



UNIVERSITY OF ILLINOIS
EXTENSION

Illinois Migrant Council

PREPARING A NEW GENERATION OF ILLINOIS FRUIT AND VEGETABLE FARMERS

a USDA NIFA BEGINNING FARMER AND RANCHER
DEVELOPMENT PROGRAM PROJECT
GRANT # 2012-49400-19565

<http://www.newillinoisfarmers.org>





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**GROWING A NEW GENERATION
OF ILLINOIS FRUIT AND VEGETABLE FARMERS**

IRRIGATION

Jeff Kindhart and Jeremy Shafer

April 2015





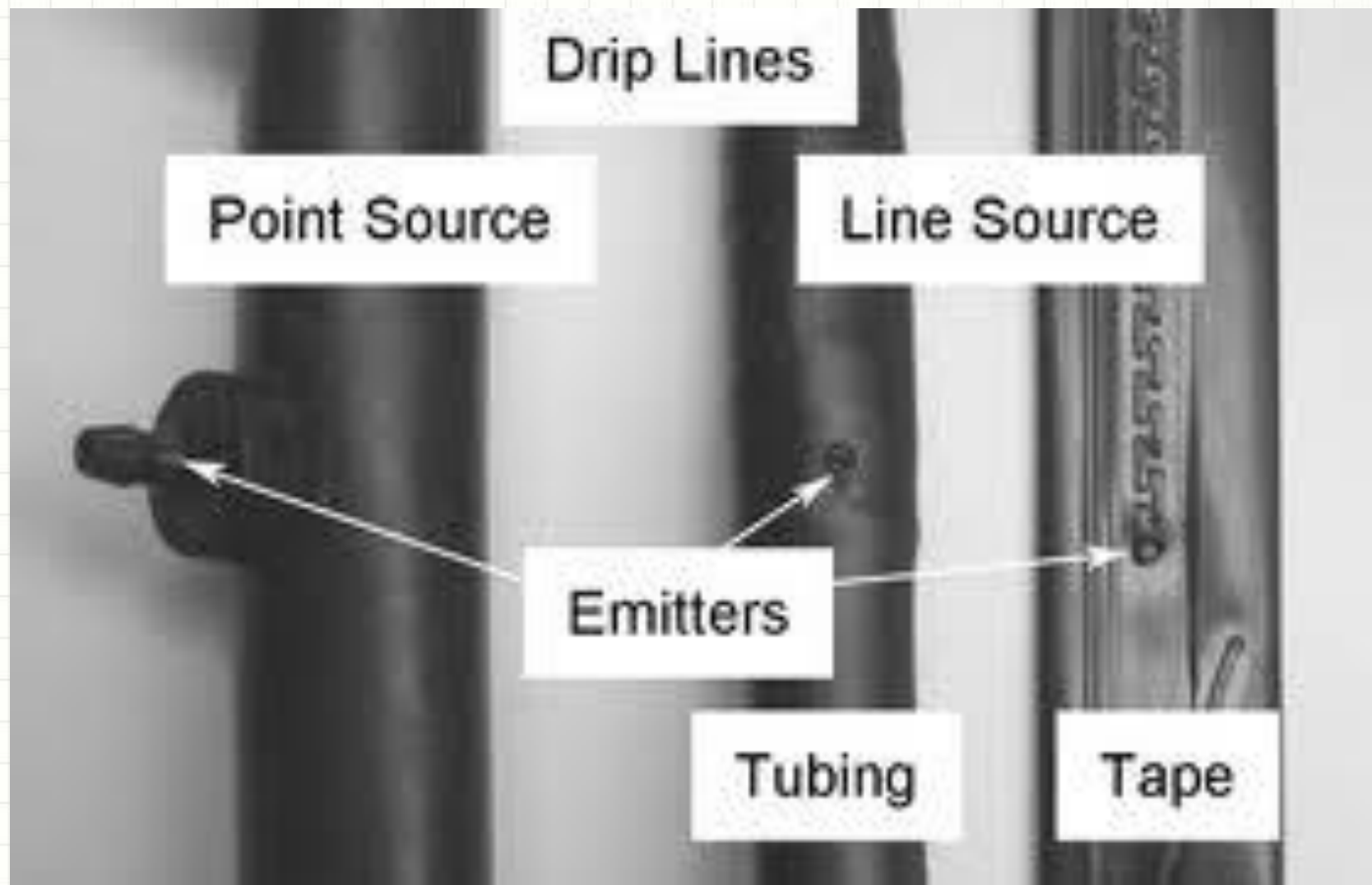




Irrigation gun with reel cart









Typical Drip System Layout



TORO.





SPECIFICATIONS

Wall thickness (mil):

0.540" (45 mil)

0.620" (45 mil)

0.690" (48 mil)

0.820" (60 mil)

Nominal flow rates (mil): 0.26, 0.4, 0.5, 1.0, 2.0

Common spacings: 18", 24", 30", 36", 42", 48", 60"

Recommended filtration: 120 mesh

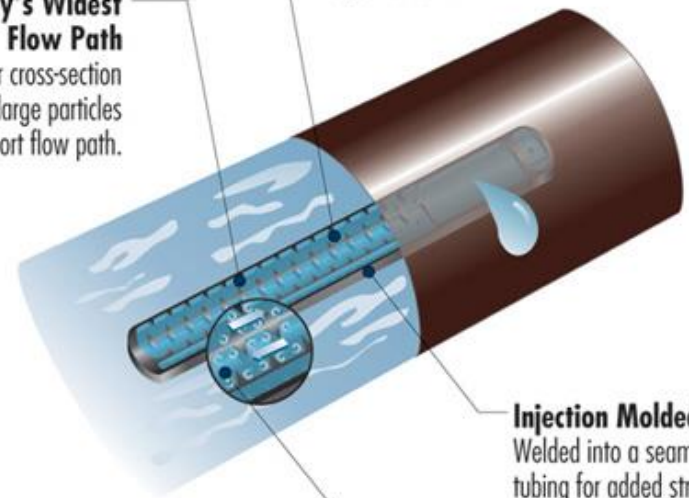
Recommended operating pressure: 10 to 30 psi

Industry's Widest Flow Path

Wider cross-section allows large particles through short flow path.

Full Length Filter

Maintains the essential supply of water to the dripper delivering a consistent output of flow.



Injection Molded Drippers

Welded into a seamless wall of tubing for added strength, durability and long-term performance.

TURBONET

Increased Flow Path Velocity

Commonly used turbulent drippers have overlapping tooth patterns, easily catching debris.

Turbonet Technology improves dripper performance by widening the tooth pattern, maximizing flow path velocity, allowing contaminants to pass easily through the dripper, virtually eliminating plugging.



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Considerations for drip irrigation

- Water Source
- Design
- Operation and Maintenance
- Other

Water Source Problems

- Surface
 - Herbicide contamination
 - Disease organisms
 - Size
 - Excessive algae
- Well
 - Size/Capacity
 - Iron
 - Sand
- Municipal
 - Volume/Pressure

Surface Water Problems



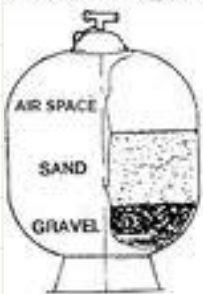
Algae Problems



Algae Solutions



Sand Filter Diagram



Two TR60 Filters w/ Manifold



Single Filter Backwash Valve



Water Source Problems

- Surface
 - Herbicide contamination
 - Disease organisms
 - Size
 - Excessive algae
- Well
 - Size/Capacity
 - Iron
 - Sand
- Municipal
 - Volume/Pressure

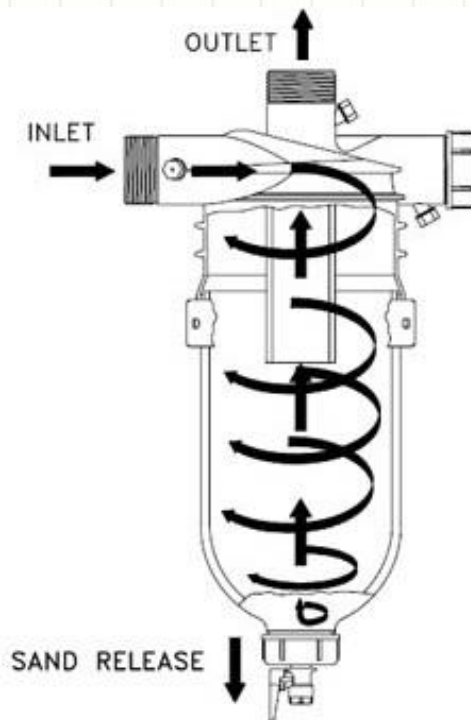








**Sand collection tank
Optional for extra \$**



Water Source Problems

- Surface
 - Herbicide contamination
 - Disease organisms
 - Size
 - Excessive algae
- Well
 - Size/Capacity
 - Iron
 - Sand
- Municipal
 - Volume/Pressure

RPZ Backflow Preventer





| FLOW RATE | | | | | |
|------------|------|------|--------|-------|---------|
| GPM | 3/4" | 1" | 1-1/2" | 2" | % Error |
| MIN | 0.5 | 0.75 | 1.5 | 2 | 3 |
| MAX | 30 | 50 | 100 | 160 | 1.5 |
| CONTINUOUS | 15 | 25 | 50 | 80 | |
| RANGE | 2-30 | 3-50 | 5-50 | 8-160 | |

Considerations for Drip Irrigation

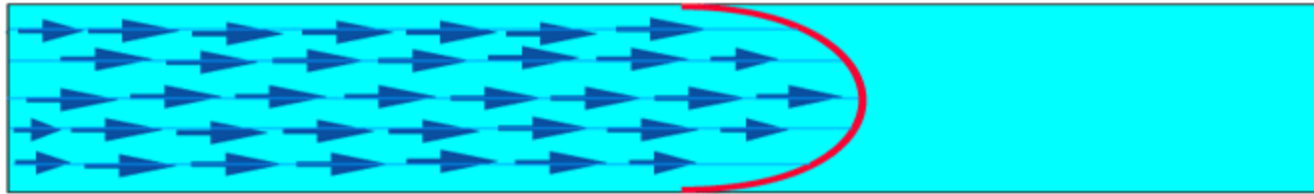
- Water Source
- Design
- Operation and Maintenance
- Other

Flow rate and friction head loss
for tubing and pipe sizes (Imperial)
(based on 10 ft/s velocity)

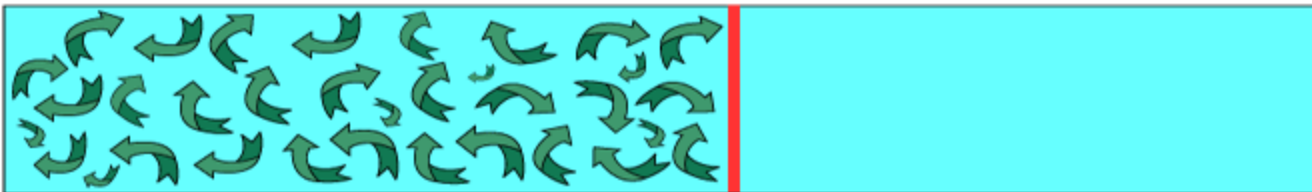
| Nom. dia. (in) | Inside dia. (in) | Flow rate (gpm) | Friction head loss (feet of head per feet of pipe) |
|-------------------|---------------------|--------------------|---|
| 1/4 | 0.311 | 2.4 | 2.15 |
| 1/2 | 0.527 | 6.8 | 1.08 |
| 3/4 | 0.745 | 13.6 | 0.69 |
| 1 | 0.995 | 24 | 0.48 |
| 1 1/2 | 1.6 | 63 | 0.26 |
| 2 | 2.067 | 105 | 0.19 |
| 2 1/2 | 2.469 | 149 | 0.15 |
| 3 | 3.068 | 230 | 0.117 |
| 4 | 4.026 | 400 | 0.084 |
| 6 | 6.065 | 900 | 0.051 |
| 8 | 8.125 | 1615 | 0.036 |
| 10 | 10.25 | 2570 | 0.027 |
| 12 | 12.25 | 3675 | 0.022 |
| 14 | 13.5 | 4460 | 0.0194 |

Laminar Flow

freshgasflow.com



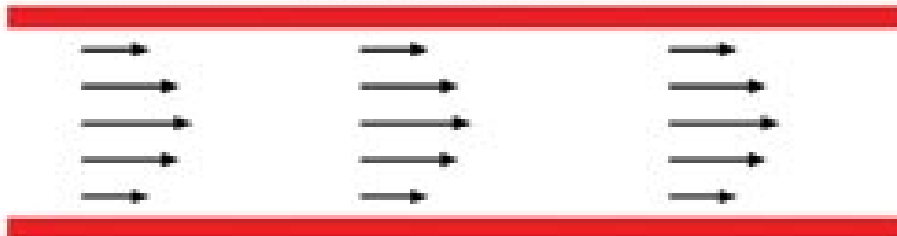
Turbulent Flow



TURBULENT FLOW



LAMINAR FLOW



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Types of Problems

- Water Source
- Design
- Operation and Maintenance
- Other

Outlet Spacing

4, 6, 8, 12, 16, 18 & 24 inch
spacing available for most
T-TAPE TSX wall thicknesses.

Contact your T-TAPE dealer
for a complete product listing.

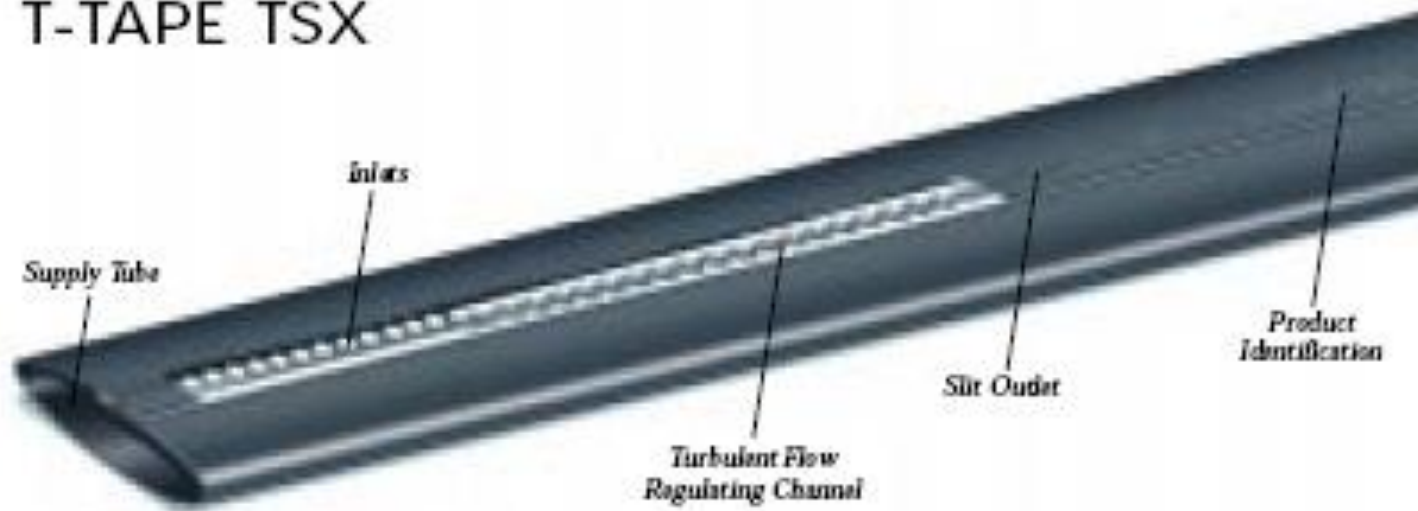
Flow Rates

Various flow rates available to
meet specific application
needs.

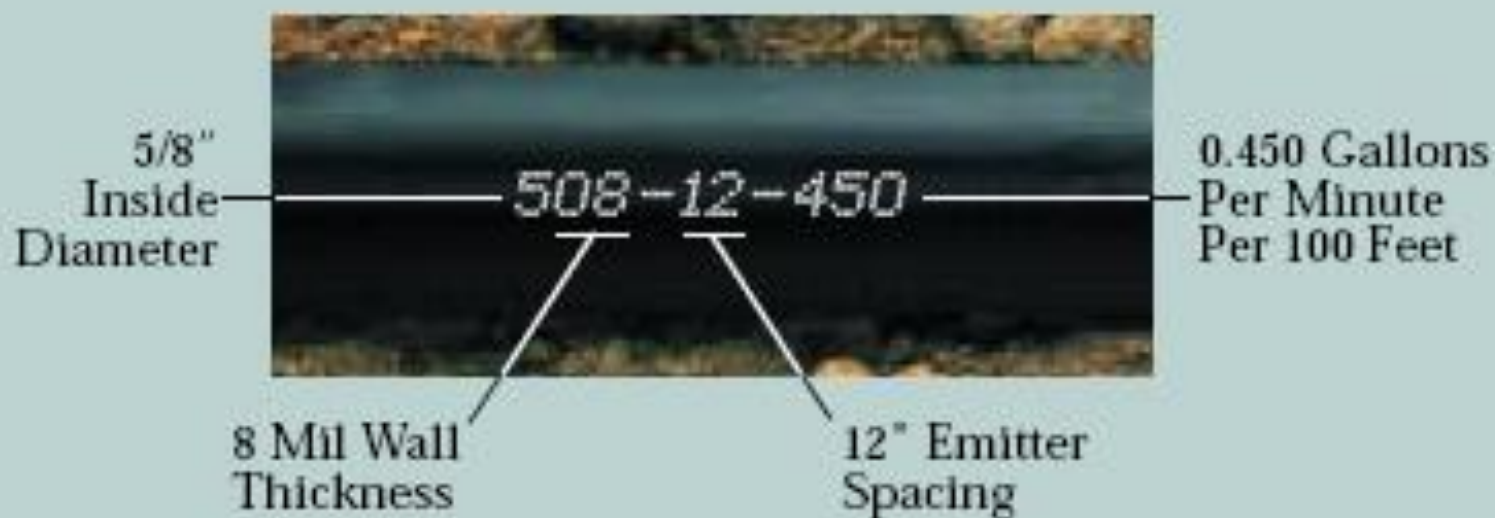
Common Flow Rates

| | | |
|------|-------|--------------|
| .170 | | .gpm/100 Ft. |
| .220 | | .gpm/100 Ft. |
| .280 | | .gpm/100 Ft. |
| .340 | | .gpm/100 Ft. |
| .450 | | .gpm/100 Ft. |
| .670 | | .gpm/100 Ft. |

T-TAPE TSX

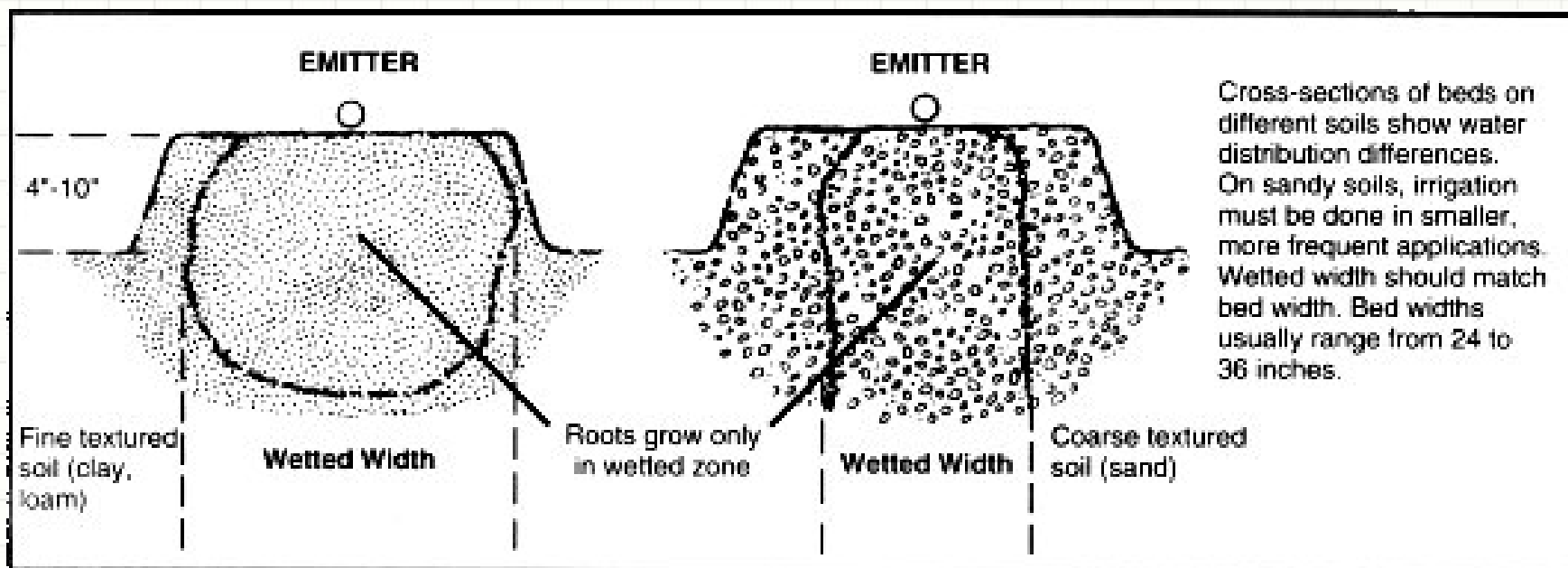


T-TAPE PRODUCT IDENTIFICATION



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Types of Problems

- Water Source
- Design
- Operation and Maintenance
- Other

Clogging Emitters

- Physical
 - Silt
 - Sand
- Biological
 - Algae
 - Bacteria
- Chemical
 - Calcium, magnesium, iron, and manganese
 - Fertilizer

Constituent**Level of Concern**

Low

Moderate

High

pH

<7.0

7.0-8.0

>8.0

Iron (Fe) mg/L

<0.2

0.2-1.5

>1.5

Manganese (Mn) mg/L

<0.1

0.1-1.5

>1.5

Hydrogen Sulfide (H₂S) mg/L

<0.2

0.2-2.0

>2.0

Total Dissolved Solids (TDS) mg/L <500

500-2000

>2000

Total Suspended Solids (TSS) mg/L <50

50-100

>100

Bacteria Count (#/ml)

<10,000

10,000-50,000

>50,000

Most Common Problem

- Management
- Management
- Management

Monitor soil moisture

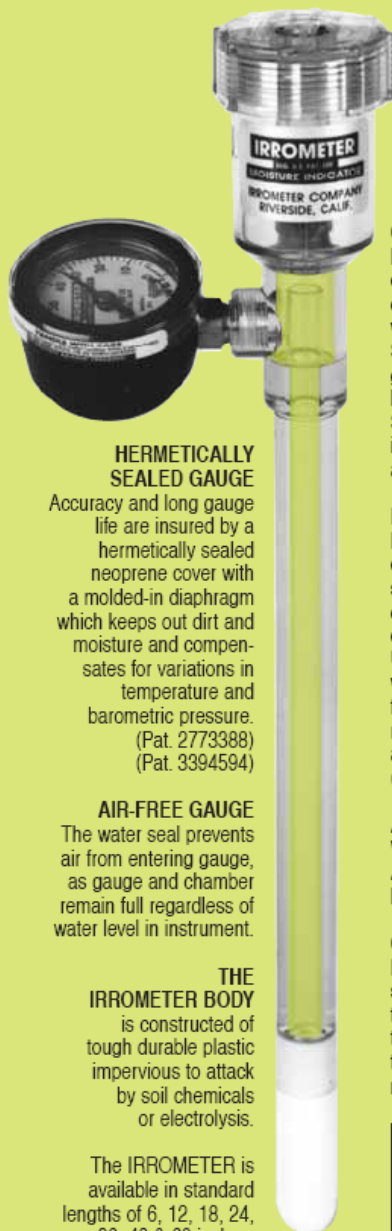


Factors that influence soil moisture

- Sun
- Wind
- Rain
- Temp
- Relative humidity
- Crop removal

Soil Moisture Monitoring Techniques

- The "Feel Method"
- Neutron Probe
- Electrical Resistance
- Soil Tension
- New Technology
- Computerized Irrigation Scheduling



HERMETICALLY SEALED GAUGE

Accuracy and long gauge life are insured by a hermetically sealed neoprene cover with a molded-in diaphragm which keeps out dirt and moisture and compensates for variations in temperature and barometric pressure.
(Pat. 2773388)
(Pat. 3394594)

AIR-FREE GAUGE

The water seal prevents air from entering gauge, as gauge and chamber remain full regardless of water level in instrument.

THE IRROMETER BODY is constructed of tough durable plastic impervious to attack by soil chemicals or electrolysis.

The IRROMETER is available in standard lengths of 6, 12, 18, 24, 36, 48 & 60 inches.

CLOSURE

Large cap for easy operation and better control. Cap removed when filling reservoir. Submerged valve gives a positive leakproof seal. Servicing is instantaneous—a twist of the wrist.

RESERVOIR

Holds a reserve supply of fluid sufficient for several irrigation cycles under average operating conditions. Unscrewing cap part way releases air and fills tube. (This is to replace fluid lost by action of drying soil.)
(Pat. 2878671)

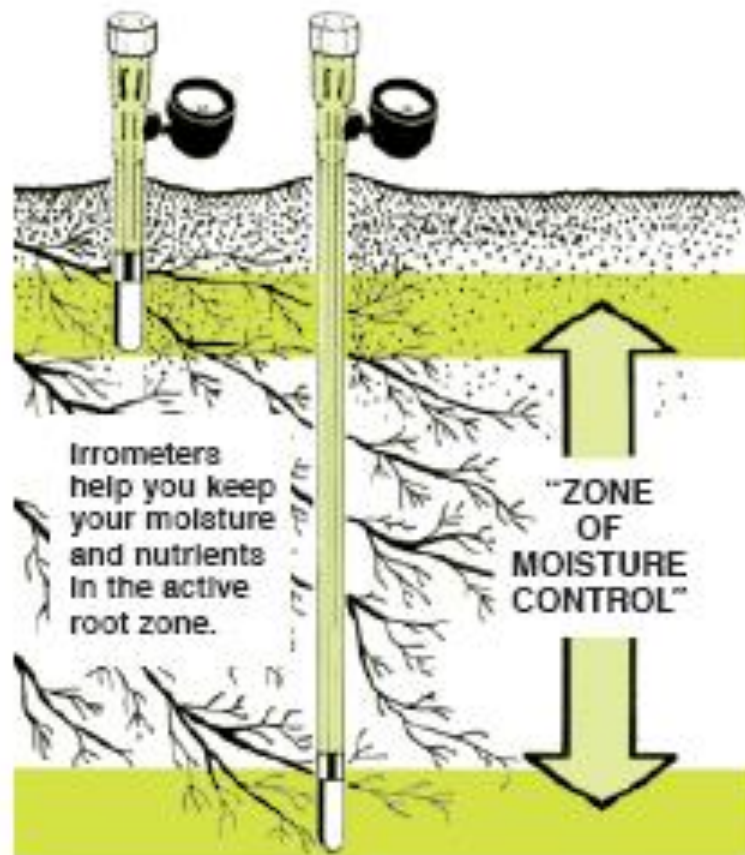
ALL SOLVENT WELDED JOINTS ARE PERMANENTLY LEAKPROOF

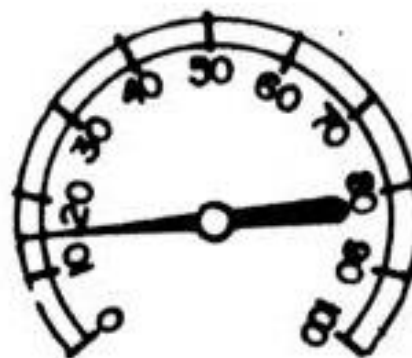
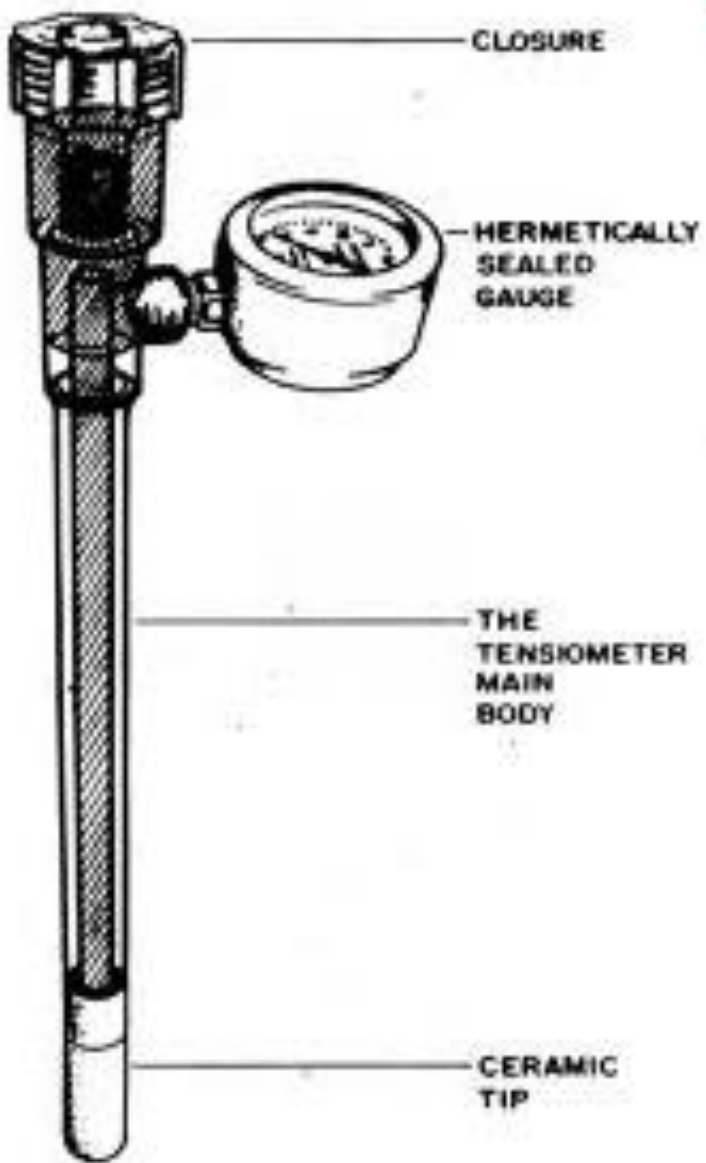
CERAMIC TIP

Has many times the strength of conventional tips. It is more porous to give quick response to variations in soil moisture.

MODEL "SR" (not pictured)

Threaded tip connection make tip replacement easy. Uses o-ring seal.



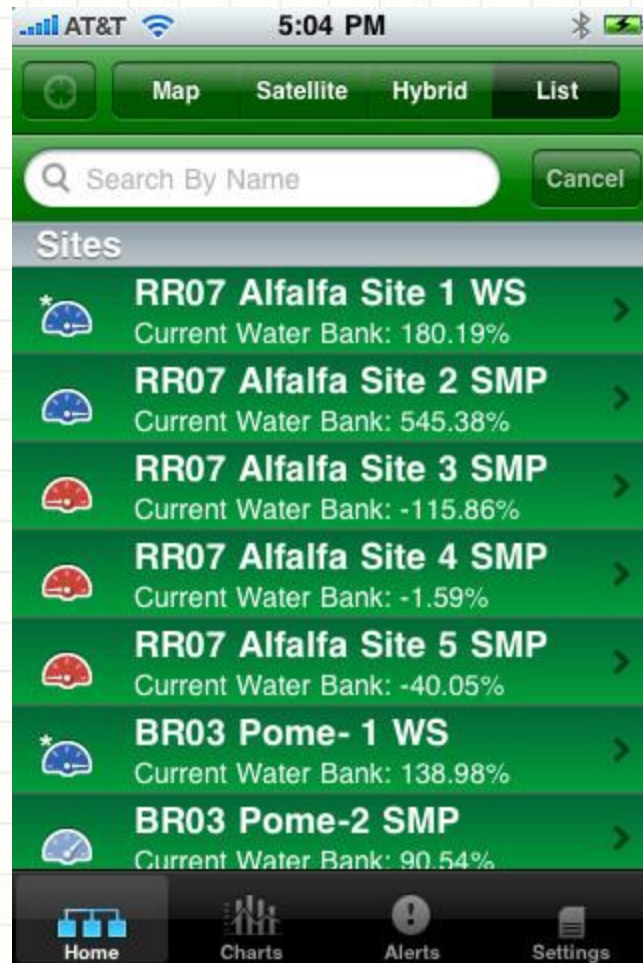


| CROP | Shallow Instrument (Inches) | Deep Instrument (Inches) | For Extra Depth, Set at (Inches) | CROP | Shallow Instrument (Inches) | Deep Instrument (Inches) | For Extra Depth, Set at (Inches) |
|--|-----------------------------------|--------------------------------|--|----------------------------|-----------------------------------|--------------------------------|--|
| Alfalfa | 18-24 | 36-48 | 60-70 | Melons | 18 | 36 | |
| Almonds | 24 | 48 | 72 | Milo | 24 | 48 | |
| Apples | 20 | 40 | 60 | Mint | 12 | 24 | |
| Apricots | 24 | 48 | 72 | Monterey Pines, Firs | 12 | 24 | |
| Artichokes | 18 | 36 | | Mums | 12 | (Placed 4-6") | |
| Asparagus | 18-24 | 36-48 | | Mustard | 18 | 36 | |
| Avocados | 12 | 24 | 36 | Nectarines | 18 | 36 | |
| Bananas | 12 | 24 | | Oats | 18 | 36 | |
| Barley | 18 | 36 | | Okra | 18 | 36 | |
| Beans (bush) | 10 | | 18 | Olives | 24 | 48 | 60 |
| Beans (Lima) | 18 | 36 | | Onions | 12 | | |
| Beans (Pole) | 18 | 36 | | Papaya | 12 | 24 | |
| Beets (sugar) | 18 | 36 | | Parsnips | 18 | 36 | |
| Beets (table) | 12-18 | 24-36 | | Peaches | 18 | 36 | 60 |
| Blueberries | 12 | 24 | | Peanuts | 12 | 24 | |
| Broccoli | 12 | 20 | | Pears | 18 | 36 | 48 |
| Cabbage | 12 | 20 | | Peas | 18 | 36 | |
| Canaigre | 18 | 36 | 48 | Pecans | 18 | 36 | 48 |
| Cantaloupe | 18 | 36 | | Peppers | 15 | 30 | |
| Carnations | 12 | (Placed 4-6") | | Permanent Pastures | 8-15 | | 24-30 |
| Carrots | 12 | 24 | | Persimmons | 18 | 36 | |
| Cauliflower | 12 | 24 | | Pineapple | 15 | 30 | |
| Celery | 10 | 20 | | Pistachio Nuts | 24 | 48 | 60 |
| Chard | 12 | 24 | | Pomegranates | 18 | 36 | |
| Cherries | 24 | 48 | | Potatoes (Irish) | 8-10 | 18 | |
| Christmas tree | 12 | 24 | | Potatoes (Sweet) | 18 | 36 | |
| Citrus; orange, lemon, grapefruit | 18 | 36 | | Plums | 24 | 48 | 72 |
| Coffee | 18-24 | 36-48 | | Prunes | 24 | 48 | 72 |
| Corn (sweet) | 12 | 30 | | Pumpkin | 18 | 36 | 48 |
| Corn (field) | 18 | 36 | | Radishes | 12 | | |
| Cotton | 18 | 36 | 48 | Raspberries | 18 | 36 | |
| Cranberries | 18 | 36 | | Sorghum | 18 | 36 | |
| Cucumbers | 18 | 36 | | Soy Beans | 18 | 36 | 60 |
| Date palm | 24 | 48 | 60 | Spinach | 12 | 24 | |
| Egg Plant | 12 | 24 | | Squash (Summer) | 15 | 30 | |
| Figs | 18 | 36 | | Strawberries | 6 | 12 | |
| Garlic | 12 | 24 | | Sudan Grass | 18-24 | 36-48 | |
| Grain and Flax | 18 | 36 | | Sugar Cane | 18 | 36 | |
| Grapes | 24 | 48 | 60 | Sunflowers | 24 | 48 | 60 |
| Hops | 24 | 48 | 60 | Tea | 12 | 24 | |
| Jojoba | 18 | 36 | | Tobacco | 8-15 | 30 | |
| Kiwi | 18 | 36 | 48 | Tomatoes | 18 | 36 | |
| Ladino Clover | 10 | 20 | | Turnips | 18 | 36 | |
| Lettuce | 12 | | | Walnuts | 24 | 48 | 72 |
| Macadamias | 12 | 24 | 36 | Watermelon | 18 | 36 | 48 |
| Maize | 18 | 36 | | Wheat-Hay | 18 | 36 | |



Table 2. Soil Water Deficit Estimates for Different Soil Textures and Selected Tensions

| Soil Texture | Soil Tension in Centibars | | | | | | |
|--|--|-----|-----|-----|-----|-----|-------|
| | 10 | 30 | 50 | 70 | 100 | 200 | 1500* |
| | Soil Water Deficit - Inches Per Foot of Soil | | | | | | |
| Coarse sands | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.6 | 0.7 |
| Fine sands | 0 | 0.3 | 0.4 | 0.6 | 0.7 | 0.9 | 1.1 |
| Loamy sands | 0 | 0.4 | 0.5 | 0.8 | 0.9 | 1.1 | 1.4 |
| Sandy loam | 0 | 0.5 | 0.7 | 0.9 | 1.0 | 1.3 | 1.7 |
| Loam | 0 | 0.2 | 0.5 | 0.8 | 1.0 | 1.6 | 2.4 |
| *1500 cbs refers to the permanent wilting point and the soil deficit value is equal to the soil's total available water capacity | | | | | | | |







Resources

- [Drip Irrigation for Vegetable Production](#) (and info sources at the end)
- [Maintaining Drip Irrigation Systems](#) (Kansas State University)
- [Drip Irrigation](#) (Washington State University Small Farms Team)
- [Drip Irrigation Web Links](#) (University of Missouri)
- [Indiana Irrigation](#), a Midwestern supplier
- [DripWorks](#), a supplier for small growers
- [IrrigationTutorials.com](#)

To reach us

Contacts

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If you have questions ...

- University of Illinois Extension Local Food Systems and Small Farms team
 - <http://web.extension.illinois.edu/smallfarm/>
- USDA's Start2Farm site
 - <http://www.start2farm.gov/>

