Vineyard Manager's Irrigation Training Program

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Compiled and delivered by :

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1.0 Drip Irrigation Basic Components

A drip irrigation system is made up of a number of components which when operating together form the drip irrigation system. Drip Irrigation systems have been in prevalent use since the early 1970's when plastics technology allowed cheap production of plastic piping and drippers, which form the majority of the delivery of the system. A well-managed drip irrigation system is one of the most efficient and effective ways of delivering irrigation water to plants. It can be effective because:

- It requires a relative low energy requirement
- Water is applied directly in the root zone of the plant
- A well designed system applies the water evenly across an irrigation block
- Application rate is low so irrigation management control is high and losses due to run off and percolation can be minimised.
- Difficult terrains and soils can be managed with a well-designed drip system
- Better management control leads to improved quality and yielding.
- Improved disease control due to non-wetting of foliage.
- Ability to inject fertilizers and chemicals into the system.

There are a number of key components, which make up a drip irrigation system and we will briefly discuss each one and the role they play in the overall system.

1.1 Pumps

The system starts at the pump and this delivers the water to the irrigation system. It is the "heart" of the irrigation system, which provides the energy to transfer the water from the water source to the plant.

The majority of pumps used for irrigation are "centrifugal pumps" which are composed of an "impeller" housed in a "volute or bowl (casing)". The impeller has curved "vanes" which when rotated by a motor spin the water creating a centrifugal force and pressure is developed at the edge of the volute. The pressurised water exits the pump and enters the system.

There are a number of different types of pumps used in irrigation systems but the type chosen will depend on the specific site application and operating parameters. The basic types are :

- **Single Stage Centrifugal Pump** – This pump comprises of one impeller and casing with a motor connected to the shaft. They are probably the most common type of drip irrigation pump in use today.

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- **Multi-Stage Centrifugal Pump** – These pumps consist of a number of impellers and bowls, which are linked, together in a common housing. They are used to develop higher heads and can be more efficient than one single stage centrifugal pump.
- **Turbine Pump** – used on a bore or mounted on a pontoon in a river or lake, these pumps consist of a series of impellers and bowls attached to a column, which connects to the motor mounted above ground. A shaft down the middle of the column drives the impellers at the bottom of the column. The impellers and bowls are mounted below the water surface.
- **Submersible pump** – a multistage centrifugal pump, which is fully submersed under the water, including the motor. Used mainly in boreholes but sometimes-mounted in Dams and Rivers.
- **Fixed Speed pumps** – Electric pumps can be designed to operate at fixed speeds usually 1450RPM or 2960RPM but this can be changed if the pumps are run through pulleys or gears. Fixed speed pumps should be used where there is not a lot of water flow variation between shift operations, although this too can generally be overcome by using specialty valves.
- **Variable Speed pumps** – In recent times with advances in electronics options are now available to provide a variable speed option to your pump set. This usually works with a pressure transducer connected to a PLC and this is set for the desired field pressure. The pump will speed up or slow down to maintain this set pressure. The advantage of this system is where you have a wide range of shift flows to cater for and the net result of ramping up and down the pumps is saving on power required to operate the system.

One of the more important aspects to consider with pumping water is to consider the pump efficiency. Pump Efficiency is shown on a manufacturers performance chart for the pump and varies for differing pumps. The efficiency varies depending on the pump duty required. It is therefore important to consider pump efficiency when selecting a pump. 100% is considered full efficiency to 0% non-efficient with a value between 70-100% desired.

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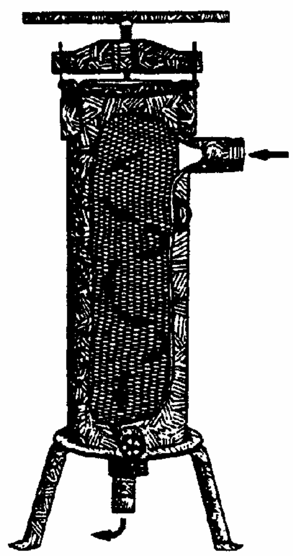
1.2 Filters

The filter is the cleansing part of the system and is essential for continued operation of you drip irrigation system. It would be likened to the "liver" cleansing out impurities, which may harm the system. Some systems just have a primary filtration system at the pump station, whilst others also have "back-up" filters situated in the field. There are varying types of filters with the main ones being:

- **Screen Filter** – A perforated screen or mesh is installed in a housing. Water passes through the screen trapping the contaminants and allowing clean water to flow through to the system. Screens can be of varying sizes stated in millimetre openings or mesh (wire density per inch). Common sizes for drip systems are filtering from 80 to 150mesh (0.18 to 0.10 mm). Screen filters can be manually or automatically cleaned by backwashing (reversing the flow of water through the screen).



Pressure Screen Filter

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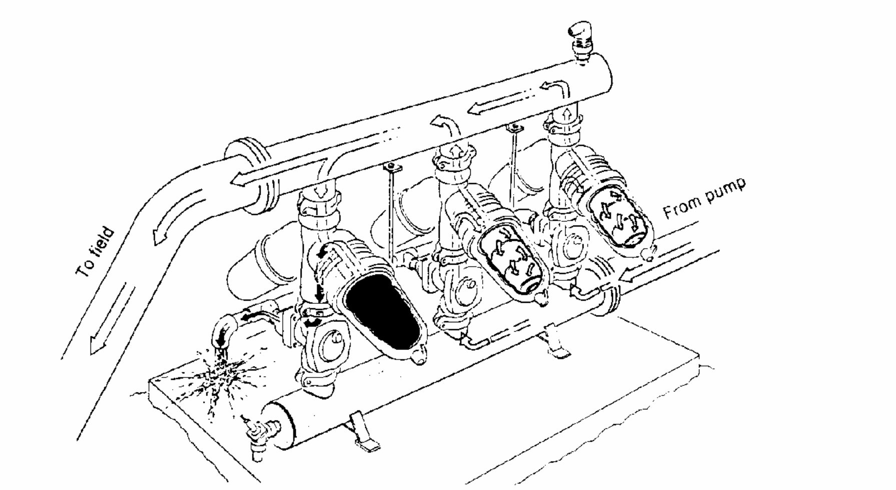
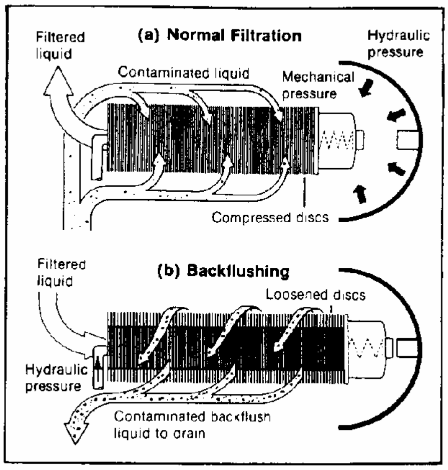
- **Disc Filter** – Disc filters comprise of a number of grooved discs wedged together in a housing. Water filters from the outside to the inside of the discs. Separating and cleaning the disc elements clean the disc filter. This can be done either manually or in some filters automatically.



Typical Automatic Disc Filter Assembly



Automatic Disc Filter Backwash process

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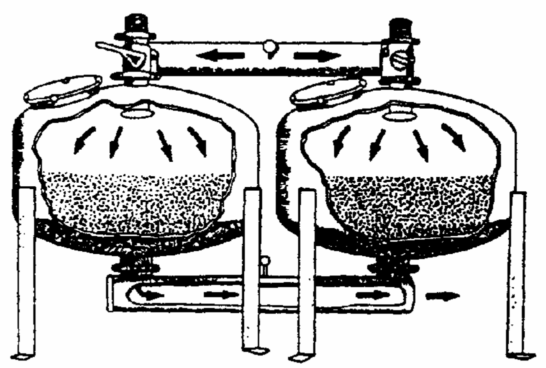
- **Media (Sand) Filters** – A sand filter has a sand or gravel media bed housed in a pressure tank. Passing the water through the media bed where contaminants are trapped by the media filters water. The media is cleaned by backwashing the filter, this is achieved by reversing the water flow through the media bed. Media filters usually have a minimum of two tanks so as to achieve clean water backwashing. Media Filters are usually capable of filtering down to 200 mesh (0.076mm).


Media Filter

Typical Media Filter Station

Drip Emitters by design have fine flow paths ranging from 0.2 to 2 mm so it is therefore important to select the appropriate level of filtration so as not to cause emitter-clogging problems. Most drip manufacturers would recommend a minimum of 120mesh (0.13mm) filtration. The other requirement governing the filtration chosen is the quality of the water supply. In open still waters for example algae may be a problem and the most suitable choice of filtration would be media as it is not prone to algae matting as a screen or disc may be. In organic materials in water supplies are usually handled well by disc or screen filters.

1.3 Chemical/Fertilizer Injectors

Drip Irrigation systems are able to deliver soluble fertilizers and chemicals via injection pumps. There are different types of injection pumps with the main ones being:

- **Venturi Injectors** – These injectors work with a venturi principle where water is passed through a tapered constriction of different sizes and a suction placed at the narrowest point. The high velocity in the restriction and the subsequent slower velocity in the expansion causes chemical to be drawn through the suction. The major drawback of these injectors is they require at least a 20 % pressure differential in the mainline to initiate flow and suction through the injector. Sometimes these injectors are set-up with a booster pump to create the pressure differential across the injector.

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- **Positive Displacement Pumps** – These are diaphragm pumps, which inject a settable amount of liquid into the line. They are usually electrically operated and are available in a range of sizes and injection rates.

1.4 Specialty Valves

There are ranges of different types of valves that can be used in a drip irrigation system with the main types being:

- **Isolation Valves** – Either Ball, Gate or Butterfly valves that are used to isolate sections of the mainline. They are placed within a system to allow areas to be isolated for maintenance and in case of mainline breakages.
- **Scour or Purge Valves** – Usually Butterfly or Ball Valves, which are placed at low points in the mainline to allow for flushing (purging) of the system.
- **Pressure Reducing Valves** – these valves maintain a constant downstream pressure regardless of fluctuations in the mainline pressure. They are used where variations in mainline pressure are expected such as wide shift flow variations or constantly changing shift operations with a fixed speed pump.
- **Pressure Sustaining Valves** – these valves maintain a constant minimum up stream pressure. They are used to slow mainline filling and for pump protection as well as maintaining pressure to filter stations whilst backwashing is occurring.
- **Check (Non Return) Valves** – These valves only allow one-way flow through them and are usually used to protect headworks and pump stations from backflow when systems shut down.
- **Air Release Valves** – These valves are used to release and induce air into the pipe work system. Air needs to be released when a system is pressurised as it speeds up the filling of mainlines and reduces the effects of water hammer. Inducing air into the pipe work system when it shuts down prevents vacuums forming in the pipes, which can cause them to collapse. Air release valves are positioned at high points in the mainline system or about every 500 m of pipe.
- **Vacuum Relief Valves** – These valves are installed downstream of control valves and prevent vacuums forming within drip lines by allowing air into the system when it is draining.
- **Foot Valves** – Foot valves are placed on the end of a pump suction line and are essentially check valves, which keep the suction line full of water. They often also incorporate a coarse strainer for preventing large debris from entering the pump.

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1.5 Control Valves

Control Valves are the valves, which control operation of the individual blocks, which make up a drip irrigation system. They can be either manual or automatic valves. Control Valve assemblies often consist of a range of components such as Back up field filters, Vacuum Relief Valves, Pressure Testing points and Isolation Valves.

1.6 Pipe work

There are three descriptive pipes used within drip systems being:

- **Mainlines** – The pipe work, which connects the pump to the control valves. This pipe is commonly either uPVC or High Density Polyethylene although in some older irrigation areas you can find other materials such as Fibrolite and Ductile Iron Concrete lined pipe.
- **Sub mains** – The sub main pipe work runs perpendicular to the vine row and supplies water to all of the lateral pipes. Common materials are uPVC or High Density Polyethylene.
- **Laterals** – The laterals run along the vine row and can be attached to a trellis wire along the row, run on the soil surface or buried (In the case of sub surface drip irrigation). The lateral can be either a Low density Polyethylene pipe with online drippers attached to it or Low Density Poly Drip line with drippers built into the drip line.

1.7 Drippers/Drip line

There are two basic styles of drip emitters being on-line, where the dripper is inserted into the lateral tube or inline where the dripper is pre-inserted at a regular spacing as part of the manufacturing process.

There are also two basic types of drip emitters being non-compensating and pressure compensating. Non-compensating drippers vary their flow rate with varying pressure whereas pressure compensating maintains a constant flow rate over a wide range of pressure.

Non-compensating drip emitters have a reasonably tight operating pressure range to maintain a small flow variation. This means that a non-compensating system has to be well designed and pipes sized to stay within these constraints. Their main advantage though is that they have no moving parts or elastometer material, which could alter over time and have relatively large flow paths. This can make them less prone to clogging than pressure compensating drippers.

Pressure Compensating drippers have a wide operating pressure range so long lateral run lengths can be achieved and smaller pipe sizes can be used than with non compensating drip systems. The trade off is a higher

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energy requirement (power cost) and the finer flow passages means there can be more susceptibility to clogging.

1.8 Flushing Points

It is important to have areas in the system where sediments can be flushed out. Flushing Valves (Ball) Valves are installed on the ends of the sub mains to allow them to be flushed. Sediments can also gather in the ends of the lateral lines and this needs to be flushed. Either installing a removable ring on the end of the line or a flushing tap, both of which can be easily opened, can achieve this. Installing flushing sub mains, which join a number of laterals together with a common flush valve/s, can save Labour when flushing.

When flushing a system it is important to achieve a flushing flow velocity of greater than 0.3 m/s to move sediments out of the system. The following table gives an indication to the flows required to achieve the minimum 0.3 m/s:

Tube ID (mm)	Required Flow Rate (L/m)
13	2
14	3
16	4
18	5
19	5
20	6
22	7
25	9
32	14

To achieve an adequate system flushing velocity from the laterals and the sub mains usually requires the control valve pressure to be increased to compensate for the extra flow or only a small section can be flushed at once.

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1.9 Control Systems

Automatic control systems can be controller or computer driven and range from very cheap and basic to highly sophisticated software driven programs. In a basic form the irrigation controller electrically operates solenoids at the control valves or at a hydraulic manifold achieves the automation. The controller is driven by a time clock and operates programs, which the user sets. Some of the more sophisticated systems have alarming functions, sensor switching and protection and PC and modem connection.

Most drip irrigation systems should employ at least basic irrigation control as it provides an effective mechanism for ensuring good irrigation scheduling and avoiding over irrigation.

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2.0 Drip Irrigation – A hydraulic understanding

2.1 Basic Hydraulic terms

To understand your drip irrigation system workings you need to have a basic understanding of hydraulics.

Pressure is the force per unit area of water within the pipe system and is usually defined in kilopascals (kPa) or pounds per square inch (psi). Pressure can also be defined in metres head (m) or feet head (ft). Generally 1 m of water is equal to 10 kPa, therefore 100 kPa is equal to 10 metres head.

Flow rate is the rate at which water flows through the system and can be expressed a number of ways such as Litres per minute (L/m), Litres per second (L/s) or cubic metres per hour (m3/hr). Drippers are usually expressed in Litres per hour (L/h). A cubic metre of water (1m3) is equal to 1000 Litres of water, therefore 1000 L/h = 1m3/hr.

Velocity is the speed at which the water travels through the pipe system and is expressed in metres per second (m/s). Water travel through mainlines in particular should be limited to no more than 2 m/s. Velocities higher than this can cause problems with water hammer and subsequent damage to pipe networks.

Ground Elevation directly effects water pressure due to the gravitational weight of the water. If a tank was filled to a 2 m depth and a pressure gauge was attached to an outlet on the base of the tank, the pressure gauge would read 2m or 20 kPa. If the same tank then had a pipeline attached which travelled a further 8m down the hill then a pressure gauge attached to the end of the pipe would be 10m or 100 kPa. This clearly demonstrates that water pressure changes directly with changes in elevation. Elevation differences therefore play a major part in engineering quality drip irrigation systems.

2.2 Friction Loss

As water flows through pipelines energy is lost due to friction of water on the walls of the pipe. As the flow rate increase so to does the frictional loss. Designers select pipes so as to balance the effects of friction, economics of pipe and energy costs.

2.3 Valves/Fittings/Filter Losses

Other items in the drip irrigation system also have friction losses such as control and specialty valves, filters and bends within the system. Manufacturers produce head loss charts for valves and filters, whilst designers usually make an allowance for bends losses in their pump duty calculations.

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2.4 Hydraulic Design Tolerances

All drip irrigation systems are designed to a hydraulic design tolerance. Simply put this is the variation of operating pressure that can be tolerated for the system to achieve a desired operation.

Pressure compensating drip irrigation systems have a large design tolerance i.e. 100 to 300 kPa is common, whereas a Non-compensating drip irrigation system would have a much smaller tolerance i.e. 90 to 110 kPa. The design tolerance is the minimum to maximum pressure that can be tolerated across an irrigation block, which operates together.

Design tolerances in non-compensating systems in particular play a part as to the watering uniformity across the block i.e. the lower the design tolerance the better the watering uniformity.

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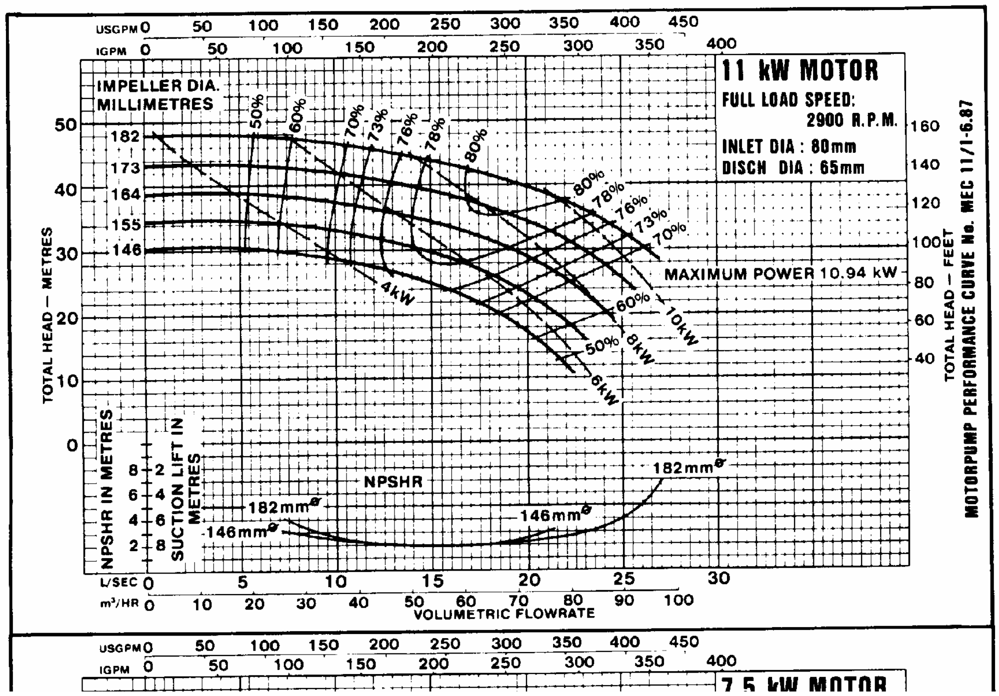
2.5 Pump Hydraulics

Manufacturers of centrifugal pumps produce pump curves typically as shown below.

80 x 65 -160



A typical single stage centrifugal pump curve

The vertical axis of the pump curve shows the pump head usually expressed in metres (m).

The horizontal axis of the pump curve shows the flow rate in Litres per second (L/s).

A number of curves are shown on the graph and these different curves display the performance for different impeller diameters.

The pump efficiency curves are shown on the graph and expressed in percentage.

The power requirement in kilowatts (kW) for the pump curves is shown as a set of lines going across the pump curves.

The Net Positive Suction Head Required (NPSHR) is shown for the pumps. This relates to an engineering calculation that is done on the suction side of the pump to ensure that pump cavitation does not occur.

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There is a limit to the extent that a pump can be placed above the water surface.

3.0 Fertigation and Chemigation Basics

3.1 Types of Injectors

Earlier we discussed the two main types of injectors being venturi type and positive displacement pumps. Venturi types are proportional i.e. if the pressure varies then so to does the injection rate. Positive displacement pumps on the other hand put exactly the amount set into the system.

3.2 Fertilizer Injection

Any liquid or fully soluble fertilizer can be injected into the drip irrigation system. Soluble NPK mixes are usually injected and local agronomy advice should be sought for specific requirements.

3.3 Chlorine Injection

Chlorine is a strong oxidising agent and is commonly used to purify water, which is contaminated with organic material. Chlorine should be used to cleanse the system of algal and bacterial slimes, which can clog emitters. There are a range of treatments which can be employed. For continuous treatment injection rates in the order of 1 to 2 PPM (parts per million) of active chlorine should be used. For intermittent treatment (ie monthly) a rate of 10 to 20 PPM should be injected for 30 to 60 minutes. Where emitter clogging has occurred super chlorination can be employed for a short duration (30 minutes) by injecting Active Chlorine up to a rate of 500PPM. After injection shut the system down, leave for 24 hours then thoroughly flush the system.

3.4 Acid Injection

Acid injection is usually used to remove inorganic material such as salts and scale build-up. The pH of the system is lowered to around 4 to necessitate effective cleaning. Taking an irrigation water sample and adding measured quantities of acid until the desired pH is reached calculates acid injection rates. The acid proportion to water proportion can then be calculated and hence the injection rate.

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3.5 Calculating Chlorine Injection Rates

Calculating Liquid Chlorine Injection rates:

$$\text{Injection Rate} = \frac{Q \times C \times 0.36}{S}$$

Injection Rate = Litres per Hour
Q = System flow rate (L/s)
C = Desired Chlorine Concentration (PPM)
S = Active Chlorine in solution(percent)

4.0 Basic Maintenance

4.1 Electric Pumps

Maintenance of centrifugal pumps mainly requires servicing and periodic replacement of packing glands and shaft seals. The motor should be clean and clear and there should be no sign of water leakage from the casing. Impellers may sometimes need replacement if abrasive waters are pumped. The pump shall rotate smoothly within its housing.

4.2 Filters

Filters need to be regularly checked for correct operation. The best way to deduce if a filter requires some manual cleaning is to check the headloss across the filter. If it is greater than 10m (100 kPa) it probably needs to be pulled apart and cleaned.

For disc filters, remove the outer casing and separate the disc elements and clean with a pressure hose or sprayer. If the disc is really dirty it can be immersed in a solution of 500PPM Chlorine for 24 hours. It is therefore often a good idea to have spare filter elements for your system whilst you are cleaning the other elements. Screen filters can be cleaned in the same way as the disc elements except the screens may need to be brushed clean.

Most automatic screen and disc filters should not require element cleaning but may require servicing of their moving parts as per the manufacturers recommendations.

Media filters will require the media to be replaced every four to five irrigation seasons. The media should be sharp crushed silica and over time this may become rounded and worn and hence lose its filtration quality.

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Chlorination of the system will also help to clean filters if the injection system is upstream of the filters.

4.3 Valves

Valves need to be checked for signs of leakages and repaired or replaced as necessary. Control valves with pressure regulators should be checked that they are still operating at the correct downstream pressure and re-adjusted if necessary. Spare diaphragms should be kept for control valves as over time these may rupture causing the valve to remain open.

4.4 Flushing the system

The most important maintenance aspect to consider in a drip irrigation system is adequate flushing to ensure sediments are cleared from the system. These can cause a potential hazard by clogging emitters. Mainlines should be drained and scoured if a mainline breakage has occurred and debris has entered the pipe. Periodically the mainline should be scoured and a check of the flush water will reveal if sedimentation is occurring.

Sub mains should be flushed at least once per month but more regularly if large sediment build up is occurring. Opening the end flushing points on the ends of the submains will flush the sub mains. The valves shall remain open until there is no trace of sediments (discolouring) in the water.

Laterals are flushed by opening the ends of the drip lines (or flushing manifolds) and achieving the minimum flushing flows as described earlier. Depending on your pump system you may be able to open some or all of the laterals at once. The Control Valve pressure may also need to be increased to achieve the flushing flow rate.

A procedure for block flushing would be to first flush the sub main and then the laterals. This order would be repeated block by block.

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5.0 Analysing System Performance

5.1 Monitoring Flow

If a pump is the heart of the system then a water meter placed in the system is the "heart monitor". It is the first sign of potential problems, which could occur in your system. When a system is first commissioned (i.e. all the valve pressures are correctly set in the field) it is important to measure the irrigation block flow rates. This gives a new system flow rate for each block. These should be recorded and kept in a safe place for later reference. At periodic times the system flows should be checked against the original flow rates. If there is no change then the system is working perfectly but an increase would indicate leakages in the system and these should be identified and repaired. A decrease is more alarming as it can indicate emitter clogging and a cleansing program should be initiated. You can always expect some minor variations in flow but anything greater than 20% should be investigated.

5.2 Distribution Uniformity of Drip Systems

Variations in emitter flow always occur in drip irrigation systems and are due to a number of factors such as:

- Pressure Variation from design tolerance
- Manufacturing Variation (Cv)
- Pressure Variation due to Elevation differences
- Emitter Clogging
- Variations in Plant Spacing to Emitter Spacing
- Soil Variations (In sub surface systems)
- Unequal discharge during start-up and drainage

An expression called Distribution Uniformity (DU) is used to measure the effectiveness of the irrigation system. This is simply expressed as:

$$DU\ (\%) = \frac{\text{Average of the lowest quarter of the drip samples measured}}{\text{Average of the entire drip samples}} \times 100$$

A field test can be carried out to determine drip irrigation systems DU by measuring dripper flow rate of a sample of drippers across an irrigation block. The DU can then be calculated.

5.3 Distribution Uniformity of Overhead Systems

The DU can also be measured for overhead irrigation systems. This is done by placing a grid of water collectors between a typical pattern of sprinklers. The sprinklers are operated for a set time and then the water is measured in each collector and recorded. The DU is then calculated the same as the drip DU and recorded as a percentage. An overhead system should return a DU of 75% or higher for the system to be effective. The overhead system test has one setback, it only tests a small sample of the

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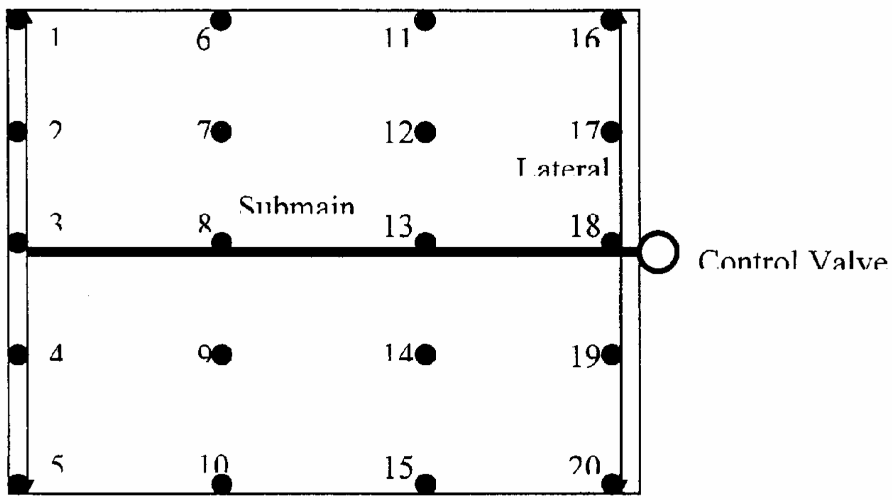
sprinklers so it may not give a true indication of the DU because of the effects of pressure variation within the irrigation block.

5.4 Testing Drip system DU

A drip irrigation system DU test is carried out by laying a minimum of twenty drip emitter test points across a block. These test points should be chosen so as to represent a cross section of pressure ranges across the block.

FIGURE 7-1: EXAMPLE OF A DISTRIBUTION UNIFORMITY MEASUREMENT GRID ON AN IRRIGATION BLOCK.



- **Step 1** - The system shall be started and enough time allowed to achieve constant pressure across the block. The tests shall then be carried out with the block held at the same pressure i.e. do not open other blocks or change the hydraulic conditions.
- **Step 2** – Sketch the irrigation block including Control Valve locations and mark the approximate test point locations. Number each location.
- **Step 3** - At each test point collect a water sample from the dripper for 2 to 3 minutes depending on measuring cylinder size. Record the Test point number and the Flow Rate. If possible also measure the pressure at each test point.
- **Step 4** – Repeat Step 3 for all subsequent test points.
- **Step 5** – Calculate DU from the flow test results.

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5.5 Analysing and understanding the results

DU results give you a benchmark of your irrigation system and give you a guide to how effective your irrigation system is to applying water to plants.

A new drip irrigation system should achieve a DU of greater than 85% but systems at 75% are still deemed satisfactory.
To understand the implications of DU consider the effects in terms of a run time multiplier to your irrigation schedules. The following table demonstrates the Run time multiplier :

System DU%	Irrigation Run Time Multiplier
90	1.11
85	1.18
80	1.25
75	1.33
70	1.43
65	1.54
60	1.67
55	1.82
50	2.00

This shows that to apply the average amount of water to the driest quarter area for a 90% DU requires running the system for 11% longer, 50% DU requires a 100% longer run time which would clearly leading to over watering of the average and wettest areas.

A poor DU result requires some investigation to ascertain where the problem/s are. First pressures should be measured across the problem block to identify the hydraulic variances. Next the emitters should be analysed more closely to see if there are any signs of clogging material, if there is a better cleansing program needs to be employed. Finally the age of the drippers and tubing may be the cause of the problem and a replacement program may need to be initiated.

Some of the other factors effecting DU such as uneven plant spacing, soil variations (Sub Surface) and fill and drainage rates need to be explored by physical examination.

System DU will fall over time as the system ages. Preventative maintenance programs though will ensure the system remains at its peak performance for many years and DU measurement should be used as an effective tool for quantifying the performance of an existing irrigation system.

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6.0 Field Exercise

6.1 The best way to demonstrate and practice our learned skills is through a field exercise. In this exercise we shall :

- Identify the major components of the drip irrigation system discussing each.
- Critically assess the layout of the existing system and recommend any improvements.
- Check the state of the system by flushing some sections.
- Identify a drip irrigation block we wish to DU test.
- Carry out a DU test.
- Calculate the system DU
- Discuss the findings and recommend remedial actions.

7.0 Developing a Preventative Maintenance Schedule

7.1 A typical preventative maintenance schedule

Preventative maintenance schedules will differ between systems due to the components used, system types, available labour and culture. A typical preventative maintenance schedule should be designed as the name implies to prevent problems occurring and minimise down times.

A typical season schedule could be as follows :

Start of Season

1. Start pump with a mainline or scour valve open. Check pressures across headwork components are all normal. Especially check the filter head loss.
2. Open and Flush Mainline – check for contaminants.
3. Open blocks in turn flushing sub mains and laterals, finally check and set control valve pressure.
4. Measure block flow rates and compare with previous records. If low employ cleansing program, if high check system for leakages and repair.

In the Season (say every four weeks)

1. Flush the submains and laterals checking contaminant level and type.
2. Employ chemical cleansing program if required.
3. Check control Valve pressures
4. Measure Flow rates and record. Implement remedial action if required.

End of Season

1. Implement a thorough chlorination program at about 10 to 20 PPM and thoroughly flush your system.
2. Drain the system for the winter.

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Ideal Parts Inventory Checklist for Repairs

1. Spare Field Filter Elements (to cover at least half of your system)
2. Spare Control Valve Diaphragms (2 off for each size)
3. Spare lateral joiners clamps, ties and fittings
4. Spare Drippers (online systems)
5. Spare solenoid coils and bases

7.2 Standard Operating Procedures

It is a good idea to develop some standard operating procedures (SOP) for you drip irrigation system. These should include:

- Start up Instructions.
- Normal and desired shift operations
- Scheduling methods and desired schedules
- Preventative maintenance programs
- Setting and adjusting the system
- Shutting down the system
- Critical Contacts and Procedures
- Operation Manuals and Technical Specifications for all equipment
- Irrigation Plans
- Other plans ie soil, topographic survey, etc.
- Approvals, Licences
- OHS&W Policy for the system

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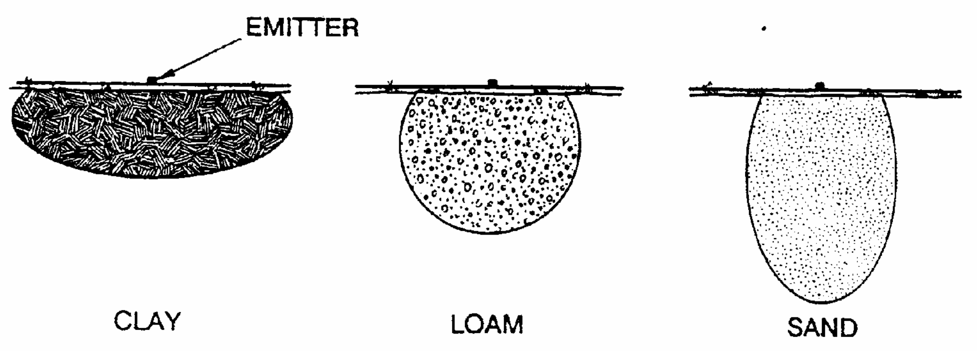
8.0 Drip and Soil Wetting Patterns

8.1 Drip Wetting Patterns

The wetting patterns from drip emitters have a characteristic “Onion” shape to them. This is caused by a horizontal capillary action induced on the water by the soil. The soil type governs the amount of horizontal movement. Coarse sandy soils tend to have a limited lateral spread whereas loam and clay soils can have a much wider lateral movement of water. It is therefore important to have an understanding of the soil type to understand the expected lateral spread of the soil. This can also be tested by placing a large 200litre drum of water on the soil to be used for irrigation and then attaching an 8L/h dripper at the base of the drum and allowing the contents of the drum to flow out through the dripper into the soil. Digging around the emitter reveals the extent of the lateral spread.



Typical Wetting Patterns

It is common for drippers in vines to be spaced from 0.5 m to 1.5m spacing. There are two strategies, either employ a wetted strip where the drip wetting patterns join along the vine row or a dripper placed directly at the vine trunk.

In recent years subsurface drip systems have begun to be used in vineyard systems. This has some advantages in that a greater volume of soil is wetted up compared to surface drip and also evaporation and surface wetness is minimised.

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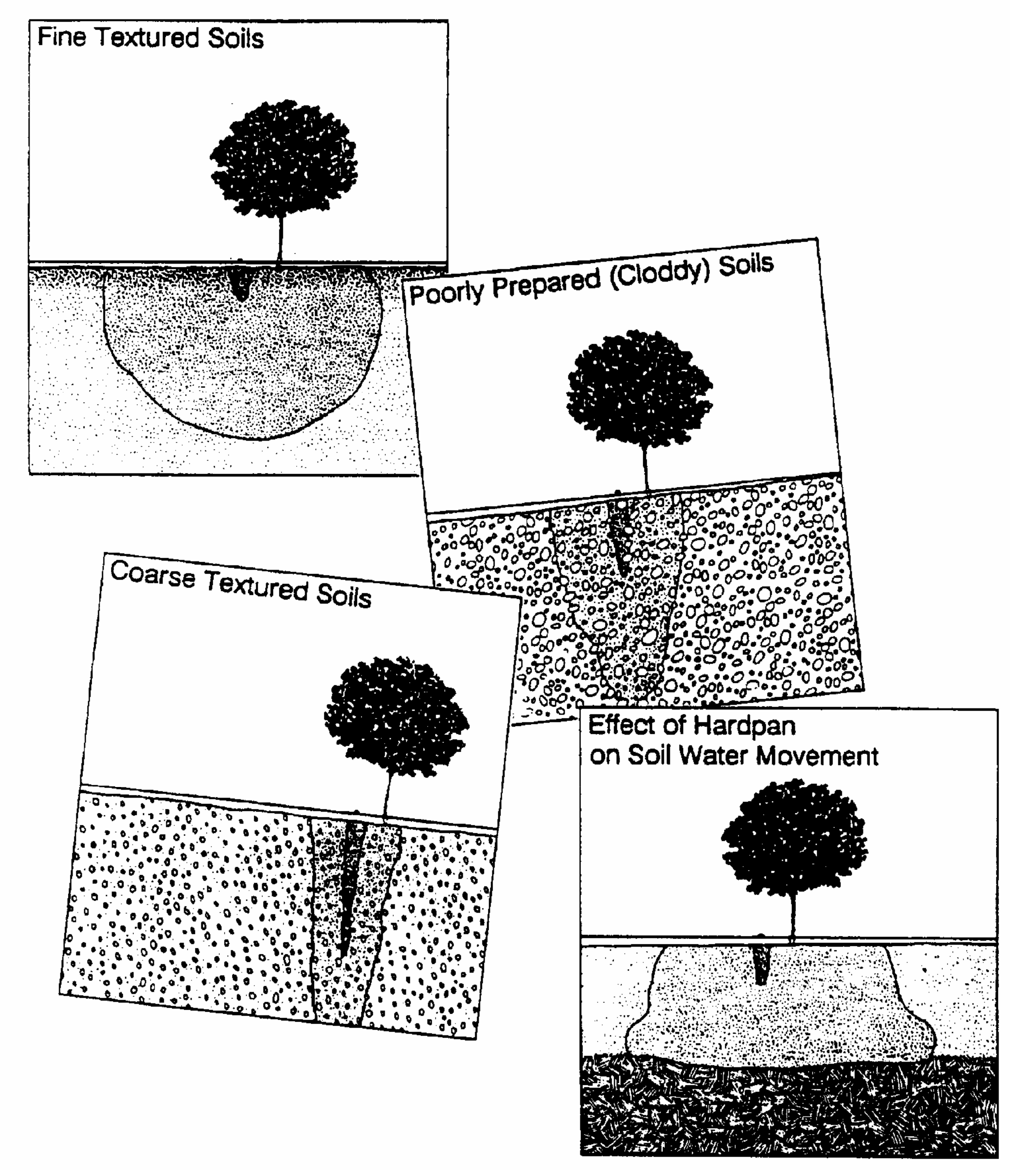
8.2 Problem Soil Types

Not all soils are ideal for drip irrigation systems and care needs to be used in some situations. Homogenous and uniform soils are easily managed and pose no real threat but problems can occur where hardpans exist below the soil surface, Also soils with large variances in water holding capacity (Readily Available Water (RAW) Values) need to be managed carefully with a drip irrigation system. The system needs to be designed so that similar areas can be irrigated together. It is therefore important to obtain a soil survey of your property.



Some samples of differing soil structures

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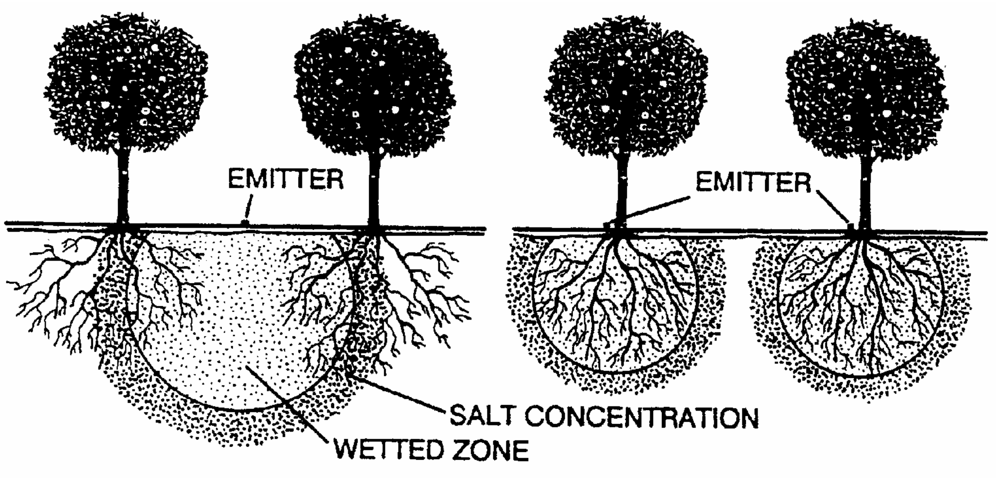

Salt effects on wetting patterns

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9.0 Developing an Irrigation Management Plan

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10.0 Benchmarking and Learning from each other

10.1 It is important this group benchmarks off each other using the information learned in this workshop and compares comparative DU results and maintenance schedules to achieve self learning and improve irrigation practices as a whole.

11.0 References

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