

N E T A F I M U S A



TOBACCO PRODUCTION MANUAL

USING DRIP IRRIGATION



WWW.NETAFIMUSA.COM

PRINCIPLES OF TOBACCO PRODUCTION

THIS SECTION IS NOT MEANT TO BE A COMPREHENSIVE GUIDE TO THE PRODUCTION OF TOBACCO BUT SIMPLY AN OVERVIEW OF PRODUCTION TECHNIQUES. AS THESE TECHNIQUES VARY FROM CLIMATE TO CLIMATE, PLEASE CONSULT YOUR LOCAL EXTENSION SERVICE FOR PRODUCTION INFORMATION SPECIFIC TO YOUR GROWING REGION.

OVERVIEW

Drip irrigation in tobacco is not new. In the early 1990's, drip irrigation was successfully used in Flue Cured tobacco in both South Carolina and Georgia. Yield increases have been obtained ranging from 20% - 40% at the same time improving the quality with a grade improvement of 10-20%.

In the last couple of years, drip irrigation has caught on in Kentucky and Tennessee with growers who experienced dry weather when the tobacco plants were knee high. They placed a thinwall dripline (8 mil) in between 2 rows of tobacco. The row spacing varies from region to region with 40 inches in Kentucky and 46 inches in Ontario, Canada.

Since supply lines and submains and the driplines are above ground, such a system can be quickly installed and removed. On a medium (loam) or heavy (clay) soil, the water spreads evenly between the beds, and the root system of the plants, already established, can easily access the water.

On sandy soils, the driplines must be installed at planting time and each row requires a dripline. Under drip the tobacco plant forms a dense fibrous root system.



Driplines hooked up to polyethylene (oval tube) submain



Mainline vinyl tube or LayFlat - vinyl tube can also be used as submain

PRODUCTION COSTS

The production cost of tobacco, to plant, to grow, to harvest and to cure ranges from \$ 4,000 to \$ 5,000 per acre. With this investment, nobody can afford to have the tobacco being affected by drought. What growers have experienced during the 2012 growing season was perhaps unusual. But an extended dry period during the critical growing stage of the crop will affect the yield and quality. Many growers use and have used a traveler to irrigate the crop, however, the amount of water required, the fuel cost and moving the traveler to the next location adds up to high operation expenses. Drip systems operate at 20-25% of the pressure compared to a traveler, use 25-30% less water and hardly require labor to operate, once installed. The end result is a reduced fuel bill, 1/6th of that of a traveler.

To irrigate 60 days or 1,200 hours during the growing season based on 60-80 acres, could result in overall savings of \$ 100 per/acre, with diesel fuel at \$ 4.00 per gallon.

Other benefits are the non-wetting of the leaves, less diseases especially black shank, which can be spread through leaves and stems, also brown spot which appears to be worse after overhead irrigation. The uniformity of a drip system is much better than with a traveler, especially in wind conditions.



Tobacco irrigated with a traveler - a high percentage of water is lost due to evaporation.

BASIC SYSTEM LAYOUT

The following components make up a drip irrigation system:

- Dripline - the heart of the system (depending upon the field conditions) can be either pressure compensating (hilly terrain) or non-pressure compensating (flat terrain).
- Filters (typically a disc or media filtration system) is the best choice to protect the dripline.
- Fertilizer Injector - injects fertilizer chemicals into the system for maximum crop performance and to clean and maintain the dripline (annual acid and or chemical chlorine treatment).
- Pipeline headers, control and air release vents complete the system.

Our intent is not to describe the process of system design in detail. Your Netafim USA Dealer is trained to design and install quality drip irrigation systems. It is important to understand how the system is put together and why certain design elements are specified.

PUMP REQUIREMENTS

The volume output of the pumping station dictates the amount of area that can be irrigated. A simple formula has been derived converting the maximum required evapotranspiration rate (ET) in inches of water per day per acre into gallons per minute per acre.

$$\text{ET (inches/day/acre)} * 18.86 \text{ (conversion factor)} = \text{GPM/acre}$$

Using this formula - an ET of 0.25 inches per 24 hours per acre would require 4.72 GPM/acre.

This calculation is for a pump running 24 hours. More commonly as a safety factor, systems are sized for 20 hours of operation. To accomplish this use the following formula:

$$\frac{24 \text{ (hours in a day)}}{\text{(number of hours desired for irrigation)}} \times \text{(GPM/acre)} \\ \frac{24}{20} \times 4.72 = 5.66 \text{ GPM/acre}$$

On flat land the pressure output required of the pump station is mainly dictated by the flushing requirements of the filters and pipes. On hilly terrain the pressure required to lift water to the highest point must also be considered. Most automatic filters require a minimum of 30 psi to self-clean properly. This is generally the pump's minimum operating pressure to operate a drip system.

FILTERS

The filter system protects the drip system from sand and other small particles which can plug the dripline's drippers. A well designed filter system maximizes the performance and longevity of your drip irrigation system. Two types of filters are recommended:

1. Netafim disc filters
2. Netafim sand media filters

An automatic filter system cleans itself when the pressure differential across the filter reaches 7 psi. A pressure differential switch in combination with a flushing controller is a common approach for automation of filter cleaning. Automatic disc filters and sand media filters utilize depth filtration which is the most effective way to remove suspended particles from the water. Manual disc filters can be used for well water.



Manual disc filter



Automatic disc filter

PRESSURE REGULATING DEVICES

PRESSURE REGULATORS

Fixed pressure regulators are commonly used with 8 mil driplines. They are pre-set at 12 or 15 psi, are non-adjustable and are recommended for use with manually operated systems.



1 1/2" Pressure Regulator
(11 - 35 GPM flow range)



2" x 4 unit Pressure Regulator
(22 - 70 GPM flow range)



2" x 6 unit Pressure Regulator
(33 - 105.6 GPM flow range)

PRESSURE REGULATING CONTROL VALVES

Pressure regulating control valves are recommended for non-pressure compensated dripline to achieve the correct working pressure in the drip system. They can be automated with a battery operated single zone controller so all zones will operate in sequence. The downstream pressure can be adjusted with the bolt on the valve pilot.



Pressure Reducing
Electric Valve



Single Zone Valve
Controller

AIR VENTS

Air vacuum vents prevent soil suction into the drippers at system shut-down. For every 50 laterals there should be one anti-vacuum vent at the highest elevation and one mounted on the flushing manifold's highest elevation. A double purpose automatic air vent must be installed at the pump and is recommended at the end of the mainline or at the highest elevation.



Combination Air/Vacuum and
Continuous Acting Air Vent



Guardian Air/Vacuum
Air Vent



Field installation of pressure control valves
and air release/vacuum air vents.

WATER METERS

It is essential to measure the water flow in order to monitor the operation of your system and crop's water use. Your drip irrigation system is designed to produce a specific flow rate at a given pressure. Changes in the flow rate may indicate leaks in the system, improperly set pressure regulating valves or even changes in the well and pumping plant. A water meter records accurate water measurements and ensures verification of water pumped - certain states may require these records.



IRT Water Meter

PRESSURE GAUGES

Use pressure gauges to ensure that the drip system, filter system and pump operate at the correct pressure. Pressure gauges are also critical to assess potential problems with the system.



Pressure Gauge

FERTILIZER INJECTION SYSTEM

The system is designed to supply fertilizer to all irrigation blocks using either an automated system or a simple injection pump. Netafim offers a fully configurable fertilizer/acid dosing unit which offers basic functions including controlled mixing of fertilizers/acids with source water into a homogenous nutrient solution, EC/pH correction of nutrient solution and water pre-treatment. Please consult your Netafim USA Dealer to determine which fertilizers may be safely applied through the drip system.



FertiKit 3G Injection System

CROP MANAGEMENT TECHNOLOGIES

The irrigation system can be monitored and controlled by an irrigation system controller. Netafim controllers operate the entire system improving irrigation efficiencies and fertilizer injection functions. From pump and valve operation, monitoring and control of automatic filters, control of chemical injections and monitoring of water flow, an irrigation system controller maximizes the performance of an irrigation system.



NMC Pro Irrigation Controller



NMC Junior Irrigation Controller



Fertilizer injection and irrigation control system.

DRIPLINES

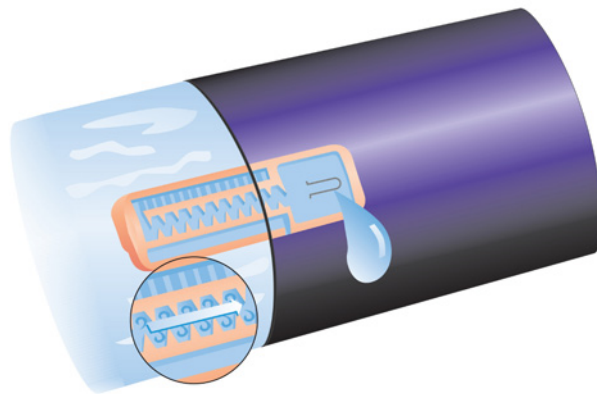
The heart of the system is the dripline, which has a short turbulent flow path with sharp teeth creating so much turbulence that the pressure drops from 12 psi to about zero in approximately ¾ inches. The passage is square and relatively large and each dripper has a filter. ‘Tapes’ on the other hand have a rectangular passage with little depth and a longer flow path and are more susceptible to clogging.

The dripper is operated at about 12 psi at the beginning of the line and the pressure can drop to about 8 psi at the end of the line. Using a 0.21 GPH dripper spaced at 24 inches in the dripline, we can make a 1,100 foot length of run on flat terrain and we would have a 15% flow variation from the beginning to the end. If a field is sloped, the dripline should be fed at the higher elevation to get a uniform water application along the row.

Typical dripper spacings are 16 or 18 inches for sandy soils and 24 inches for clay soils. If drip systems for Tobacco could be installed permanently, subsurface, about 12 inches deep, then rotation crops like corn or soybeans can also be irrigated with the same drip system.



Streamline Dripline and Dripper



Exploded View of Streamline Dripper

- Short turbulent flow path with sharp teeth
- Large, square flow path
- Secondary filtration maintains water supply out of dripper and reduces clogging
- Wider cross section allows large particles to pass easily

STREAMLINE DRIPLINE	
SPECIFICATION	630 SERIES
WALL THICKNESS	8 MIL
INSIDE DIAMETER	.636"
NOMINAL FLOW RATES GPH @ 10 PSI	0.16 OR 0.24
MAXIMUM OPERATING PRESSURE	15 PSI



Dripline - 1 line per row of Tobacco



Dripline - between 2 rows of Tobacco

SURFACE OR SUBSURFACE

The cost of the annual system is not only the cost of materials, but also the cost of the installation and retrieval of the 8 mil Streamline dripline. The labor cost could be \$100 per acre and then you have to dispose of the thinwall dripline.

A permanent subsurface drip system, SDI, does have a higher cost for materials because we use the Typhoon dripper with larger flow passages. Typhoon dripper flow rates are 0.18 or 0.25 GPH. The lower flow is used because the run length can be longer which makes the system more economical. Also, the wall thickness of the dripline is increased from 8 mil to 13 mil.

A larger diameter tubing 0.875 inch inside diameter will be used if the row length exceeds 900 feet on flat terrain. A typical run would be 1,300 feet, but we can go as far as 1,600 feet on flat ground. Refer to the charts below for Length of Run information and uniformity.

It is very important that permanent SDI systems are well designed so that the system will perform over a long period of time. The end of the driplines are connected to a common PVC flush line, which will have a vacuum release on the higher end and a flush valve at the lower elevation.

- Streamline Driplines with 8 mil wall thickness for annual use should be regulated for 12 psi output pressure.
- Typhoon Driplines with 13 mil wall thickness for permanent subsurface should be regulated for 15 psi output pressure.
- For undulating terrain, we recommend our pressure compensating dripline, DripNet PC, which emits the same flow regardless of the pressure.

STREAMLINE 8 MIL (5/8") DRIPLINE LENGTH OF RUN ANNUAL USE ON FLAT TERRAIN AT 10 PSI

DRIPPER SPACING	GPM PER 100 FT @ 94% EU		94% EU		92% EU		90% EU	
	0.16 GPH	0.24 GPH	0.16 GPH	0.24 GPH	0.16 GPH	0.24 GPH	0.16 GPH	0.24 GPH
12"	0.229	0.362	602'	450'	728'	543'	828'	618'
16"	0.172	0.271	731'	546'	885'	661'	1,007'	751'
18"	0.153	0.241	791'	590'	958'	715'	1,090'	814'
24"	0.115	0.181	959'	715'	1,159'	865'	1,319'	985'

STREAMLINE 8 MIL (7/8") DRIPLINE LENGTH OF RUN ANNUAL USE ON FLAT TERRAIN AT 10 PSI

DRIPPER SPACING	GPM PER 100 FT @ 94% EU		94% EU		92% EU		90% EU	
	0.16 GPH	0.24 GPH	0.16 GPH	0.24 GPH	0.16 GPH	0.24 GPH	0.16 GPH	0.24 GPH
12"	0.229	0.362	1,004'	810'	1,218'	980'	1,390'	1,116'
16"	0.172	0.271	1,213'	975'	1,470'	1,180'	1,678'	1,345'
18"	0.153	0.241	1,309'	1,050'	1,590'	1,273'	1,813'	1,450'
24"	0.115	0.181	1,580'	1,265'	1,917'	1,530'	2,185'	1,740'

TYPHOON 13 MIL (5/8") DRIPLINE LENGTH OF RUN PERMANENT SUBSURFACE USE ON FLAT TERRAIN AT 10 PSI

DRIPPER SPACING	GPM PER 100 FT @ 94% EU		94% EU		92% EU		90% EU	
	0.18 GPH	0.25 GPH	0.18 GPH	0.25 GPH	0.18 GPH	0.25 GPH	0.18 GPH	0.25 GPH
16"	0.207	0.284	650'	530'	786'	640'	895'	730'
18"	0.184	0.253	703'	574'	850'	694'	968'	790'
24"	0.138	0.190	850'	950'	1,030'	840'	1,170'	957'

TYPHOON 13 MIL (7/8") DRIPLINE LENGTH OF RUN PERMANENT SUBSURFACE USE ON FLAT TERRAIN AT 10 PSI

DRIPPER SPACING	GPM PER 100 FT @ 94% EU		94% EU		92% EU		90% EU	
	0.18 GPH	0.25 GPH	0.18 GPH	0.25 GPH	0.18 GPH	0.25 GPH	0.18 GPH	0.25 GPH
16"	0.207	0.284	1,147'	937'	1,390'	1,134'	1,582'	1,290'
18"	0.184	0.253	1,240'	1,012'	1,500'	1,225'	1,708'	1,394'
24"	0.138	0.190	1,495'	1,219'	1,809'	1,477'	2,059'	1,680'

UNIFORMITY

Uniformity can be expressed as a flow variation - which is the difference in flow between the first and last dripper on the line.

We usually design with a 15% flow variation but this also depends on the crop. It is said that 1% increase in emission uniformity (EU) will produce 1% more yield. In arid areas with a valuable crop, a design should have no more than a 10% flow variation. A permanent system with a 15 - 20 year life span should have no more than 15% flow variation.

UNIFORMITY	
EU %	FLOW VARIATION
94	13%
92	15%
90	19%

Realize that there is also a friction loss on the manifold or submain line increasing the flow variation between the first dripper on the first line and the last dripper on the last line, assuming that the land is flat. Use the 92% column for the dripline length on flat ground (charts on the previous page). Always run the submain from a higher elevation to a lower elevation, every 2.31 feet of elevation represents 1 psi.

WATER USE & IRRIGATION SCHEDULING

When using drip irrigation, we want to maintain a certain moisture level in the soil. At planting we may irrigate every day to get the transplants going and when established every 3-4 days to encourage deeper root growth, in the absence of rain. The soil texture will dictate the frequency of irrigation.

After the plant is knee high, the tobacco plants need more water and adequate soil moisture for leaf expansion and internode elongation. The ET rate can be 0.25 - 0.30 inches per day, depending on the growing stage of the plant this could mean an application rate of 0.2 inches or more per day.

A typical drip system in tobacco in Kentucky uses 1 line/2 rows (40 inches) with 0.24 GPH at 24 inch spacing which delivers 0.24 inches in 8 hours. That means if the grower has a 30 acre plot, he can irrigate three 10 acre zones with a flow of 116 GPM (about 4 GPM/acre)

With sandy soil, we would use 1 line per row (46 inches) with a 0.16 GPH dripper at 18 inch spacing for example. The same 30 acres would have 4 zones of 7.5 acres and the application rate in 6 hours would be 0.24 inches/day.



Typical Streamline Dripline, 8 mil, 18" dripper spacing on sandy soil



Healthy, large Tobacco leaves

WATER USE & IRRIGATION SCHEDULING (CONT.)

Netafim recommends 120 mesh filtration for all driplines. A manual filter is usually sufficient for filtering well water. For surface water, we recommend an automatic filter or oversized manual filter if the flow is relatively low.

A drip system provides an easy channel for getting fertilizer into the root system of the plant. It can be applied by a small pump at the (control) head of the system. Adequate Nitrogen supply during the rapid growing stage is important, this can be delivered directly to the root zone and be taken up by the plant.

With drip you are not over-irrigating so if rain is predicted, the soil can still take some more water. This can be a problem when using a traveler because you may just have applied 1.5 inches of water the previous day. And if you thought it would rain, and delayed irrigating overhead, you are behind schedule and the plants will suffer.

Constant soil moisture avoids water logging and promotes a healthy and dense root growth which can take up sufficient water and nutrients for the plant.

Tobacco may ripen early if heavy rains occur during the end of the growing stage. Physiological reactions within the leaf are made favorable due to high moisture content.

With drip and no rain you can control the ripening process and improve the quality of the leaves.



SYSTEM START-UP

OVERVIEW

This section offers guidelines for the successful startup and operational testing of your drip irrigation system. Many times your Netafim Dealer will conduct initial start-up and testing of your system. However, during the course of operation there may come times when the system needs to be started after a shutdown such as the off-season or following repairs. These procedures should be followed after any extended shutdown of your system. All drip system owners should make themselves familiar with the process of start-up and testing of their drip system.

SYSTEM STARTUP

Whether you have just installed a new system or are starting the system up after sitting through the off season, these simple steps, taken before irrigation will help to ensure optimum system performance.

1. Flush the well before operation through the filter. A new well or one that has been sitting during the off-season, may discharge sand at startup. This 'plug' of particles can overwhelm the filtration system causing it to repeatedly trigger an unproductive backflush cycle. If the well discharges sand on a regular basis it may be necessary to install a sand separator before the regular filtration system. Consult your Netafim USA Dealer for more information on sand separators.
2. Thoroughly flush the laterals and mains before system operation. In new systems, during installation, it is possible that dirt and PVC pieces accumulated in the system - these need to be flushed out properly. Since a drip irrigation system for tobacco is used for a relatively short period of time, the driplines are only flushed at startup because the system is removed from the field after harvest. In a subsurface system, the end of the driplines are connected to a common flush manifold and can be flushed at any time with hardly any labor.
3. Check for leaks in dripline laterals. Laterals are occasionally damaged during installation. System start-up is the right time to check for leaks, before the crop canopy expands making repairs difficult.

STARTUP PROCEDURE

The following steps are meant as general guidelines for seasonal or periodic maintenance startup procedures and may not be applicable every time the system is started.

1. Open all the valves to the field as would be done to run an irrigation set. If multiple sets, start with set 1.
2. Based upon water quality, you may need to run the pump on initial startup to a flush pond or ditch. This allows the water to clear up prior to diverting into the irrigation system.
3. Allow irrigation system to reach design operating pressure and flow rate.
4. Open mainline flush valves and close as many submain valves as required to properly flush the mainline. Consult the Netafim irrigation dealer for the proper sequence.
5. Flush each drip zone. Consult with the irrigation dealer for proper sequence of flush manifold valve and or number of laterals to be sequentially flushed. It's very important to know the proper amount of time to flush the manifold valves and or individual laterals which is why we recommend consulting a Netafim irrigation dealer for timing guidelines. Continue through the entire irrigation system.
6. Return to the pump station and confirm the proper operating pressure and flow are achieved.
7. Check the system for leaks and repair.
8. Re-flush individual lines after leaks are repaired. If laterals are connected to a common flush manifold, do not re-flush the entire zone.
9. Check for proper operation of all system components; pumps, controllers, valves, air vents, pressure regulators, gauges, water meters, filter system and chemical injectors.
10. Record readings from all pressure gauges and water meters and check on the frequency of backflush cycle of the filters. The filter backflush frequency can change dramatically with water quality. Consult the Netafim irrigation dealer for proper advice on equipment management.

SYSTEM PRESSURE AND FLOW TESTS

Upon initial startup it is best to evaluate the uniformity of your drip system. This is accomplished by:

1. Measuring the pressure in the system at various points and comparing this to the design pressure.
2. Reading the water meter or calculating the system flow and comparing the result to the designed flow rate.

These evaluations should be conducted as part of system startup and as an ongoing part of system maintenance. Consult the maintenance section of this manual for a complete program for system care.

SYSTEM PRESSURE EVALUATION

Drip systems are typically designed to operate between 10 and 15 psi. Measuring the pressure at several points in your drip system is the simplest way to evaluate the performance. A good evaluation will include pressure measurements at a minimum of three points along the header end of the field and three points at the far end of the field. Pressure measurements at more points in the field including along the length of the laterals will give a more complete picture of system uniformity but are usually not necessary if the end pressures are within one psi of the header pressure.

SYSTEM FLOW RATE

A water flow meter is an important component of every drip system. It gives the operator a quick indication of the operational performance of their system and is used to determine proper water application rates. Every new system should be designed with a water flow meter. Older systems without water flow meters should be retrofitted with one. The system design should include an estimated system flow rate and the measured flow rate should be within +/- 5% of the designed rate. To calculate the flow rate expected for each zone use the following formula:

$$\frac{\text{Total dripline length / dripper spacing (ft)}}{\text{dripper spacing (ft)}} \times \frac{\text{Dripper flow rate (GPH)}}{60} = \text{GPM}$$

CONVERTING SYSTEM FLOW RATE TO INCHES OF APPLIED WATER

Irrigation schedules are usually based on evapotranspiration (ET) rates which are expressed in inches of water evaporated over a given time period, usually a day or week. It is simple to convert a flow rate in GPM, either read from a meter or calculate as outlined on previous page, to inches of water applied per hour by using the following formula.

Inches of water applied per hour = $(0.00221) \times (\text{flow rate, in GPM}) / (\# \text{ acres})$

or

$$\text{Inches/HR} = \frac{1.6 \times \text{Dripper flow rate (GPH)}}{\text{Row spacing (ft)} \times \text{Dripper spacing (ft)}}$$



MONITORING YOUR DRIP SYSTEM

To achieve the highest yields and water savings possible with a drip irrigation system, it is necessary to monitor your system and make adjustments. In addition, regular system monitoring may give advance warning of potential problems.

MONITORING SYSTEM PRESSURE AND FLOW RATES

As presented earlier, measurements of system flow and pressure give a good picture of the system's performance. Because of the large number of variables at play in an irrigation system the measured water application rate may not exactly match the predicted rate. Still large differences in calculated versus measured values may indicate a problem with your calculations or a physical system problem such as a broken or clogged line. Over the growing season changes in the flow rate or pressure in your system can be used to diagnose problems with the system. The following chart details some of the problems that can be diagnosed by monitoring system pressure and flow rate. This is by no means a comprehensive list but is a good place to start.

INDICATION	POSSIBLE PROBLEM
Gradual decrease in flow rate	Dripper plugging Possible pump wear (check pressure)
Sudden decrease in flow rate	Stuck control valve Water supply failure
Gradual increase in flow rate	Incremental damage to dripperline by pests
Sudden increase in flow rate	Broken lateral, submain, main line Pressure regulator failure
Large pressure drop across filters	Debris buildup in filters Inadequate flushing of filters
Gradual pressure decrease at filter inlet	Pump wear or water supply problems
Sudden pressure decrease at filter outlet	Broken lateral, submain, main line Pressure regulator or water supply failure
Gradual pressure increase at filter outlet	Dripper plugging
Sudden pressure increase at filter outlet	Stuck control valve Other flow restrictions
Sudden pressure decrease at submain	Damaged or broken lateral

DRIP SYSTEM MAINTENANCE

The maintenance of your drip irrigation system is very important. Consult an authorized Netafim USA Dealer for important instructions on drip irrigation system maintenance to ensure maximum system performance and life.

ADDITIONAL QUESTIONS

For questions not covered in this manual, contact an authorized Netafim USA Dealer, a Netafim USA District Sales Manager or Netafim Customer Service at (888) 638-2346.





NETAFIM USA
5470 E. Home Ave.
Fresno, CA 93727
CS 888 638 2346
www.netafimusa.com