Information Sheet

4.6 Principles underlying chemical ripening and late-season quality maintenance

Basic concepts

Ripeners can be used for chemical ripening (i.e. to improve low cane quality caused by prolonged periods of vigorous growth) or for late-season quality maintenance (i.e. to maintain high quality when vigorous growth resumes after winter as it does in the South African growing cycle). The exact timing will be different for other countries.

Probably the most important consideration when planning to spray any of the registered products for chemical ripening is crop growth vigour and associated crop maturity at the time of spraying. It is of paramount importance that spraying takes place when the cane is growing vigorously and crop maturity is low. Why is this so important?

To answer this question, one must understand how chemical ripeners work within the sugarcane plant to bring about a ripening response. During the process of photosynthesis in the mature green leaves, carbon dioxide is converted to sucrose (Figure 1 below). Not all the sucrose produced by photosynthesis is available for storage in the stalk, because stalk elongation, the formation of new leaves, and metabolic maintenance of the rest of the plant requires energy. Energy is provided by sucrose, which is broken down to its component sugars, glucose and fructose, and then used during respiration to fuel these growth and metabolic maintenance processes. The portion of sucrose not used for these processes is stored in the stalk. In vigorously growing sugarcane, where stalk elongation and new leaf formation is rapid, the portion of sucrose available for storage is therefore relatively small. This is the reason why prolonged periods of vigorous growth during summer, or resumption of vigorous growth after winter, causes a decline in cane quality.

Chemical ripening

During periods of vigorous growth, chemical ripeners improve cane quality by slowing down growth processes mentioned above, thereby decreasing the demand for sucrose as an energy source and increasing sucrose storage in the stalk (acceleration of stalk ripening). In Figure 1, the lower demand for sucrose to fuel new growth is indicated by the thinner orange arrow, while the increased capacity for sucrose storage in the stalk is indicated by the thicker black arrow.

Sugarcane grows vigorously during hot weather if the crop is disease-free, well-nourished with nutrients and not experiencing drought stress. Stress, especially from lack of available moisture and low temperatures, will rapidly reduce plant growth rate, and hence, accelerate sucrose storage (crop maturity) through a process called natural ripening. Adequate soil water supply, to maintain sucrose production by the mature green leaves, is important both before and after spraying for sustaining the ripening process.

Applying chemical ripeners to very mature cane, which is experiencing drought stress, can lead to detrimental effects (ageing of leaf canopy, excessive stalk desiccation and associated cane quality loss, increased levels of eldana damage as well as an increased danger of the development of sour rot). However, when using chemical ripeners to maintain high cane quality in late-season crops (for the South African growing cycle), the recommendations below apply.

Late-season quality maintenance

When cane quality is at a peak following prolonged slow growth during winter, certain registered products can be applied during August – October to maintain high quality into the late-season (typically crops harvested in November – December under South African conditions) by delaying onset of vigorous growth because of late-winter/spring rainfall and warmer temperatures. In other countries the timing of this quality maintenance requirement, if any, might be different.

For quality maintenance purposes the crop will mostly be slow-growing and at peak maturity when spraying needs to take place. However, at spraying, the leaf canopy must be in good vegetative state (seven or more open and healthy green leaves) and soil moisture reserves (and supply of irrigation water) must be adequate to prevent drought stress for the duration of the treatment period.

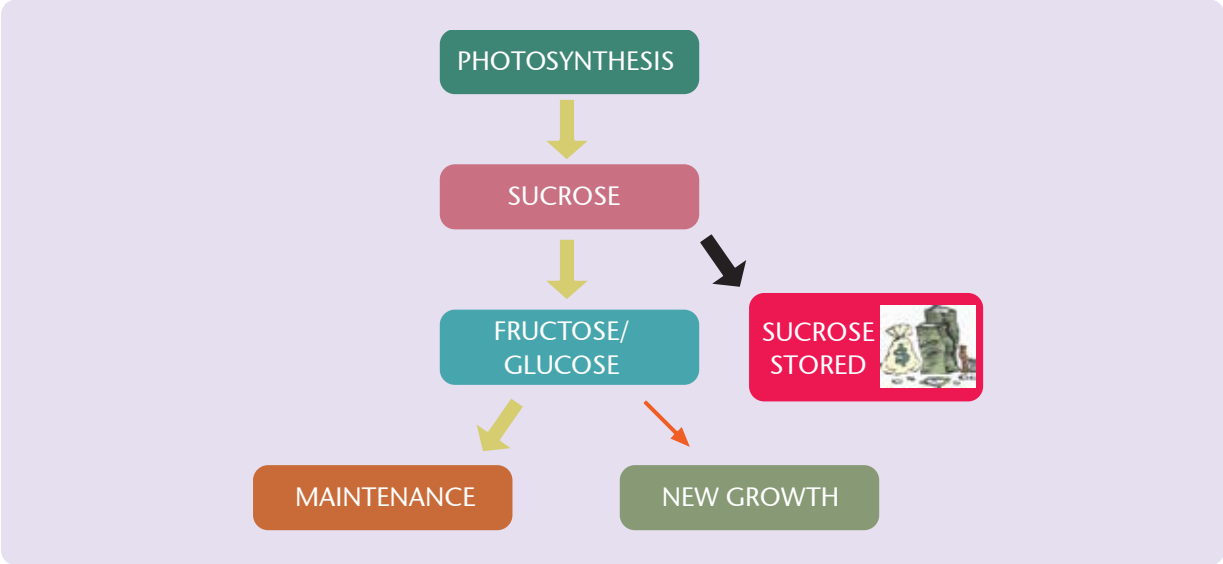


Figure 1. *Simplified scheme illustrating how sucrose formed during photosynthesis is used as an energy source for new growth and metabolic maintenance of existing biomass. The sucrose not used for these purposes is available for storage in the stalk. When used for improving cane quality (chemical ripening), ripening chemicals slow down growth, thus reducing the demand for sucrose as an energy source (indicated by thinner orange arrow), thereby increasing the proportion of sucrose that can be stored in the stalk (indicated by thicker black arrow). When used for* ***late-season quality maintenance,*** *these chemicals delay the onset of vigorous growth (also indicated by thinner orange arrow).*

Indicators of vigorous crop growth and determination of whole-stalk juice purity

A reliable visual indicator of vigorous growth in the field is cane stalks with 8 or more open and healthy green leaves COMBINED with long upper internodes (Figure 2, left). Green leaves that are bunched together at the top of the stalk (because of short upper internodes) indicate that growth was not vigorous (Figure 2, right).

Sugarcane most suitable for chemical ripening or late-season quality maintenance should have:

- no symptoms of pest and disease,
- a uniform stand with no lodging, and
- no flowered stalks.

Visual inspection, combined with knowledge of the whole-stalk juice purity status of the crop, will greatly facilitate decision-making for purposes of chemical ripening and late-season quality maintenance. For chemical ripening purposes, whole-stalk juice purity at the time of spraying should be below 75% for ETHEPHON (and other trade names) and below 85% for FUSILADE FORTE, MODDUS (and other trade names). Refer to SASRI Information Sheets 4.8, 4.9 and 4.10).

Possible exceptions may arise if portable refractometer measurements indicate sufficient immaturity in the top third of stalks despite estimated whole-stalk juice purities being above 85% (caused by very high maturity in lower parts of stalk). Also, for purposes of late-season quality maintenance, the 85% whole-stalk juice purity threshold do not apply because the crop will mostly be mature when spraying needs to take place after winter. Refer to SASRI Information Sheet 4.7 for information on how to determine whole-stalk juice purity through laboratory testing or through estimation on the farm with a portable refractometer together with the smartphone application **PurEst®**.

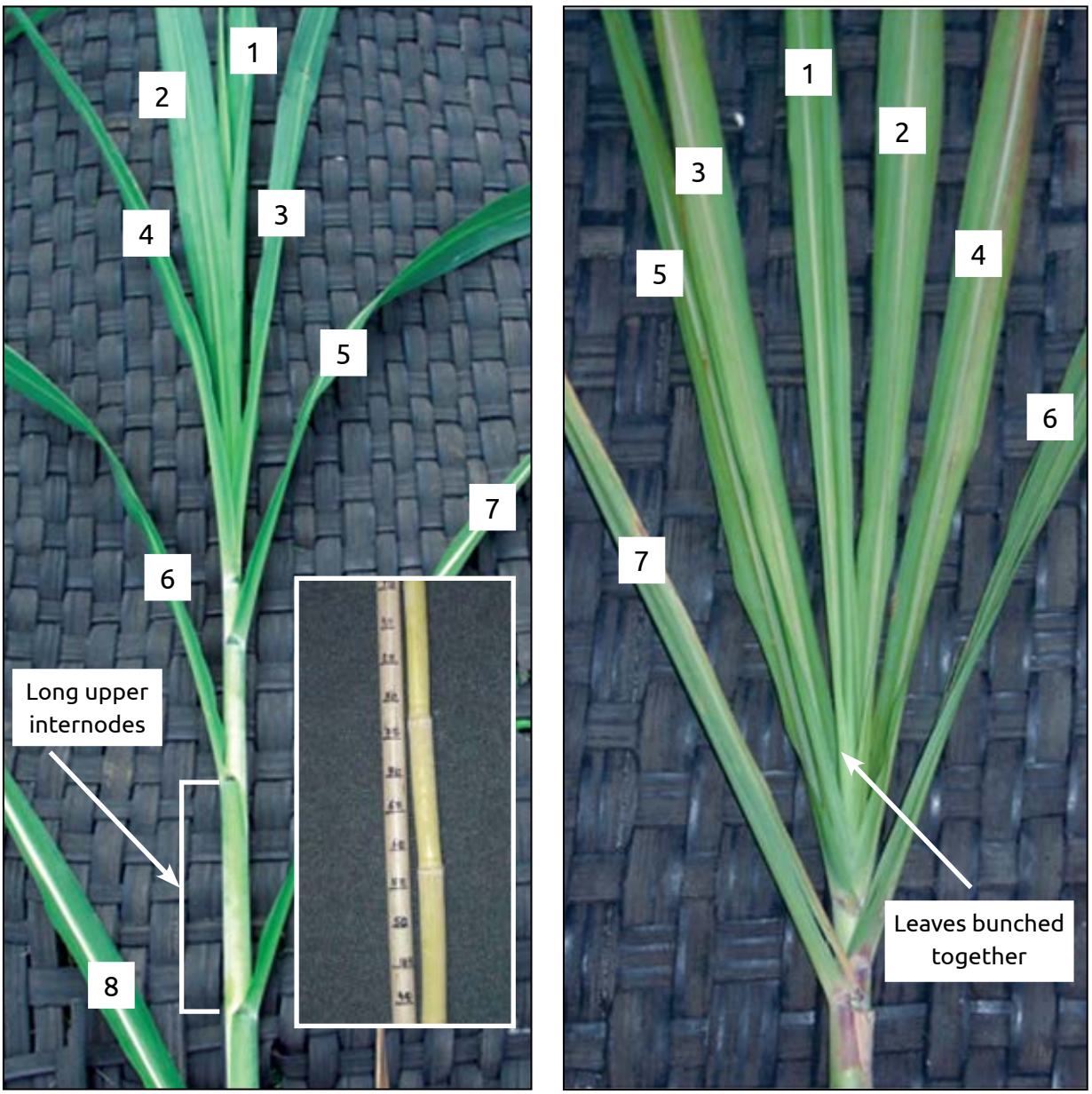


Figure 2. *An example of a sugarcane plant displaying vigorous growth suitable for* ***chemical ripening*** *(left). Note the presence of eight green leaves as well as long upper internodes. In the inset, the cleaned stalk of the same plant is shown. Note the long internodes (± 20 cm) of similar length below the natural breaking point of the stalk, which indicates consistent vigorous growth. On the right is an example of a plant that, despite the presence of numerous green leaves, is not growing vigorously as indicated by the leaves bunched together at the top of the stalk. If falling within the right harvesting window period (typically November – December harvest in South Africa), the latter is an example of a crop that could be considered for spraying for purposes of* ***late-season quality maintenance.***

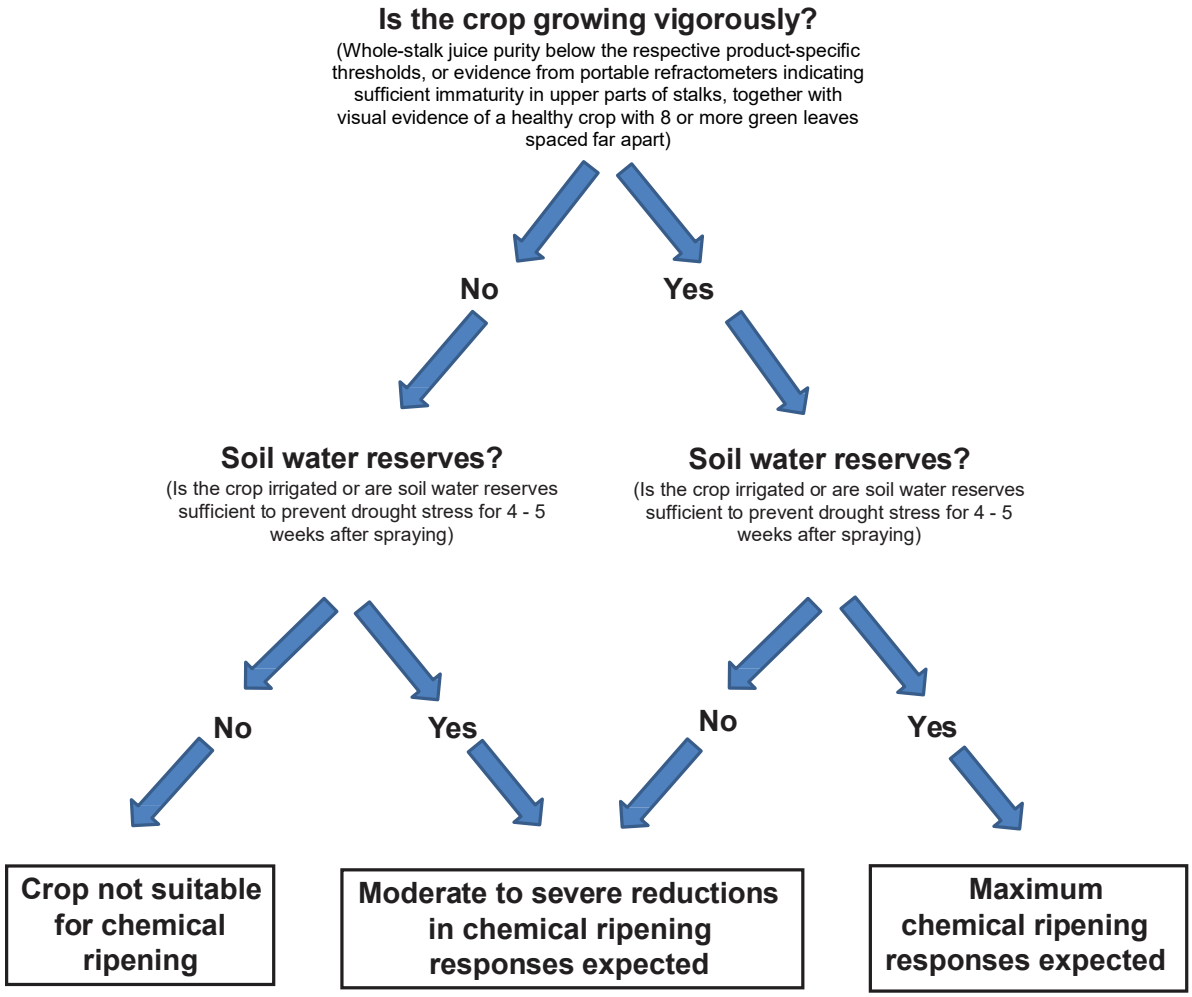
Important note on drying-off

To achieve maximum chemical efficacy, it is recommended that sprayed crops be irrigated for as long as possible after product application yet allowing enough time without irrigation to avoid complications during harvesting (stool damage due to wet soil and poor burning efficiency). Excessive drying-off, causing drought stress, will interfere with chemical action and diminish the benefits from using these chemicals. Excessive drying-off can lead to deterioration of cane quality and increased susceptibility to eldana and sour rot.

Determining suitability for ripening

Use whole-stalk juice purity data and the decision tree provided below as tools to determine the suitability of a particular crop for **chemical ripening.** If the crop is suitable for **chemical ripening,** consult SASRI Information Sheets 4.8 – 4.10 for detailed information on the use of registered chemicals available for ripening sugarcane, namely Ethephon, Fusilade Forte, Moddus (and other trade names). For guidance on **late-season quality maintenance** refer to the dedicated sections within these information sheets.

Decision tree to assist in establishing suitability for chemical ripneing



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