1 The Trickle Irrigation Concept

1.1 Introduction to Trickle Irrigation

Trickle or drip irrigation is a form of microirrigation. The term microirrigation is often used to describe the frequent, low pressure application of water to a crop. Microirrigation includes emitters utilizing drip, spray or stream patterns and microsprinklers.

Microsprinklers usually have flow rates in excess of 100 Lph (25 gph) and apply the water head to head, providing 100% coverage of the area to be irrigated. Microsprinklers can be distinguished by having a moving part such as a spinner or other device to increase the diameter of throw. **This manual does not cover the design of a microsprinkler system.** These types of systems should be designed similarly to other sprinkler irrigation systems and follow the design principles found in the *B.C. Sprinkler Irrigation Manual.*

Trickle / Drip irrigation uses emitters to place water only in the vicinity of the plant rooting area. Water is generally applied at a low flow rate but in an amount sufficient to replenish the crop water requirement on a very frequent basis, usually daily. Drip irrigation is characterized by the slow application of water as droplets, usually at flow rates of 2 - 4 Lph (1/2 - 1 gph) through emitters placed close to the centre of the plant. Trickle irrigation systems utilize stream or spray systems that have flow rates of 10 - 60 Lph (2.5 - 15 gph) but do not throw the water more than 1.5 m (5 ft).

For the purpose of this manual the term "*trickle*" will be used when describing trickle/drip systems in a general sense. Trickle systems can be classified into three categories:

Tape system – consists of thin-walled hose with wall thickness ranging from 4-20 mil with the discharge system built into the seam of the hose.

Drip emitter system – uses a more rigid drip hose that has emitters plugged in or emitters manufactured inside of the hose to discharge water as a point source.

Spray emitter system – uses a rigid drip hose with emitters plugged in that distribute water by means of a spray pattern.

Note: Trickle irrigation systems operate on an entirely different concept than sprinkler systems. Managers and operators must recognize the differences in set times and intervals and be prepared to accept a higher level of maintenance requirements. Improper maintenance and installation is usually the reason why systems fail or do not perform properly.

Topics Covered in this Manual

This manual provides guidance on the design and operation of trickle irrigation systems for British Columbia conditions and crops. Material is organized to cover trickle irrigation design in the same order as a designer would approach a system design. The topics covered are:

Calculating Trickle Irrigation System Flow Requirements

An assessment of the trickle irrigation system water use needed to ensure that the water source used will be capable of delivering enough water. This assessment must take into account both the peak flow rate and the annual water usage.

Plant Water Requirements

Maximum crop water requirements must be determined to ensure that the drip system will be capable of supplying sufficient water during peak use periods. This section outlines a method of calculating peak water requirements on a per plant basis.

Emitter Performance

This section is very technical. The information provides an overview of emitter operating principles and determining application and emitter uniformity.

Emitter Selection

Information on the emitter operating principles and methods of pressure reduction are explained. Emitter selection must take into account pressure reducing principles, method of installation, water quality and crop type.

Emitter Placement

An emitter must be placed in the right proximity to a plant's rooting area if best system performance is to be achieved. Considerations for the burying of drip systems is also provided.

Greenhouse Systems

Plant water requirements, lateral design and operating sequences for greenhouse trickle systems differ substantially from orchard or row crop type systems. General information on these types of systems is provided.

Piping Design

Tables, graphs and charts have been included to assist in the design and selection of adequate lateral, submain and mainline piping. Lateral line design information includes tape, drip and spray emitter systems.

Total System Pressure Requirement

The methodology for calculating total system pressure requirement is outlined.

Filtration

All trickle systems require a filter to protect the system from plugging due to particles in the water supply. Filter selection and sizing information is provided.

Water Treatment Requirements

Trickle irrigation systems are susceptible to plugging caused by particulates in the water supply as well as algae growth in the lateral lines. Chemical precipitates from Calcium, Magnesium, Iron and Sulpher concentrations can also plug emitters. Information on chemical treatment to keep drip irrigation systems operating smoothly is provided.

Irrigation Scheduling

Scheduling of trickle irrigation systems is different than sprinkler irrigation systems. Techniques that can be used for monitoring soil moisture under drip irrigation regimes and scheduling irrigation applications are provided.

Fertigation

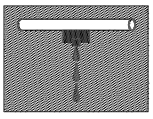
Trickle systems are ideal for the precise application of fertilizers to horticultural crops. Methods for calculating injection rates are outlined.

Landscape Trickle Design

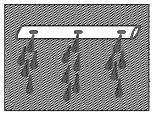
Determining plant water requirements for landscape systems is different than agricultural systems. Additional information and considerations for landscape systems are provided.

A glossary of terms is given at the back of this manual. British and SI units are used interchangeably as per the most common terminology used. **Volumes are always specified in litres or U.S. gallons.** A conversion table is included in the back to assist in metric conversion.

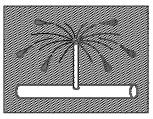
Examples are used throughout the manual to illustrate how to use the equations and perform the calculations. Three example designs are carried through the entire manual. These are characterized by the following symbols:



Point Source System



Line Source System



Spray Emitter System

1.2 Trickle Irrigation Design Procedure

A task is usually made much easier if the steps that need to be taken are outlined in an organized fashion. This manual has been prepared with this in mind. While not all of the steps must be followed in the chronological order shown, this approach offers the best chance of success.

Emitter selection, operating times and filtration requirements are all interdependent. Changing the decision on one of these items will dictate changes in the rest of the system design. Many iterations may have to be assessed before the correct selection of product and design can be matched up.

A flow chart indicating the steps to assist in trickle irrigation design is shown in Figure 1.1. The numbers highlighted in the chart indicate what section of the manual should be used to find the information.