U.S. DEPARTMENT OF AGRICULTURE Natural Resources Conservation Service	**MICROIRRIGATION GENERAL PLANNING WORKSHEET**	WV Eng WS 441B 08/11

General Introduction to WV Microirrigation Irrigation

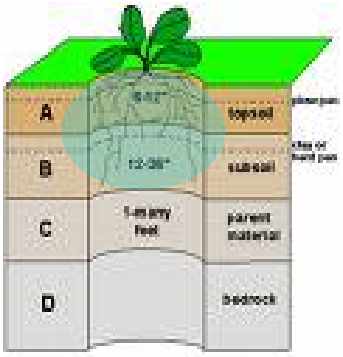
Drip irrigation of row crops is increasing throughout the United States. This irrigation method has the advantage of precisely applying irrigation water in both location and amount, thus offering the potential of increased profit due to reduced water, fertilizer, costs and increased revenue due to increased yield and reduced management effort. Originally, drip irrigation was used in landscapes, as a means to reduce water costs for homeowners and commercial sites. For agriculture, drip was first used to irrigate specialty crops like grapes and tree crops where water is slowly and directly applied daily (if no or inadequate rainfall occurs) to the root zone, thus preventing moisture stress to the plant while maintaining constant soil moisture. Microirrigation is the most preferred method of water application to plants because the operator can accurately control the amount (in/day) and rate (GPM) of water applied and timing (hr./day). Microirrigation surface drip systems are typically selected to minimize water use, maximize yield and quality by taking advantage of the management control provided by drip irrigation.

Water supply in WV can be a challenge because most wells can provide adequate yield for domestic water or light livestock use, but they are not able to supply the volume, rate or quality of water necessary for acreage associated with orchard, vegetable or greenhouse irrigation.

WV generally uses two types of irrigation method, overhead sprinklers (solid set, traveling gun, etc.) and microirrigation. Overhead sprinklers water the entire crop field area normally every 2-3 days and have an application efficiency of 55% to 70%. Microirrigation applies water (daily) directly to the plant roots at a 90% (very efficient) water application rate.

Advantages and Disadvantages of Microirrigation

As good as microirrigation is, it may not meet everyone's needs.



Advantages:

A) A smaller volume of water is required to supply the plants needs, (50% or less than sprinkler methods).
B) Lower operating pressures (8psi-15psi) and lower flow rates (0.2-2.0 GPH/emitter), requiring less energy (smaller pumps) and less time to operate.
C) A high degree of water control is possible.
D) It can be used for various types of crops, i.e. bedded plants, orchards or greenhouses.
E) It is very flexible.
F) Disease and insect damage is reduced because the soil is moistened, not the leaves.
G) Chemicals and fertilizers can be directly injected into the system, requires less chemicals.

H) Less labor and operating expenses.
I) Fields with slope can be designed with a uniform application using Pressure Compensated (PC) point source emitters or PC line source emitters, assuring equal amounts of water applied throughout the area.
J) Normally less weed growth since the water moistens the beds but not the area between the rows.
K) Work best with a plastic or mulch cover, further reducing water losses.

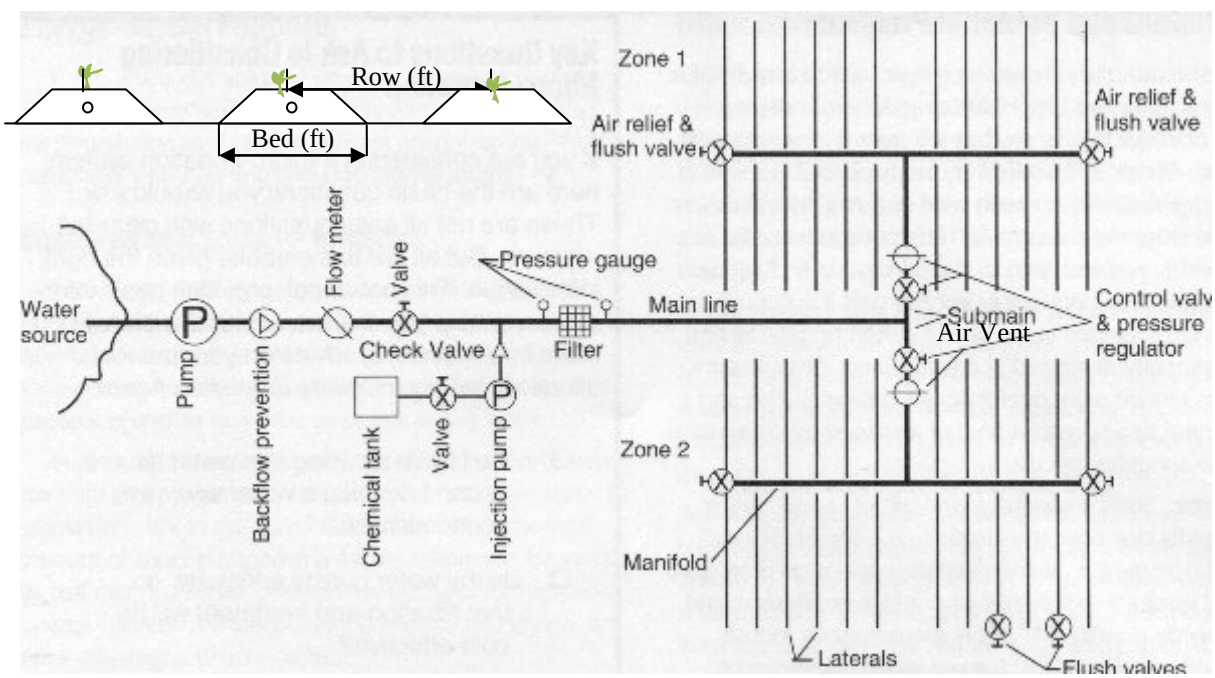
Disadvantages:
A) Good water quality is required, small orifices tend to clog more often.
B) Distribution area of moisture is limited. Sands have more vertical water movement (gravitational forces predominate) than clays, clays are more uniform and capillary action predominates
C) Microirrigation always requires a filtration system that must be often checked.
D) System does not provide frost protection.
E) Rodents and insects may damage laterals.
F) Not suitable for cereal grains or closely planted crops.
G) Higher level of management is required.
H) Initial investment and annual cost of maintenance may be higher.
I) Inadequate field flushing (if installed in a high tunnel) allowing for fungi or salt build up in the soils.

The basic microirrigation system is similar to other irrigation systems. However, as noted above, microirrigation uses much less water, is very efficient and waters the plant daily to maintain soil moisture within the root zone profile. Starting at the source of water, the following is a list of practices or components associated with the irrigation system.

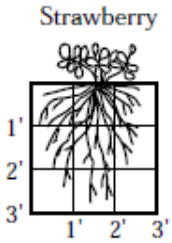
1. Water supply or source
    a. Well, pond, river, spring, municipal water, other.
    b. Reference NRCS WV Conservation Practice Water Well (642), Pond (378), Spring (Development (574), document river
    c. Document known or estimated water quality (Table 6), rate (GPM) and volume (gallons), WV Eng-63, WV Eng WS-642 C, Water Quality Test for Irrigation Water (http://www.aasl.psu.edu/Irrigation%20brochure.pdf) or other.
2. Pumping Plant – Pump delivers water at a rate (GPM) and required pressure (ft or psi) to the irrigation system.
    a. Type of pump: deep well turbine, centrifugal, solar, portable PTO, other
    b. Reference WV Conservation Practice Pumping Plant (533)
    c. Complete WVEng WS 533A and B
    d. Must have two check valves to prevent water contamination of source.
    e. Document pump and water surface elevation, natural ground, highest and lowest elevation to where water will be delivered and maximum distance.
3. Distribution Lines or Irrigation Pipeline (Main and Sub-main line) - water distribution is a network of main, submain pipes in graduated sizes.
    a. Reference WV Conservation Practice Irrigation Pipeline (430).

b. Appurtenances – Control valves, air vents, drains, pressure regulators, thrust blocks, etc.
c. Table 1 provides a quick reference for sizing a manifold, submain and/or irrigation main.

4. Microirrigation System
   a. Reference WV Conservation Practice Irrigation System, Microirrigation (441), WVEng WS441-A, WVEng WS 441-C, WVEng WS 441-D
   b. Manifold or Header – polyethylene or PVC pipe that the irrigation laterals or drip tape attach to.
   c. Laterals (line source) or emitters (point source) microirrigation – manufactured drip lines with a pre-selected emitter spacing and application rate (GPH/emitter), reference Table 2 and 3. Point source emitters are individual drippers that are punched into a polyethylene flexible line (not pre-set). Either one delivers water to the plant at a predetermined rate and pressure requirement.
   d. Filtration system - Filters water so the microirrigation won't clog.
      i. All drip systems require filtration of the water.
      ii. The manufacturer specifies filter mesh sieve size or opening measured in microns and placed downstream of the control valve.
      iii. When well water is relatively clean a disc and or screen filter may be used.
      iv. When water source is from a river or pond, a centrifugal sand filter (5-12 psi) and a disc filter, (pressure loss typically 2-5 psi) is required for protection, in addition to the pump suction strainers.



Microirrigation Drip Tape Spacing and Configurations

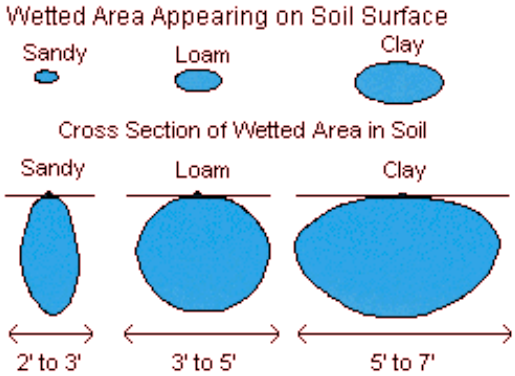


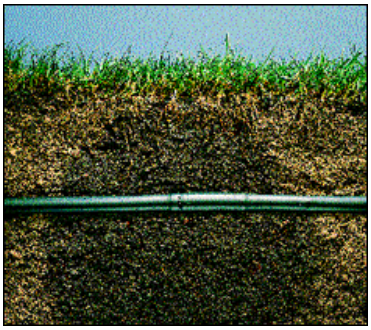
The goal of a microirrigation system is to apply water directly or as close as possible to the root zone of the crop. As the crop matures and expands, so do the roots within the soil root structure. Typically the root zone will expands to the edge of the dripline of the plant canopy, so a plant with a leafy surface area that is two feet in diameter will have a mature root zone extending that same width. This information is necessary for determining the area that should be irrigated under the plant.

For most vegetable or fruit crops, a single drip tape is placed in the bed (area where the crop is planted) under plastic or mulch. For wide beds (4 feet or wider), two tapes may be placed in the bed for a more uniform wetting pattern. If the bed is on the contour, place the tape upslope of the seed or plant. Try to place the manifold at the highest elevation of the zone so the water flows down slope from the valve, aiding in draining and flushing the tape.

The depth at which the drip tape is placed may vary. For the most part, drip tape is buried about 3 to 12 inches (8 - 30 cm.) below the soil surface depending on soil type and past experiences. If the tape is buried too deep, the amount of water required to germinate the seed may be prohibitive by the upflux properties of the soil.

Another factor when determining the selection of the type of lateral or dripperline is determining the spacing of the dripper line emitters. The type of soil more than the type of plant influences the emitter spacing. Every soil has a slightly different wetting pattern (see diagram) and the soil wetting pattern is key to providing water to the crop's root zone.





Crops grown on heavy clay soils normally use emitters with 12 inch (30 cm) to 18 inch (46 cm) spacing verses the lighter sandy soils. Sandy soils usually require 4 inch (10 cm) -6 inch (15 cm) emitter spacing, because the water in sandy soils drain more vertically than horizontally. Again, these decisions are based on the soil type, soil amendments, land slope and the crops to be grown.

Because WV soils are typically clay or clay loam, the typical microirrigation tape selected for brambles, vegetables or flowers in West Virginia is either Non-pressure compensated or pressure compensated, has a 12 inch (305 mm) spacing, 5/8 inch (6 mm) in diameter, require 10 to 15 PSI pressure and are medium flow (0.45 - 0.6 GPM/100') to supply the required amount of water in approximately one (1) hour per

day to the plant. Extremely low flow tapes may be selected, but they require a longer time to irrigate to meet the consumptive use demand and may have a tendency to clog more frequently.

Microirrigation Drip Tapes or Laterals

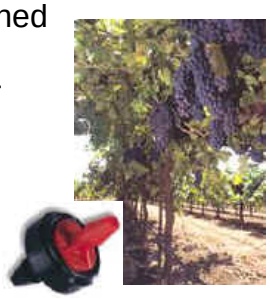
Many drip tapes now on the market offer a range of tape diameters, wall thickness, emitter spacing's, and emitter flow rates and are either pressure compensated (PC) or not. PC microirrigation tapes are always required when any part of the planted row exceeds a 3 % slope.

There are numerous types of drip tape manufactured. Each manufacture will provide a general description and specifications such as

- Spacing; typically 12", but can be 4", 8", 12", 16" and 24" and it is the equal distance the drippers are placed along the in-line tape.
- Emitter Flow Rate at a Pressure: reported as GPM/100' or GPH/emitter.
- Pressure: Optimum pressure (PSI) for 90% Emitter Uniformity (EU) and the pressure needed or allowable pressure variation (PSI).
- Tape diameter: (in)- normally 5/8" but can be 7/8" or 11/8"
- Thickness: typically 8 or 10 mil, but available in 4,6,8,10,12 & 15 mil
- Required filtration; Reference Table 2 and 3.

The laterals (dripper tape or drip lines) provide water to the plants. The emitters on the lateral allow the water to discharge of at very low rates through small orifices. Emitters are divided into two categories; Point Source and Line Source, and are unique to microirrigation. The line is either solid or manufactured with emitters set at various spacings.

Point source emitters are individual emitters manually placed/punched (by operator) into a plastic pipe.

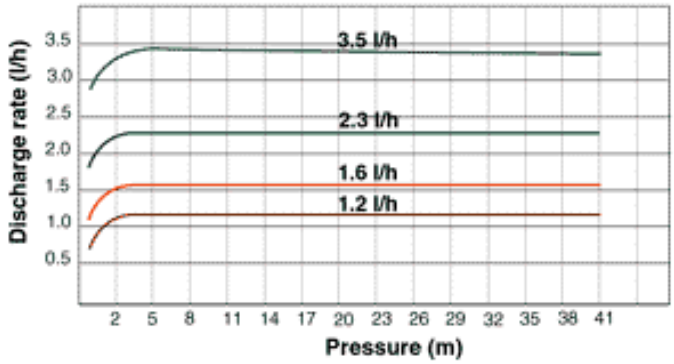


- Used mainly for fruit crops, tree crops, nursery containers or where crops are not evenly spaced or are spaced far apart.
- Have operating pressures 5-60 psi and application rates ranging from 0.5 to 2.0 gallons/per hour per emitter
- Require a 100 -200 mesh filtration unit.
- Depending on the terrain select for flat grades or hilly terrain (pressure compensated).

Line source emitters are pre-manufactured and embedded at equally spaced distances (6"-24") with a uniform flow rate.

- They are for closely spaced crops such as vegetables, small fruit or irrigation mats in greenhouses (emitter spaced from 4" – 24").

- Typical operating pressure ranges from 10-30 psi, 12 psi is most typical.
- Discharge rates ranging from 0.1 -1.0 GPM/100' feet of line.
- Require 120 -200 mesh filtration unit (depending on specific dripline or emitter.
- Line source emitters are normally used on level ground on lines installed in rows up to 300 feet long (limited by ground slope and carrying capacity).
- On rolling or hilly terrain (3 -10% slope), select a Pressure Compensated Line. These have emitters that supply the same flow rate over a wide range of line pressure.



The thicker the microirrigation tape (lateral) wall thickness the more durable (but stiffer) and the tape selected depends on how the grower intends to use the tape. If a grower plans to re-use the lateral, permanently bury it (i.e. for blackberries, etc.) or suspend it in a vineyard, a 12-16 mil thickness works well. A "one time" use lateral would typically be 6-8 mil tape. Table 1 and Table 2 provide typical manufacturer information, tape characteristics, specifications for various tapes, diameters, spacing and flow rates of microirrigation tapes.

The quality of the majority of drip tapes is generally excellent as shown in Table 3. Coefficients of manufacturing variation generally are less than 0.05. Emitter discharge exponents generally are between 0.50 and 0.60.

Drip tape can be buried or installed on the surface. Installation and extraction equipment is available for drip tape. Several manufacturers offer a method of heat-welding tape to repair leaks and to couple tape as it is extracted from the field.

Therefore, when planning a microirrigation system, consider the quality (Table 4), rate and quantity of water delivered by the source location. Verify the required amount of water is available throughout the flowering and growing season, especially during drought conditions. Not only is the amount of water delivered daily to the crop important, but how uniform the water is applied is of equal importance. An improperly selected dripline may provide water to all of the plants, but some may get to much and others too little or none at all. This will impact the overall quality and quantity of the crop, wasting precious resources and time. So take the time it takes, select the correct system so it provides the best possible conditions providing optimum yields, minimum losses and maximize labor time.

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NRCS can assist with planning the microirrigation system and with determining if the water supply can meet the specific crop watering needs once the following information is provided (circle, fill in the blank or attach information). A final design will follow after the layout and landowner decisions are finalized.

Land Operator _____ Address _____, WV
Lat. _____, Long. _____Field Office_____ County _____ Program _____
Prepared By _____ Date _____

1. Gather Basic Irrigation System Information
   a) Location Map: Provide location map and directions to farm.

   b) Document crop and type (fruit, vegetable or nut crop), growing season, bed width (in), row width (ft), row slope (%), row length (ft) and number of rows in each zone. Complete WV ENG WS 441-A and WS 441-C.

   c) Topographic Information: Is the general terrain flat, hilly or steep? _____, _____% slope

   d) In general are the soils in the field(s) __Clay,___Sandy Clay, __Karst, __Rocky, __ High Water Table, __other____? (Refer to WVEng WS 441-442 F Soil Water Holding Capacity).

   e) Draw a general schematic showing dimensions of irrigation field or high tunnel, number of rows, length and width of beds, and water source

   f) Are the crop rows' placed on the contour? __ Yes, __No.

   g) What is the maximum Row Slope? _____%

   h) What is the maximum Row Length? _____ ft

   i) Design Information Aerial Maps, Soils Maps, Topographic Map or survey (provided by NRCS)
      i) Design Layout
         (1) Provide bar scale and north arrow
         (2) Planned irrigation areas (usually smaller than the field), crop row direction, row number, length and row slope.
         (3) Known utilities.
         (4) Location of existing buildings within planning area.
         (5) Water source location, water quality, quantity, rate and the other uses of water.
         (6) Survey and provide spot elevations of i) planted area, garden high tunnel, etc. perimeter and high and low points within the field, ii) planned pipeline layout (length, slope, etc.), iii) rows and note the minimum and maximum row slopes, iv) planned and/or existing location of the manifold (header that attaches to irrigation line), submain (attaches to manifold) and main line from the water source to the submain or header.
         (7) Survey and locate existing pipe length, diameter and type of pipe.
      ii) Soils Map
         (1) Field name and crop zone(s) outlined.
         (2) Soils description, texture, and unified texture, suitability group, permeability, available water capacity (in/in soil to root depth), water table, depth to bedrock, limiting features, soil PH and other needed properties of the soils where the crops are grown.

2. Water Source:

   a) The source of water is a well, spring, pond, river, other_____.

   b) Well; ____certified well drillers report and pump curve _____ GPM;

   c) Dry Weather Spring: _____ GPM;

   d) Dry Weather Pond Volume _____ gallons (estimate volume below 4.0' depth), _____ ac. watershed;

   e) River or Stream Name; _____, low flow velocity _____ ft/sec, _____ depth (ft), ____ width (ft).

   f) Do you know the history of the water supply? __ Yes, __No. How dependable is it?_____

   g) Elevation of natural ground at water source _____ ft.

   h) Highest elevation to where water will be delivered is ___ ft. and approximate distance from source is ____ ft.

   i) Lowest elevation to where water will be delivered is ___ ft. and approximate distance from source is ____ ft.

   j) Distance to the furthest point of application from the water source is___ ft.

   k) Rate the irrigation water quality throughout the year and the potential for clogging (reference Table 7)?
      i) Is it rated __ slight, ___ moderate, __ severe.
      i) Does it stain or have iron in it ? __ Yes, __No
      ii) Is it cloudy? __ Yes, __No
      iii) Is there algae? __ Yes, __No
      iv) Is it hard (calcium build-up)? __ Yes, __No
      v) Is it turbid? __ Yes, __No
      vi) Is the PH less than 7.0 or greater than 8.0? __ Yes, __No

      If yes to any of the above questions or has a rating moderate or severe, the landowner will provide the water quality test and the information to the irrigation supplier for a recommendation for filtration. All ponds require sand filters to remove algae and a secondary mesh filter.

3. Pumping Plant

   a) Will the water source be used for multiple purposes? __ Yes, __No. If Yes, _____ GPD is required for _____ purpose for a duration of _____ hours/day.

   b) Is there an existing pump? __ Yes, ___No. If yes , _____type, _____ make/model, _____ HP, _____number, ____ pump curve and _____ age?

   c) What is the required pump pressure? _____ PSI. If a pressure tank is on the system what size is it _____ gallons and what is pressure is it set at_____ (psi)?

   d) Will the pumping plant be housed above or below ground ? _____

   e) Will the system be automated (electrical) or manually operated? _____

   f) Will fertilizer or chemicals be injected into the system? __ Yes, __No.

g) Are there any other concerns or needs that need to be reported? _____

h) What is the maximum pumping rate estimate? _____ GPM

4. Reference associated WV Conservation Practice Standards for guidance and specifications.
   a. Irrigation System, Microirrigation (441) and WVENG WS 441A,C and D
   b. Pumping Plant (533) and WVENGEDCD 533A,B and C
   c. Irrigation Pipeline (430)
   d. Critical Area Planting (342)
   e. Mulching (484)
   f. Nutrient Management Planning (590)

Irrigation Pumping Plant General Planning Example (reference Table 1 for general friction losses)
What are the estimated pressure losses from the well pump to the microirrigation? Example below shows a general estimate verses a specific friction loss estimate. Review with the designer or the system and the pump installer. Verify at the pump curve to determine if it is adequate?
Estimate Total Dynamic Head of System (all pressure (feet) numbers are rounded up)

If the depth of the water in the well (after drawdown) is below NG ……..	70’
Well Pipe110’- 1.25” steel (assume same as Sch 40 PVC for example) (110’ x 3.1/100) = 3.41 PSI..	8’
Table 1) 1” SCH 40 PVC main line flow is 12 GPM and 100’ long; (100 x 3.7/100 =3.7 PSI …..	9’
Sch 40 Water line to 30-50 PSI Pressure Tank (50 PSI x 2.31) …..	116’
	203’

If the maximum elevation from NG from the pressure tank to the highest elevation in the field is	30’
If the losses in the disc filter (5PSI) and miscellaneous items are 3 psi (5+2=7) PSI or ……..	17’
Table 1) 1” SCH 40 PVC main line flow is 12 GPM and 300’ long; (300 x 3.7/100 =11.1 PSI …..	26’
Table 1) 1” PE- (max 40 psi) header flow is 12GPM and is 120’ long; (120 x 4.5/100 =5.4 psi ….	9’
Required pressure of drip tape is 10 psi + estimated 2 PSI loss ……	28’
Est. Pressure Head (47 PSI)	110’

Remember to check if there is a pressure tank and if so what is the pressure rating? If it supplies 30-50 psi and it is at natural ground, would 50 psi supply adequate pressure to the irrigation system? Contact your irrigation supplier and discuss with your water well pump installer for guidance.

The above computation is only a rough estimate, a detailed pipeline hydraulic analysis is required for the final design.

TABLE 1: FOR A FIELD OR ZONE PIPELINE MANIFOLD, SUBMAIN OR MAIN PIPE

QUICK ESTIMATE FOR PIPE DIAMETER (MAX. 5 FT/SEC) AND PRESSURE LOSS (PSI) FOR DIAMETER.

Manifold PE –DR,9 (255 PSI),11 (200 PSI), 13.5 (160 PSI)	1/2" Dia.	3/4" Dia.	1.0" Dia.	1.25" Dia.	1.5" Dia.	1.0" Dia. Lay Flat (Max. 21 PSI)	1.5" Dia. Lay Flat (Max. 21 PSI)
Max. GPM	4	8	13	22	30	24	75
Max. PSI/100'	6.4	5.9	4.5	3.1	2.6	17.3	19.5

Main/Submain Sch 40 PVC	1/2" Dia.	3/4" Dia.	1.0" Dia.	1.5" Dia.	2.0" Dia.	3.0" Dia.	4.0" Dia.
Max. GPM	4	7	12	22	50	110	190
Max. PSI/100'	6.6	4.6	3.7	2.92	1.9	1.2	0.9

TABLE 2. TYPICAL MICROIRRIGATION DRIP TAPE INFORMATION

TYPICAL Tape Diameter (1MM = 0.03937 INCH)					
mm	10	12	16	22	35
Inch	0.39	.48	0.63	0.875	1.37
Fraction In	2/5	1/2	5/8	7/8	1 3/8

TAPE EMITTER SPACING (1MM = 0.03937 INCH)					
mm	102	203	305	406	610
Inch	4	8	12	16	24

Typical Flow Rates (1 Liter/Hr = 0.264172 Gal/Hr)									
Liter/hour	.53	.79	.91	.57	2.27	.4	1	1.2	1.8
GPH	0.14	0.2086	0.240	0.1505	0.5996	0.1056	0.2641	0.3170	0.4755

TABLE 3. TYPICAL MICROIRRIGATION MANUFACTURER* INFORMATION

Typical Manufacturer (Drip Tape Name)	Diameter (inch)	Wall Thickness	Emitter Spacing in Tape (in)	Flow Rate gpm/100'
Trickle-eez (T-Tape), (0 % slope w/ 90% EU) 150 filtration @ 8 psi, 12" spacing	5/8"	4, 6, 12, 15 mil	8 12	0.34 0.45
Netafim -(UniRam Heavywall)-RAM570 Vineyards, undulating fields; 0.42, GPH/ emitter; 120 Mesh Filtration 90% EU @ 7-60 psi	5/8", 7/8"	17 mm	18 24 36	0.47 0.35 0.23
ToroAg (Aqua-Traxx);0.27GPH/ emitter 200 Mesh Filtration, (0 to 1.0% slope with 90% EU) @ 10 psi	5/8"	4, 6, 8, 10, 12, 15	8 12 24	0.67 0.45 0.22
ToroAg (Aqua-Traxx PC); 0.27 GPH / emitter, 10 psi; 200 Mesh Filtration (4-25 psi operating pressure with 90% EU)	5/8", 7/8"	8,10,12,15	8 12 24	0.67 0.45 0.22
Queen-Gil; 5/8", 8-12 psi 120 Mesh Filtration (-2.00 to 2.0% slope with 90% EU)@10psi	5/8"	6, 8, 10,12, 16 mil	8" 12"	0.13 (low); 0.66 (med); 1.0 (high) 0.51 (med); 1.0 (high)

* No manufacture is endorsed by NRCS; the above information is only used for example.

Footnote -This document Is PART OF BUL258, one of a series of the Agricultural and Biological Engineering Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, original publication date April 1990. Reviewed June 2003. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.; Don J. Pitts, former professor, irrigation specialist; Dorota Z. Haman, associate professor; Allen G. Smajstrla, professor, Agricultural Engineering Department Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Table 4. Reference "The Knowledge Plant", "Hardie Micro-Irrigation Design Manual" by M J Boswell and Fertigation by C. Burt, K. OConner and T. Ruehr "; "UF Cooperative Extension Service (see footnotes)"

	Plugging Hazard Based on Concentration		
	Concentrations		
Factor	Slight	Moderate	Severe
Clogging - Physical			
Suspended solids(filterable) (ppm)	< 50	50-100	> 100
Clogging- Chemical			
pH	< 7.0	7.0 -8.0	> 8.0
Dissolved solids (EC mmho/cm)	< 500	500 to 2000	> 2000
Manganese (ppm)	0.0-0.2	0.2-0.4	> 0.4
Bicarbonate (EC mmho/cm)		<100	
Total Iron (ppm)	< 0.1	0.1 to 1.5	> 1.5
Sulphides (ppm)	0.0-0.1	0.1 to 2.0	> 2.0
Hardness*	< 150	150 to 300	> 300
Clogging - Biological			
Bacteria (population per litre)	< 10,000	10,000 to 50,000	> 50,000
*Hardness as ppm $CaCO_3$, Todd, 1980 (Modified from Nakayama and Bucks, 1986)			

Sand media size and screen equivalents

Sand Number	Sand Diameter (in)	Sand Pore Diameter (in)	Screen Mesh
8	0.059	0.008	70
11	0.031	0.004	140
16	0.026	0.003	170
20	0.018	0.002	230
30	0.011	0.001	400

Copper Sulfate ($CuSO_4$) Levels Safe for Fish

Alkalinity Value ($CaCO_3$, mg/l)	Addition of Copper Sulfate
below 40	do not use
40-60	1.0 lb per acre-ft of water
60-100	1.3 lb per acre-ft of water
over 100	2.7 lb per acre-ft of water
(1 ppm = 2.7 lb per acre-ft) (Dupress and Huner, 1984)	

Table 6–12 Plugging potential from irrigation water used in micro irrigation systems

Problem	Low	Medium	Severe
Physical			
Suspended solids, ppm	50	50 -100	> 100
Chemical			
pH	7.0	7.0 – 8.0	> 8.0
TDS, ppm	500	500 – 2,000	> 2000
Manganese, ppm	0.1	0.1 – 1.5	> 1.5
Iron, ppm	0.1	0.1 – 1.5	> 1.5
Hydrogen sulfide, ppm	0.5	0.5 – 2.0	> 2.0
Biological			
Bacteria population - no. per mL 1/	10,000	10,000 – 50,000	> 50,000

1/ Bacteria populations reflect increased algae and microbial nutrients.

Table 6–13 Typical composition and classification of water used in micro irrigation systems

Source of water	Physical 1/ suspended solids (ppm)	Physical 1/ dissolved solids (ppm)	Chemical 1/ iron or manganese ppm	Biological 1/ bacteria population number/mL	Biological 1/ classification - physical/chemical/ biological
City water	1	500	0.05	10	0-4-0
Runoff water	300	50	0.05	10,000	10-0-6
River water	70	900	0.10	4,000	6-8-4
Well water	1	1,650	0.05	40,000	0-10-9

1/ Physical and biological composition of water can change during the season and between seasons.