# Information Sheet

## 3. DRAINAGE

## 3.3 Drainage in irrigated fields

### Introduction

This information sheet is aimed at helping farmers understand irrigation related drainage problems. It also provides advice on what records and monitoring systems need to be established to ensure that drainage and associated irrigation problems are prevented or can be rectified efficiently, with appropriate professional assistance.

### What are the causes of drainage related problems?

All irrigation is likely to result in some water being lost from the root zone as a result of deep percolation. This is not necessarily detrimental, as a certain amount of deep percolation is necessary to maintain a salt balance. In many humid areas where rainfall is > 500 mm/annum, deep percolation as a result of rain and irrigation is normally sufficient to ensure a salt balance. However, problems can arise if:

- deep percolation is insufficient to maintain a salt balance particularly in more arid/dry areas,
- the quality of irrigation water is poor,
- irrigation systems are operated with low uniformities and/or excessive amounts of water are applied,
- natural drainage is insufficient to prevent a rising water table.

### What is drainage?

Drainage is the disposal of excess water and/or salts which are damaging to sustainable crop production. For roots to grow efficiently there needs to be a balance between air and water in the soil. Too much water results in the development of anaerobic conditions, which severely restricts root growth and adversely affects soil health. As a result cane growth will be stunted. Insufficient water or a high salt content in the soil will also result in stress and stunted growth.

### Surface and Sub-surface Drainage

Drainage is usually divided into surface and sub-surface drainage. Surface drainage is mainly used to remove excess water after rain, and sub-surface drainage is primarily aimed at lowering the water table where natural drainage is insufficient. Nevertheless, both types of drainage are complementary and should be considered together. Sub-surface drainage is not always necessary, but adequate surface drainage is critical to a highly productive cropping system.

#### Surface drainage

In surface drainage, land surfaces are reshaped as necessary to eliminate excessive ponding or standing water and to establish slopes sufficient to induce controlled gravitational

**Without waterlogging, roots can exploit soil moisture and nutrient reserves.**


**Roots cannot develop where a surplus of water excludes oxygen.**

flow overland and through channels to an outlet. Surface drainage may be divided into structures which:

- remove water directly from land by land forming and ditching, and
- divert and exclude water from land by diversion structures.

Very often excessive standing water results from a poor farming system and problems can be reduced by improved field layouts and the adoption of controlled traffic, zero tillage/trash mulching farming systems which result in reduced compaction, improved infiltration rates and reduced runoff, particularly from upland areas.

### Sub-surface drainage

In subsurface drainage, ditches and buried drains are installed within the soil profile to collect and convey excess ground water to a gravity or pumped outlet in order to lower the water table. The drop in pressure resulting from discharge induces the flow of excess ground water through the soil into the drains. Interceptor drains are used to prevent water entry onto the land when ground water moves laterally. Interceptor drains are constructed at approximately right angles to the direction of groundwater flow. Relief drains are used when land surfaces are nearly flat, flow velocities are low, or the interception of ground water is ineffective. Relief drains are commonly (but not always) constructed approximately parallel with the direction of ground-water flow.

Designing a drainage system, including the safe disposal of drainage effluent, requires a highly skilled and experienced professional team. A detailed survey of the land and good records are required for optimal designs. Negotiations with adjacent land owners and communities, may also be necessary.

## Monitoring and record keeping, the key to mitigate drainage problems

Standing water or salt deposits are good indicators of the need for drainage; however, there are many cases where, in the absence of such indicators, the effects of poor drainage and associated problems may be overlooked. Of primary concern in an irrigated environment is the:

- accumulation of salts, and/or
- a high or rising water table.

Understanding the causes of such problems plays a critical role in developing an appropriate mitigation strategy and relies on good record keeping.

### Monitor soil and water

Soil and water samples should be collected from all irrigated fields and associated watercourses annually and sent to SASRI's laboratories for analysis of salt and sodium levels. More frequent water sampling may be necessary as the quality of water often changes during a season. Refer to SASRI information sheet 5.6 "Water Quality" and 5.8 "Soil salinity/sodicity in the sugar industry" for further information on soil and water quality measurements and associated interpretations. If there are any concerns regarding the results of soil and water analyses, appropriate Soil Science and Agricultural Engineering professionals should be consulted.

**Land smoothing before planting is often needed to prevent yield loss due to ponding or standing water. A trash/mulch blanket results in greatly enhanced infiltration rates and reduced stormflow/surface runoff loads from upland areas.**

**Bad irrigation water management and poorly designed or performing irrigation systems can result in water-logging.**

### Monitor water table

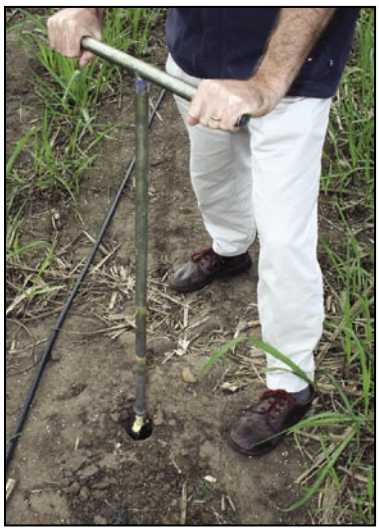
If there is insufficient natural drainage, and/or if deep percolation is excessive, the water table will rise. Generally the water table should be maintained at least 0.8 m from the surface, unless there is a naturally occurring wetland in which case the cane should be removed and the wetland rehabilitated (refer to Information Sheet No. 1.3 titled "Understanding and Managing Wetlands for the Sugarcane Farmer" *(Information Sheet 1.3)*. If the water table rises to within 0.8 m of the soil surface due to irrigation, soil health will deteriorate in the root zone and crop

yields will decline. Salts will be deposited in the root zone as a result of the high water table and large areas of land can become unproductive. Thus, in addition to monitoring soil and water quality, holes should be augered on all irrigated fields on a regular basis, particularly during the main growing period (December to March), to establish whether there is a water table problem. If such a problem is suspected, a more thorough investigation is needed in order to develop a suitable mitigation strategy. Part of a more thorough investigation is to establish a network of observation wells in order to monitor water table levels on a regular basis throughout a season. Furthermore, the irrigation system hardware and the watering strategy will need to be carefully evaluated in order to determine if these are contributing to the problem.

## Monitor and evaluate irrigation system

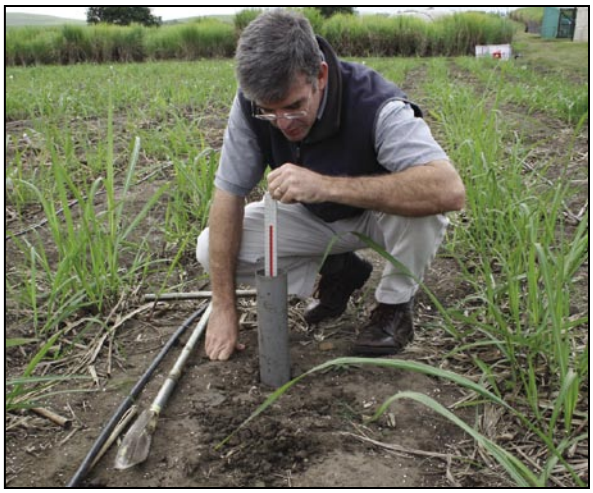
If the irrigation system is performing poorly, parts of the field will often receive excessive water. Thus, even if overall water applications are not excessive, parts of the field will still be receiving excessive water and the resultant deep percolation from these areas could contribute to a rise in the overall water table levels. Furthermore, if the irrigation water applications are excessive compared to crop water usage and leaching requirements, due to poor scheduling, the resultant deep percolation will exacerbate these water table problems. Drainage is expensive, so, both the irrigation system and its management need to be optimised to ensure that costs of drainage infrastructure are minimised for new installations or to ensure that any existing drainage installations are not overloaded and rendered ineffective. Information Sheet No. 5.4.5 titled "Water conservation strategies for irrigated sugarcane" should be referred to for guidelines on irrigation water management.

## Conclusion



**Observation well hole which has been augered using a Dutch screw auger.**

Drainage problems often develop over long periods of time, sometimes decades. Growers should therefore be vigilant in taking the measurements recommended in this Information Sheet. It is important to keep records and monitor trends, even if the results do not indicate any immediate problems.



**Observation wells help to monitor water tables.**

**Irrigated fields require careful management and constant monitoring for the build up of salts and a rising water table.**

**If an irrigation system is properly designed and maintained and water applications are applied uniformly to match crop water usage, water-logging problems are minimised.**

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