

Complying with the GWPA Requirements

Irrigation Systems and Their Performance

Purpose of Irrigation

Irrigation is the process of supplying water, in addition to natural precipitation, to field crops, orchards, vineyards, or other cultivated plants. Irrigation water is applied to ensure that the water available in the soil is sufficient to meet crop water needs. The role of irrigation is to improve production and the effectiveness of other inputs.

Overall, irrigation water is applied to maintain a favorable water balance in the crop root zone, but, in order to maintain this balance, an excess of water is applied resulting in some water becoming **deep percolation** (water that passes vertically through the root zone to deeper soil layers below the crop root zone) or **surface runoff** (applied water that does not enter the soil and flows off the lower portion of a field). Both deep percolation and surface runoff are not available for use by the crop, although in some areas, deep percolation and surface runoff can play a vital role by helping to leach salts from the crop root zone, for cooling and frost protection, and for groundwater recharge. The components of the water balance are shown in the following figure:

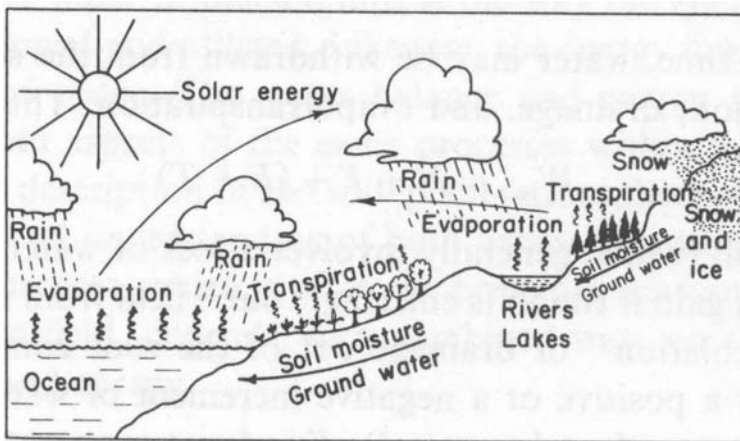


Figure 1. Hydrologic cycle.

The amount of irrigation water that needs to be applied will depend on numerous factors including the crop grown, field size and slope, soil type and variability, labor requirements and availability, and the method of applying the irrigation water to the crop.

Irrigation water can be applied to a crop by several different irrigation methods including surface irrigation, sprinkler irrigation and microirrigation.

Types of Irrigation Methods

Surface irrigation methods use the soil surface to spread water across a field or orchard to the plants being irrigated, and include furrow irrigation, border or flood irrigation and basin

irrigation. In furrow irrigation, small channels or furrows are used to convey water across a field, and the water infiltrates through the bottom and sides of the furrow, wetting the nearby soil (Fig. 2).



Fig. 2. Furrow irrigation using gated pipe



Fig. 3. Border irrigation on young trees.

In border irrigation, a field is divided into strips separated by border ridges running down the slope of the field. The width of the strips is usually from 20 feet to 100 feet. The area between the ridges is flooded during irrigation. Border irrigation is used for tree crops and for crops such as alfalfa and small grains (Fig. 3). In basin irrigation, a field is divided into sub-units or basins separated by border ridges, but the ground inside each basin is level. During irrigation, the basins are filled with the desired amount of water, and the water remains ponded within the basin until it infiltrates into the soil.

In *sprinkler irrigation* (Fig. 4), water is applied throughout the field by means of rotating sprinklers or mini-sprinklers connected to a pressurized pipe system. Sprinklers spread water over a radius of 5 feet to 300 feet depending on design. The pipe system supplying the sprinklers can be permanent, moveable (either continuous-move or periodic-move), portable, or a combination of the three, and the system can be operated either automatically or semi-automatically.



Figure 4. Sprinkler irrigation on vegetables.

In *microirrigation*, water is applied to the plants through emitters so that water leaves the emitter as a droplet. Water is supplied to the emitters (drippers or microsprinklers) (see fig. 5) through a network of mainline and lateral pipelines that are usually made of plastics. A head unit is used to regulate pressure, filter the water and add nutrients (see fig. 6).



Figure 5. Drip irrigation emitter.



Figure 6. Drip irrigation filters.

Performance of Different Irrigation Methods

Whether the irrigation practices used by a grower who wants to use a regulated pesticide in a GWPA conforms to DPR's requirements will depend on management practices and how well the irrigation system performs. Use of a GWPA regulated pesticide in a Leaching GWPA is contingent on the grower irrigating efficiently so that each irrigation application, for 6 months following the chemical application, is 133% or less of the irrigation requirement at the time of irrigation.

Assessing the Performance of Different Irrigation Methods

Different irrigation methods rely on different ways of transporting irrigation water from the water source to the crops in the field. Assessing the performance of different irrigation methods requires slightly different approaches to account for the differences in the physical features of each method. The requirements for assessing the performance of each of the three main types of irrigation methods -surface, sprinkler and micro-irrigation- are discussed below.

Surface Irrigation Methods

Surface irrigation methods use the soil surface to spread water across a field or an orchard to the plants being irrigated, and include furrow irrigation, border or flood irrigation and basin irrigation. In *furrow irrigation*, small channels or furrows are used to convey water across a field, and the water infiltrates through the bottom and sides of the furrow, wetting the nearby soil (fig. 2). In *border irrigation*, a field is divided into strips separated by border ridges running down the slope of the field. The width of the strips is usually from 20 feet to 100 feet. The area between the ridges is flooded during irrigation. Border irrigation is frequently used for tree crops and for crops such as alfalfa and small grains (fig. 3). In *basin irrigation*, a field is divided into

sub-units or basins separated by border ridges, but the ground inside each basin is level. During irrigation, the basins are filled with the desired amount of water, and the water remains ponded within the basin until it infiltrates into the soil.

Performance Indicators

The performance of surface irrigation methods can be assessed by comparing the amount of applied irrigation water (Net Irrigation Application) to the amount of water necessary to refill the crop's root zone (Net Irrigation Requirement). When the amount of water infiltrating the soil exceeds the amount needed to replenish the soil moisture, the excess water becomes deep percolation-water that flows through the soil past the root zone. When the water is applied at a rate faster than the rate at which water can infiltrate the soil, the result is surface runoff-water flowing off the lower end of the field. In DPR's GWPA regulation, up to 33% of the applied water can become deep percolation or surface runoff.

Simple Method of Estimating the Efficiency of Irrigation

A simple way of calculating irrigation efficiency is to determine the net irrigation requirement from historic records of crop water use for a specific crop during a specific period, and to determine the applied water by measuring the rate of flow onto the field and the duration of the irrigation event. Historic crop water use information is presented in the section "Net Irrigation Requirement" and methods of measuring the applied water are presented in the section "Net Irrigation Application".

Sprinkler Irrigation

In sprinkler irrigation, water is applied throughout the field by means of rotating sprinklers or mini-sprinklers connected to a pressurized pipe system (fig. 4). Sprinklers spread water over a radius of 5 feet to 300 feet depending on design. The pipe system supplying the sprinklers can be permanent, portable, or a combination of the two, and the system can be operated either automatically or semi-automatically.

Performance Indicators

The performance of sprinkler irrigation methods can be assessed by comparing the amount of applied irrigation water (Net Irrigation Application) to the amount of water necessary to refill the crop's root zone (Net Irrigation Requirement). When the amount of water infiltrating the soil exceeds the amount needed to replenish the soil moisture, the excess water becomes deep percolation-water that flows through the soil past the root zone. When the water is applied at a rate faster than the rate at which water can infiltrate the soil, the result is surface runoff-water flowing off the lower end of the field. Sprinkler irrigation systems should be designed and operated to minimize surface water runoff. In DPR's GWPA regulation, up to 33% of the applied water can become deep percolation or surface runoff.

Simple Method of Estimating the Efficiency of Irrigation

A simple way of calculating irrigation efficiency is to determine the net irrigation requirement from historic records of crop water use for a specific crop during a specific period, and to determine the applied water by measuring the sprinkler application rate (in/hr) and the duration of the irrigation event. Historic crop water use information is presented in the section “Net Irrigation Requirement” and methods of measuring the applied water are presented in the section “Net Irrigation Application”.

Microirrigation

In microirrigation, water is applied to the plants through emitters so that water leaves the emitter as a droplet. Water is supplied to the emitters (also called drippers or microsprinklers) through a network of mainline and lateral pipelines that are usually made of plastics. A head unit is used to regulate pressure, filter the water and add nutrients.

Performance Indicators

The performance of microirrigation methods can be assessed by comparing the amount of applied irrigation water (Net Irrigation Application) to the amount of water necessary to refill the crop’s root zone (Net Irrigation Requirement). When the amount of water infiltrating the soil exceeds the amount needed to replenish the soil moisture, the excess water becomes deep percolation-water that flows through the soil past the root zone. It is unusual in microirrigation, but if the water is applied at a rate faster than the rate at which water can infiltrate the soil, the result is surface runoff-water flowing off the lower end of the field. In DPR's GWPA regulation, up to 33% of the applied water can become deep percolation or surface runoff.

Simple Method of Estimating the Efficiency of Irrigation

A simple way of calculating irrigation efficiency is to determine the net irrigation requirement from historic records of crop water use for a specific crop during a specific period (in midsummer, this may be daily for drip irrigation), and to determine the applied water by determining the microirrigation application rate (in/hr) and the duration of the irrigation event. Historic crop water use information is presented in the section “Net Irrigation Requirement” and methods of measuring the applied water are presented in the section “Net Irrigation Application”.