Information Sheet

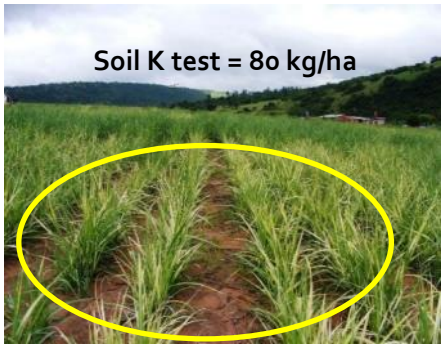
7.5 Potassium management

Potassium (K) is an essential nutrient for sugarcane production with uptake typically ranging from about 1.5 - 2 kg K per ton of cane produced (a typical 100 tc/ha crop will remove between 150 - 200 kg K/ha). Potassium plays a role in several metabolic functions in the crop and is important for sugar production, photosynthesis and respiration in the plant. It is necessary for regulating uptake of other nutrients and provides protection against several stress conditions, such as drought. Sugarcane is also a luxury consumer of K so will take up amounts well in excess of crop requirement (luxury consumption). This can lead to poor sugar recovery and high ash content. Excessive K application represents an unnecessary cost to the grower with no benefit, thus it is important to understand the many factors that affect K availability and use in the crop, and to follow the recommended application rates.

Deficiency symptoms

- Older leaves show symptoms first.
- On older leaves, dead patches form with yellow, browning and dark red stripes between leaf veins and on edges and tips (appears scorched).
- Midribs turn red.
- Young leaves may have a dark-green appearance.
- Slow growth with thin, stunted stalks.
- Poor uptake of other essential nutrients.
- Weak roots and low resistance to disease and drought stress.
- May resemble salt burn.

Symptoms of potassium deficiency in sugarcane ▶

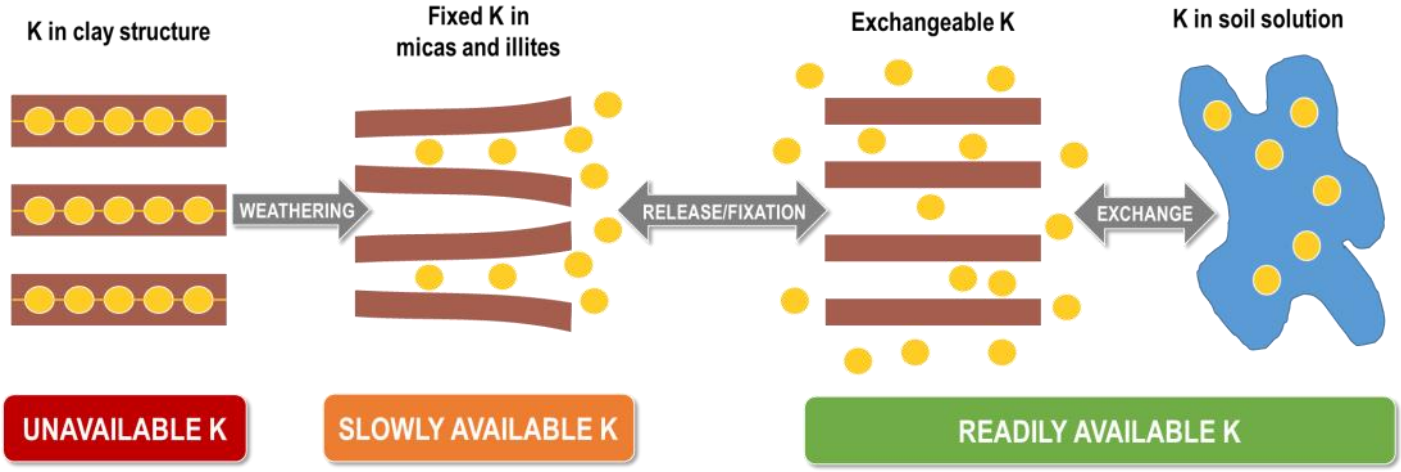


Impact of excess potassium

- Leads to high ash content of sugarcane juice with reduced sugar recovery in the mill.
- Can inhibit uptake of some nutrients (competitive antagonism), particularly magnesium (Mg) (Mg deficiency is seen as orange freckle on leaves) and sometimes calcium (Ca).
- Excess K provides no benefit for higher yield or sugar content.

Potassium availability in soils

Potassium exists in the soil in three main forms, namely: **Unavailable K, slowly available** and **readily available.**



▲ Potassium exists as unavailable structural K in soil minerals, slowly available K (reserve K) held between clay layers that can be released slowly into soil solution and available K (exchangeable and solution K) that the plant can readily use.

- **Unavailable K**

Most of the K in our soils is held as structural components in soil minerals (such as K-rich feldspars). The weathering of these minerals takes a long time so this K is generally not considered available to crops and usually not considered in K nutrition. It accounts for between 90 to 98% of K in most soils.

- **Slowly available K**

Less weathered and some alluvial soils often have a high amount of soil minerals that are able to trap K between the structural clay layers ("fixed" interlayer K). This is not permanent and K can be released into soil solution for plant uptake. This is often also called "Reserve K". The rate of the release will depend on the type of clay minerals holding the K, the amount in the readily available fraction, soil moisture and the availability of other cations to exchange with.

In some soils with K-fixing minerals, fertiliser applied K can be trapped or "fixed" by these soil minerals. This can lead to short-term deficiencies, though over time this is usually released back into soil solution as the readily available K is depleted by crop uptake and other removal factors.

- **Readily available K ('soil test' K)**

This K is most easily used by the crop and is found in soil solution and on exchange sites on clay minerals and organic matter. As the crop uses K from solution, additional K is released into the soil solution from the exchange sites.

Potassium availability is affected by **clay content and clay mineral type, soil moisture, temperature** and **relative amounts of available and slowly-available K reserves**. High levels of base cations (calcium and magnesium) have also shown to decrease K uptake by sugarcane, and higher K-thresholds are used in base-rich soils. Potassium is generally not prone to leaching losses, but may be susceptible in sandy soils and some organic soils. Erosion losses pose a risk on uncovered soils on steep slopes.

Potassium recommendations

The high K requirement of sugarcane, along with luxury uptake of K without apparent negative impacts on sugarcane production, has led to the belief that excessive rates of K application are necessary and beneficial for optimal growth. However, this approach is wasteful with respect to nutrient use and represents an unnecessary cost without benefit to the grower. It is thus important to optimise application rates by becoming aware of the factors affecting K requirements and adopting the recommendations developed over many years for sugarcane under the wide range of conditions in South Africa.

The baseline K fertiliser recommendations are derived by taking many soil and management factors into account. This includes the exchangeable K soil test, the threshold for the soil sample, the base status of the soil, the target yield and crop cycle. These factors are all used to determine the K-fertiliser requirement. Further adjustments to the recommended application rate are made if the fields are green cane harvested and mulched and the amount of slowly available K in the soil.

▲ **Regularly sample soils to assess K content. The FAS Agricultural Laboratory offers K analysis as part of their routine soil analysis package.**

Potassium application guidelines

Some generalised application guidelines for K are given below.

Plant cane

- It is generally advised to use a combination of applying K at the bottom of the planting furrow and broadcasting. A maximum of 100 kg K/ha is allowed for the furrow application (to avoid salt damage to the sett), with the remainder being broadcast.
- Avoid applying the K fertiliser directly on the setts as this may cause salt damage to emerging roots, especially where high rates are required or other fertilisers are to be included in the application (N and P salts).
- A maximum of 250 kg K/ha is advised as past trials demonstrate little yield response at higher K application rates, but may promote luxury consumption.
- Attempt to coincide top dressed K with rainfall/irrigation to promote movement into the soil.
- Account for other K sources when adjusting fertiliser K application rates.

Ratoon cane

- Ratoon K recommendations should ideally be based on a soil test, otherwise a crop removal factor is used to estimate requirements.
- Band K either side of the stool line for optimal benefit.
- Where green cane harvesting is practised and the residues mulched, K can be applied to the mulch layer (avoid bare soil surfaces) on either side of the stool lines, ideally coinciding with sufficient rainfall to flush K down to the soil surface.
- A maximum of 250 kg K/ha is advised to avoid luxury consumption by the crop.
- Attempt to coincide top dressed K with rainfall/irrigation to promote movement into the soil.
- Account for other K sources when adjusting K application rates.

While SASRI advises and strongly encourages growers to undertake regular soil testing to optimise nutrient application rates, it is possible to estimate crop removal using crop removal factors for a typical crop for a given yield. This does, however, not account for loss and transformations that may have occurred in the soil. The general base guidelines are given in the table below.

Adjustments to these rates are made when used in conjunction with soil testing and management practises.

Baseline K rates (kg/ha) for different target yields for sugarcane

Region	Yield target (t cane/ha)						
	50	75	100	125	150	175	200
Rainfed	105	155	200	200	200	200	200
Irrigated	105	155	200	240	250	250	250

Precautions for K use

- Excessive K application rates lower sugarcane quality and, in extreme cases, leads to salt problems in the soil and reduce Ca and Mg uptake – adhere to application recommendations.
- K uptake is reduced in dry, compacted, acidic or waterlogged soils. Remedy these constraints prior to applying K.
- K leaching can occur on sandy soils (<10% clay). Regular soil test to ensure adequate K supply for crop growth.
- High rates of gypsum on sandy soils can also promote leaching of K, thus K fertiliser should be applied a few weeks after the gypsum applications.

Available potassium fertiliser formulations

K-Products	K %	Other %	General Notes	Application notes
Potassium chloride (KCl, Potash, Muriate of potash)	50	-	• Ease of handling, high K • Adds chlorides	Broadcast or banded application
Potassium sulphate	40	S:38	• Adds S • Costly	Banded applications are likely to be most effective
Potassium nitrate	38	N:13	• Adds N • Costly	
Potassium magnesium sulphate	18	Mg:11 S:22	• Adds S and Mg • Costly	
Condensed molasses solids (CMS)	5-6	N:1 P:0.2 Ca:1 Mg:0.8 S:1.1	• Low cost, adds range of nutrients and organic matter • Handling requirements, variable test values	Broadcast or band application

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