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SUGAR CANE VARIETY RESEARCH FOR THE CARIBBEAN
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UNITED NATIONS
 ECONOMIC COMMISSION FOR LATIN AMERICA Office for the Caribbean



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1. Sugar in the Caribbean

Though sugar is one of the traditional commodities of the Caribbean, the last 20 years have seen big changes in production and organization, and the industry is still unstable. The many reasons for change - competition from beet and corn sweeteners in our traditional markets; competition for land and labour with other development; lack of investment or foreign exchange for modernization or maintenance of factories; irrigation systems, etc.; sociological criticism; land reform and increased Government involvement - need not concern us here. Table 1 highlights in particular the decline in production of the English-speaking Caribbean.

The major innovation in the past 20 years has been the increased mechanization of sugar cane agriculture, particularly of harvesting. In several ways this itself has been responsible for a reduced standard of crop husbandry and quality of cane delivered to the factory, and the exercise has not saved money; rather, it has been forced on the industry by the shortage of labour, particularly seasonal labour.

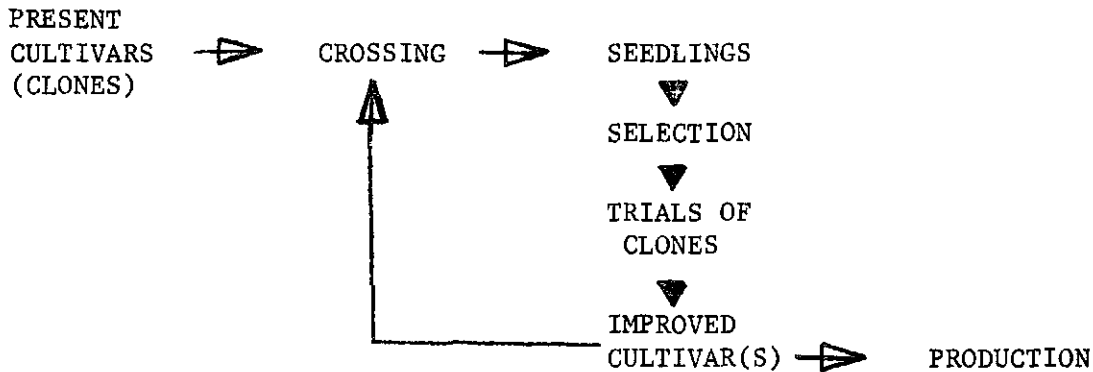
These factors - declining production and changing field technology have repercussions on both the scale and priorities of sugar cane research effort in the region.

2. Fundamentals of a Breeding Programme

As with all plant breeding, continuity is very important. A short project approach is not appropriate: breeding of some other crops has suffered from this, with periods of inactivity between projects when staff disperse and genetic collections are lost or mixed. With a semi-perennial crop like sugar cane the longer

generation time and the need to keep collections intact in the field (rather than as seed in a storeroom) makes continuity even more important.

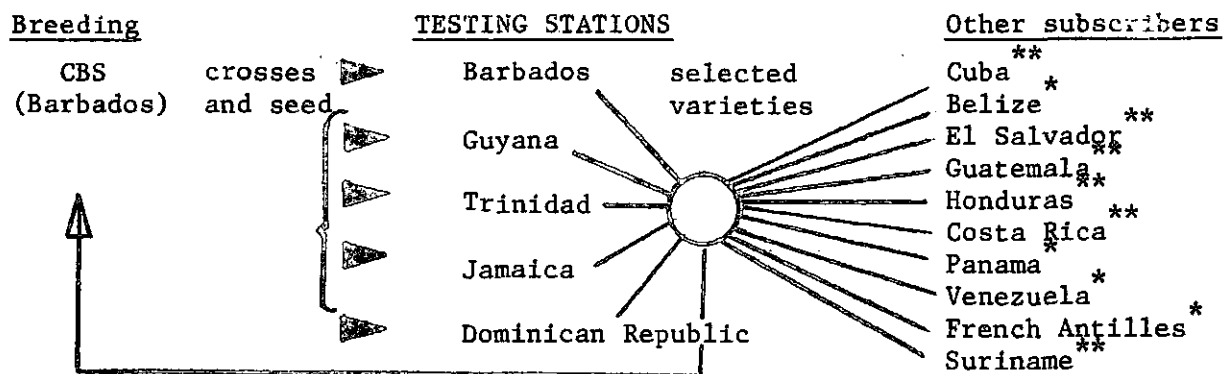
In the Caribbean, sugar cane breeding is essentially applied research: all research is directed towards obtaining commercial varieties of superior performance for the prevailing ecological and industrial conditions. In its simplest form it is a recurring cycle of crossing and selection with a cycle time of 8-12 years.



Ancillary research has been directed into such subjects as flowering mechanisms and control; induction of mutations; physiological and morphological features of the plant that optimise performance.

3. West Indies Organization

The remainder of this paper describes the network of sugar cane variety improvement effort centered on the Breeding Station (WICSCBS) in Barbados. The Station has been regionally supported since 1932 and since 1962 belongs to the Sugar Association of the Caribbean (SAC). It is financed out of cesses on production. Seed from crosses made each year is sent to major members who raise seedlings and operate independent selection and testing programmes. At some stage promising selections, by this time clones, are offered for exchange among all other members and to further members who do not undertake programmes from the seedling stage. Each station raises about 30,000 seedlings p.a.: with 6 co-operating stations the region has effective access to nearly 200,000 seedlings p.a. . The Breeding Station, however, occupies no more than a consulting position vis-à-vis the variety testing programmes.



* as of 1982-83.

** Contracts in recent years, in abeyance.

In addition five industries in Africa subscribe to the scheme.

Members exchange information freely and meet once a year for a two or three-day Workshop held alternately in Barbados or one of the other Testing Stations.

4. Research Programme

As mentioned above, the core of the programme concerns immediate commercial objectives. Operational research is directed towards optimising the processes of crossing, variety selection and quarantine including the collation of regional data to help formulate the breeding plans. Increasingly this feed back of information and of regionally-selected varieties is in turn generating separate breeding programmes, e.g. North Caribbean, South Caribbean. We would visualise possibilities for other regions, e.g. Central America, though we believe also that there will always be widely adapted varieties and widely adapted crosses deserving of trial in all environments.

Alongside the commercial programme the WICSCBS carries on large genetic base-broadening programme. Some 50% of all crosses made each year involve 'wild' species and more primitive generations, through which genes for better ratooning, better disease resistance and other desirable traits may be introduced. Part of this long-term programme is also directed towards high

biomass production. It is hoped to study in further detail the levels of minor sugars (which interfere with sucrose recovery) and qualities of fibre by co-operation with other laboratories.

5. Facilities and Staff

The WICSCBS has 40 acres of land, occupied by the genetic collection (used as a source of flowers for crosses) and seedlings of early generation families. The genetic collection is very diverse: approximate numbers of clones are:

Caribbean region commercial-type hybrids	900
Commercial-type hybrids from other areas	60
Saccharum spontaneum	60
S. robustum	30
S. barberi	5
Noble (S. officinarum)	100
Ripidium arundinaceum	9
Early generation hybrids in B-B programme	600

Staff numbers have fluctuated recently:

- 2 to 5 scientists
- 2 to 5 technical assistants
- Field manager
- Secretary
- 12 to 16 field staff

A simple laboratory equipped for cytology, plant pathology, meristem culture and sugar cane analysis (sugars and fibre), library, hybridisation house, seed packing room (dehumidified) and normal agricultural equipment completes the facilities.

6. Achievements

Improved varieties have made major contributions to the industry in four spheres:

- a) Improved ratooning. The number of years between replanting is determined, under astute management, by the economics of the farm and the decline in production in successive ratoons. With a large 'overhead' component of costs on Caribbean plantations, high yields of cane must be maintained and

replanting cycles are therefore fairly short. This is also important nationally (filling quotas and earning foreign exchange). Soil type, climate and management affect the ratooning capacity, but varieties play their part. In Barbados, for example, ratoons as percentages of total areas harvested have increased:

1950: 61% 1960: 70% 1970: 76% 1980: 77%

A new variety capable of maintaining yields for one more year has to make an economic contribution to the industry, and improved ratooning capacity must form the major thrust of our breeding effort;

- b) Higher sucrose: It costs the farmer no more to grow a high quality variety so long as versatility is maintained. Caribbean industries are slowly introducing systems of premium payment to encourage better cane quality and this in turn will focus on this aspect of a variety's performance. Calculations for the Barbados industry for the past 15 years suggest that improved sucrose content due to varieties should be of the order of 1.5%; in fact, this has not been realized due to simultaneous declining standards of cleanliness and freshness of cane delivered to the factories. What can be said is that, without the improved varieties, sugar recovery % cane would have fallen by 1 1/2%;
- c) Disease resistance: It is not practical to use chemical control for diseases in sugar cane: resistance of varieties is paramount. Mosaic (virus) has been eliminated in most Caribbean sugar industries by the use of resistant varieties over the past 25 years, and similarly Leaf Scald (bacterium) has been brought under control. No other diseases of economic consequence were present until 1974, when Smut (fungus), followed by Rust (fungus) in 1978,

spread rapidly through the region, severely infecting certain major commercial varieties. These two diseases have already been brought under control by switching to resistant varieties along with intensive study of variety resistance testing techniques partly undertaken by the WICSCBS. It is noteworthy that countries with the more active variety testing programmes - Guyana, Barbados, Jamaica, Cuba, Dominican Republic, Panama, Belize - have overcome these diseases with new varieties, while others have had to revert to older varieties or tolerate losses caused by infection; and

- d) Harvestability: Changes in harvesting techniques are profoundly affecting agricultural practices and cane quality. A variety that presents itself to a harvester, tops and cleans of leaf trash easily, does not shatter and has a slow rate of deterioration will optimise harvester performance and factory recovery of sugar. Harvester designs are improving slowly, particularly with increasing interest in harvesting without burning. Improvements in varieties are hard to quantify, particularly in the Caribbean industries that are in various stages of transition from traditional hand methods (though with poorer standards of work) to full mechanisation.

The major part played by WICSCBS varieties is indicated in Table 2.

7. Constraints

As can be seen, the WICSCBS structure is small and administration simple. This has advantages but means that it is very dependent on the strength of the network of associated Testing Stations. Also, any multi-disciplinary work (e.g. the reasons for ratoon decline) is difficult owing to the specialist nature of the WICSCBS staff and its relative isolation. I would list five aspects that deserve attention:

- a) Size of market for varieties and financial support: Considering its size and diversity, the WICSCBS breeding programme is at present under-utilized. Financial support on a per ton basis

is increasing for the owner members (SAC) due to inflation, falling sugar production and some uncertainty in foreign subscriptions. Some Central American industries treat research as an occasional extravagance to be indulged when sugar prices are high. Many have grown B varieties though never subscribed to the WICSCBS (Table 2). Other member countries such as Cuba are building up their own breeding programmes. To use an economic term, the 'critical mass' of our membership may fall to the point where it cannot support a comprehensive programme of research in varieties or in other fields. There was some hope that the Group of Latin American and Caribbean Sugar Exporting Countries (GELPLACEA) would strengthen regional research effort. However, the English-speaking Caribbean has stood aloof from GEPLACEA and no financial support has been generated. Technical co-operation and exchange on a free basis is developing among some GEPLACEA members; in the variety sphere with the Government-assisted breeding programmes in Brasil and Mexico;

- b) Quarantine: Quarantine regulations have restricted, or at least slowed down, the desired scale of variety exchange in the Caribbean. The WICSCBS has been active in developing safe pre-export procedures (through meristem culture) that make elaborate intra-regional post-entry quarantine unnecessary but has been only partially successful in selling this to Government officials. The impetus has now been reduced since we no longer have a plant pathologist on staff;
- c) Computer facilities of our own are long overdue. Micro computer abilities have now developed to the point where we have decided to purchase, but the regional exchange of information has suffered in the interim;
- d) Language barriers are real obstacles to closer ties between us and the Spanish-speaking industries;
- e) Air freight is unreliable in the Caribbean though this may seem trivial, the inability to deliver perishable cargo from Barbados to Central America threatens to cause the termination of contracts; and

- f) Lack of vision for other uses of sugar cane in the region, apart from Cuba and Puerto Rico (with their own energy research funding), means that the full potential of sugar cane breeding (e.g. for fibre) is not being exploited, even though predictions world-wide are that sugar cane will play a major role in the longer term as a source of fuel and fibre as well as carbohydrate sweetener.

8. External Linkage and the Future

Sugar cane has not, until recently, been considered a priority crop for research funding by international agencies such as CGIAR, but WICSCBS is in touch with the IBPGR of FAO and we hope for at least project support. One project on in vitro quarantine was supported by a CDB grant. SAC's thinking is that, while project support is very welcome, it does not secure the core objective of the breeding programme for sugar production over the longer term. To that, I would add the programme for other uses for sugar cane.

In the face of the decline in many of the islands' industries, strengthening of the Station would be achieved only by strengthening ties with mainland industries, in Central and South America and Africa, who lack genetic collections, staff, experience and climate equivalent to those of the WICSCBS in Barbados. Simultaneous with a strengthened breeding programme there would be need for strengthened testing programmes in some countries and a mechanism for more immediate exchange of information and of varieties on a larger scale than in recent years. Nevertheless, we have already a network of sorts on which such developments could be built.

Table 1
3-year Average Sugar Productions for Periods
10 Years apart in some Caribbean Sugar-
Producing Countries

Country	Production, thousands m.t. (3-year average)			Principal operator of industry	Principal operator of sugar research
	59-61	69-71	79-81		
Cuba	6,198	6,348	7,510	Govt	Govt + Univ
Dominican Republic	931	1,011	1,107	Govt + Pvte	Govt + Pvte
Haiti	59	64	58	Pvte	Pvte
Puerto Rico	971	379	171 ^{1/}	Govt	Govt + Univ
U.S. Virgin Islands	11	0	0	-	-
Jamaica	420	391	244	Govt ^{*/} + Pvte	Govt ^{*/}
Leewards + Windwards	84	36	37	Govt ^{*/}	Govt ^{*/}
Barbados	168	148	116	Pvte	Govt ^{*/} + Pvte
Trinidad	218	230	117	Govt ^{*/}	Govt ^{*/}
Guyana	319	372	307	Govt ^{*/}	Govt ^{*/}
French Antilles	246	182	114 ^{1/}	Pvte	Pvte
Belize	21 ^{2/}	64	106	Pvte	Pvte
Mexico	1,509 ^{2/}	2,485	2,819	Govt + Pvte	Govt
Guatemala	78 ^{2/}	188	447	Pvte	Pvte
El Salvador	51 ^{2/}	128	224	Pvte (?)	Pvte (?)
Honduras	22 ^{2/}	59	176	Pvte	Pvte
Nicaragua	64 ^{2/}	153	202	Pvte + Govt	Govt + Pvte
Costa Rica	65 ^{2/}	153	205	Pvte	Govt + Pvte
Panama	27 ^{2/}	77	204	Pvte + Govt	Pvte + Govt
Venezuela	219 ^{2/}	454	336	Govt + Pvte	Govt + Pvte

^{1/} Excluding 1981

^{2/} Excluding 1959

^{*/} In English-speaking industries, Government generally operates through an autonomous corporation or Board with research attached to a Ministry of Agriculture or by a specialist research institute. Hence Governments do not directly subscribe to the W.I. Central Sugar Cane Breeding Station.

Table 2
Origins of Major Varieties Grown in the Past 20 Years

	Numbers of varieties originating from breeding programmes in							
	Barbados	Cuba	Dom. Rep	Puerto Rico	Guyana	Indonesia	India	U.S.A.
Cuba	3	2	-	-	-	1	-	-
Dominican Republic	3	2	2	1	-	-	-	1
Jamaica	6	1	-	-	-	-	-	1
Barbados	6	-	-	-	-	-	-	-
Trinidad	2	-	-	-	-	-	-	1
Guyana	4	-	-	-	3	-	-	1
French Antilles	7	1	-	1	-	-	-	1
Belize	3	-	-	-	-	1	-	1
Mexico	1	-	-	1	-	-	1	-
Nicaragua	2	-	-	-	-	-	-	1
Costa Rica	3	-	-	-	-	-	1	1
Panama	4	1	-	1	-	-	-	-
Venezuela	3	-	-	1	-	-	-	1

