

SETTING THE SCENE

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In his opening address, the President of SASTA mentioned the interaction of biological and a biological factors we have to deal with. I wish to mention the practical constraints and challenges facing our industry in future.

The SA sugar industry is producing sugar economically despite a number of constraints. Some of the reasons for being an efficient and successful producer include

- the climate is ideal for ripening of the cane; the temperatures are moderate to cool in autumn and winter and the rainfall is usually high in the warm summer months and lower during autumn and winter
- with the early ripening the industry can have a long milling season, regularly extending from April to December
- prior to eldana, low sucrose varieties produced acceptable sucrose contents because the cane was 18 to 24 months old and sufficiently mature to have good milling traits
- modern sugarcane hybrids, starting with the release of NCo310 in 1945, and subsequent ones, are able to produce acceptable yields of sugar in these marginal conditions.

Present constraints to greater sugar yields

Climate

The mean rainfall of the rainfed areas is about 900 mm per annum, compared to Queensland in Australia and Sao Paulo in Brazil of more than 1 500 mm and 1 250 mm, respectively.

The frequency and intensity of droughts (such as the three in recent years) which reduced the total crop by up to 35%.

The supply of irrigation water is limited in those areas that can be irrigated.

Temperatures are moderate for a tropical crop; not excessively hot in summer and cool to cold in winter.

Solar radiation, on average, is not high and thus the crop cannot store more photosynthate.

Soils

About 60% of the soils are problem soils. These problems include shallowness, clay content, slope, low infiltration rate and waterlogged conditions.

Only 20% can be classed as good soils.

Not many soils are suitable for irrigation.

Ratooning in local conditions is not good. POJ2878 would not ratoon more than two or three times whereas, in one site in Colombia, it produced economic yields from the time it was planted in 1937 until the field was replanted again in 1985. The same variety was grown in the same field for 48 years.

Terrain

Apart from areas in eastern Transvaal and Zululand, most of the cane is grown in hilly and undulating terrains. This restricts the use of machinery for many farm operations and requires that the growers construct water and soil conservation structures. These are costly procedures.

The sugarcane plant

Sugarcane is a tropical plant and thus requires tropical growing conditions.

The modern varieties were bred from three or four species of *Saccharum*, notably *S. officinarum* (the source of sugar) and *S. spontaneum* (the source of hardness, ratooning and stalk numbers). Sugarcane inherited 80 chromosomes from the former and only 40 from the latter, but the modern varieties have variable chromosome numbers between 105 and 120. The large and variable chromosome numbers affect the inheritance patterns (as dosage does not seem to be important in visible traits) and chromosomes can be lost or gained without any visible effect. Normal genetic experiments thus have to be interpreted cautiously.

Contrary to crops such as wheat and tobacco and inbred lines of maize and sunflower, where crosses yield uniform offspring, those of a cross of two sugarcane varieties are extremely variable and the mean sucrose yield is usually less than the mean of the parents. Hence large numbers of crosses and seedlings have to be planted to ensure that seedlings with improved traits can be selected.

The generation interval in sugarcane is long (several years for conventional breeding systems) and this makes the programme slow to respond to new constraints compared to two or three generations per annum in maize, wheat, sugar beet and tobacco. By having shorter generation intervals, back crossing and line development can be speeded up. (In sugarcane back crossing is not practical as the offspring is so variable and the useful gene combinations of the recurrent parent are lost.)

The size of the crop makes harvesting and experimentation difficult and expensive.

Breeding

To ensure pollen fertility and seed set, all sugarcane flowers have to be kept in warm conditions of more than 20°C.

Many varieties do not flower freely locally and hence sophisticated facilities are required to obtain flowers from promising parent varieties.

The option of importing varieties and expecting them to yield as well as in the country of origin does not work in practice, as almost all imported varieties are not adapted to local irrigated conditions, let alone rainfed areas and droughts.

Diseases

The major disease affecting cane yield is RSD. In addition smut, mosaic and rust are serious diseases and commercial varieties have to be resistant to them.

There are a number of minor diseases such as gumming, Pokkah boeng, brown spot and red rot, and these are controlled through resistance.

Pests

Eldana is a major limiting factor in improving sucrose yields. It infests cane that is older than 12 months and the sucrose content of infested cane is significantly lower. All cane in the areas where eldana occurs has to be harvested before the sucrose yield has peaked, thus reducing the profitability in these areas.

Challenges for researchers

- To obtain more information on the genetic control of important traits so as to breed a new generation of varieties.

- To monitor disease and pest evolution so as to screen varieties in advance for potential epidemics.
- To improve screening procedures by using biotechnology, and insert genes with relevant promoters to improve quality and resistance traits.
- To be able to model the crop so that all agronomic problems can be solved using computers.