



Information Sheet

5.2. Irrigation strategies during water limiting periods

This information sheet aims to guide irrigation management under conditions of limited water supply (generally drought). The effective use of water during and after situations of limited water supply, as well as key considerations and sugarcane management are also discussed.

Droughts are an inherent part of the South African climate. With erratic weather patterns and increasing competition for limited water resources, periods when water is not available to meet full crop water requirements are becoming increasingly frequent. Therefore, more effective water use is critical to ensure sustainable agricultural production.

It is important to note that a well-maintained farm in good condition is more likely to survive during a drought and recover thereafter. This will include a large proportion of young ratoons, suitable variety disposition, good plant population, sound fertiliser programme, healthy soils (pH, salinity, sodicity, organic material, good structure and no compaction), no pests and diseases, a well-designed and maintained irrigation system and a culture of optimal irrigation scheduling. However, during periods of limited water supply, more strategic and careful management is needed.

During periods of normal water supply, it is essential to accurately schedule irrigation based on crop water use and ensure efficacy of irrigation equipment. However, during periods of limited water supply more careful management is needed to maintain production and financial sustainability. Unfortunately, there is no single solution to cope with a farm's specific drought management requirements and the actions taken may be different depending on each unique situation. Each grower therefore needs to take these decisions based on merit and to suit the prevailing circumstances.

Strategic planning

During periods of limited water supply, growers need to make strategic decisions to ensure effective use of the available water. One of these decisions is whether to reduce the area irrigated or to spread the limited water over larger areas. Reducing the area irrigated aligns to the goal of maximising income by concentrating water application on higher potential fields to limit yield losses. Spreading the limited water over larger areas helps to ensure rapid recovery after the drought, and in the case of severe droughts, to limit plant mortality. The priority ranking of each of these goals will affect the type of actions that are needed. The most successful strategies will look at both optimising income during the drought as well as speeding up recovery, although these may have different levels of importance.

The following information can be used to manage sugarcane during and directly after a period of limited water supply. The success of any strategy will be the product of implementing several inter-related actions rather than due to a very limited number of actions.

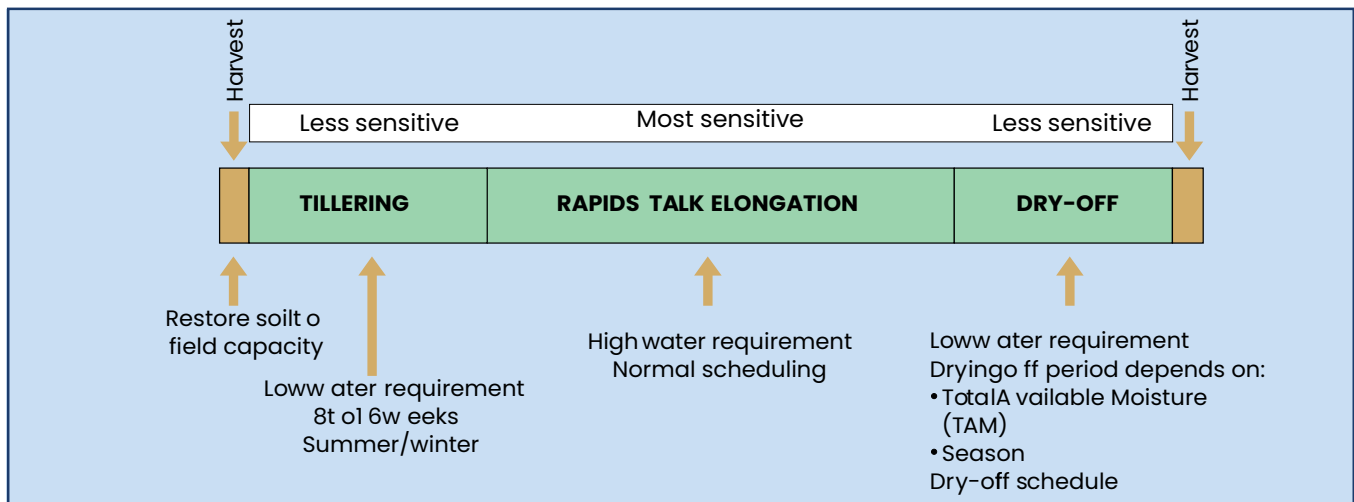
Crop water requirements

Understanding the key water demand periods for a growing crop provides a basis to plan your limited water supply management strategy. Figure 1 presents a generalised water requirement for a sugarcane crop from establishment to harvest.

It is good practice to try to refill the soil profile shortly after harvest to ensure good germination. Thereafter, the subsequent irrigation water application can be delayed until approximately 50 mm of water has been 'used' by the crop, on most soils. In these fields, it is necessary to evaluate the water holding capacity of the soil to avoid unnecessary application, while adopting soil water conservation practices to reduce losses.

During early growth in the tillering crop (low leaf and root biomass), water requirements are relatively low. During drought, smaller amounts of irrigation and allowing for mild stress can be considered in the tillering phase.

During rapid stalk elongation there is a sharp increase in the crops water demand and the crop yield is typically most sensitive to water stress in this period. In a drought situation, where soil water reserves are depleted, frequent water applications are needed to provide adequate water in the rapid stalk elongation phase. However, it is advised to only supply sufficient water to meet the immediate crop demand to reduce other losses (leaching, runoff or soil surface evaporative losses).



▲ Figure 1. Critical stages of crop water requirements.

Drying-off involves stopping all irrigation applications for a period of time prior to harvesting. During dry-off, it is beneficial to limit water to improve sugarcane sucrose content. While the water demand is relatively lower, it is still necessary to supply adequate moisture to ensure crop survival. Depending on the soil moisture status and prevailing climatic conditions, the irrigation scheduling and dry-off period can be adjusted accordingly. The determination of optimal drying-off periods for specific soil, climate and seasonal conditions can be facilitated by consulting your local SASRI Extension Specialist. Do not apply chemical ripeners on sugarcane if the drying-off period is going to be extended.

Spreading limited water

There is good evidence that spreading limited water over a relatively larger area results in optimal overall returns due to gains in irrigation and rainfall use efficiency, as well as reductions in variable production costs. Sugarcane is a hardy crop and mild water stress often results in increased sucrose content.

Overall, a flexible approach is best where some fields may not receive some irrigation water applications based on growth stage. Irrigation can be limited on some fields just to keep the crop alive but can be brought back to normal irrigation when the water situation improves, rather than being completely abandoned. Normal irrigation cycles will therefore have to be adjusted to allow for a strategic management approach.

Although the maximum growth of sugarcane requires timely and adequate irrigation (or rain) throughout the active growing period, there are two phases in the growing period when the effects of stress are less severe and water can be saved:

- *Prior to harvesting, when water stress is induced by 'drying-off': mild stress is beneficial and a strategy to increase sucrose content. Considerable water savings can be made.*
- *In the tillering phase, before rapid stalk elongation commences: mild water stress in this period has minimal impact on yield, provided the stress does not affect final tiller numbers.*

Conversely, during rapid stalk elongation the effects of water stress will be relatively more severe and irrigation water applications should be concentrated during this period.

Irrigation is also important for germination and to limit stool mortality.

Prioritise and give special attention to seedcane fields to ensure the availability of seedcane to replant fields after the drought. In addition, prioritise fields with young ratoons and high productivity fields to optimise yield during the drought and ensure a speedy recovery.

The fallow period of fields due to be replanted can be extended until after the drought. It is advised to establish a drought tolerant/resistant green manure crop to protect the soil.

Spreading limited water over a large area will result in a decreased yield but will assist in a rapid recovery. When conducting this, adopt other water conservation approaches to limit evaporative losses and reduce soil temperatures. In this regard, crop residue from the prior harvest (green cane harvesting) or imported mulch and organic materials applied to bare soil surface can drastically reduce water loss and promote more efficient water use.

Reduction in irrigated area

Reducing the area irrigated by abandoning fields is a drastic step that should only be considered under severe water restrictions. The long-term consequences can be very costly.

Early eradication of fields infected with pests and diseases can be considered. This will limit pest and disease pressure on healthy fields. Where a decision is taken to abandon a field because of diseased cane, the crop should be completely eradicated to prevent spread of the disease (*refer to Information Sheet 4.2: Cane stool eradication*).

If fields are to be abandoned, the following should be prioritised:

- Fields with high pest and disease levels (smut, mosaic, RSD and eldana).
- Fields with serious weed problems such as creeping grasses and knot-grass.
- Fields with poor plant population.
- Old ratoons especially on marginal soils.
- Fields that are close to be replanted.

During droughts, the fallow period of fields due to be replanted can be extended especially fields with ratoon stunt (RSD). Planting a low input green manure crop like sunn hemp (*Crotalaria juncea L.*) should also be considered. An extended fallow or rotation crop often aids the rejuvenation of soils and helps with the control of pests and diseases. Water is conserved during the fallow and cane yields in subsequent seasons are often significantly boosted, potentially making up for the lost growth during the fallow.

Abandoning fields will result in more water being available for other fields. This also results in better yields for these fields but the recovery period after the drought will be slower due to a larger replant programme.

Where limited available water needs to be shared with other high cost permanent crops such as fruit orchards, cane fields can be abandoned to free up water to keep orchards alive.

Unfortunately, there is no single solution to cope with drought and the actions taken may be different for each unique situation. Therefore, each grower needs to take decisions based on prioritised goals and to suit the prevailing farm specific circumstances. Optimal plans for specific circumstances can be investigated in detail with the DRIP decision support tool and consulting with your SASRI Extension Specialist.

Drought Irrigation Program (DRIP)



DRIP is a decision support tool developed by SASRI. DRIP is an Excel-based program that can support the development of farm irrigation strategies when current and expected future water supply is limited. It estimates the impacts of a defined irrigation strategy on crop survival, yield and profitability. Likely consequences of different soil water depletion thresholds, field priorities and field abandonment can be explored. The programme requires custom installation by SASRI specialists.

Other factors

Pests and diseases

All pest and disease infections will have a negative impact on yield during a drought, and may increase in occurrence in stressed crops. Ensure that pests and diseases are controlled at all times.

SMUT will be a problem during and especially directly after the drought. Pay special attention to frequent smut and mosaic roguing operations from September until May. This will be important on all varieties, but especially on those varieties that can develop high levels of smut (N14, N19, N25, N36, N41, N43) and mosaic (N19, N57) in the Irrigated North. Smut and mosaic will have a serious negative impact on yield during a drought.

ELDANA levels will increase in stressed sugarcane. Frequently inspect fields and move fields with high levels of infestation forward in the harvest program. Do not age or carry-over more susceptible varieties. Consider the use of registered insecticides when cane needs to be carried over.

RSD and NEMATODE infected cane is extremely sensitive to water stress and yields will be impacted.

Weeds

Do not neglect weed control, especially with a sparse canopy due to the drought. The use of pre-emergent herbicides may be difficult therefore also plan for post-emergent control. The weed control period will also have to be extended due to slow canopy formation.

Soil and fertiliser management

- Avoid unnecessary soil cultivation to conserve soil moisture and organic matter. Where crusting is present shallow cultivation can improve water infiltration.
- Spread cane tops and crop residue/mulch (trash) to limit soil evaporation soil evaporation.
- Nitrogen (N) and potassium (K) fertiliser can be reduced but it is not necessary to reduce the amount of phosphorus (P) application. It is advised to split nitrogen applications and the use of N-strip or N-monitor plots are useful to refine second split application rates. To limit volatilisation of nitrogen avoid applying N-fertiliser to dry soils (particularly ammonium-based fertilisers) and try irrigate soon after application.

Chemical ripening

Do not ripen cane suffering from water stress. Injudicious use of chemical ripeners, especially hormonal products, during water stress can have a negative effect on both yield and quality and can lead to higher levels of eldana damage.

Irrigation equipment

Ensure that all irrigation systems and equipment are well maintained to limit losses and ensure efficient use and uniform application of water. Pay attention to worn nozzles, correct water pressure, leaks, etc.

For more information on managing drought-affected sugarcane see Information Sheet 4.5 Management of cane affected by drought.



Marius Adendorff (Extension Specialist, Komati)

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