

– PRODUCTION GUIDELINE –

Sugarcane



agriculture,
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GENERAL ASPECTS

Classification

Scientific name: *Saccharum officinarum*

Common names: Sugarcane (English), suikerriet (afrikaans), umoba (Isi-zulu/siSwati), moba (Sepedi), mofha (Venda), Letlhaka la sokore (Setswana/Sesotho)


Sugarcane is any of several species of tall perennial true grasses of the genus *Saccharum*, tribe Andropogoneae and it belongs to the grass family called Poaceae. The official classification of sugarcane is *Saccharum officinarum*. It is common in tropical and subtropical countries throughout the world. Several different horticultural varieties are known, and they differ by their stem color and length.

Sugarcane is composed of six species of perennial grasses of the genus *Saccharum* L., in tribe Andropogoneae of the Poaceae. There are two wild species (*S. spontaneum* L. and *S. robustum*) and 4 cultivated species, *S. officinarum* L., *S. barberi*, *S. sinense* and *S. edule*. The 4 cultivated species are complicated hybrids, and all intercross readily. All commercial canes grown today are inter-specific hybrids.

Origin and distribution

Sugarcane is indigenous to tropical South and Southeast Asia. Different species likely originated in different locations, with *S. spontaneum* occurring in the wild from eastern and northern Africa, through the Middle East, to India, China, Taiwan, and Malaysia, and through the Pacific to New Guinea. The center of origin is probably in northern India which forms the smallest chromosome numbers. *S. robustum* is found along river banks in New Guinea and some of its adjacent islands and is indigenous to the area. *S. officinarum* (or noble cane) most likely originated in New Guinea. It is only suited for tropical regions with favourable climate and soil. *S. barberi* probably originated in India. *S. sinense* occurs in portions of India, Indo-China, southern China and Taiwan. *S. edule* is thought to be a sterile form of *S. robustum* and is found only in New Guinea and nearby islands.

Sugarcane has been cultivated since ancient times and it was one of the first “cash crops” of early colonial America. It grew plentifully in the southern states, and was a major source of income for many plantations. It is grown



readily in the United States in Hawaii, Louisiana, Florida and Puerto Rico. The countries that produce the largest amounts of sugarcane are Brazil, India, China, Mexico, Thailand and Pakistan.

Cane sugar is currently grown primarily in tropical regions. The highest latitudes at which cane is grown is in South Africa (KwaZulu-Natal), Argentina and at the southern extremes of the Australian industry at approximately 30 ° S, 34 ° N in northwest Pakistan, and 37 ° N in southern Spain.

The first New World sugar cane mill began grinding in about 1516 in the Dominican Republic. Sugar production spread to Cuba, Jamaica, Puerto Rico, and the other Greater Antilles by the end of the 1500's.

Production levels

South Africa

The South African sugar industry is consistently ranking in the top 15 out of approximately 120 sugar producing countries worldwide. There are approximately 26,400 registered sugarcane growers in South Africa, covering the provinces of KwaZulu-Natal, Mpumalanga and the Eastern Cape. Of the 26,000 sugarcane growers, more than 25,000 are small-scale growers producing about ten percent of the total crop. Large-scale growers (approximately 1,400) produce approximately 83% of the total sugarcane crop, while milling companies, with their own sugar estates, produce approximately seven percent of the crop. The bulk of the sugar belt receives sufficient rainfall to grow cane without irrigation; however, parts of northern KwaZulu-Natal and Mpumalanga regions produces cane under irrigation (approximately 30 percent of total production). Cane growers are represented by the South African Cane Growers Association.

There are 14 sugar mills in South Africa. Four mills are each owned by Illovo Sugar Ltd and Tongaat Hulett Sugar Ltd. Three mills are owned by Tsb



Sugar RSA Ltd, while Umfolozi Sugar Mill (Pty) Ltd, UCL Company Ltd and Gledhow Sugar Company (Pty) Ltd each own one mill. Only two mills are located in the Mpumalanga province, while the remainder is located in the KwaZulu-

Natal province. The sugar millers are represented by the South African Sugar Millers' Association Limited. Four of the mills are known as "white end" mills and produce their own refined sugar.

For the 2013/14 season, sugar production is estimated at 2.1 million tons, almost eight percent more than the 2.0 million tons produced in the 2012/13, on a higher sugar cane crop. In the 2011/12 season, South Africa produced its lowest sugar crop in the past 15 years at 1.8 million tons, due to a drought-affected production season. Sugarcane is produced each season from 14 mill supply areas, extending from Northern Pondoland in the Eastern Cape to the Mpumalanga Lowveld. Of the 430 000 ha currently under sugar cane, about 68% is grown within 30 km of the coast and 17% in the high rainfall areas of KwaZulu-Natal. The balance is grown in the northern irrigated areas that comprise Pongola and the Mpumalanga Lowveld.

South Africa continues to be one of the world's most cost-competitive producers of high quality sugar. It is a diverse industry combining the agricultural activities of sugarcane cultivation with the industrial factory production of raw and refined sugar, syrups and specialised sugars, and a range of by-products. Table 1 illustrates the production of sugar in South Africa for the 2011/12 season (actual), the 2012/13 season (estimate) and the 2013/14 season (forecast).

TABLE 1 The Production of Sugar in South Africa

Marketing years	Area planted (ha)	Area harvested (ha)	Yield (mt/ha)	Cane crushed (mt)	Sugar production (mt)	Cane/sugar ratio
2011/12	378,307	270,705	62,1	16,800,277	1,832,438	9,2
2012/13 (Estimate)	380,000	274,000	63,1	17,278,000	1,952,000	8,9
2013/14 (Forecast)	385,000	280,000	64,6	18,100,000	2,100,000	8,6

Source: <http://www.thecropsite.com/reports/?id=1944>

Internationally

Sugarcane is the world's largest crop by production quantity. Sugar is produced in 120 countries. Global production now exceeds 165 million tons a year. Approximately 80% is produced from sugar cane, which is largely grown in tropical countries. The remaining 20% is produced from sugar beet, which is grown mostly in the temperate zones of the northern hemisphere. seventy countries produce sugar from sugar cane, 40 from sugar beet, and



10 from both. The ten (10) largest sugar producing nations represent roughly 75% of world sugar production. Brazil alone accounts for almost 25% of world production and was the largest producer of sugarcane in the world.

Brazil produced 588 million tons of sugarcane in 2012/13. World production is close to 1,6 billion tons annually and is concentrated in tropical regions, particularly developing nations in Latin America, Africa, and Asia. In Brazil, sugarcane currently covers 9.5 million hectares, or 1% of the country’s total area. The crop is grown primarily in the south-central and north-eastern regions, with South-Central Brazil responsible for close to 90% of Brazil’s sugarcane. In that region, the harvest runs from April to December, and in the north-east, it lasts from September to March. The state of Sao Paulo alone accounts for 60% of the country’s total sugarcane production.

Brazil uses sugarcane to produce sugar and ethanol for gasoline-ethanol blends (gasohol), a locally popular transportation fuel. In India, sugarcane is used to produce sugar, jaggery and alcoholic beverages. In the United States, sugarcane is grown commercially in Florida, Hawaii, Louisiana, and Texas.

TABLE 2 Sugarcane production in 2012 for the top ten producing countries

Country	Tons
Brazil	721,077,287
India	347.870.000
China	124,038,017
Thailand	96,500,000
Pakistan	58,397,000
Mexico	50,946,483
Colombia	38,000,000
Philippines	30,000,000
United States	27,900,000
Indonesia	26,341,600
World	1,832,541,194

Source: *Food and Agriculture Organization of the United Nations.FAOSTAT.*
<http://faostat3.fao.org/home/index.html>

Major production areas in South Africa

The sugarcane growing areas of South Africa are KwaZulu-Natal, Mpumalanga and the Eastern Cape. In Mpumalanga province, sugarcane is





produced in areas such as Malalane and Komatipoort, while in KwaZulu-Natal province sugarcane is produced in Pongola, Umfolozi, Felixton, Amatikulu, Darnall, Gledhow, Maidstone, Sezela, Umzimkulu, Dalton, and the Noodsberg and Eston areas.

Cultivars

TABLE 3 Sugarcane recommended varieties in South Africa:

NC0376	CP66/1043	N12	N14	N16	N17
N19	N21	N22	N23	N24	N25
N26	N27	N28	N29	N30	N31
N32	N33	N35	N36	N37	N39
N40	N41	N42	N43	N44	N45
N46	N47	N48	N49	N50	N51
N52	N53	N54	N55	N56	N57

Source: <http://www.sugar.org.za/sasri/variety/index.htm>

Description

Mature plant

Sugarcane is a tropical, perennial grass that can grow up to 4.25 m tall and is generally about 5.1 cm thick. When ripe, the cane is usually about 2 to 4 m tall.

ROOTS

The roots system is fibrous.

STEM

The plant forms lateral shoots at the base to produce multiple stems, typically the 3 to 4 m high and about 5 cm in diameter. The stems grow into cane stalk, which when mature constitutes approximately 75% of the entire plant.



STALK

Sugarcane stalk is roughly cylindrical in shape, divided into joints varying in length from 5.08 cm





depending on rate of growth and is composed of many distinct nodes and internodes. The above ground portion of the plant bears leaves and flowers. A small portion of the stalk below the ground is called the rootstock.

LEAVES

The leaves of the sugarcane plant grow alternately on opposite sides of the stalk from the nodes. They consist of a sheath and a blade. The leaves are usually 0.61 to 0.92 m in length and vary from 0.5 to 10.16 cm in width, depending on the variety.

Essential part

The stem is the essential part, they are crushed and shredded by rollers in a process called grinding to extract the remaining sugar.

Climatic requirements

Temperature

Sugarcane grows best in warm, sunny, frost-free weather areas. It requires a tropical or subtropical climate with a minimum of 600 mm of annual moisture. However, it also grows well in a subtropical climate. It can grow well where the temperature ranges from 20 to 35 °C. Optimum temperature for germination of stem cuttings is 32 to 38 °C. Sugarcane responds to a long period of sunlight of about 12 to 14 hours. High humidity (80–85 %) favours rapid cane elongation during the main growth period.

Water

The soil should be kept loose and thoroughly moistened during planting and watered afterwards till the plants have attained to their full height.

Rainfall

Rainfall between 1100 and 1500 mm is adequate provided the distribution is right, abundant in the months of vegetative growth and followed by a dry





period for ripening. A total of at least 1,500 mm of rain each year or access to irrigation supplies is required.

Soil requirements

Sugarcane grows on almost all classes of soil, but it needs fertile, well-drained soil. Humid soils from 100 to 150 cm deep with good drainage are most suitable. It grows well in deep, well-drained soils of medium fertility of sandy loam soil textures with a pH range from 6.0 to 7.7. The optimum soil pH is about 6.5 but sugarcane can tolerate considerable degree of soil acidity and alkalinity.

Waterlogged soils, which have no drainage, are not suitable. Sugarcane is regarded as a relatively salt sensitive plant. Salinity induces water stress, which is evident in cane by premature wilting, scorching of the leaves, and restricted growth and, in severe cases, death of the plant. Salt-affected soils and river waters with high salt content are confined mainly to those areas of the sugar industry receiving minimum annual rainfall; less than 760 mm, i.e. in Mpumalanga.


CULTIVATION PRACTICES

Propagation

Propagation can be done by stem cutting off sections of the stalks called “setts” or seed pieces. Stem cutting has become the most common reproduction method and each cutting must contain at least one bud. Stem cuttings of immature canes 8 to 12 months old are used. Cane setts with roots and shoots are known as settlings/tissue culture. Settling can be raised either in nursery beds or in polythene bags. Single node settlings are used as a planting material in spaced transplanting technique. When the settlings are of about 6 week old, they are transplanted in the prepared main field. Little portion of stem with one bud is known as bud chip. Bud chips are used to raise settlings in a nursery. Settling are ready in 5 to 8 weeks for transplanting in the main field.

Soil preparation

The soil should be left fallow for a period before new sugarcane is planted. Ploughing ensures that the soil is broken into fine even particles which help the roots of the new plants reach food and moisture and also to incorporate



previous crop's crop residues and organic manures. Destruction of the old crop can be done by either mechanical or chemical means. Chemical preparation and planting is undertaken by means of furrow openers. Conventional preparation is done with ploughs and harrows. However, where there are signs of compactions, subsoiling or chiseling to a depth of 50 to 75 cm would be adequate to break the hard compact sub-pan layer. Disc should be used to break clods. Sugarcane does not require a fine tilth, with excessive use of machinery damaging soil structure. Land shaping should be done to provide the required gradient for draining excess water during rainy season.

Field layout and design

Involves the initial leveling of the field, establishment of drainage systems, contour planning and the construction of roads which ensures ease of access to the field. Sugarcane is planted by adopting two systems, i.e. the ridges and furrows system and flat system. In all these systems sugarcane setts are directly planted. In the finely prepared field, ridges and furrows are formed using a tractor and some small farmers open furrow manually also. Flat system: for planting, shallow furrows are opened with a plough and the setts are dropped and covered by soil.

Planting

There are two methods of planting, namely manual and mechanical. The cane setts are manually placed end to end (or overlapping) together with fertilizer in the furrow and then covered with soil. With mechanical planting, the three operations of opening the furrow, planting the setts and applying fertilizer are conducted simultaneously.

Timing of the planting operation

The ideal time for planting is from mid-February to April (autumn) under irrigation condition, when adequate moisture is present for a quick canopy and optimum use of summer conditions. Under rain-fed conditions planting should be done from September to November (spring) once the rain has soaked the soil. In the Midlands, planting should not go beyond October, as the vector for mosaic is active thereafter and rapid spread of the disease may occur. Autumn planting is possible, but conditions must be favourable for germination before winter.



Row spacing

Closer spacing tends to result in higher yields, provided there is adequate moisture in the soil. Row and plant spacing for manual planting is 1.0 to 1.3 m x 0.5 m. For normal mechanical operations, the best row spacing is between 1.4 and 1.6 m. The setts are planted at a degree angle or laid horizontally in a furrow and thereafter are covered lightly with soil until they sprout then the sides of the furrow are turned inwards. Optimum cover is 50 mm of soil. Covering of the soil is best done by hand and compressed by foot to eliminate excess air pockets. Pieces of mature sugarcane (“setts”) are planted using special machines which cut the cane into setts, drop them into furrows, add fertiliser and then cover the setts with soil. Planting with water at one litre per metre before covering is very effective in improving germination in dry soils.

Depth of planting

Furrows for planting should be approximately 100 mm deep. Sets should be cut into five bud lengths.

Fertilisation

Fertiliser is applied to promote development of the plant. Fertiliser can be spread by hand by applying a standard container of fertiliser over a pre-determined length of cane row. Mechanical distributors can also be used to apply fertilizer. Sugarcane crop producing huge quantity of biomass generally demands higher amounts of nutrient elements. For producing higher cane and sugar yields on a sustainable basis application of adequate amounts of fertilizer nutrients viz., N, P and K is essential.

Nitrogen requirement of sugarcane is greatest during the tillering (formative) phase. This is required for adequate tiller production and canopy development. Tillering in field grown sugarcane commences around 30 to 45 days after planting. Therefore, adequate N supply should be made available to the crop in the soil from the start of the tillering phase. Further, crop requirement for N is higher in early grand growth period.

Phosphorus need of sugarcane is greater in the formative phase of the crop. Thus, the optimum time of P application is during initial stages of crop growth. Therefore, sufficient P must be made available in the soil during formative phase for absorption by the crop.



Potassium applications are usually done along with N application. This is because of better utilisation of N by the crop in the presence of K; therefore, potassium should be applied along with N. However, late application of K at around six months has also been found to improve sugar recovery.

In general all the phosphorus should be applied before four months, nitrogen before six months and potassium before seven months period. General fertiliser guidelines for nitrogen, phosphorus and potassium are shown in Table 4.

TABLE 4 Sugarcane recommended nutrient in South Africa

Region	Crop	Nutrients (kg/ha)			Remarks
		N	P	K	
Inland	Plant cane	100–200	40	100	N and K for plant cane in 2 split application
Coastal Lowland	Ratoon	140	20	150	
Natal Midlands	Plant cane	80	60	125	
	Ratoon	120	40	175	
Lowveld	Plant care	120	40	125	
	Ratoon	100	10	175	

Source: http://www.sugarcanecrop.com/agronomic_practices/fertigation/

It is recommended to perform soil analysis for the correct quantity of fertilisers for sugarcane.

Irrigation

The frequency of irrigation depends on the stage of development of the cane. Light, frequent irrigations are preferred when the seed is germinating and the young seedlings are getting established. As the root system extends into deeper and deeper soils, the irrigation intervals should be extended, and the amount of water applied with each irrigation increased. As the cane approaches maturity, extended irrigation intervals should be scheduled to reduce the rate of vegetative growth, dehydrate the cane, and force the conversation of reducing sugars to recoverable sucrose.

Weed control

Weed control methods employed will be either hand weeding or by application of herbicides. It is necessary to spray herbicide (weed killer) in order to prevent weed competition and losses in sugarcane production.



Sugarcane is most susceptible to weed competition during the first eight to 10 weeks after cane begins to sprout. Approximately 8–10 weeks after the herbicide application it may be necessary to follow with a hand-weeding operation. Young sugarcane needs plenty of moisture and protection from weeds. Farmers use a cultivator implement which is hitched to a tractor to break up the soil and uproot weeds. When the sugarcane is taller, sunlight can't reach the ground, preventing most weed growth.

Weeds can also be removed from the field manually by hand hoeing. Selection of pre-sprouting herbicides should be based on soil texture and organic matter content, weed problem and the variety of sugarcane. Pre-sprouting herbicides should be applied immediately after planting. Recommended herbicides and chemicals for weed control in sugarcane can be used.

Pest control



Sugarcane can become infested by a variety of diseases and pests.


Eldana borer (*Eldana saccharina*)

Eldana borer is the caterpillar of the moth *Eldana saccharina*, an insect that is indigenous to Africa. It is a very active, tough, brown, rather leathery borer that wriggles vigorously when disturbed. It has a dark brown colour. The presence of *Eldana* can usually be detected by the 'frass', which it pushes to the exterior of the cane stalk through the holes it has bored. *Eldana* is a voracious feeder and in severe infestations the entire crop can be damaged, leading to serious crop loss.

Damage: Eldana larvae feeds initially as a scavenger on the extensively inside the cane stalks. It causes severe loss in cane quality, in addition to infestation of the borings by the red rot fungus (*Glomerella tucumanensis*). Losses are particularly severe with this borer because damage is mainly in the lower half of the stalk, where the most sugar is stored.

Control is done by the following:

- The use of recommended insecticides.
- Important natural control is achieved by predators such as ants, cockroaches, spiders and mites.

- 
- For planting, select stalks that show no signs of borer attack. Bored stalks should be milled or burnt.
 - Plant varieties that have been proven less susceptible to *Eldana*, e.g. N12 and N21.
 - Apply only the amount of nitrogen recommended by the fertiliser Advisory Service at the Experiment Station. In areas with history of *Eldana*, increase the amount applied by 20 to 30 kg N/ha.
 - Field hygiene is important. Remove whole stalks from the field and leave no stubble.
 - At harvest, burn heavily infested and drought stressed cane.
 - Reduce other stress factors such as poor drainage and weed competition, which can also induce an increase in *Eldana*.

Sesamia borer—'top grub' (*Sesamia calamistis*)


This borer is the larval stage of an inconspicuous moth. It is widespread in the sugar industry, including the high altitude areas. Although it looks almost the same as *Eldana*, this borer is pinkish in colour, is far less lively, does not move backwards and is not an active silk spinner. It occurs in most cane fields, but is seldom of importance.

Damage: The damage caused by *Sesamia* borer is similar to that caused by *Eldana*, but younger tissue is attacked (often young plant or ratoon cane) and damage is less severe. It is probably most noticeable in very young cane where, as 'top grub', it causes 'dead hearts'. This results in the death of early tillers, which are usually satisfactorily replaced by new growth. *Sesamia* damage is often associated with a strong, offensive odour when shoots are sliced open. *Copious frass* such as that produced by *Eldana* is not characteristic of *Sesamia*, which feeds far less voraciously. A secondary reddening of the stalk tissue, caused by the red rot fungus, may occur following *Sesamia* damage.

Control: Natural control by parasites prevents serious outbreaks of *Sesamia*, and applied control measures have rarely been necessary. The use of insecticides is not recommended.

Chilo borer (*Chilo sacchariphagus*)

Chilo sacchariphagus is a serious pest of sugarcane discovered in South Africa. Like most moth borers of sugarcane, the moth is khaki colour. The larvae are pale in colour, with distinctive brown patches along the upper surface of the body.



Damage: Eggs are laid on the green leaves of sugarcane and hatch within days. Larvae move to the whorl of the plant and bore into the young leaves. This results in the young growing leaves showing the characteristic ‘shothole’ effect as they expand and grow. Larvae bore into the stalks and mainly feed on the upper internodes of stalks.

Control: Biological control is considered to be sufficiently effective. Other practices such as varietal resistance have been shown to be effective.

Soil insects

A number of insects attack the subterranean part of sugarcane plants and although they remain unseen, the damage they cause can draw attention to their presence. For example the Lamellicorn beetles, (Scarabaeoidea), Nitidulid beetles (*Carpophilus humeralis*. F., *Carpophilus* spp.), Margarodes scale and termites (white ants).

TERMITES (WHITE ANTS) (*MACROTERMES NATALENSIS* HAV.)

Termites are small, soft-bodied, creamy insects which inhabit nests and which resemble ants.

Damage: Termites inhabit subterranean nests from which they forage. It is in the course of their foraging that they may attack cane at soil level, sometimes causing the stalks to collapse.

Control: The use of recommended/approved insecticides—the dipping of setts in insecticide will protect the seed material.

MARGARODES SCALE

It is commonly known as “earth pearl” and is noticed usually when land is prepared for replanting. The scale may occur in very large numbers as small glistening spheres on the soil surface.

Damage: The “pearls” is the encysted larvae of a sucking insect, which feeds on roots.

Control: Control measures are not considered necessary.

Leaf-eating insects

Many insects nibble the leaves of cane but few of them occur in numbers large enough to cause economic losses.



TRASH CATERPILLARS OR RATOON WORMS (*MYTHIMNA PHAEA* HAMPS.)

Adult moths are the colour of cane trash but the caterpillars are striped in alternate light and dark shades of a brown-grey colour. The larvae attack the leaves of young ratoon between April and November and are capable of completely defoliating the crop. They are a problem only when trashing is practiced instead of burning.

Damage: The larvae move onto the young ratoons at dusk and feed on the leaves. Mature larvae pupate in the trash. The moths serve to spread the infestation to adjacent fields.

Control: The use of recommended insecticides is necessary. Wide variety of parasitic insecticides and pathogens attack trash caterpillars in the field and are important as natural controlling factors.

ARMYWORM (*SPODOPTERA EXEMPTA* WALK.)

Armyworm moths are dark coloured, with brown to black forewings and white hindwings. The larvae, which attack the leaves of young cane plants, are green and black in colour with longitudinal black striped and a green underside.

Damage: Young plant may be completely defoliated.

Control: Use of recommended insecticides.


Sap-sucking insects

Among the sap-suckers are many insects of minor importance which are common in sugarcane. They all feed by tapping the sap stream and sucking juices from the plant. Black sooty mould (*Capnodium* sp) often develops on the sticky honeydew which the insects produce as they feed.

GREEN LEAF SUCKER (*NUMICIA VIRIDUS* MUIR.)

Green leaf-sucker is small, inconspicuous insects, which are native to South Africa. They are not easily noticed in the field unless infested shoots are bent over and shaken, whereupon the dislodged insects fall to the ground. The adults are about 7 mm long, bright green in colour and have rather flat wings. They move by hopping or in short jerky flights.

Damage: The females lay eggs in a row of punctures in the midrib on the lower side of the cane leaf. The nymphs are paler in colour than the adult but both feed by sucking the sap from the leaves and when feeding they poison



the plant. The first symptom is a weakening of the tissue, followed by buckling and drooping of the leaves. Later, the leaves become a blotchy yellow colour and often die at the tips and along the edges. The growing point of the stalk may be affected and the top of the stick becomes flabby.

Control: Burn and harvest mature cane. Recommended/approved insecticides should be used only in extreme cases and should be applied when the first adults appear and again two to three weeks later.

LEAF HOPPER (*PERKINSIELLA SACCHARICIDA* KIRK.)

It is found throughout the cane belt. Adults are about 7 mm long, slender with discontinuous brown to black wing markings. Nymphs are smaller, thicker-bodied and wingless.

Damage: they are sap-suckers. The moth eggs cause conspicuous red blotches on the plant. Eggs are occasionally inserted in stem tissue and may cause distortion of the stem. Sooty mould may develop on the leafhopper's excretions of sticky honey-dew.

Control: Natural control by predators and parasites is usually adequate.

SUGARCANE APHID (*MELANAPHIS SACCHARI* ZEHNT)

Sugarcane aphids are pale-coloured insects with small, soft bodies. The young are wingless and some individuals remain so throughout life. Others which increase in number as winter approaches, develop two pairs of membranous wings in the adult stage.

Damage: Aphides are sap-suckers and, like perkinsiella, excrete honey-dew on which sooty mould may develop. The winged form serves to spread the infestation. In a severe outbreak the sooty mould associated with it may block the stomata.

Control: Aphid populations are kept in control by natural enemies such as maggots of syrphid flies, minute parasitic wasps and four or five species of ladybird beetles (Coccinellidae). No applied control measures are recommended.

SUGARCANE MEALYBUGS (*SACCHARICOCCUS SACCHARI* CKLL./*DYSMICOCCLUS BONINSIS* KUWANA)

Mealybugs are soft-bodied, egg-shaped, pink insects up to 5 mm long. They are found in clusters between the leaf sheaths and stalk where they suck the juice from the joints.



Damage: Mealybugs stunt the growth of cane.

Control: Natural enemies, include a disease caused by a fungus, apparently a species of *Aspergillus*, small parasitic wasps of the family Encyrtidae, the predatory caterpillars of a Tineid moth, and the maggots of a fly related to the vinegar flies (Drosophilidae).

Insect of lesser importance

In addition to the insects already mentioned many others occur in sugarcane fields. Although they may live at the expense of the crop, the toll they take is negligible and control measures are not necessary. Examples: Orthoptera (*Cyrtacanthacris rubella* Serv., *Zonocerus elegans* Thunb), Homoptera (*Locris areata* Walk., *Locris arithmetica* Walk., *Pulvinaria saccharia* De Lotto, *Pulvinaria iceryi* (Signoret)—in South Africa it is recorded as a pest only in glasshouses., and *Aulacaspis madiunensis* (Zehnt), Lepidoptera (*Marasmia trapezalis* Guen., *Parnara mathias* F., *P. detecta* Trim. and *Busseola fusca* Hamps.) and mites (Acarina).

Nematodes

Plant-parasitic nematodes are typically worm-shaped animals ranging in size from less than a half to over five millimeters in length. They live in the soil or within the plant roots where, by means of a protractible hollow styled in the mouth cavity, they pierce and suck out the contents of the root cells.

In South Africa several tons of sugarcane are lost each year due to plant-parasitic nematodes. The damage caused by the nematodes as they feed on the roots limits the uptake of water and nutrients from the soil. This results in poor tillering and shoot development and hence a decrease in crop yields. Plant-parasitic nematodes species found associated with sugarcane in South Africa are *Pratylenchus*, *Paratrichodorus*, *Xiphinema* and *Meloidogyne* that appear to be important pests.

Damage: They include stunted, patchy growth with the plants bearing narrow, longitudinally rolled leaves. Tillering may be reduced so that fewer stalks are produced and the stalks themselves are thin and stunted.

Below-ground symptoms are more diagnostic, namely a sparse root system with short, stunted lateral roots. Galls may be visible on the roots if *Meloidogyne* is present and if *Pratylenchus* is abundant, numerous, small, reddish-brown lesions may mark the roots. Stubby lateral roots are easily seen on the root system when *Paratrichodorus* is present in large numbers.



Control: The registered nematicide should be used.

Disease control

Ratoon stunting disease (RSD)

Ratoon stunting disease (RSD) can be a serious and often unsuspected cause of loss of yield. It is a dangerous disease, caused by the bacterium *Clavibacter xyli* subsp *xyli*. Its distribution differs widely from area to area. Approximately 9% of the fields throughout the South African sugar industry are infected, ranging from only a small percentage in the Lower South Coast and Midlands areas to more than 40% in the Umfolozi area. RSD is an insidious in that it can spread rapidly and has difficult to recognised symptoms. Infection can only be identified with certainty by submitting samples to the Experiment Station for diagnosis.

Symptoms are as follows:

- Diseased stools become stunted, often giving affected fields an uneven appearance, particularly in ratoon crops.
- Red-brown dots or streaks at the base of the nodes may be seen when mature stalks are sliced lengthwise. These may be inconspicuous in some varieties, eg Nco 376.

Control should be done by the following:

- Plant only healthy seedcane or clean seed cultivation
- Sterilise cane knives and harvester blades. This is particularly important when cutting seedcane fields or nurseries.
- Eradicate volunteers completely before replanting.

Smut

Smut is a fungal disease of sugarcane caused by a fungus (*Ustilago scitaminea*) in South Africa. It is most severe in the irrigated northern areas and in northern Zululand. It occurs in all areas on highly susceptible varieties. Smut is most common in poorly grown cane.

The following symptoms will appear:

- Dark brown, whip-like structures usually develop from the tops of infected shoots and stalks.
- Severely infected stools degenerate into clumps of grasslike, unmillable shoots.



Control can be done by the following:

- Plant resistant varieties.
- Plant disease-free seedcane.
- Rogue affected fields and plough out severely smutted fields. Eradicate volunteers before replanting.
- Registered/approved chemicals can be used.

Mosaic

Mosaic is the most damaging virus disease of sugarcane in South Africa. Severe outbreaks of mosaic are largely restricted to the cooler area of the southern coastal hinterland and high altitude inland areas. Mosaic is capable of causing severe yield losses in several important varieties.

Mosaic will be recognised by the following symptoms:

- Mottling of young leaves, seen as darker green 'islands' on a paler green background at the base of leaf blades.
- Infected stools tend to have a yellow-green appearance on the young internodes of the stalk and may be severely stunted.

The best control is achieved by planting resistant varieties of healthy seed cane and by avoiding proximity to maize.

Leaf scald

Leaf scald is an important disease in South Africa, caused by the bacterium (*Xanthomonas albilineans*). It is potentially a very serious disease, and can cause unpredictable and severe damage to susceptible varieties.

Symptoms are as follows:

- Blotchy leaf chlorosis.
- Narrow, sharply defined white lines on the leaves.
- Leaves wither and curl inwards.
- Red streaks at the nodes within affected stalks.
- In susceptible varieties, growing under stress, stalks, whole stools or patches of cane may suddenly wilt and die.

Control is done by planting resistant varieties of healthy seed cane. Use sterilised knives when preparing seed cane.



Rust

Rust is the most dreaded disease to the production of sugarcane; it is caused by a fungus (*Puccinia melanocephala*). Severe rust infection is often likely to reduce yields. Rust is more severe during or after cool, wet weather.

Symptoms

- Orange to brown pustules on the lower surfaces of leaves.
- Severely infected leaves may die prematurely.
- In a serious outbreak, affected fields have a general orange-brown colouring.
- Most conspicuous on young plants.

The best control is achieved by planting resistant varieties.

Red rot

Red rot is a disease caused by a fungus (*Physalospora tucumamensis/ Colletotrichum falsumwont*). It is most likely to be severe in the cooler areas. It can cause very severe losses due to premature stalk death and reduction in sucrose content.

The following symptoms will appear:

- Internal red discolouration of the stalk tissues, with characteristics white blotches.
- Rotting often occurs at the nodes, affecting the buds.
- Stalks affected in this way may germinate poorly if planted.
- Elongated red lesions on the leaf midrib.
- When the disease is advanced, cavities may form within the stalk, often containing a grey fungal mycelium.
- Seriously rotten stalks may die and become 'mummified'.

The best control is achieved by planting resistant varieties and to avoid standover cane. Cut affected cane early.

Gumming

Gumming is a disease caused by a bacterium (*Xanthomonas vasculorum*) and it is most common in areas of high humidity, such as the mistbelt and irrigated areas.



Gumming is recognised by the following symptoms:

- Straw coloured streaks of varying length starting from the tips and margins of older leaves.
- If the stalk becomes systemically infected, sharply defined, dark red-brown streaks tend to develop on the leaves.
- A silver gum may be exuded from these darker striped areas on the lower surface of the leaves.
- Gum pockets form inside young stalk tissue.
- Leaf chlorosis may follow infection of the stalk.

Control is done by avoiding planting susceptible varieties in areas prone to gumming and by selecting disease-free seedcane.

Pokkah boeng

Pokkah boeng is a disease caused by a fungus (*Gibberella moniliformis*) and can occur on most varieties, but causes little damage.

Symptoms are the following:

- Mild chlorosis and slight distortion at the base of young leaves.
- The growing point may become distorted.
- The growing point of susceptible varieties may die.

No control measures are necessary.

Brown spot

Brown spot is a disease caused by a fungus (*Cercospora longipes*) and it is noticeable in the mistbelt and in cooler areas.

The disease is recognised by red-brown leaf spots, surrounded by a narrow yellow 'halo'. Spots are oval to linear, varying in size from small flecks to 10 mm or more in length. Severely infected older leaves may die prematurely.

Plant resistant varieties when brown spot infection is very severe.

Eye spot

Eye spot is a disease caused by a fungus (*Helminthosporium sacchari*) and is rare and there have only been sporadic outbreaks.

Symptoms are the following:

- Oval lesions with reddish centers and straw-coloured margins.

- Straw-coloured 'runners', which turn reddish, extending from the lesions to the leaf tip.
- Severe infection kills the growing point and may cause leaves to die-off.

No control measures are necessary.

Harvesting

Harvest maturity

Sugarcane can be harvested after 12 to 16 months when it is 2 to 4 m tall. It is ideal to harvest sugarcane between April and December when rainfall is less frequent and the plant's sugar content is at its highest. Traditionally, sugarcane is burnt before harvesting to remove leaves, weeds and other trash that delay harvesting and milling. Sugarcane is harvested green rather than burnt. It is necessary to harvest green sugarcane.



Harvesting methods

Sugarcane is harvested mostly by hand and sometimes mechanically. Harvesting is done manually using various types of hand knives (such as cane knives) or hand axes. Among the several tools, the cutting blade is usually heavier and facilitates easier and efficient cutting of sugarcane. When harvested by hand, the field is first set on fire. The fire spreads rapidly, burning away dry, dead leaves, but leaving the water-rich stalks and roots unharmed. With knives, harvesters can cut the standing sugarcane just above the ground. With mechanical harvesting, sugarcane combine or chopper harvester is used. Machines move along the rows of cane removing the leafy tops of the cane and cutting the stalks into short pieces.

POSTHARVEST HANDLING

Grinding

The stems are crushed and shredded by rollers in a process called grinding. During grinding, hot water is sprayed over the shredded material to extract the remaining sugar.



Storage

Raw sugar is stored at bulk sugar terminals before being sent to refineries. Blakes Loops is typical of a storage yard close to the mills. The mills have full and empty bin yards as well as holding yards for storage. Dome technology can be used for sugar bulk storage.

Transport

Sugarcane is transported from the field to an open area or siding by a tractor-drawn self-loading trailer. Most sugarcane are transported by road to the mills in specialised trailers hauled by tractors or heavy road lorries and trucks or by rail. Transport used should be thoroughly cleaned before use, in order to minimise the risk of re-infection with diseases. Bulk sugar is transported from the mills in containers by road or rail to the terminals, where it is carried by conveyor belts into the storage shed. When a ship arrives it is filled quickly via conveyors.

Marketing

The South African Customs Union (SACU) is the primary market for the South African sugar industry. The SACU market comprises South Africa, Botswana, Lesotho, Namibia and Swaziland. Access to the market is regulated by the Southern African Development Community Sugar Cooperation Agreement. South Africa and Swaziland are the only sugar producing countries in SACU. The region's sugar demand is estimated at approximately 2.2 MMT or 37 kg *per capita*. Post estimates that the South African sugar industry supplied about 1.7 MMT (1.8 MMTRV), Swaziland about 310 000 tons (330 000 MTRV) and imports, mainly from Brazil, about



190 000 MT (200 000 MTRV) to the SACU market in the 2012/13 MY. South Africa's sugar sales into the SACU market grew, on average, by approximately two percent per annum in the past ten years and post believes this trend will continue into the 2013/14 season. Hence, South Africa's sugar sales into the SACU market is expected to reach almost 1.8 MMT in the 2013/14 MY.

From South Africa's SACU sales, approximately 45% is sold to industrial customers, with the balance sold directly to consumers at retail. Approximately 77% of sugar sold to customers is refined sugar and the balance is brown sugar. Exports and imports for raw sugar and refined sugar for the 2011/12 and 2012/13 MY (May 2012 to December 2012) are Japan (30 000 MT raw sugar), Mozambique (7,064 MT raw sugar and 45 688 MT refined sugar), Angola (25 882 MT refined sugar), Indonesia (36 000 MT raw sugar) and Zimbabwe (14 790 MT raw sugar and 26 474 MT refined sugar) were the major export destinations for South African sugar, so far in the 2012/13 MY.

Sugar imports reached 192,660 MTRV in the 2011/12 MY, representing 11% of production. Sugar imports are expected to stay at the same level in the 2012/13 MY, but should decrease to its normal six percent of local production in the 2013/14 MY or about 150 000 MTRV, on an increase in sugar production. Most sugar imports are from Brazil.

PRODUCTION SCHEDULES

Activities	January	February	March	April	May	June	July	August	September	October	November	December
Soil sampling	X											
Soil preparation	X	X										
Planting		X	X	X	X							
Fertilisation		X	X	X								
Irrigation		X	X	X								
Pest control				X	X							
Disease control				X	X							
Weed control				X	X	X						
Harvesting				X	X	X	X	X	X	X	X	X
Marketing	X				X	X	X	X	X	X	X	X

UTILISATION



Sugarcane is used for sugar production, as raw material in human food industries, as a fertiliser and as livestock fodder.

The primary use for sugarcane is to process sugar, which is then used in producing an infinite number of products. The type of sugar produced by sugarcane is called sucrose. Sucrose is used as a sweetening agent for foods and in the manufacturing of cakes, candies, preservations, soft drinks, alcohol and numerous other foods.



It adds taste, texture and colour to baked goods and provides energy for yeast used in baking bread. It adds body to yogurt and helps to balance acidity in tomato sauces and salad dressings. Sugar helps to preserve jams, cereals, cakes, candies, cookies and drinks.

Tender, moist cakes and the golden-brown, crispy essence of biscuits are due to the presence of sugar in them.

The pulp from the cane is recycled and used to make cardboard and other forms of sugar board that can be used as ceilings etc. Recently sugarcane has also been used to manufacture Biofuel, which serves as a replacement for oil-based fuel and related products. The pulp of sugarcane can also be left aside in the sun to produce a fertiliser that is nourishing food for other plants and flowers. After a few months the pulp will turn black to form a fine powder. This black powder is used as fertiliser for other plants and flowers.

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