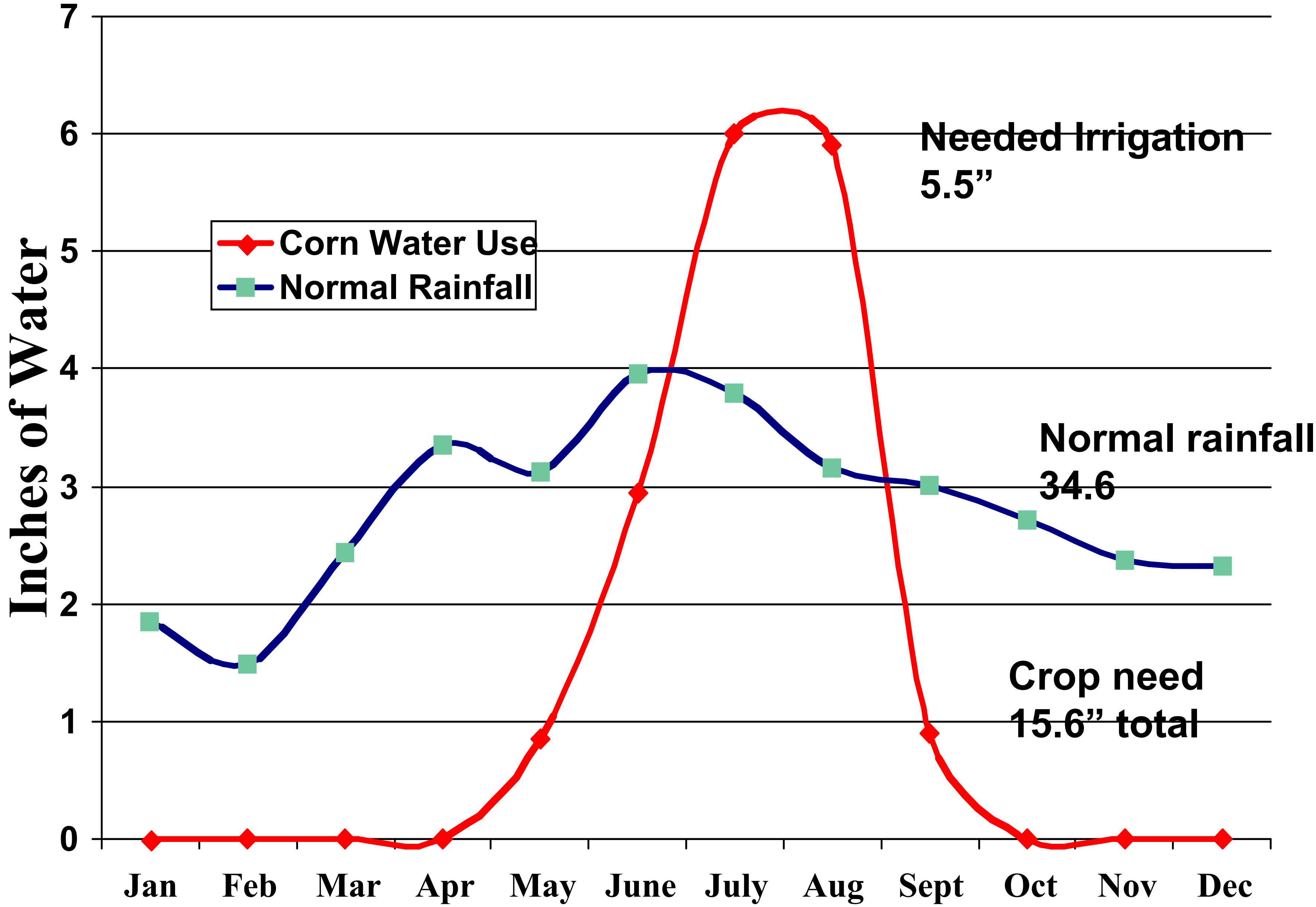
•Use Water withdrawal assessment tool to screen and Register purposed withdrawal that maybe constructed in the next 18 months.

www.miwwat.org

Chemigation / Fertigation

Lyndon Kelley
MSU Extension / Purdue University Irrigation Management Agent
269 - 467 - 5511

WWW.msue.msu.edu - find St. Joseph Co.
- then hit the Irrigation button



Inches of Water
7
6
5
4
3
2
1
0
Corn Water Use
Normal Rainfall
Needed Irrigation
5.5”
Normal rainfall
34.6
Crop need
15.6” total
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec

Pesticide and Nitrogen issues - Cons of Irrigation

- Irrigation is most common on light / sandy soil that often have high poorly protected aquifers.
- Irrigated soil will often be maintained with higher soil moisture than non-irrigated, increasing the potential of leaching pesticides and nitrogen.

Pesticide and Nitrogen issues - Pros of Irrigation

- Lack of water accounts 45% yield variation on light / sandy soil.
- Irrigation allow higher pesticides and nitrogen use efficiency, using nutrients that maybe lost post harvest.
- The greatest potential of leaching pesticides and nitrogen happen early in season, often prior to irrigation application season.

Using irrigation to get the most from pesticides and nutrients

Timely application of irrigation water :

- Improves incorporation of herbicides.
- Improves activation of herbicides.
- Improves activation / reactivation of insecticides.

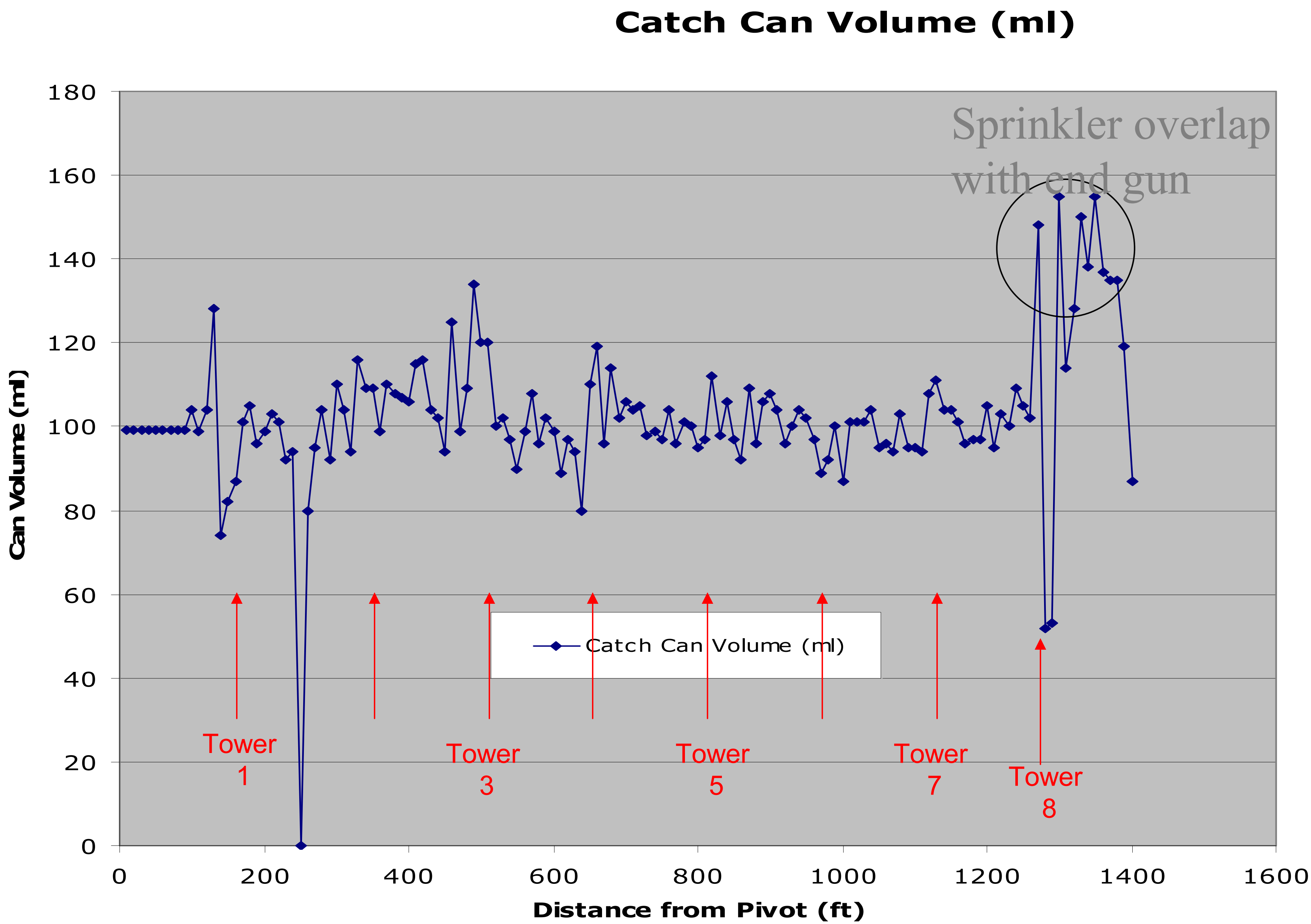
- Reduce nitrogen volatilization
- Maximizes yield to utilize the resources

Irrigation System Evaluations for Uniformity

Over and Under applied areas will likely be over or under applied each application multiplying the negative effect.

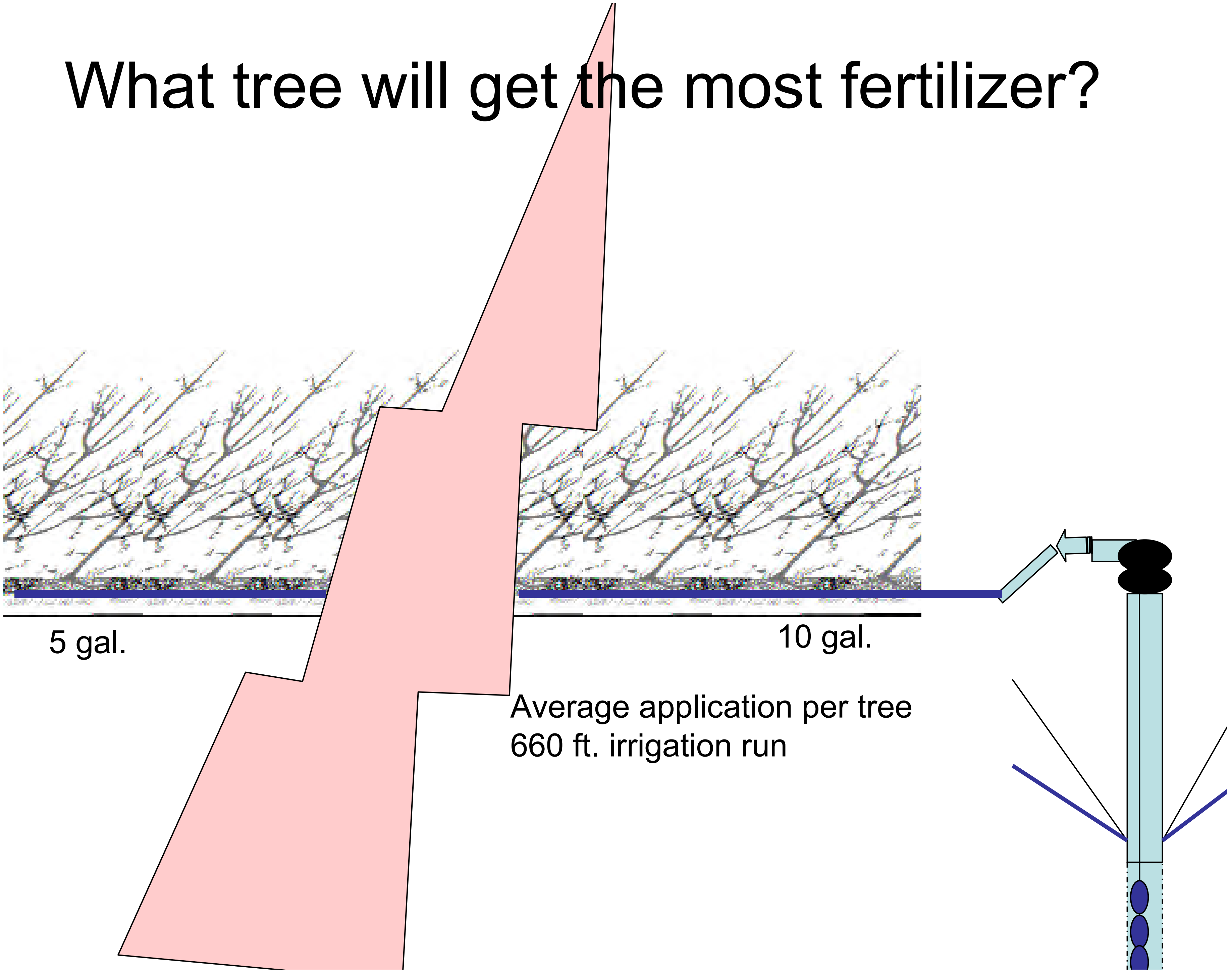
A 30% deviation on a field in an 8” irrigation application year will have areas receiving as little as 5.6” and as great as 10.4”

A 15% or less deviation from the average is ideal.



http://web1.msue.msu.edu/stjoseph/anr/anr.htm

What tree will get the most fertilizer?



Uniformity of Water Application

Dr. Rodney Thomas Fernandez
Associate Professor
A216 Plant and Soil Sciences
Michigan State University
East Lansing, MI 48824-1325
Phone: 517/355-5191, ext 336
Fax: 517/353-0890
Email: fernan15@msu.edu

BUL265 – University of Florida
Field Evaluation of Microirrigation Water Application Uniformity
A.G. Smajstrla, B.J. Boman, D.Z. Haman, D.J. Pitts, and F.S. Zazueta2

Publication #FS98-2

Field Evaluation of Container Nursery Irrigation Systems: Uniformity of Water Application in Sprinkler Systems

Dorota Z. Haman and Thomas H. Yeager

Preventing Irrigation Runoff

(comparing irrigation application rate to soil infiltration rate)

Preventing Irrigation Runoff

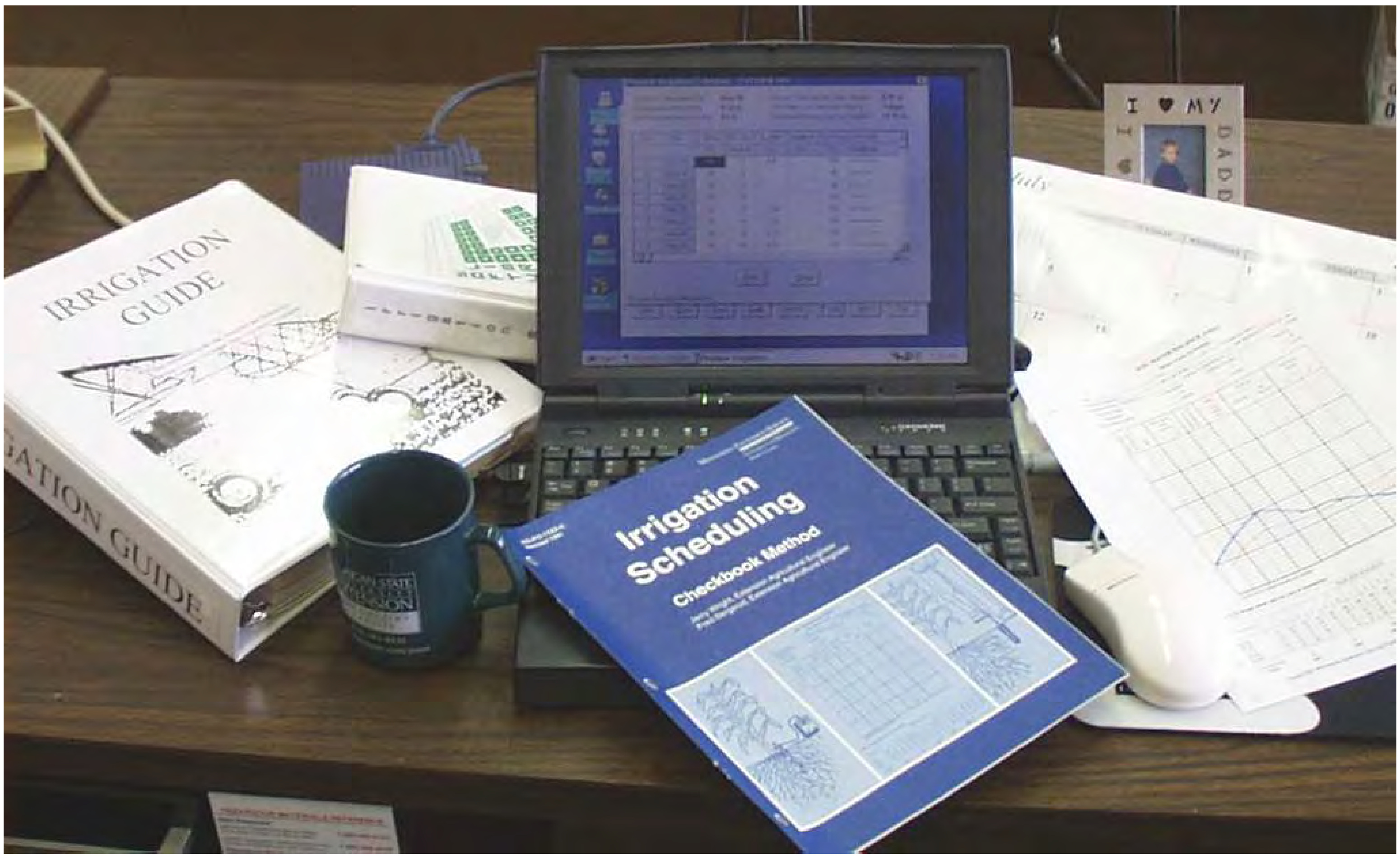
(comparing irrigation application rate to soil infiltration rate)

Sprinkler package or nozzle selection along with pressure dictates water application rate .

Factors that **increase** runoff :

•Small Wetted area or throw of sprinkler
•Low Pressure
•Larger applications volumes
•Soil compaction
•Heavy soils
•Slope
•Row hilling

Irrigation Scheduling
Checkbook Method

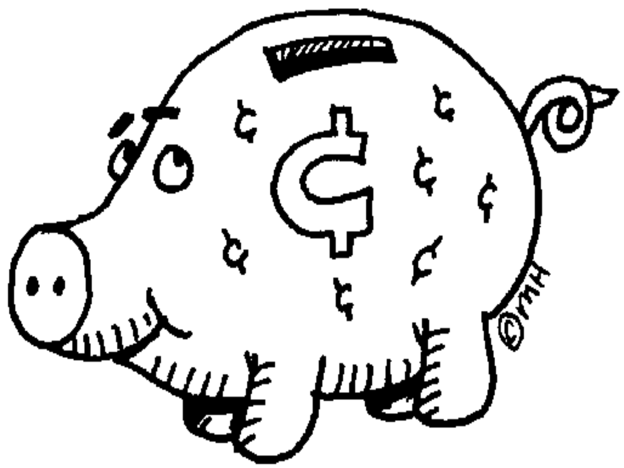


Think of your soil as a bank

Soil type :
Heavier soil can hold more water / foot of depth than light soils

Water holding capacity:
The soil (bank) can hold only a given volume of water before it allow it to pass lower down.

Intake rate:
Water applied faster than the soil intake rate is lost.



Rooting depth:
The plant can only get water to the depth of it's roots.

Deletion:
Plants may can pull out only 30 – 60% of the water

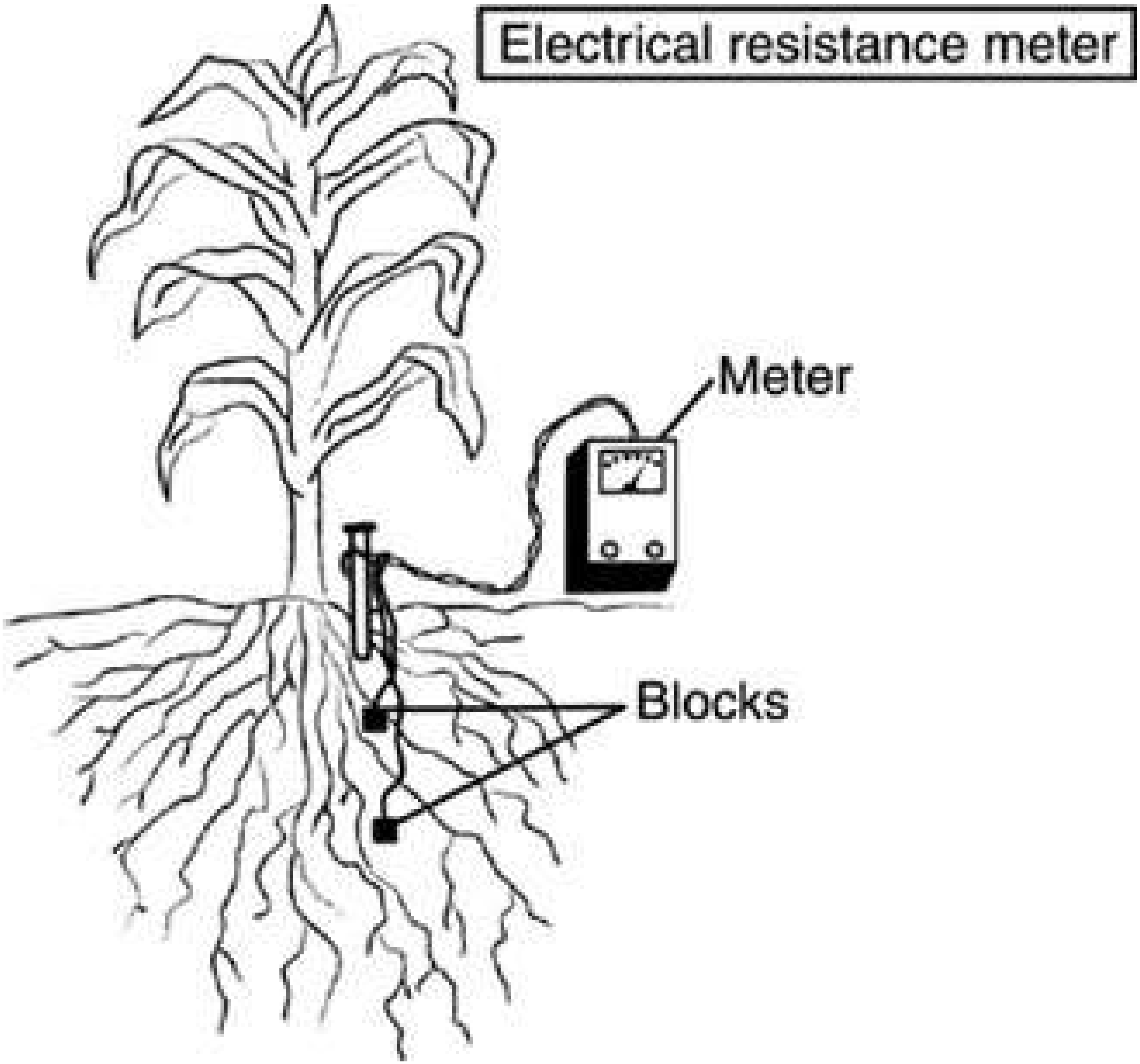
Water lost from the bottom of the profile can wash out (leach) water soluble nutrients and pesticides.

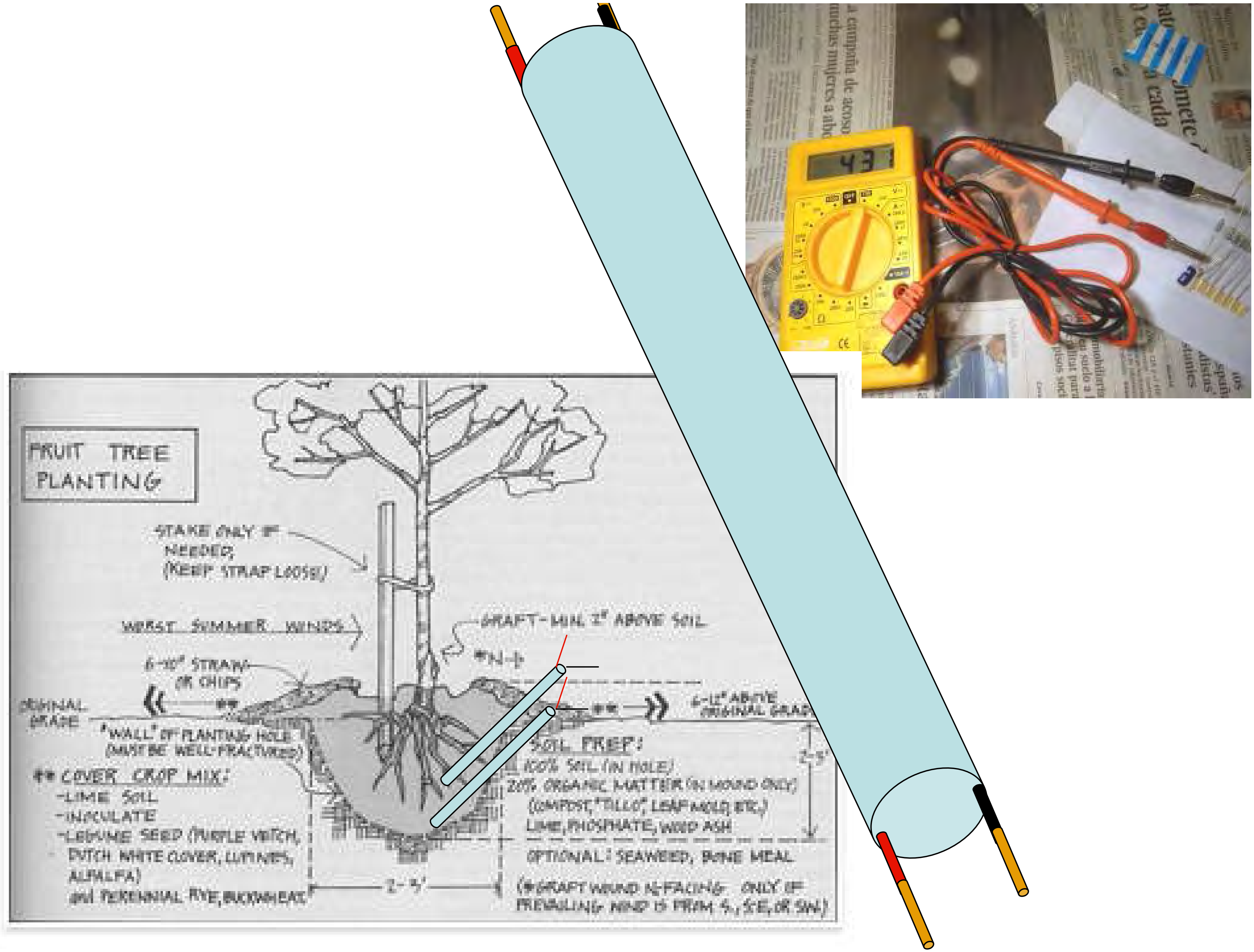
Methods to Estimate Soil Moisture

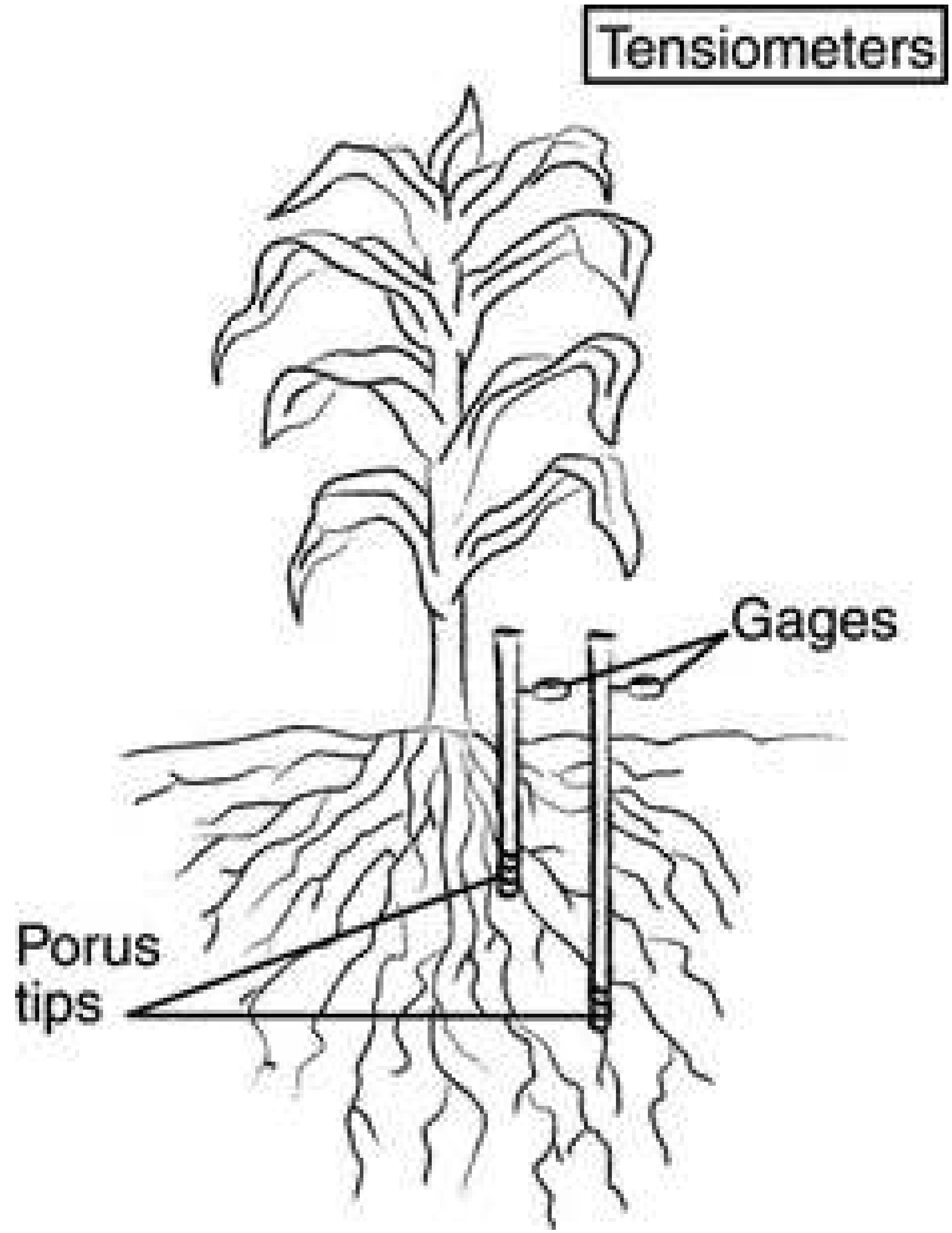
- Feel an Appearance
- Electrical resistance – electrodes on blocks in soil
- Tensiometers – measures soil moisture tension

Table 12. Guide for judging soil water deficit based on soil feel and appearance for several soil textures.

SOIL TEXTURE CLASSIFICATION					
Moisture deficiency	Coarse (loamy sand)	Sandy (sandy loam)	Medium (loam)	Fine (clay loam)	Moisture deficiency
in./ft.					in./ft.
.0	(field capacity) Leaves wet outline on hand when squeezed.	(field capacity) Appears very dark, leaves wet outline on hand, makes a short ribbon.	(field capacity) Appears very dark, leaves wet outline on hand, will ribbon out about one inch.	(field capacity) Appears very dark, leaves slight moisture on hands when squeezed, will ribbon out about two inches.	.0
.2	Appears moist, makes a weak ball.	Quite dark color, makes a hard ball.			.2
.4	Appears slightly moist, sticks together slightly.	Fairly dark color, makes a good ball.	Dark color, forms a plastic ball, slicks when rubbed.	Dark color, will slick and ribbons easily.	.4
.6	Appears to be dry, will not form a ball under pressure.			Quite dark, will make thick ribbon, may slick when rubbed.	.6
.8		Slightly dark color, makes a weak ball.	Quite dark, forms a hard ball.		.8
1.0		Lightly colored by moisture, will not ball.	Fairly dark, forms a good ball.	Fairly dark, makes a good ball.	1.0
1.2	Dry, loose, single-grained flows through fingers. (wilting point)	Very slight color due to moisture, loose, flows through fingers. (wilting point)	Slightly dark, forms weak ball.	Will ball, small clods will flatten out rather than crumble.	1.2
1.4			Lightly colored, small clods crumble fairly easily.	Slightly dark, clods crumble.	1.4
1.6					1.6
1.8			Slight color due to moisture, powdery, dry, sometimes slightly crusted but easily broken down in powdery condition. (wilting point)	Some darkness due to unavailable moisture, hard, baked, cracked sometimes has loose crumbs on surface. (wilting point)	1.8
2.0					2.0

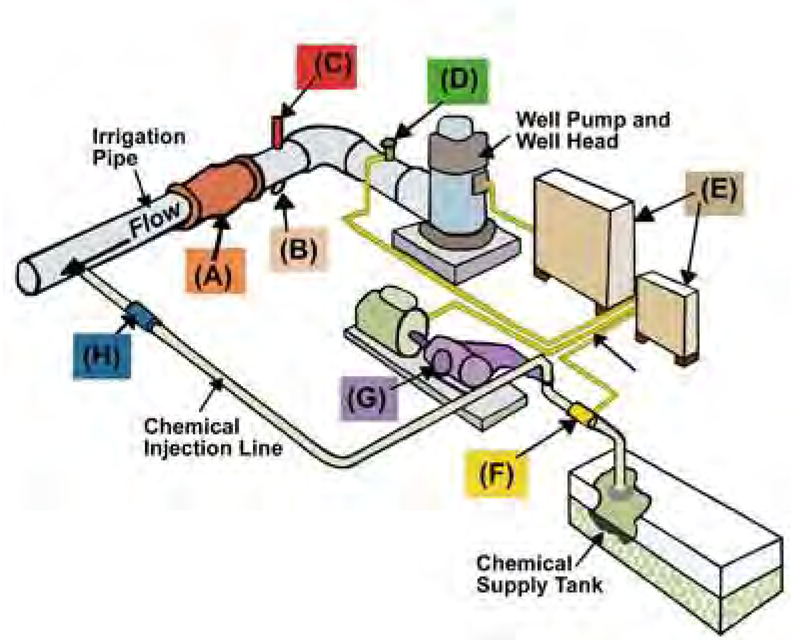

Electrical resistance meter
Meter
Blocks


FRUIT TREE PLANTING
STAKE ONLY IF NEEDED, (KEEP STRAP LOOSE)
WORST SUMMER WINDS
GRAFT-MIN. 2" ABOVE SOIL
6-10" STRAW OR CHIPS
ORIGINAL GRADE
6-12" ABOVE ORIGINAL GRADE
'WALL' OF PLANTING HOLE (MUST BE WELL-FRACTURED)
** COVER CROP MIX:
-LIME SOIL
-INOCULATE
-LEGUME SEED (PURPLE VETCH, DUTCH WHITE CLOVER, LUPINES, ALFALFA)
and PERENNIAL RYE, BUCKWHEAT
SOIL PREP:
100% SOIL (IN HOLE)
20% ORGANIC MATTER (IN MOUND ONLY)
(COMPOST, "TILLO", LEAF MOLD, ETC.)
LIME, PHOSPHATE, WOOD ASH
OPTIONAL: SEAWEED, BONE MEAL
(*GRAFT WOUND N-FACING ONLY IF PREVAILING WIND IS FROM S., S.E., OR S.W.)
2-3'
2-3'


Tensiometers
Gages
Porus
tips

Chemigation – Application of pesticide via irrigation water.

Fertigation – Application of fertilizer via irrigation water.



Chemigation / Fertigation

- Allows immediate incorporation of chemical.
- Un-matched carrier solution ½ " = 13,577gal.

Chemigation Label

- Chemigation label provide specific Mixing application and safety precautions.
- Federal pesticide laws requires products applied through irrigation systems to have a federal chemigation label.

Fertilizer solution – Growers responsibility

Chemigation Equipment

- Backflow protection (chemigation valve)
- Positive displacement injection pump
- Injection nozzle with back flow protection
- Storage / mixing tank
- High Pressure hose (injection hose, 160 psi)
- Supply hose (sized to gravity flow need volume to pump)

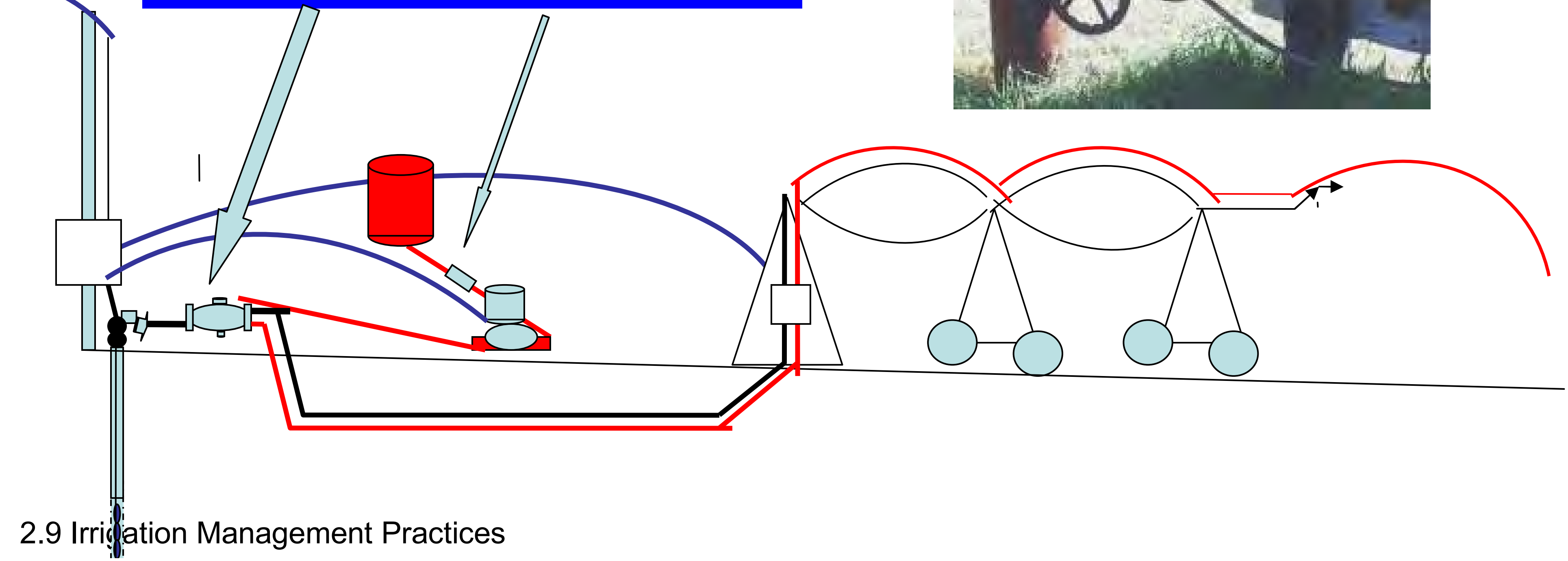
Chemigation Valve Requirements

Indiana and Michigan have specific chemigation valve requirement for public water supply connections but not for private water supplies.

Both State require adequate protection of water supply in law or well code.

Are appropriate backflow prevention devices in place and properly maintained if fertigation or chemigation is used?

Backflow prevention safety devices are used and properly maintained if fertigation or chemigation are used.

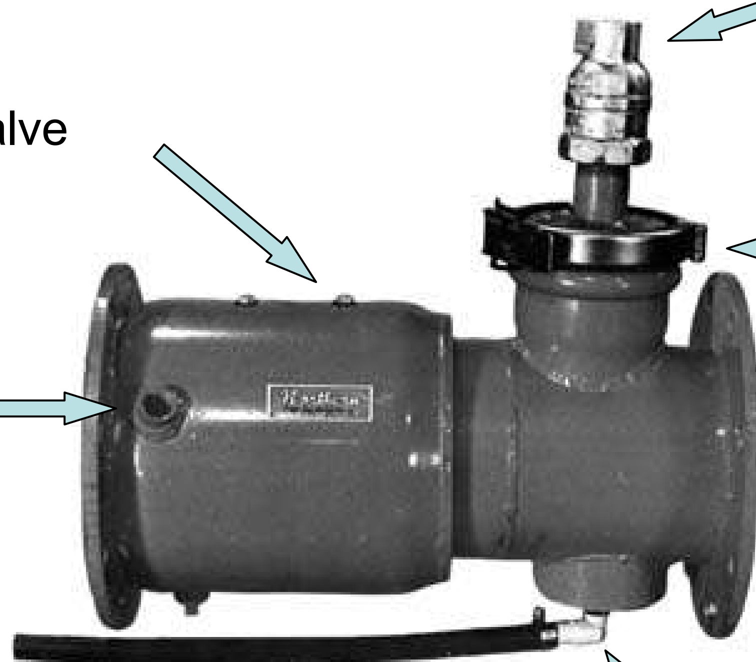


Most chemigation valves consist of:

air and vacuum relief valve

spring-loaded check valve

4 inch inspection port



injection port for
introducing the
chemicals

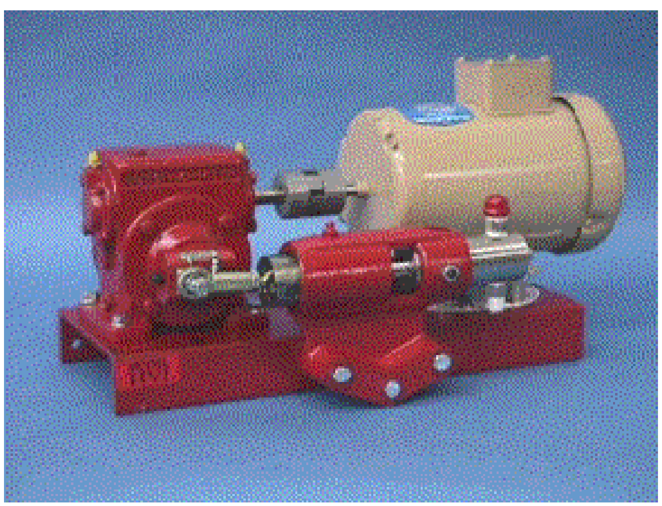
Flow direction

a low pressure drain

Positive displacement injection pump

- Piston and Diaphragm pumps are most common
- Pump capacity should be <u>double</u> your estimated flow need.

Example- to apply 30 lbs of N to an area that takes 2 hours to irrigate. Liquid N solution(28%)contains 3.1 lbs. N per gallon, so about 10 gallon / 2 hour or about 5 gallon per capacity. You need a injection pump rated at 10 g/hour maximum delivery.



University of **Massachusetts**

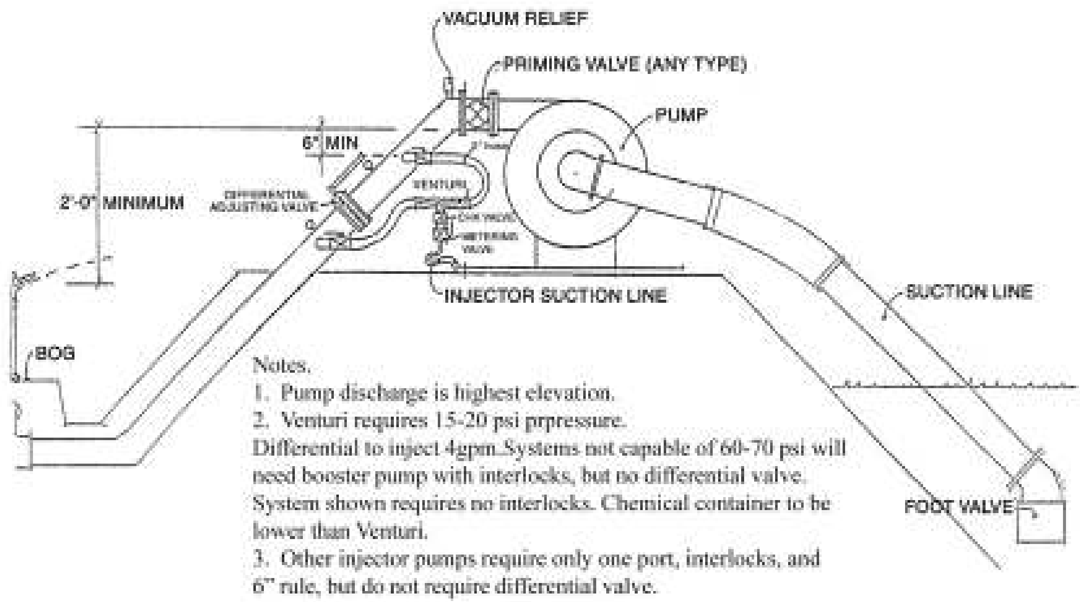


Figure 2. Cranberry bog backflow prevention and chemigation. Example of atmospheric loop and venturi injector.

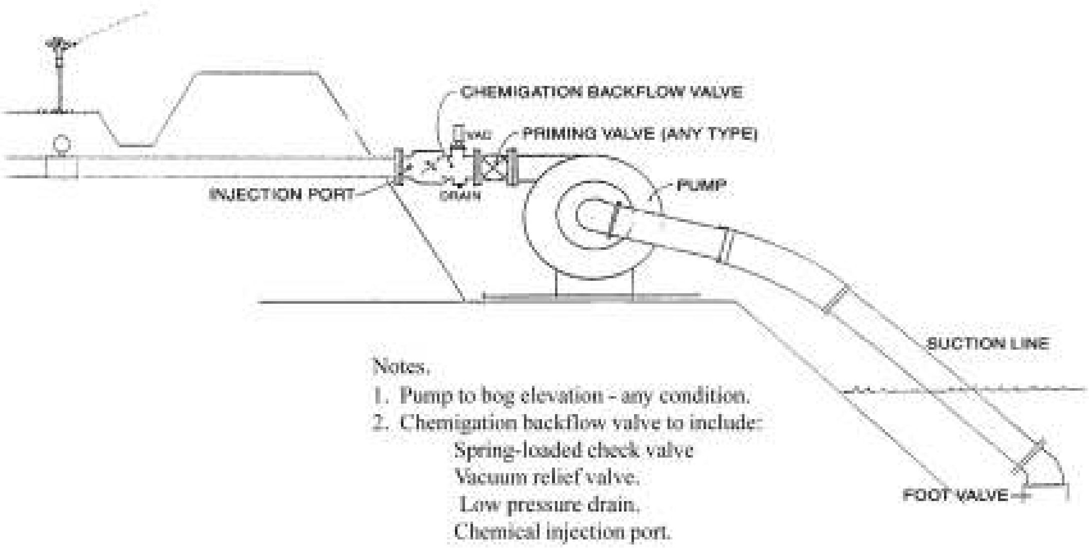
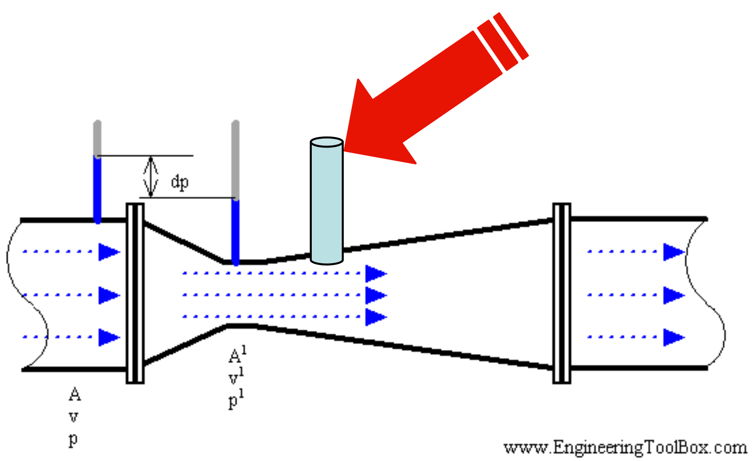


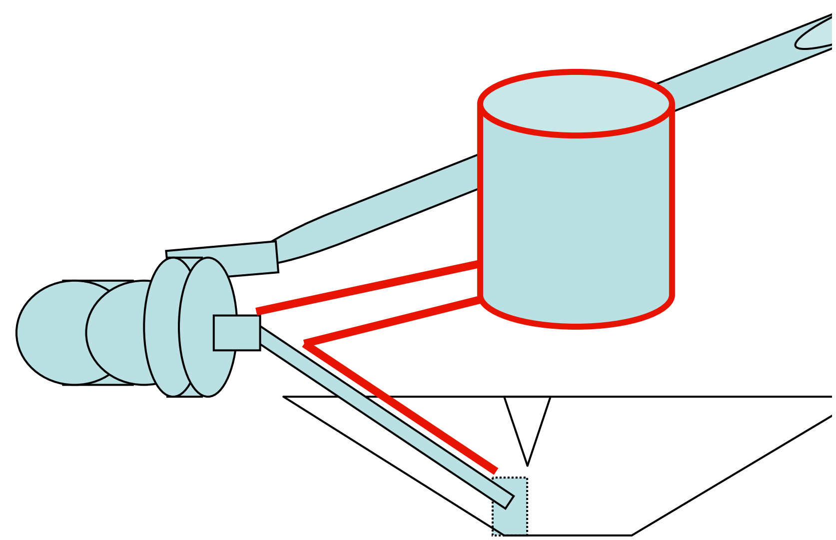
Figure 3. Cranberry Bog backflow prevention and chemigation. Example of chemigation backflow valve, pump not 2 feet higher than head.

Injection Methods
(Bad ideas)

Venturi injection-
•Chemical concentration increase as water is pumped further.
•For safety reasons, system must be completely down flow of back flow valve.



Injection on suction side of pump
•Chemical concentration increase as water is pumped further.
•Major backflow / contamination threat



Injection nozzle with back flow protection

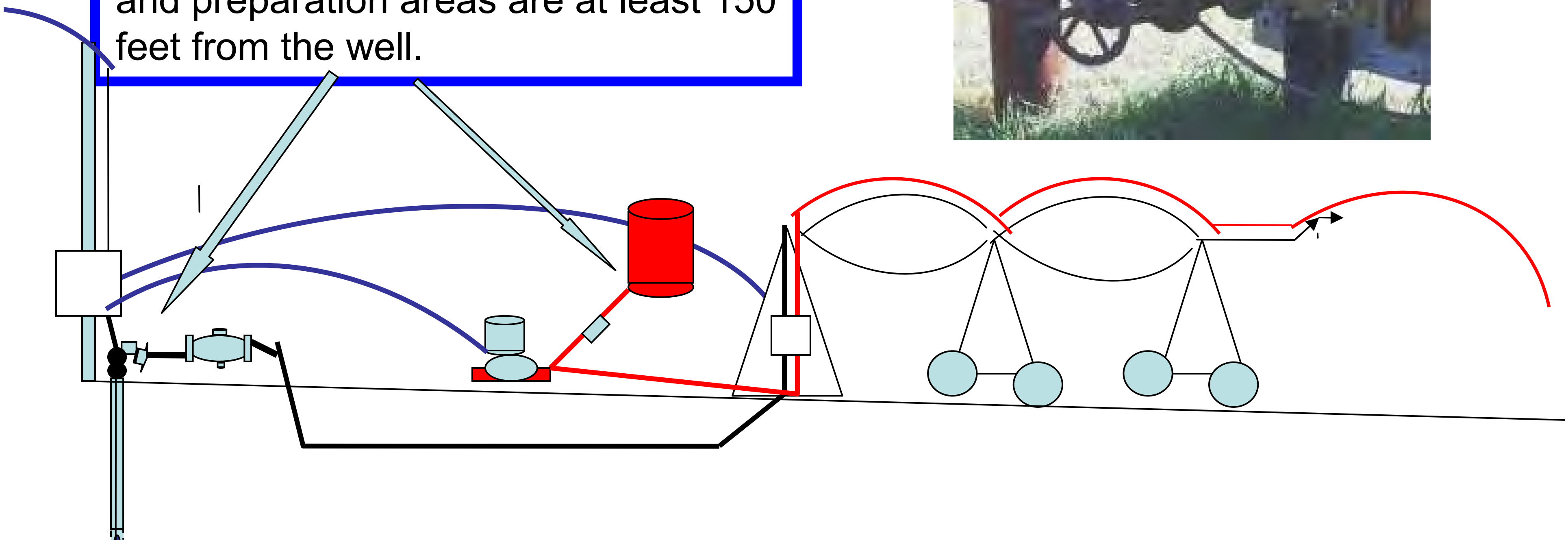
- Prevents irrigation water from back feeding to chemical supply tank if injector pump stops.
- “ Making fertilizer / chemical”

Storage / mixing tank

- Plastic or stainless
- Sized just larger than greatest single application need.
- " not a good place for long term storage"

Maintain appropriate set back distances if fertigation or chemigation is used?

Distance requirements between well and contamination, and agricultural chemical/fertilizer storage and preparation areas are at least 150 feet from the well.



High pressure hose

- injection hose, 160 psi burst strength minimum
- Hose clamp and barb up to 100 psi, over 100 psi consider hydraulic hose and fittings.

Vacuum line hose

- Adequate wall strength to prevent collapse
- Double size of High pressure hose
- Consider inline filter or strainer

Six Easy Steps to Calibrating a Center Pivot for Chemigation

Calibrate the injector pump. Determine the injection rate at the injector pump setting to be used. This must be done with the system running so the injector pump is working against pressure. To do this, calibrate from the suction side of the injector pump, letting the injector pump draw from a calibration container. Calibrate by determining the time (in minutes) to pump 1 gallon of liquid.

Injector Pump Rate (gal/hr) = $\dfrac{60}{\textit{Minutes to Pump 1 Gallon}}$

Determine the total hours to cover the field at the speed the center pivot will be operated.

Time to Cover Field = Hours

Determine the total gallons to be injected. Multiply the injector pump rate (from Step 1) by the total hours to cover the file (from Step 2).

Total Gallons to be Injected $= \dfrac{\textit{Gallons}}{\textit{Hour}} \times$ *(Hours to Cover Field)*

Six Easy Steps to Calibrating a Center Pivot for Chemigation

- Determine the chemical amount required to cover the field. Multiply the field acreage by the chemical rate as specified. For nitrogen, it would be pounds N per acre and for pesticides it would be the rate that is recommended on the label.

- *Total Chemical Volume = Field Acres X* $\dfrac{\textit{Chemical Volume}}{\textit{Acre}}$

- Add the chemical (Step 4) to the injection supply tank and then fill the supply tank to the total volume as determined in Step 3.

- Make sure you have a method to agitate the injector supply tank to mix the chemical and keep the chemical in solution (chemicals will settle out if not agitated)

-

Chemigation Calibration Tube

Fertigation is used on the Smith farm annually.

"We apply about the last 1/3 of the nitrogen through the pivot for irrigated fields.

Fertigation lets us apply nitrogen to just the irrigated portion of the field. This way, we don't over-fertilize the dry corners."

Chemigation / Fertigation Calibration

Find the irrigation application amount you wish to chemigate with.

- Avoid over filling the profile anywhere in the application area.
- Allow for near future rainfall that may overfill root zone
- Have a known pumping time for the area at the application rate.

Example: ½” application takes 4 hours.

Chemigation / Fertigation Calibration

Calculate the total volume of chemical / fertilizer need for the <u>actual</u> area to be irrigated.

- Deduct for dry areas / corners

Example:

- 11 acres – 1 dry acre = 10 acres
- a 30 lb.of N/ acre application will require 300 lb. total N.
- Given that 1 gal. of 28% N contain 3.1 lb. of actual N
- 300 / 3.1 = 97 gal. of 28%

Chemigation / Fertigation Calibration

Calculate the application per minute needed

Example: 97 gal. of 28% over a 4 hours. period

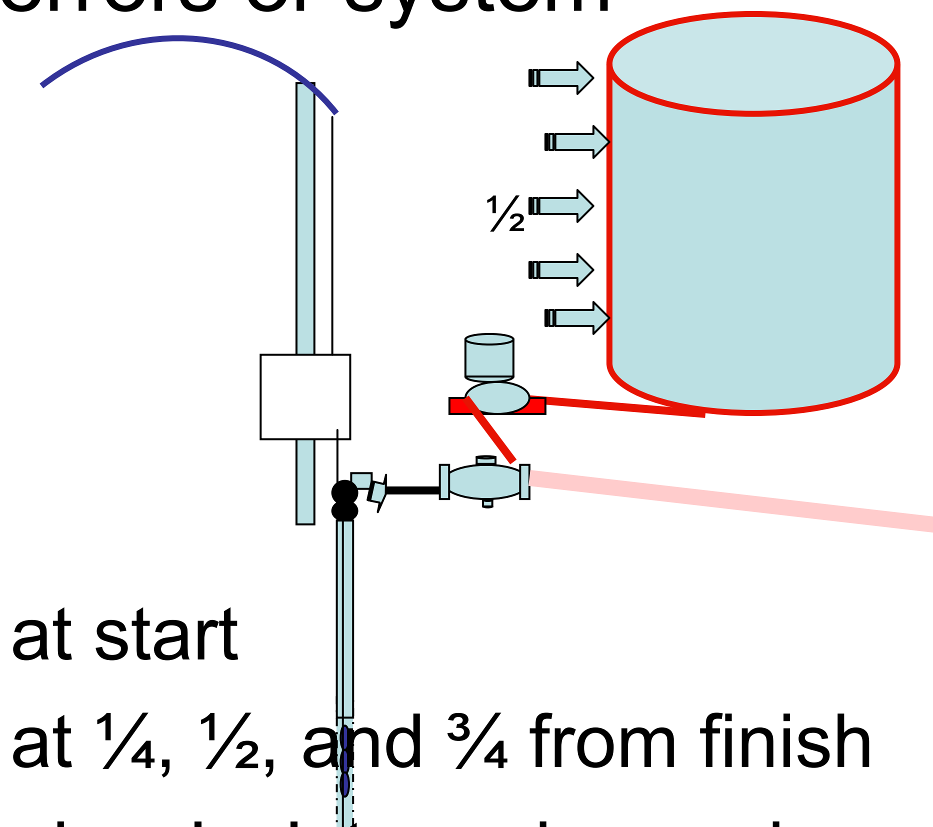
4 hours * 60 minutes = 240 minutes

97 gal. / 240 minutes = 0.40 gal. / minute

Adjust pump to deliver 0.40 gal. of chemical/ minute

Chemigation / Fertigation Calibration

Monitor for calculation errors or system malfunctions.



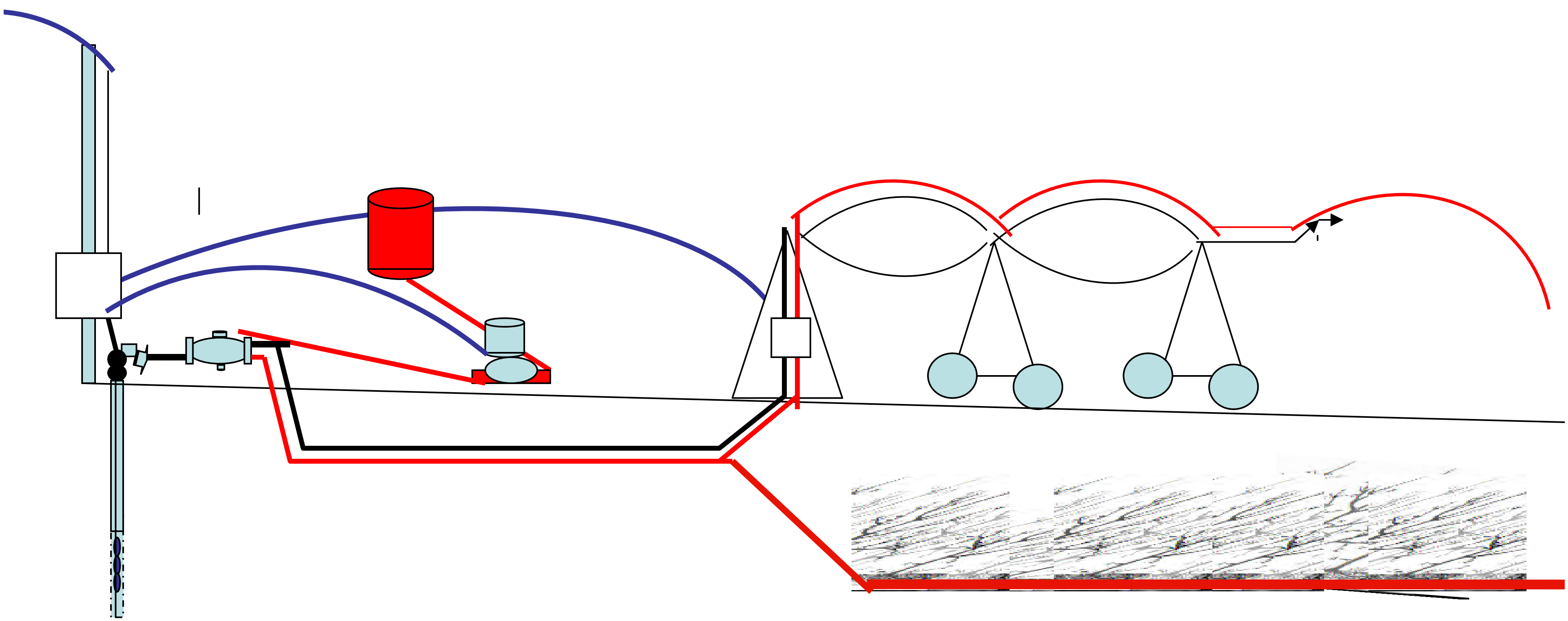
- Shut downs
- Backflows
- Hose burst

Mark the supply tank level at start

Mark the supply tank level at ¼, ½, and ¾ from finish

Monitor and adjust if needed, calculate and record the actual applied amount for future decisions.

Chemigation / Fertigation Systems - Safety Interlock



Backflow situation – What do I do?

Pump, Pump, Pump as soon as possible.

Nebraska study showed 990 /1000 gallon recovery in the first hour when pumping started immediately.

- 999 /1000 gallon after the first day of pumping.
- 99.9% one day pumping recovery is reduced 10-20% if you start 24 hour later.