OTHER REGIONAL DEVELOPMENTS

The COMESA-SADC-EAC initiative

Given the many regional economic communities forming part of the eastern and southern Africa region, it has not been possible so far to implement a true project of regionalisation. With SADC, COMESA, EAC, IOC and IGAD in this part of Africa, there is potential to develop a common project for the harmonisation of the whole region. To that effect COMESA, SADC and EAC have agreed to hold a tripartite summit early in October 2008 to discuss the possibility of a common FTA with a view to becoming a better integrated region in the future.

Others

Efforts towards regional integration were given a significant boost by the challenge posed by food security issues upon Mauritius but also on the region. From 30 July to 3 August 2008, the Chamber participated in a workshop on the Preparation of a Regional Programme on Agriculture Production in Lusaka, Zambia. This first Preparatory Committee meeting also initiated strategies to tap resources from the newly-established EU Food facility which is intended to address structural reforms and production in the agriculture sector.

Otherwise, the Chamber pursued its involvement in promoting trade exchanges and agricultural production in Mauritius and the region, namely by increasing business contacts among operators and increasing its members' exposure to new opportunities. The Chamber was present at the *Foire Internationale de l'Économie Rurale* (FIER MADA) in Madagascar from 31 July to 5 August 2007, and at the *Foire Mauricienne à Madagascar* in November 2007. A third major event to which the Chamber participated was the Agro Industry 2008 (Dar-es-salaam) held in Tanzania in May 2008. That last event was focused on project build-ups essentially as relevant business contacts, interested investors and project opportunities were pre-identified in a number of countries of the region prior to the event, namely through the expertise of PROINVEST and all major trade promotion agencies.

It is to be noted, lastly, that the Chamber participated in a regional workshop *Atelier Régional du Programme Régional de Protection des Végétaux (PRPV) sur le Développement des Filières Semences et Plants de Qualité et des Zones Protégées* held in Madagascar from 21 to 29 April 2008. Stakeholders during that event were able to assess production management and importation issues for plant material among IOC countries and the various certification and control systems in place. They also determined practical modalities for the implementation of protected areas for safe trade exchanges of horticultural goods.

chapter six

Research and Scientific Progress

Research and Scientific Progress

Mauritius Sugar Industry Research Institute

Sugar Cane

Crop Improvement

Breeding

In line with the objectives of the cane breeding programme, 119,599 seedlings were produced and 100,000 retained for selection, 42 per cent being for the humid zone, 21 per cent for the dry zone and 27 per cent for the super humid zone. Emphasis was laid on the use of wild species in order to strengthen the genetic base-broadening programme aimed at introducing new genes into local breeding populations and to produce multi-purpose varieties with enhanced fibre content for co-generation.

Seventy-five varieties have been planted in 10 trials (T1) in the four major soil groups (B, F, L and P) and are being evaluated in plant cane and three ratoon crops for their suitability for mid-season harvesting (mid-August to mid-October). Twenty-five varieties have also been planted in a second series of six trials (T2) in three major soil groups for evaluation at early-season (June/July) and/or late-season (end October/November) harvests. The agronomic performance of about 202 varieties was reviewed in some 64 trials planted in the major environments. Two varieties *M 2627/92*, suitable for the sub humid zone, and *M 683/95* (super humid zone) were found promising and have been proposed for multiplication in large observation plots.

Members of the three Regional Committees which comprise representatives from large/medium-planters, Farmers' Service Corporation and the Institute as well as planters' advisers, evaluated nine promising varieties at 21 sites at the establishment phase and at the pre-harvest stage of cane growth.

The number of accessions in the germplasm collection has been raised to 2,026. They include species of *Saccharum* and allied genera (222), early generation interspecific hybrids (226), and commercial hybrids (1,534) of which 678 are of foreign origin, 38 of the 40 wild (*Saccharum spontaneum*) clones, the 10 multi-purpose higher fibre (HF) clones and the eight high quality (HQ) parent varieties with exceptionally high sucrose content, imported from the West Indies Central Sugar Cane Breeding Station (WICSCBS).

A new group of 70 M-varieties were exported to various countries - Australia (5), *Côte d'Ivoire* (26), Philippines (8), Mozambique (2), Uganda (11) and Tanzania (18). In addition, fuzz of five genetic combinations was exported to Pakistan.

Among the wide range of varieties being cultivated on miller-planters' land, 12 occupied 93 per cent of the area under cane in 2007 compared to only seven grown on 91 per cent of the area in 1995. For small planters (cultivating <10 hectares) only six varieties occupied 95 per cent of the area in 2007. A total of 24 varieties are now recommended for planting in the various soil groups and for harvest at different periods of the crop season. Among the newly-released varieties, variety *M 703/89* is being rapidly adopted by planters. Increasing interest is also being shown for variety *M 2593/92*.

Physiology

Sugar production in 2007 followed the downward trend being observed since 2001. This is due to a reduction in area harvested (1,398 hectares) and to a regressing sugar productivity resulting from lower cane yields and extraction rates. The 2007 crop season was in fact adversely affected by a poor rainfall distribution with relatively long dry spells interspersed with high rainfall events. The substantially higher minimum temperatures recorded were also detrimental to cane maturation. Other factors that contributed to the lower sugar production were the extended harvest period in some sectors, cane losses from mechanical harvest and higher loads of extraneous matter.

Work on a subset of varieties comprising precocious, early, high-sucrose and late ones confirmed that though the best criterion for assessment of earliness is pol % dry matter cane, pol % cane on a fresh weight basis is far less time-consuming, cheaper and quicker to apply. The best period for the assessment was mid-May but high sucrose varieties would best be identified in mid-August with the precision being better when done in ratoon crops. Pol % dry matter cane will henceforth be adopted for categorisation of parents for breeding purposes while pol % cane fresh weight will be used for selection purposes.

The quality of cane was monitored in all the sugar cane sectors and the results were communicated to growers and millers for decision-making on harvest of the different varieties and on the start of the milling season. By the end of May, pol % cane and juice purity were in fact higher than those of corresponding period of the reference 2001 crop. Indeed, the island average was 10.7 per cent against 9.0 per cent in 2001 and this was translated in 5.0° increase in juice purity. The better cane quality in 2007 at the end of May was due to the mild water stress and above normal temperature amplitudes prevailing during April and May. This advantage was however lost as the month of June was rainy, resulting in extraction rates at the start of the 2007 crop season being lower than those of 2001.

Research and Scientific Progress

Crop Protection

Pests

Infestation by the soft scale *Pulvinaria iceryi* was less than in previous years with only about 11 hectares affected. The white grub *Hoplochelus marginalis* was not detected in all the light traps or soil samplings carried out. Localised infestations by *Heteronychus licas* occurred on about 125 hectares and were treated successfully with thiamethoxam or imidacloprid. Infestation by armyworms also occurred in several regions (500 hectares) and approximately 300 hectares were successfully treated with cyhalothrin or indoxacarb. An unusual infestation by the maize webworm *Angustalius malacellus* was observed on young plant canes at Belle Vue S.E. and insecticide indoxacarb had to be applied to reduce the infestation.

Studies on the dispersal of young stages of the soft scale *Pulvinaria iceryi* highlighted the importance of wind in the spread of the pest. Transmission of the Sugar Cane Yellow Leaf Virus by the aphid *Melanaphis sacchari* has in addition been confirmed in laboratory studies.

Diseases

Sugar cane diseases were low in commercial fields. Gumming disease is subsiding in the East of the island and leaf scald incidence was low in highly susceptible varieties in the western sector where conditions favouring the disease usually occur. As in 2006, smut was again found in one field of *M 1186/86* at Argy but it was absent in fields of the same variety at other locations. Peak yellow spot infection was reached in June rather than April-May, probably because of the below normal rainfall recorded in the centre of the island during March to May. The percentage leaf infection in reference varieties such as *R 570, R 579* however did not exceed 22 per cent. Brown rust (*Puccinia melanocephala*) was insignificant during the year.

Islandwide surveys on the distribution and epidemiology of yellow leaf caused by the Sugar Cane Yellow Leaf Virus showed more than 50 per cent infection in 13 varieties, thereby confirming the widespread nature of the disease. Variety *M 1176/77* appeared to be resistant to the disease as none of the 275 samples tested was positive. It could also be deduced that *R 573* is tolerant, with only 6 per cent infection.

Resistance trials to evaluate promising local clones and foreign varieties against major diseases were completed for gumming, leaf scald, smut and yellow spot. The information obtained is being used in variety selection. Dual row planting of varieties in the nurseries was also evaluated and found to be appropriate for increasing field density without the production of cuttings being compromised.

Weed Management

Two trials established in plant cane to evaluate the efficacy of the tank-mix Dinamic (amicarbazone) + acetochlor in pre-emergence of weeds and cane showed the tank-mix Dinamic + acetochlor to be comparable to the standard but superior to Dinamic alone. The tank-mix Dinamic + acetochlor at 1.05 + 3.6 kg a.i.ha^{-1} will consequently be recommended as an additional pre-emergence herbicide treatment for both plant and ratoon cane.

Four trials to evaluate the new tank-mix Dinamic + ametryn + MCPA (1.05 + 2.0 + 1.5) kg a.i. ha^{-1} for general early post-emergence and pre-emergence weed control and to determine its phytotoxicity on cane showed that Dinamic alone was effective on a wide spectrum of broad-leaved weeds and on *Digitaria horizontalis* but not on sedges and some grasses. In tank-mixes with ametryn and MCPA, the level of weed control improved significantly and was comparable to that with the standard Dinamic + Krismat. However, some phytotoxicity was observed on the sugar cane variety *M 1394/86*, a moderately susceptible variety.

The good efficacy of the tank-mix Dinamic + ametryn + MCPA confirmed that it can be used as an alternative to the standard Dinamic + Krismat in ratoon cane, particularly with respect to the new strategy in weed management to delay the first herbicide application. The new tank-mix will be recommended to growers for use in early post-emergence of weeds in both plant and ratoon canes as follows:

- For susceptible sugar cane varieties: Dinamic + ametryn + MCPA (1.05 + 1.2 + 1.5) kg a.i. ha^{-1}
- For tolerant sugar cane varieties: Dinamic + ametryn + MCPA (1.05 + 1.6 + 1.5) kg a.i. ha^{-1}

Crop Management

Cultural Operations

A new cropping system developed in Australia and based on the adoption of reduced tillage, controlled traffic, and a fallow period or legume break is being adapted to improve productivity, particularly in the increasing areas harvested mechanically. A trial has been laid down at Belle Vue S.E. where the traditional planting method, i.e. conventional tillage + 1.62 m row spacing with no legume break is compared to a new cropping system which combines the following practices: reduced tillage and fine derocking using a stone crusher ('*broyeur*'), growing of lablab (var *Rongai*) for three/four months before replanting sugar cane in dual rows at 1.88 m between pairs of rows to match harvester track width. The trial will be harvested in 2008.

Irrigation

The net area under irrigation has increased on miller-planters' lands. Most of the increase occurred in the East as a result of an important shift from intensive to occasional irrigation. The additional area irrigated amounted to 200 hectares. Islandwide, there was a net 8 per cent increase in area under the high-pressure overhead system, which is practised on 30 per cent of the total irrigated area. Area under centre pivot has reached 37 per cent and continued to increase with the procurement of five new units bringing the total number of the units to 101. The increased areas under centre pivot and high pressure overhead system were offset by a lower surface under dragline and drip particularly in the West and in the South.

Monitoring of soil moisture on a real-time basis under centre pivot and drip irrigation showed that in both systems drainage rates remained low under low rainfall, but increased much faster under drip than under centre pivot with the advent of rain. Maximum rates of about 1.2 mm day^{-1} were observed under drip irrigation compared to only 0.3 mm day^{-1} under centre pivot. Water use efficiency, expressed in terms of kilo of cane produced per unit of water consumed was higher for centre pivot (98 kg ha^{-1} mm^{-1}) than for drip (94 kg ha^{-1} mm^{-1}), in spite of the latter's higher cane yield. This study shows that a more efficient use of rainfall occurs under centre pivot and that soil moisture sensors can be used to monitor irrigation to minimise drainage underneath the root zone.

The possibility of extending the useful lifetime of buried driplines is being investigated by replanting a drip-irrigated sugar cane field using minimum tillage practice (MTP) and without replacing the existing driplines. When compared against a field under conventional planting with new driplines installed, preliminary results showed that early cane growth with conventional planting and new driplines is only marginally superior to MTP with old driplines.

Research and Scientific Progress

Soil and Nutrition

Controlled Release Fertilisers (CRF) have often been claimed to improve nutrient utilisation efficiency by crops by virtue of the slow release of the nutrient when applied to soils. Three types of urea-based polymer coated CRF's having release time period of 3, 6 and 9 months have been evaluated to determine the benefits to be gained in the use of CRF in sugar cane nutrition. Preliminary data showed that the CRF releasing its nitrogen within three months increased the efficacy of urea and produced yields that were comparable to ammonium nitrate fertilisers.

Field trials have confirmed that concentrated molasses stillage (CMS) enriched with urea to attain fertiliser equivalence of the formulation 19-0-19 was just as effective as ammonium nitrate based granular blended fertiliser 19-0-19. As CMS is in liquid form, its rapid incorporation into the soil after application would be an advantage when compared to surface banding of urea based granular fertiliser because ammonia volatilisation would be reduced significantly.

While fertilisation of sugar cane is focussed on the three major nutrients (NPK), continued mining of secondary nutrients (CaMgS) and trace elements such as Zn, Mo, B, Cu and Mn without replenishment may also lead to a degradation of soil fertility. Monitoring of the nutrient status of sugar cane by foliar diagnosis fortunately showed that at present there is still no cause for concern as the concentration of the secondary and trace elements remained well above their reported critical values irrespective of soil types.

Sugar cane cropping and mechanisation have been shown to exert both positive and negative effects on soil quality. Soil organic carbon (SOC) stocks in the top 30 cm layer did not show any significant decline after more than 50 years of continuous sugar cane cultivation or as a result of mechanised farm operations. However, SOC derived from sugar cane residues was significantly lower in fields that had undergone intensive derocking. Tillage led to mixing of topsoil into the subsoil and thereby decreased the organic matter content in the topsoil while increasing its content in the subsoil. Cropping also tended to improve the chemical quality of the soils, presumably because of the application of organic amendments. In this context, trash blanketing was found to increase the labile fraction of SOC by nearly 40 per cent in the top 30 cm profile when compared to fields where trash had been burnt at harvest. Mechanisation on the other hand is invariably found to cause soil physical quality to decline. The main effect was topsoil compaction which would lead to a decrease in water infiltration rates.

Mechanisation

In the humid zone it is now possible, instead of trash burning, to incorporate the trash using flail disc harrows. This practice is strongly being advocated as opposed to the standard discs as it will improve soil quality and is cheaper.

Planting material can also be prepared mechanically provided that the required modifications are brought to the commercial chopper harvester. Billet length would then become more uniform and billet quality would be improved as a result of a reduction in mechanical damage to the buds. The amount of planting material prepared by the modified harvesters in 2007 was 10,500 tonnes, while the area planted either manually or mechanically using these mechanically prepared setts amounted to 900 hectares.

Moreover, for fields targeted for mechanised harvesting higher cane yields would be obtained when the setts are planted at 30 cm depth (with or without earthing up) than when the setts are placed in standard 20-cm deep furrows.

Forty chopper harvesters and two wholestalk harvesters were in operation during the 2007 harvest, cutting 1,454,550 tonnes of canes on 18,550 hectares. Monitoring of cane losses in mechanised chopper harvesting showed that pick-up and extractor fan losses remained the two most important sources of loss.

Sugar Technology and Engineering

Evaluation of the automatic cane analyser (Infra Cana), which uses Near Infra Red Spectroscopy, in cane analysis for payment purposes by the Cane Planters and Millers Arbitration and Control Board (CPMACB) continued during the 2007 crop at Savannah. At the end of the crop season, some 12,000 cane samples were scanned with the analyser and parallel tests were done on the same samples using conventional method. The data have served to consolidate the calibration equation. Based on the success achieved, the CPMACB has considered the adoption of the analyser for payment purposes to the sugar cane planting community.

Centralisation of cane milling activities continued in 2007. Two factories (Riche en Eau and Mon Trésor) have ceased to operate and have transferred their cane milling activities to Savannah where the hourly cane crushing capacity was raised from around 160 to 350 tonnes. Savannah has, apart from adopting the cane diffusion technology, also erected and commissioned a power plant of 83 MW installed capacity next to the mill.

Electricity export to the grid from power plants located in sugar mills increased from 1,016 GWh in 2006 to 1,226 GWh in 2007. Electricity from bagasse alone increased from 303 to 347 GWh and was equivalent to about 16 per cent of the total electricity generated from all sources on the island.

Research on bioplastic production from sugar cane biomass has allowed the efficiency of hydrolysis of the bagasse cellulose/hemicellulose fractions to rise from 20 per cent to around 30 per cent. This improved efficiency is however still low from the viewpoint of commercial production.

Crop Diversification

Potato

Upon evaluation of local clones and foreign commercial varieties for yield and processing quality, three local clones were found to be high-yielding, tolerant to late blight and suitable for processing. If their good performance is confirmed with certified seed in 2008, they will be released for commercial exploitation. Among the foreign varieties, two were found to be suitable for crisps and French fries, but their yields were low.

Seed Potato

The 1,111 tonnes of seed potato produced in 2006 were certified for ware production in April. Some 39 tonnes (3.6 per cent) had to be discarded because of the presence of viruses above the recommended level of 10 per cent. With the exception of soft rot observed after plantation and which is linked to climatic conditions, all remaining seed performed well.

The seed programme for 2007 was curtailed following the liberalisation of seed import. Furthermore, seed size was reduced to 30-200 g and 30-150 g in first and second seasons respectively. Consequently, only 534 tonnes of seed were produced. Detection of viruses by ELISA on 1,450 samples showed the level of infection to be 5.4 per cent.

The aeroponic system for the production of minitubers was expanded. About 25,250 minitubers of variety Belle Isle were produced from about 8,600 potted tissue culture plantlets under shade house conditions. The two techniques, tissue culture and aeroponics, will allow a constant output of pre-basic seed for field multiplication.

Research and Scientific Progress

Isolates of bacterial wilt were collected around the island and characterised. The new race 3 biovar 2, observed in 2005 and 2006 was not found. On the other hand, isolates collected from *Zinnia* sp. at Réduit, ware potato from the market and from soil turned out to be race 1 biovar 4. The latter is similar to race 1 biovar 3, the common race in Mauritius.

Below normal rainfall from the months of May to September were unfavourable for late blight *(Phytophthora infestans)* development. The disease was well managed with the recommended fungicides, including the new systemic fungicide Infinito (fluopicolide + propamocarb-HCl).

Bacterial soft rot *(Pectobacterium carotovorum)* was common and was in fact severe during the first and second seasons. Some fields, particularly in the Centre and South of the island, showed as high as 60-80 per cent infection and yield was significantly reduced. Variety *Mondial* was more prone to the disease than *Delaware* and *Spunta*.

Palm

The study sponsored by the Mauritius Research Council on optimum sucker population density in pejibaye palm cultivation was pursued with the harvest of palm hearts at two of the five sites two years after planting. No significant difference in edible heart weight was found among planting densities. Thus, denser planting than currently recommended can be contemplated.

Pitaya or Dragon Fruit

Work on pitaya *(Hylocereus undatus)* continued at Réduit, Pamplemousses and Belle Rive with numerous crosses made between the clone Local White 1 and its two compatible clones Local Red 1 and Local Red 2 and among the compatible red clones themselves. Clones Local Red 1 and Local Red 2 flower earlier than the clone Local White 1, as early as November provided that adequate water is available during the months of August and September. Since the two red clones are cross-compatible, fruit production may start as early as December before the festive season. Marketing tests showed that the fruits are readily accepted by consumers.

Biotechnology

The tissue culture laboratory set up in the mid 1990s for the micropropagation of sugar cane plantlets is now being more and more utilised for multiplication of other crops. In addition to some 25,000 sugar cane plantlets, more than 10,000 disease-free plantlets of potato variety Belle Isle as well as 2,000 plantlets of five promising potato clones were produced from the laboratory. The plantlets were planted either under solar dome or under glasshouse conditions to obtain mini-tubers which will be used for seed production. Some 5,000 plantlets of *Aloe vera* and banana were also produced.

The development of transgenic sugar cane tolerant to drought was pursued with a number of transgenic plantlets of the Australian variety *Q 117* produced following microprojectile bombardment of embryogenic callus with a drought resistant CBF4 gene driven by the *Ubi* promoter. Some 200 plantlets from each of two transgenic lines of *Q 117* were transferred to the glasshouse for a drought assay. The expression of some abiotic-stress-resistance genes were highly up-regulated under normal environmental conditions due to expression of the CBF4 gene in one of the transgenic line. Phenotypic differences were also observed between the two transgenic lines.

Real-Time reverse transcriptase polymerase chain reaction (RT-PCR) assay is now routinely used for the detection of *Sugar cane yellow leaf virus* from both sugar cane leaves and from its aphid vector *Melanaphis sacchari*. Four genotypes of the virus have been reported to exist elsewhere and were all identified in Mauritius.

Environment and Natural Resources Management

Derocking of Small-Planters' Cane Lands and their Suitability for Mechanisation

The data acquired in 2001-02 from the Land Resources and Agricultural Suitability Map of Mauritius and from aerial photographs were updated in collaboration with the Farmers Service Corporation in 2006-07 by a field survey covering the whole island. The survey revealed that only 3,919 hectares (18 per cent) were rock-free soils whereas the remaining 18,012 hectares (82 per cent) were gravelly, rocky or stony soils. Areas free of rocks and rock piles on the surface covered about 2,900 hectares; areas derocked but comprising few scattered rock piles on the surface amounted to 9,272 hectares while areas partially derocked or non-derocked with moderate to high density of rock piles occupied some 5,840 hectares.

While only about 102 hectares have been prepared for full mechanisation, the area suitable for full mechanisation, provided fine derocking and land planning measures are implemented, in fact covers 3,421 hectares. Areas suitable for partial to full mechanisation represented another 21.7 per cent (4,767 hectares) of the total area under sugar cane. The remaining 13,642 hectares of land are either suitable for partial mechanisation only, excluding mechanised harvest or are not at all suitable for mechanisation, the main constraint being either isolated small plots within built-up regions or steep slopes or presence of deep drains in super humid regions or very rocky soils.

Mechanisation Implementation and Progress in Miller/Corporate Planters

A survey on the implementation of mechanisation by miller/corporate planters through proper land preparation showed that land suitable for full mechanisation (M1 class) now constitutes almost 50 per cent of their cultivated sugar cane land area (22,718 hectares). Much of the progress achieved had been in the North and South sectors. Sugar cane land classed as M2 (land suitable for full mechanisation - land planning measures are in progress or are required) represented 15 per cent of the total area under sugar cane with 47 per cent of the 6,421 hectares being located in the South sector. With regard to land classified as M3 (suitable for partial mechanisation, excluding mechanised harvest with land planning measures in progress or required) and land in M5 category (not at all suitable for mechanisation) make up 24 per cent and 12 per cent, respectively, of the area under sugar cane.

Extension Activities

About 970 soil samples from small planters' land were analysed for fertiliser and soil amendment recommendations.

Three Recommendation Sheets as well as an Info Sheet advising sugar cane planters on practices to be adopted after cyclone *Gamede* were issued. A manual on 'Good Management Practices to improve the productivity, competitiveness and sustainability of the Mauritian Sugar Cane Industry' was also published for the benefit of the sugar cane planting community.