CANE BREEDING

COPERSUCAR BREEDING PROGRAM
Jacques Y. J. Miocque
Copersucar, Sao Paulo, Brazil

ABSTRACT

The Copersucar breeding program was started in 1968 with the installation of the Camamu Experiment Station in the State of Bahia for the obtention of cane seeds. The seed germination and the clone selection is carried out in the experiment stations situated in the State of Sao Paulo and under the ecological cultivating conditions of the future SP varieties.

The climatic conditions in Camamu are especially favorable to sugar cane tasseling and seed production. The amount of seeds obtained meets the demands of several research institutes. By means of tasselling control it is possible to coincide the tasseling of a great number of progeny at the same time. The viability of the seeds is increased by specific treatments. The first six SP varieties resistant to smut and mosaic were released in 1978.

INTRODUCTION

The Copersucar breeding program began in 1968 by the enterprise of the "Cooperative Central dos Produtores de Azucar e Alcooil" which comprises 74 sugar mills in the center-south region of Brazil. On the coast of the State of Bahia a crossing station has been installed in an area offering more favorable conditions to flowering than were found in the State of Sao Paulo. The Camamu Experiment Station, longitude 39°07'W, latitude 13°55'S, is placed in an especially appropriate region to obtain sugarcane seeds for crossing researches.

In 1969 the first tassels were cut. They came from the collection planted the year before. The crossing campaign is held every year in May and June. The seeds obtained are sent to the Copersucar Experiment Stations in the State of Sao Paulo where they are sown. The clones are selected and multiplied in the fields of the co-operated sugar mills.

The Experiment Station Itamogi, in the State of Parana, has been especially installed by Copersucar to test the resistance to the diseases which occur most frequently in the sugarcane regions of the State of Sao Paulo where the future varieties will be planted. These varieties have been given the name SP, registered with the ISSCT.
PURPOSE OF THE BREEDING PROGRAM

The purpose of the program is the production of sugarcane varieties adapted to the edaphological conditions of the regions where the mills affiliated to Coper- sucar are installed. These are situated in the center-south region of Brazil between the parallels 23° and 15°S. The sugarcane is planted on a strip of land which goes from sea-level (Campos, State of Rio de Janeiro) to 840 m altitude (Sao Carlos, State of Sao Paulo).

When selecting the clones, special importance is given to the following criteria:

- Productivity of the sugarcane aiming at a bigger quantity of sugar produced per area, according to the economical standard established by Hugot.

- Ratooning ability under the conditions of low temperature and deficient rainfalls at the time of harvesting.

- No tasseling under the climatic conditions of the center-south region of Brazil.

- Adaptability to low fertility soils (cerrado).

- Ability to mechanical harvesting.

EDAPHOLOGICAL CONDITIONS

The woods which covered the 50 ha of the Camamu Experiment Station were partially cut down for the plantations. The soil of the upper parts of the station where sugarcane is planted is latosol (Typic Haplorthox). Its iron content is low, its aluminum content high and there is low saturation of bases and little natural fertility. The retention of humidity of this argillaceous siliceous soil is low, its porosity high, permitting good development of the sugarcane root system. Due to the use of fertilizers applied at several times during the year and the heavy rainfalls, the sugarcane vegetation is vigorous.

CLIMATIC CONDITIONS FOR THE TASSELING OF SUGAR CANE

After several years of meteorological observations it has been possible to gather the information characterizing the climate of the Camamu Experiment Station.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual medium maximum temperature</td>
<td>28.6°C</td>
</tr>
<tr>
<td>Annual medium minimum temperature</td>
<td>20.1°C</td>
</tr>
<tr>
<td>Monthly maximum temperature: January</td>
<td>29.8°C</td>
</tr>
<tr>
<td>Monthly minimum temperature: August</td>
<td>17.9°C</td>
</tr>
<tr>
<td>Annual medium relative humidity</td>
<td>78.3%</td>
</tr>
<tr>
<td>Annual rainfalls</td>
<td>2013.5 mm</td>
</tr>
<tr>
<td>Annual number of rainy days</td>
<td>275 days</td>
</tr>
<tr>
<td>Annual solar illumination</td>
<td>2148.3 hours</td>
</tr>
<tr>
<td>Annual medium solar radiation</td>
<td>425.9 cal/cm²/day</td>
</tr>
</tbody>
</table>
These characteristics of the Camamu climate correspond in Koeppen’s classification to the tropical climate Af. The amplitude of the variations during the year is small and there are no limiting levels to tasseling and the viability of pollen.

At the time of the floral induction in January, February and March the dark period varies from 11 h 14’ to 12 h 15’.

ORIGIN OF THE INTRODUCED VARIETIES

In 1969 a research was carried out in order to gather a collection of progeny constituted by all the varieties existing in the experiment stations and private collections of the sugar mills from all parts of Brazil. The purpose of this research was the study of the very often little known genetic potential of these varieties.

During the following years this collection was completed with varieties imported from Canal Point, Hawaii, Argentina and Australia according to J.A. Mangelsdorf’s suggestions.

ORGANIZATION OF THE COLLECTIONS

All the varieties are planted in a general collection in which each variety undergoes a rigorous identification control. This collection provide the basic observations about the tasseling of each variety under the climatic conditions of Camamu. It is cut once a year, at the end of June, supplying the seed-pieces for the plantation of the crossing collections. The tassels of the general collection are not used for the crossings.

The crossing collections used for the harvesting of the tassels and which are originated from the general collection, are planted in several sorts of soil and topography. The plantations are arranged in such a manner that they are exposed to sunlight in different ways. Each collection is grouped according to its period of tasseling.

After several years of observation a system of plantation in holes has been adopted. The space is standardized: 2.5 m between the holes and 4 m between the rows. This space permits the maximum exposure to sunlight in relation to the natural potential of Camamu. At the same time it allows the weed control by rotary cut and facilitates the phytosanitary control executed by tractor. It offers as well an easier access at the occasion of the harvesting of the tassels even when the sugar canes are well developed.

The number of the holes planted of each variety goes from 4, 8 to 12, depending on the importance of the progeny for the crossings.

CROSSING CAMPAIGN

The crossings are carried out in May and June. The tassels are cut and maintained alive in an acid solution. The crossings are performed under open rainshelters. In order to prepare the acid solution, the use of pure water from various origins has been tried out. At present rainwater is being used. When there is a lack
of rain, stream-water is used after having suffered an adequate treatment (Miocque\textsuperscript{10}) with bentonite and aluminum sulphate. The results were favorable. From the 1103 existing varieties in the collection only 879 varieties have been used as progeny.

During the 1978 crossing campaign, 49,421 kg of seeds were produced. The medium germination rate was of 160 seedlings per gram. The seed production is allotted to the annual Copersucar program of 2 million seedlings, to experiments and to the supplying of seeds to the agreements with the Instituto Agronomico de Campinas, Brazil (5. 5. 871 kg), the Estacion Experimental Agricola of Tucuman, Argentina (0.995 kg), and the Victoria Milling Co, Philippines (0.220 kg).

**TASSELING OBSERVATIONS**

At the Camamu Experiment Station the conditions for natural tasseling are particularly favorable. The tasseling starts at the end of April and goes till the end of June, but there is a greater intensity between May 10th and 20th, when 60% of the varieties flower. The tasseling rate is 92%.

The tasseling observations are made according to the classification of the tasseling periods of each variety. These records make it possible to establish the program of the crossing to be followed each year. The sex rating is carried out during the crossing campaign. There are 491 male progeny (sex 1-2-3), 184 intermediate progeny (sex 4-5-6) and 204 female progeny (sex 7-8-9).

It was observed that there were only 27 no-tasseling varieties. In a general way only few variations have been observed from one year to the other related to natural tasseling and sex rating. This is possibly due to regularity on the climate.

**Tasseling periods:**

- up to 4 May: early
- from 5 to 13 May: medium early
- from 14 to 22 May: medium
- from 23 to 31 May: medium late
- from 1 to 9 June: late
- from 10 to 19 June: late reluctant
- from 20 onwards: reluctant

**TASSELING CONTROL**

Research referring to tasseling control is carried out to cause the floral initiation of varieties which even after several years of cultivation have not yet tasselled (Allard\textsuperscript{1}). On the other hand they provide the possibility of altering the period of tasseling to allow crossings of progeny which normally tassel at different periods (Coleman\textsuperscript{2}).

In order to cause the differentiation, application to the soil of several chemical products such as calcium silicate and sodium borate has been tried out. Ethrel and Gibberelina have been used for leaf spraying. Based on the principle that the reluctant varieties need a longer dark period in order to produce the floral stimulus,
experiment in natural conditions was carried out (James\textsuperscript{9}).

Even after a several year lasting period of adaptation to the cultivating conditions in Camamu, certain varieties had not yet tasselled naturally up to then (Georges\textsuperscript{9}). Therefore, one collection was planted along the border of a wood so that the shade of the trees would simulate the sunset. In 1978, by this mean, it was possible to obtain the tasseling of the following varieties: B51415, B5227, B6362, B59163, B60191, B5924, D117, DB136/56. Varieties with a long vegetative cycle, as the Hawaiian ones, are only able to receive floral induction after more than one year of vegetative cycle or sometimes in ratoon.

In order to delay the tasseling of the early tasseling progeny, the ratoons are cut back between August and October. A second cutting back is made in December. This method requires the plantation of the sugarcane in separate collections, according to each period of tasseling.

The method of leaf cutting (Julien\textsuperscript{6}) was used as well. It was carried out at the beginning of January, before the floral induction of the early tasseling varieties (Moore\textsuperscript{11}). In the first operation, the leaves were cut just a little above the apical stem. Twenty days later, before the leaf spindle attains its complete development, a second leaf cutting takes place just below the last visible dewlap. These two cuttings delay the period of the floral initiation until the end of February. Some varieties showed a development of the lateral stems weakening the tasseling.

After some experiments on the interruption of the dark period (Latouette\textsuperscript{7}) it was observed that the tasseling of the earliest variety of the collection, P57-150-4, could be avoided altogether. For this purpose, a tungsten lamp of 100 W was used for two hours, from 8 p.m. to 10 p.m., from January till March. The best progeny were planted in the shape of a star with eight beams. On each beam are planted 10 holes of one progeny. The lamp was placed at a height of five meters in the center of the “star”.

By means of this process it is possible to obtain tassels at various periods. The holes situated at a greater distance from the source of illumination tassel earlier, while the holes placed directly under the lamp produce tassels later. This method has produced excellent results under the existing conditions. In 1978, by means of these different methods of tasseling control, it was possible to coincide at the same time the tasseling of 607 progeny from a total of 879 progeny used in the crossing campaign.

**FUZZ TREATMENT**

The fuzz is separated from the spikes of the tassels and put into a dryer at a temperature between 35°C and 40°C in order to remove humidity excess. Afterwards all the fuzz is processed by the method da Silva\textsuperscript{12,13} and stored with silica gel in hermetically closed drums. Low humidity rate is very important to the preservation of the germination rate of seeds. During the last years the drying has been improved a great deal. A freezer is no longer used. Seeds preserved at ambient temperature in closed containers with silica gel have germinated after five years.
COPERSUCAR SELECTION SCHEME

Crossing in Camamu
De-fuzzing and storage
Sowing in Sao Paulo Experiment Stations

Space planting
Continuous planting

1st selection — ratoon of seedlings
2nd selection
3rd selection
4th selection
5th selection

Plant cane
Resistance to diseases
Multiplication
Trials in sugarmill fields

Clone trials in the State of Sao Paulo
6th selection — Plant cane and ratoon
Results of official smut testing
Release of SP varieties

REFERENCES


EL PROGRAMA DE FITOMEJORAMIENTO DE COPERSUCAR.


RESUMEN

El programa de mejoramiento genético de Copersucar, fue iniciado en 1968 con la instalación de la Estación Experimental de Camamu en el Estado de Bahía, para la obtención de semilla de caña. La germinación de la semilla y la selección clonal se realizan en estaciones experimentales en el Estado de San Pablo, bajo las condiciones ecológicas en que deberán cultivarse las futuras variedades SP.

Las condiciones climáticas de Camamu son especialmente favorables para la floración de la caña de azúcar y para la producción de semilla botánica. La cantidad de semilla producida permite satisfacer las necesidades de varios institutos de investigación. Por medio del control de la floración, se hace posible coincidir el momento de floración de un gran número de progenies al mismo tiempo. La viabilidad de la semilla se incrementa por medio de variados tratamientos. Las primeras 6 variedades SP, resistentes al carbón y al mosaico, fueron liberadas al cultivo en 1978.