

Prof. Dr J. JESWIET: RESULTS OF CROSSING IN SUGAR-CANE AND OTHER SACCHARUM SPECIES FOR THE SUGAR-CANE CULTURE IN JAVA

In the times before \pm 1880 when the Java sugar-cane culture was a government culture, the cultivated varieties had a white colour and a soft bark. This was in relation to the very simple factory-implements with their wooden presses and by lack of chemical clearing of the juice. These varieties were the Lahaina and the Djapara-cane. In the eighties the Black Cheribon-cane had been introduced; this was attacked by the *serehdisease* probably a bacterial disease, which lowered the product in such a way that owing to this and to the world constellation, a crisis for the Java Sugar Industry arose.

This crisis led to the foundation of the Experiment Stations for the Java Sugar Industry. Dr SOLTWEDEL, the first Director of the Experiment Station „Midden Java” and some of the best sugar planters, indicated a method by which the variety was saved and could be maintained in culture. The cane was brought to nurseries in the mountains on a level above sea-surface where the disease did not occur and from there sound cuttings for the planting cane had to be sent every year to the factories in the plain. This measure brought an increase of costs, *but allowed later to cultivate new and better producing, but susceptible varieties.*

This help was not satisfying and in that period a lot of varieties from the whole sugar-cane-area were imported and tested. Among the innumerable imported canes none of them was better than the Black Cheribon cane. *Although these results*

were bad, the advantage for future was the possibility for crossing with all these old varieties.

A last effort for getting immune canes against the sereh-disease was made by the Netherl.-Indian-Gov. by sending J. D. KOBUS to British India in 1890. He brought a lot of varieties to Java and among these a slender, very rich cane, the Chunnee cane, which proved to be immune against serehdisease. In the fields of the Exp. Station East Java he made hybrids from it with Black Cheribon cane and other noble canes. *These Chunnee-crossings showed really immunity against sereh disease, had an intermedial size and a good sugar content but proved to have a lack of weight in relation to the thicker noble canes, the real Sacch. officinarum.* Furthermore these hybrids were attacked by another disease, the mosaic disease. Nevertheless these hybrids are yet cultivated in Argentine, Formosa, Egypt, Br. India, Florida and other sugar producing countries (33, 36, 213, 105 P. O. J. and others.) They have a very strong root-system, resist extreme climatical condition. *By crossing back these original hybrids once more on different varieties of the thick-stemmed Saccharum officinarum, he got hybrids with a higher cane-weight.* This method was very important and was later on followed by me in other species-crossings. Another way in which KOBUS tried to get results was the crossing of the Chunnee hybrids with one another. But all these hybrids could not equal the product of the *Saccharum officinarum* varieties.

MOQUETTE, a planter, and WAKKER, the second director of the East Java Experiment Station (Proefstation Oost Java: P. O. J.) chosed also cross-fertilisation as the only effective remedy against diseases. From the crossings made by MOQUETTE, only a few reached culture, though without during success. Both workers made crossings with the Kassoer cane, in the conviction that this was a wild cane. The results were disappointing in habit and in sucrose, but the hybrids had long, dark green leaves. *These Kassoer-crossings were not attacked by mosaic disease and proved later to be immune against sereh disease and to have a very strong root-system.* This method was of great importance for future. WAKKER sowed also the products of free wind-pollination and got out of the seeds of the black Banjermasin-cane the very useful form 100 P. O. J., of which I found later that it originated from Loetherscane as a father. From the latter I pointed out that this cane probably is related with *Sacch. sinense* Roxb. In connection with this the 100 P. O. J. was more resistant against diseases than the other varieties, cultivated at that time as 247 B and others, who were for 100 % *Sacch. officinarum*. Later on many types of this susceptible *S. officinarum*-blood came in cultivation, (EK2, DI52, EK28, SW3,

SW111, and others), which all were susceptible to rootrot mosaic-disease and sereb. EK28 was the least susceptible variety for the two latter diseases but the more for root-rot. With these forms was reached a "higher content of obtainable sugar", one of the wishes of WAKKER. But they did not answer the other expectation of WAKKER "a great resistance against diseases". To get sound material, they all had to be grown in the mountain nurseries; therefore they remained very expensive.

About this time I got my position in Java and found at the Experiment Station a lot of seedlings of the Chunnee-blood, a small collection of original canes and a small collection of seedlings, made by Miss Dr WILBRINK between 100 P. O. J. and Kassoer and Cheribon x Kassoer.

My first work was to describe the original forms to know the parents exactly. This had been tried in Java just as in other countries, but the methods had failed (SOLTWEDEL and others).

My method is based on the pattern of small groups of hairs on the outer bud scale and on the leafsheaths. By doing this work, it appeared that instead of one botanical species: *Sacch. officinarum* L., there were at least still two other species of *Saccharum*, which produced sugar for the worldconsumption.

These two other species are: *Saccharum sinense* Roxb., already described by ROXBURGH and originally cultivated in Annam, China and Japan, and *Saccharum Barberi* Jesw., cultivated in Br. India.

Next to these 3 species is to mention the wild-growing *S. spontaneum* L. From the 3 cultivated species, *S. sinense* and *S. Barberi* have characteristics, which are typical for *S. spontaneum* L. and are opposite to those of *S. officinarum*, the noble sugar-cane.

By this study in describing the different original forms, also Kassoer got its turn and by the characteristics it could be determined as a crossing of one of the varieties of *S. officinarum* with *S. spontaneum*. The Kassoer has been found in the neighbourhood of mountain nurseries with Black Cheribon-cane; round about these nurseries the *S. spontaneum* grows everywhere. This gave a possibility for the crossing. Afterwards I made the crossing and got canes of the same habit, whereas BREMER found the same number of chromosomes. My morphological work has been justified by his cytological work, not only in this case, but also for the species and the other hybrids.

I tried to get good varieties in three directions:

- a. by crossing varieties within the species *Sacch. officinarum*.
- b. by working in KOBUS' line with the Chunnee blood.
- c. by working in WAKKERS and WILBRINKS line with the Kassoer-blood, that proved to be *S. spontaneum*-blood.

The first crossings did not give immunity; all varieties were susceptible for root-rot, sereh and mosaic. The Chunnee-blood was immune against root-rot and sereh. The Kassoer-blood was immune against root-rot, sereh and mosaic disease.

As we have seen WAKKER made Kassoer hybrids in 1893. From these none has been kept. Under the direction of KOBUS in 1902, 1907, 1908 and 1909, crossings of Kassoer with striped Preanger have been made. Only two types were kept in the standard-collection (1807 P. O. J. and 1808 P. O. J.).

In 1911 Miss WILBRINK made 2 series of crossings: 100 P. O. J. x Kassoer and Cheribon x Kassoer. I closely selected these hybrids in 1913 with regard to habit and other characteristics and they were enlisted with P. O. J. numbers. Most of them were very ill-formed. The selected ones were tested on their pollen-qualities and those with sterile pollen used as "mothers", the others as "fathers" in the crossings.

In 1916 I applied KOBUS' principle of crossing back to *S. officinarum* the above mentioned Kassoer hybrids. In some of the crossings very nice and well-formed hybrids were obtained. MOQUETTE, WAKKER, KOBUS and WILBRINK had not done this and therefore they were disappointed with the Kassoer-blood. The best results were obtained with 2364 P. O. J. as a mother (100 x Kassoer) and EK28 as a father (100 x EK2?). In 1921 I got from this crossing 32 panicles with 2266 seedlings. From them were selected as the best ones 2872—2883 P. O. J. Among these numbers was 2878 P. O. J. with the desired characters: quick growth, good tillering, straight stalks, long internodes, high product, hardly not lowering, strong root-system, not too broad leaves, practical immunity against sereh and mosaic and root-rot, solid and juicy mark, high sugar content, high percentage of germination in buds of the planted cuttings.

The descent of this cane is as follows:

Black Banjermasin × Loethers (100 P.O.J.)	× = 2364 P.O.J. × =	{	2714, 2722,
Black Cheribon? × S. spontaneum (Kassoer)			2725, 2878,
EK 28 presumably 100 P.O.J. × EK 2			2883.

Born in 1921, there were in 1926 30.000 bahoes (a unit of surface = 0.7 hectare) of this cane under cultivation and in 1928 $\frac{1}{8}$ of the surface and in 1930 about 100 % of the surface.

In the period 1926/27, 2878 P. O. J. was tried in 257 field-experiments against the other Java-varieties and won in 241 cases, was in 14 cases equal to, and only in *two* cases inferior in production to its competitors.

It showed (Arch. v. d. S. Ind. Ned. Indië 1927 pag. 89) "so overwhelming superiority to *all* varieties and *all* types of soil

in *all* sugar districts of Java as not any species of cane had ever done before." On page 90 of that publication is to be found that the surplus production of this new variety is 35 % of the existing production.

By this production the cost price per weight of unity of sugar is enormously decreased, therefore the profit increased. Moreover the mountain nurseries are no more necessary and so the costs for planting decrease. Further on it is very convenient to have only one variety in the factory fields. If it should be allowed to make ratoonings — which is not yet so in Java — the costs of production could be decreased considerably more, but the chance of infection by diseases and insects would increase.

The work done by me in Pasoeroean has been continued by Dr O. POSTHUMUS. He tries to get better seedlings in the way of nobilizing three and four times the wild *S. spontaneum* and by crossing these types amongst each other.

The method of selection has remained the same in general. Only nowadays groups of young seedling plants are distributed to many typical places in Java with their own conditions, so that selection by the local circumstances may do its work. Till now results have not been obtained in the sense of immunity. This is to say that till now new results are not known because publications of the Experiment Station on this matter have been stopped.

Dr RÜMKE made crossings between *Saccharum* and *Erianthus* without results for practice.

Dr BREMER planned the forming of a high number of chromosomes by crossing different types in successive series. This to get giant types. He made the plan and I tried the beginning of the series on his behalf. The work has been continued and in six years the giant type has been reached. Such work is very nice but, with the character: gigantic growth are to combine all the other characters for field and factory and this gives many difficulties.

In 1929 I was enabled by the Government of the U.S. of America to join the Expedition to New Guinea in my quality as an expert for sugar-cane.

As I had prophesied in my publication about the origin of sugar-cane N. Guinea brought us the wild relative of the cultivated sugar-cane. I named it *Sacch. robustum* Jesw. It is very long and thick and combines all the characters of the most different varieties of *S. officinarum* L., but none of the many varieties contains sugar. The advantage is, that we have under the innumerable new forms of cane such with a length of 9 m and straight strong stalks. If this factor might be introduced in

our hybrids, who are now between 5 and 6 m long, it will be possible to increase the production of the same area with 40 to 50 %.

Here the Java production first in intervals of 5 years in tons:

1911	1.484.783	} without 2878
1916	1.639.080	
1921	1.694.083	
1926	1.990.070	
1930	2.970.836	} with 2878 for ± 100 %
1931	2.842.487	
1932	2.612.436	

and further years give reducing ciphers by the crisis, caused by closing of many factories. The production went down in 1935 to 515.511 tons, but is now increasing by better times.