

Irrigation Design Management - Agricultural Irrigation Manual

Chapter 4

Irrigation Types

Various types of irrigation techniques differ in how the water obtained from the source is distributed within the property. In general, the goal is to supply the entire property uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little.

No single irrigation system is the solution for all orchard or vineyard situations; otherwise there would not be such a range of them still available. Each producer needs to examine a range of factors for each crop type including soil type, tree density, tree layout and training system along with existing equipment. Future planting or re-planting should also be considered. Overriding these is the finance available to install a system along with the operating costs once in place.

If planning to install or upgrade an irrigation system, the cost of professional assistance can be a small price to pay compared to the costs of an inadequate system. Purchasing the best equipment available will not ensure success, correct design and installation is essential. Poor irrigation design leads to poor yields of small low quality fruit. Irrigation companies and consultants offer everything from site survey to complete installation. Do not fall into the trap of having the system designed to a price. A better policy is to develop a complete plan which meets your needs and upgrade the property in sections as finance becomes available.

A professional design should include natural surface contours, location and size of all pipe work, shift arrangements, legend and details of how the system operates. In a practical sense the system must have the flexibility to allow irrigations to be scheduled for the different crop types and ages over the range of soil types and depths on the property. Installation of a new irrigation system without a detailed soil survey should not be considered. Otherwise it may not provide the boost in yields and quality expected nor pays for itself.

Finally when the design is finished have it independently checked. Important aspects to have checked are hydraulic design, suitability of the system for the plantings, the standards used in the design, the equipment selected and the operational procedures involved. Before purchasing, consultation with other good growers having relevant experience is recommended.

Irrigation is the artificial application of water to land for the purpose of agricultural production. Effective irrigation will influence the entire growth process from seed germination, root growth, nutrient utilization, plant growth and re growth, yield and quality.

The key to maximizing irrigation efforts is uniformity. The producer has a lot of control over how much water to supply and when to apply it but the irrigation system determines uniformity. Deciding which irrigation systems is best for your operation requires knowledge of equipment, system design, plant species, growth stage, root structure, soil composition, and land formation. Irrigation systems should encourage plant growth while minimizing, soil erosion, and water loss. Losses of water will occur due to evaporation, wind drift, run-off and water (and nutrients) sinking deep below the root zone.



Figure 17 Vineyard Irrigation Uniformity

Micro Sprinkler

The other method sprays water through the air and are referred to as micro sprinkler systems. However, because of the low pressure and low volume, the wetted diameter is relatively small. The spinners are small and usually placed on short risers. Due to low pressure the water droplet has a short distance to travel before it reaches the soil surface. The wetted area of these spinners is small, compared to their big cousins (sprinklers) giving them greater control over the area that they applied water to.



Figure 18 Inverted Micro Spinner

Under Tree Micro Sprinklers

Advantages

- Precise application and adjustment of quantity and rate possible.
- Low pumping costs, operating at the same pressure as drip irrigation.
- Larger wetted zone than with drip irrigation thus plants are less likely to suffer from water stress should there be any delay in irrigation.
- Leaf disease impact is uncertain, leaves remain dry but relative humidity's will be enhanced.
- Fertigation and Chemigation can be utilized.
- Intermediate wetted area regarding weed control compared to drip and overhead sprinklers.
- Other management tasks generally not obstructed during irrigation application.
- Suitable for automation.
- Efficient utilization of limited water supplies and no runoff.
- Filtration is required but is not as critical as for drip irrigation.

Disadvantages

- Mini-sprinklers and laterals can be easily damaged by workers.
- Intermediate management expertise required relative to drip and overhead sprinklers.
- Ants and a number of other insects can block some mini-sprinkler emitters.
- Mini-sprinklers should be checked regularly to ensure they are functioning correctly for optimum coverage, uniformity of water distribution is easily obstructed by plant parts.

Mini-sprinklers can provide similar performance to low-level impact sprinklers, but require less pressure to operate. Mini-sprinklers are more prone to failure to start than impact sprinklers. At the start of each irrigation cycle, sprinklers should be checked as it is common that a few will need assistance to start. Mini-sprinklers are more prone to blocking and physical damage than impact sprinklers.



Figure 19 Vertical Micro Spinner



Figure 20 Inverted Micro-jet

Under-vine mini-sprinkler systems, which produce a wetted area of greater size, often are preferred. In general, they wet more soil than drip emitters do, are easy to install, and tend to plug less frequently than drip emitters. They can be used to replace drip systems as vineyards age. These sprinklers spray water in a 6-18 foot diameter circle. Generally, they are allowed to run 6, 8, or 12 hours, two to four times per week.

Drip Irrigation

Drip irrigation has been around for a number of years but is seeing increasing usage in recent years. The advantages of drip irrigation are lower volumes of water are needed, water is applied directly to crop root zone so non-target areas and plants are not watered, smaller pumps and lower water pressures are needed and crop plants are not wetted. Filtration is needed due to small orifice size, even with filtration plugging can be a problem in some instances, it can be difficult to visually determine if the system is working properly and increased management is required to make the best use of the system. Another disadvantage of drip irrigation is that it may not be effective, with certain soil types, in establishing crops. In some cases overhead irrigation may be needed to establish both direct-seeded and transplanted crops. This is especially true on coarse, sandy soils where lateral water movement is poor.



Figure 21 18 mm Drip Line

Applying water directly to the soil surface or subsurface and allows the water to dissipate under low pressure in a predetermined pattern. A wetted profile develops in the plant's root zone beneath each dripper. The shape depends on soil characteristics. Ideally, the area between rows or individual plants remains dry and receives moisture only from rainfall.

Drip Irrigation

Advantages

- Precise application and adjustment of quantity and rate possible.
- Most efficient utilization of limited water supplies due to less evaporation and runoff.
- Leaves remain dry so leaf diseases are not enhanced.
- Most efficient use of power for water application.
- Fertigation and Chemigation (pesticides) can be utilized.
- Small wetted area so weed control requirements are lessened.
- Reduction in the time taken till harvest has been demonstrated in Israel and South Africa due to higher plant temperatures (less evaporative cooling from wet surfaces).

Disadvantages

- Drip emitters are subject to clogging and require expensive filtration systems and periodic chemical treatment of water.
- Drip emitters and laterals are easily damaged by workers particularly during pruning and harvest.
- Drip systems require expert management for best performance.
- Effectiveness of application is difficult to assess without tedious inspection.
- Regular/frequent applications are required because of the limited wetted zone produced.

- Other management tasks not obstructed during irrigation application.
- Suitable for automation.

Drip irrigation is widely used and has advantages such as lower water use and the ability to incorporate fertilizers, "Fertigation," which also reduces fertilizer use and run-off. On steeper hillsides, drip may be the only choice as overhead irrigation will be difficult to manage without run-off and soil erosion. Disease pressure can be reduced, as canopies are not wetted, especially important in vigorous, heavily shaded vine situations. Also, drip-irrigation has more potential to control shoot growth and moderate vigor.



Figure 22 Drip Line

Overhead Irrigation

Some orchards and vineyards use overhead sprinklers mounted on high permanent standpipes that clear the tops of trees. Unlike other irrigation systems overhead sprinklers wet all the foliage of the tree and can therefore be used for frost control. Wetting the foliage has disadvantages. Likelihood of disease infection is increased.

Overhead sprinklers are exposed to wind which disrupts evenness of watering and the height above the ground leads to high evaporation losses on hot windy days. Overhead sprinklers are not readily accessible, thus any repairs or the cleaning of blocked jets is time consuming.



Figure 23 Overhead Irrigation

Overhead Solid-Set Sprinklers

Advantages

- Long life of components.
- Relatively free from breakdowns (low maintenance).
- Filtration is not required unless there is a lot of floating rubbish in the water supply.
- Suitable for automation.
- Eliminates dust and traction problems in the roadways.
- During the hot summer afternoons the green vegetation in the roadways will help to reduce the temperature.

Disadvantages

- High running costs.
- Inappropriate timing of irrigation could wash pesticides off plant.
- Distribution patterns are distorted by wind and fluctuate with variable water pressures resulting in uneven application. Generally the potential for uniform application of water is less than with under tree systems.
- Leaf disease impact is uncertain. Leaves are wet for a brief period every 5-10 days.
- Water loss from evaporation and runoff is high (up to 25%).
- Leaching and runoff of fertilizers can be enhanced.
- Other management tasks obstructed during irrigation application.
- Generally unsuitable for Fertigation