IMMUNITY AND CROSS-FERTILISATION IN THE GENUS SACCHARUM

by

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Most of the cultivated forms (clones) of the species *Saccharum officinarum L.* are more or less affected by diseases, some of which may thus influence the product that failure of the crop is the consequence. Consulting the worldliterature about Saccharum, one repeatedly finds that for certain varieties, cultivated in one or another country, calamities broke out, caused by diseases, by which further cultivation of that form was stopped in that country. Such reports are mentioned from Mauritius, Cuba, Hawaii, and we also know them from Java. Here however, cultivation was not given up by the Dutch, but by improving the cultivation they tried to escape the disastrous influence of the disease and to keep the variety.

In the eighties the Black Cheribon cane, the chief sugarcane variety then cultivated in Java, was attacked by the sereh-disease, probably a bacterial disease, by which the product declined in such a way that owing to this and to the world constellation, a crisis arose for the Sugarcane industry in Java.

Science was called to the aid and it was the first Director of the Experiment Station „Midden-Java", Dr. Soltwedel, who indicated a method, by which the variety was saved and kept in cultivation. He and some of the best sugarplanters of West Java advised to plant sound seeds of the Cheribon-cane in nurseries in the mountains on a level

above sea-surface where the disease did not occur, and from there the planting cane had to be imported in the factory fields; this proved to be a success.

These measures though saving the cane caused a considerable increase of costs, because at one or another time, depending on the condition of soil and climate of every factory, sound planting material had to be imported on a broad scale. But on the other hand these same measures allowed us to cultivate later new, also susceptible varieties, but with higher crop production, got by crossing the old, original forms.

Most of the cane planters were not satisfied by this solving of the problem and tried to find as well in our Malayan Archipelago as everywhere else forms, as productive as or better than the Black Cheribon, but if possible immune against the sereh-disease. Innumerable forms were imported and tested for this purpose, but there was among the thick canes no one showing immunity, although some of them, f. i. the red Fidji cane proved to be less susceptible to this disease. This cane and its relatives make a higher tonnage than the Black Cheribon but are as a rule lower in sucrose. Most prominent of these imported canes from those days were Fidji cane, Striped Preanger, Loethers, Banjermasin hitam, White and Black Manilla, Striped Batjan cane and many others, but none of them were a match for the old Cheribon cane. Though the Java planters did not succeed in getting immune canes, this import of cane was of great importance for future, as many of these forms later on were used as parents in successfull crossings. The last effort for getting immune canes was made by the Government of Netherlands India, which sent out J. D. Kobus to British India in 1890. He gathered and brought with him many forms which were kept in quarantine for one year on the island Banka. From there only a few reached the Experiment Station in Pasuruan, Java

and among them a very short and slender cane, the „Chunnee" from the Northern Provinces, which proved to be resistant against the sereh disease, showed a high sucrose content in its juice, but gave a low tonnage and a lot of work by cutting the very many slender stalks. So it was not suitable for the factory-fields, but was chosen by Kobus as a father cane in crosses with the Black Cheribon and other noble canes. He expected to get hybrids: „which adopt next to the high sugar-content of the two parents the size of the one and the resistance of the other" (Arch. v. d. Java Suiker Ind. I. 1893 p. 32). He got however intermedial hybrids in size, with full resistance and some of them with high sugarcontent (33, 36, 105, 139, 213, 234 P. O. J. a. o.).

About that time a „new" disease (of course not new because it is to be found everywhere in Java and other islands of the Malayan Archipelago in the small gardens of the natives from the mountains on 2100 M. sealevel to the hot plain) drew the attention. This disease is caused by a virus which is carried from infected plants to healthy ones by a plant-lice Aphis maidis as has been discovered by E. W. Brandes and stated for Java by Wilbrink. As a consequence of the infection the chlorophyll is affected and this process may develop so far, that the plant cannot assimilate normally, shows a great shortage in the production of solid materials and remains short and meager. This disease ravaged the sugar-cane plantations of noble cane in the Argentine and Formosa and is now attacking the cane in Cuba and Louisiana. Java fought and is still fighting this disease; the affected plants are selected and removed from the fields. This Java method has been imitated in all sugarcane disctricts of the world. It is of course impossible to discover all the infected plants and new infections are possible by flying female lices, sucking on the affected cane and afterwards on healthy plants. The

infection on a big scale appears to occur in the beginning of the rainy season [1]).

It appeared that not only the Black Cheribon cane and other thick forms, belonging to the species S. officinarum L. were affected by the mosaic disease, but also the Indian Chunnee cane and its hybrids with the noble cane, obtained by Kobus in 1897, the latter hybrids even for 100 %.

Yet Kobus had attained a great succes with this crossing: he had produced sereh-proof seedlings with a high sugar content, but with a shortage in caneweight and entirely susceptible to the mosaic disease, though not so badly attacked by it as the noble canes, so that they maintained a rather high product in countries, with extensive cultivation like Argentine, Formosa and Br. India. In these hybrids the strong rootsystem, which successfully resisted the extremes of moisture and drought drew the attention. Does sereh-immunity correspond with the vigorous root system?

Later on Kobus crossed these original Chunnee-crossings once more to different forms of Saccharum officinarum L. and obtained hybrids with a higher caneweight. He also crossed the Chunnee seedlings with one another and got in that way also plants with a better production-power, which however could not equal the principal thick forms, all belonging to the real sugarcane: Saccharum officinarum L.

Moquette and Wakker have also taken cross-fertilisation as the only and effectual remedy in the struggle against diseases. About this work Wakker says (Arch. J. S. Ind. I. 1893 p. 391): „In the first place we are able in this way to try to combine divergent, good properties, e.g. the high sugarcontent of the Cheribon and the vigorous growth of the Kassoer". Both made this crossing in the conviction

[1]) P. J. van Breemen. Eenige waarnemingen omtrent het zwermen van Aphis maidis Fitch issued in: Mededeelingen van het Proefstation voor de Java Suiker-Industrie 1926, No. 18.

that „Kassoer" was a wild cane, a botanical species of sugar cane. The results were disappointing in habit and in sucrose; but the canes were long and the leaves dark green. Of neither of their efforts samples have been preserved for us.

That Wakker was in deep earnest when trying this method may appear from another part in the same record p. 386: „We must try to obtain one or more varieties, which are to be preferred in some respects to those we possess already. These respects are:

1°. a higher sugarcontent;

2°. a great resistance against diseases."

He thinks the second point, the resistance, will be reached more easily and did not presume at that moment, that his thought would be adopted later on by others, who were to succeed in realising both the requirements in the crossing derived from this Kassoer-blood. This cross made by Moquette and Wakker was looked upon as immune against mosaic-disease, and later on also proved to be immune against sereh-disease.

The Kassoer differs from the common, cultivated forms of S. offic. L. in such a high degree that Wakker called it a „wild cane". It had been sent to Krüger, Director of the Experiment-station of West Java at Kagok and had been found on the Tjerimai, a volcanous mountain in W. Java. After his opinion there was a possibility that we should have here an original, wild growing form of Saccharum officinarum L. (W. Krüger Das Zuckerrohr und seine Kultur 1899 p. 24).

At the same time Wakker obtains from his cross-fertilisation in 1893 the 100 P. O. J. of which I presumed later on when studying its properties, that it originated from the Loethers-cane as the father, whereas Wakker assures us, that the fruit was obtained from the Banjermasin cane. Also in this sugarcane a higher resistance played a great part, though formerly it was not known why; later I

pointed out that the Loethers-cane is probably related with *Saccharum sinense Roxb.* (J. Jeswiet. Beschrijving der soorten v. h. Suikerriet. Meded. van het Proefstation v. d. Java Suiker Industrie 3e Bijdrage Dl. VI No. 13). It is not pure Sacch. officinarum L. and in connection with this descent this form is more resistant against sereh than the undermentioned ones. Bouricius gave us the once generally planted 247 B, of which the parents are unknown, but which probably originates from the Red Fidji cane. This form is in all its habits a very type of Sacch. officinarum L. and very susceptible to sereh and mosaic disease. Later on forms of Batjan blood are cultivated (S. W. 3, S. W. 111, 90 F., D. I. 52) and forms of Lahaina blood (E. K. 2, E. K. 28), which all of them are of S. officinarum blood and hence susceptible to root-rot, mosaic-disease and sereh; the least susceptible to the last two diseases is the present principal variety E. K. 28. All these forms were also grown in the mountain nurseries and the factory-plantations had to be regularly renewed with sound material. With these forms the first possibility was obtained, presumed by Wakker: „a higher content of obtainable sugar", but the mountain-nurseries remained indispensable for the sereh-disease, while the mosaic-disease required to be fought. Only the Chunnee-hybrids made by Kobus need not to be grown in the mountain-nurseries as they are immune against the sereh.

In the beginning of the organization of the Experiment-stations there was a deep interst for the description of the original forms After Soldwedel's death a big album was published: „Vormen en kleuren van Saccharum officinarum", which drawings had been made under the supervision of Soldwedel. After that Wakker and Moquette set to work to describe and identify the different forms; this was the last revival of that work in Java. Afterwards the interest for the collection decreased and the program of cross-fertilisation was energetically taken in hand.

The original, rich collection of the Experiment-station with a list of 413 numbers had dwindled away in 1912 to a small collection of about 70. After arriving at the Pasoeroean Station in that year I took up as soon as possible the work of Wakker and Moquette, and studied the forms of the collection of the Experiment-station, classified them and described them partly. (J. Jeswiet. Beschrijving der soorten van het suikerriet, 1e Bijdrage Meded. v. h. Proefstation v. d. J. S. Ind. VI, No. 5 and following parts till 1926), according to a method based on little characteristics of buds and leafsheeths and others. Then it appeared to me that instead of one: Sacch. officinarum L. no less than three botanical species of the genus Saccharum produced sugar for the worldmarket and that these two other species, which contrasted in most of their properties with Saccharum officinarum L., above all by their high resistance against diseases, might be of great use for the cross-fertilisation. Finally I contributed an article in the „Archief voor de Java Suikerindustrie in Nederlandsch Indie 1925" about the *species in Saccharum* [1]). In that article I first cancelled from the genus *Saccharum* the subgenera *Sclerostachya, Eriochrysis* and *Leptosaccharum,* erroneously placed there by Hackel and I removed from the subgenus Eusaccharum that group of species whose members did not answer to the conclusive characteristic of awnless spikelets. Besides this characteristic of bearing an awn or a rudiment of it there is a whole series of charactersitics which we find in those species and which do not occur in the genuine Linnean Saccharum species *Saccharum officinarum L.* and *Saccharum spontaneum L.* On the other hand I found that by various authors many forms had been classified as belonging to Saccharum officinarum L., which did not agree with its characteristics. These forms deviated from a mor-

[1]) J. Jeswiet. Bijdrage tot de systematiek van het geslacht Saccharum. Meded. v. h. Proefst. v. d. Javasuiker-industrie 1925. No. 12.

phological point of view to such an extent from Saccharum officinarum L. that I had to classify them as separate species. This opinion was supported by the cytological investigations of G. Bremer and by the geographical distribution of the 4 species of which only one grows wild as far as we presently know.

The Saccharum officinarum L. occurs everywhere in the tropical zone as a cultivated plant. All imported, original forms in cultivation however come from the Indian (Malayan) Archipelago, New Guinea and some of the island-groups of Melanesia and Polynesia. The two last habitats produce many original varieties, cultivated by the primitive natives there and formerly selected by them.

As there is a considerable great number of original forms in New Caledonia, like in New Guinea and in Borneo, all selected by natives, there is a great probability that we have to consider these groups of islands (Malaya or Melanesia or Papua) as the part of the world where S. officinarum L. *originated* and that there may be in these regions anywhere immune or rather immune varieties from which may descent the now known original thick tropical native canes. This was already brought forward by Sagot and Raoul in their work about Sugar cane.

For *Sacch. sinense Roxb.* we know as original habitat S. E. China, North Further India and the Liu-Kiu-isles and other islands from the archipelago of Japan.

The innumerable forms grown in N. British India strongly deviate from the two mentioned before. They show, however, much affection to the wild growing cane, *Sacch. spontaneum L.* Together they form a quite deviating group among the cultivated forms of sugarcane and I took them together under the name of *Saccharum Barberi* Jesw. The fourth species is the only wild growing one: *Saccharum spontaneum L.*, a vigorous, robustly growing grass, which is most variable and has a very wide distribution. In the

old world it occurs from Sicily, Egypt, across Africa, India, Further India, China, Japan, Formosa, Malay Archipelago, Australia, etc., and so it accompanies everywhere the cultivated sugarcane in Eurasia, Africa and Australia, but lacks in America. This made Barber presume that Saccharum officinarum L. could be derived from S. spontaneum L. In my opinion this is absolutely impossible. Sacch. sinense Roxb. and Sacch. Barberi Jesw. on the contrary show all sorts of characteristics, which we can trace also in Sacch. spontaneum L., whereas Sacch. officinarum L. has quite opposite characteristics.

Besides these four species of Saccharum I found among the cultivated canes a lot of intermediate forms among some of the species mentioned or derived from their crossing, which could be traced by the little, morphological characteristics. After I had classified the forms from our collection into the 4 species and various dubious forms, which were so divergent that they were quite out of place in the diagnosis of these 4 species, these deviating forms were indicated by me as hybrid-forms and the relation of many of those forms with the four species was estimated; in one case only that origin was not only estimated, but even proved. This was the case with the *Kassoer-cane*, about which further more.

If we consider now the behaviour of these four species in regard to the two most pernicious diseases in the cultivation of Java sugarcane, then we see that all cultivated forms of Saccharum officinarum L. are more or less susceptible to mosaic-disease whereas all these forms, together with the greater part of the related forms from the standard-collection at the station to the sereh-disease. Within the species there are definite groups of related forms, as the Batjan group; the Lahaina group and the Djapara group, which all of them possess a sensitive root-system, whereas many of the New Guinea forms e. g., taken together in the

collection of the Experimental Station as the Ceram group show strong roots and are therefore less sensible for change of moisture in the soil. and not so badly attacked by sereh disease.

The forms belonging to Sacch. Barberi Jesw. are all of them immune against the sereh-disease, but are all, as far as known, affected by mosaic-disease.

The numerous forms of Sacch. sinense Roxb., which are hard to distinguish from one another show us in the first place immunity against sereh-disease, whereas many forms, a. o. Uba-cane, are also free from mosaic-disease, whereas others may be affected by it.

In Sacch. spontaneum L. mosaic-desease or sereh have never yet been observed.

After I finished this classification into species within the genus Saccharum, Bremer started the cytogical investigation [1]). In Saccharum officinarum L. he found 40 chromosomes, in Sacch. spontaneum L. 56 chromosomes [2]) and in Sacch. Barberi Jesw. 46 chromosomes haploid. So far I cannot yet dispose of data for Sacch. sinense Roxb.

In forms which I indicated as morphologically deviating from the species, Bremer found likewise deviating numbers of chromosomes, e. g. in the so-called Loethers-cane, which is probably related to Sacch. sinense Roxb. It has haploid 49 chromosomes [3]) and shows besides the characteristics of the Sacch. officinarum L. other ones, which indicate relation with Saccharum sinense Roxb. Besides

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[1]) G. Bremer. Een cytologisch onderzoek aan eenige soorten en soortbastaarden van het geslacht Saccharum, 's-Gravenhage 1921.

[2]). Once Bremer found in one form resembling S. spontaneum L. but with deviating characters 40 chromosomes.

[3]). G. Bremer. Een cytologisch onderzoek van eenige praktijksoorten en hare ouders. Mededeelingen v. h. Proefst. v. d. Javasuikerindustrie L 924—6.

in its number of chromosomes this descent manifests itself in a hybrid of this Loethers cane, the 100 P. O. J., formerly *the* early ripening cane variety for Java. This cane always struck me by its rather high resistance against sereh in contradistinction to the crossings, cultivated at that time, (247 B., S. W. 3, S. W. 111, D. I. 52), which all belong to the species Sacch. officinarum L. and are very susceptible to sereh disease and mosaic-disease. All of them have after Bremer haploid 40 chromosomes, whereas 100 P. O. J. shows diploid 89 chromosomes.

What has been done in Java besides Kobus' work with the Chunnee blood to get immune seedlings? The first attempt in that direction was made in 1885 bij Dr. Soltwedel[1]), who tried to cross the Loethers cane with the Glonggong Jav. *Erianthus arundinaceus* (*Retz.*) Jesw. which did not succeed. In 1887 he tried to cross Sacch. spontaneum L. with Loethers cane, for which crossing he applied for the first time in history of sugar cane hybridisation castration of the flowers of the wild mother parent, but did not obtain any seedling.

Next came in 1893 Wakker from the Experiment Station in Pasoeroean and Moquette an enthousiastic planter of Sidhoardjo with their Kassoer crossing, already mentioned and which got lost. Later on, under the supervision of Kobus, crossings with Kassoer cane were made in 1902, 1907, 1908 and 1909, and of these sets of seedlings only the numbers 1807 P.O.J. and 1808 P.O.J. (Striped Pranger × Kassoer) were registered and kept in the standard-collection.

Then in 1911 Miss Wilbrink, than at the Pasuruan Station, made again crossings with the promising Kassoer cane. From these crossings arose 2 series of seedlings:

[1]). Verslag der werkzaamheden, verricht in den proeftuin te Semarang. Tijdschrift v. Land- en Tuinbouw en Boschcultuur 1886—87 0. 104).

(100 P.O.J. × Kassoer) and (Cheribon × Kassoer) which I closely selected in 1913 with regard to their habit and other characteristics and afterwards enlisted with P.O.J. numbers. These forms had no direct value for practice[1]). They showed a vigorous growth, but were as a rule, slender, often made roots on the nodes, flowered strongly, most of them were inside dry or hollow and they lowered easily All of them passed examination for their pollen quality and those which did not produce fertile pollen were used in crossings as mother parents, shortly as „mothers"; the pollen-producers were used as father-canes.

In 1916 I applied the same principle, followed by Kobus with his diluted Chunnee crossings, on these Kassoer seedlings. I crossed them once more with Sacch. officinarum L. and hoped te get not only a better weight in the seedlings but also to get rid of the mosaic disease. Chunnee blood and Kassoer-blood were also crossed with each other to combine the strong root-system and sereh-immunity of both of them with the immunity against mosaic disease of the Kassoer blood. Only few crossings could be made because weather conditions were very bad that year and only with some indifferent father-types, the best ones not flowering at that time. But the few selected seedlings in both directions looked better than the Chunnee crossings especially through their long, straight habit and dark-green leaves. Encouraged by this, ample place was given to Kassoer blood in the program of 1927. It rained very much during that crossing season, many sugar-cane forms bloomed and the flowering-period of many groups and many forms and species agreed with each other. I could make combinations on a big

[1]) The only direct Kassoer-crossing, which was cultivated on a rather large scale on the heaviest and on the best soils of the factories was Tjepiring 24, made in 1904 on the factory of that name. Those made by Wilbrink were tested in factory fields but did not succeed. They showed just as Tjepiring 24 immunity and a very strong root system.

scale and crossed each of the mothers of Kassoer blood with an equal series of good pollen-producers among the best forms of Sacch. officinarum L. with the object to know which mother-form would give the best seedlings in most combinations.

Mother-forms of S. officinarum were also crossed with some good pollen-producers of Kassoer blood.

Many different combinations succeeded and only a few of the mothers came to the foreground. In Cheribon × Kassoer blood I mention: 2194 P.O.J.; in Preanger × Kassoer blood: 1808 P.O.J. and in 100 × Kassoer blood; 2364 P.O.J. which was the best mother of all. It gave in various combinations good seeds and from her offspring I could select many good, strong plants. As of each of these new combinations only a hundred seedlings were planted out in the field, it proved from the favourable result, that the percentage of good plants in these combinations is rather high.

In the same year I treated the Chunnee crossings in the same way and planted them in the northern half of the field, the Kassoer descendants in the southern half. In this way the enormous difference in the two groups was obvious; the Chunne- blood slender, not long and yellow-leaved; the Kassoer blood robust, long and dark-green. The last group of characteristics manifested itself very strongly in these Kassoer-crossings which delivered forms which in their habits showed a great resemblance to the best cultivated forms of S. officinarum grown in practice, even equaled and surpassed them.

What was this Kassoer however? As has been quoted above Krüger and others thought it was a wild cane. In 1915 I described Kassoer cane in the „Mededeelingen van het Proefstation v. d. J. S. Ind. VI No. 13" and found, when investigating the hair-characters of the buds and of the leaf-sheath, spikelet and mode of flowering, many

characteristics of Sacch. spontaneum L. and on the other hand many characteristics which pointed to Sacch. officinarum L. So I pronounced the supposition that Kassoer should be a direct crossing between some form of Sacch. spontaneum L. and some of Sacch. officinarum L. There is a great chance that Kassoer is a seedling of Black Cheribon. In the time when Krüger received this cane there were everywhere in the surroundings of the Tjerimai its habitat, mountain nurseries of the Black Cheribon cane and everywhere in that neighbourhood the robust Glagah or Sacch. spontaneum L. is to be found. As Black Cheribon has mostly sterile pollen the combination is easy to understand. In the tables of descent of the Experiment-station has been written for Kassoer: Black Cheribon? × Sacch. spontaneum L. I tried to make this combination, but as a rule there is a great difference in flowering time between the two species.

In 1917 however I could cross one of the last flowering forms of Sacch. spontaneum L., collected in the mountains with a Cheribon × Fidji seedling 2064 P.O.J. and obtained from two panicles six seedlings, *which each of* them showed the Kassoer properties in habit and little characteristics. Three of them were put in the collection (2775—2777). Besides this Bremer proved in 1922[1]) that the haploid number of chromosomes of the original Kassoer and the „self-made" Kassoer was equal viz. 68. By stating this hybrid nature we knew, that the immunity against mosaic-disease and sereh and the strong root-system were due to Sacch. spontaneum L. while the luxurious growth was a consequence of the cross-fertilisation of the two different species. Therefore it became necessary to collect more of the broad-leaved, straight, thick Sacch. spontaneum forms in the mountains of Java and to cross them with the good mother-types of Sacch. officinarum, in order to increase

[1]). G. Bremer. Een cytologisch onderzoek van eenige soorten en soortbastaarden van het geslacht Saccharum, 's-Gravenhage 1921.

the number of immune types for further work. This happened and a great number of long, robust seedlings of different blood is now present in our collection. The consequence is that the seedlings, as e.g. 2364 P.O.J., are hybrids of Sacch. spontaneum L. and Sacch. officinarum L. (so called Kassoers) crossed back to Sacch. officinarum.

In the year 1917 many seedlings of different descent were selected; only five of them reached the factory fields, all of them seedlings of 2364 P.O.J., viz. 2714, 2722, 2725 P.O.J. from the combinations of that mother with E.K. 28; 2727 P.O.J. from that with Striped Batjan and 2753 from that with a Chunnee seedling 1507 P.O.J. The first three proved to be commercially immune against sereh, while 2714 appeared commercially immune against mosaic-disease; the two others proved sometimes to be affected by mosaic-disease, but could easily be kept free from it. They flowered however very richly and 2725 moreover very early. The rapid development of the panicle requires in sugar-cane a rather large quantity of the sugar deposited in the stalk, so that e.g. the stalks of 2714 P.O.J. showed inwardly dry top-pieces and so the form did not come up to the expectations regarding its product; this form also showed a tendency to lower and had a somewhat sensitive root-system. 2722 P.O.J. is a good cane, but requires moist soil and a high gift of fertilizer; without this growth is too slow; 2727 appeared to be a good cane on heavy soils with highly developed immunity; 2753 is the strongest of all, but susceptible to mosaic disease.

In the seedling plots of the combination (2364 × E.K. 28) I had observed some less or non-flowering plants, but they had a less good habit, were mostly too slender. Yet I might hope that in a great number of seedlings I should have an opportunity to find the good qualities of the existing forms: immunity, good habit, strong root-system, good sugar content, combined with if possible lack of flowering.

As I wanted to eliminate this factor „flowering", I made every year new combinations, but none of them were so satisfactory as the one: (2364 P.O.J. × E.K. 28). Therefore I tried every year to get as many panicles of this combination as possible in order to have an opportunity to plant thousands of seedlings. Unfortunably the years 1918, 1919 and 1920 showed such bad weather-conditions, that none of the seedling-plots of that combination could be called a succes. In 1918 out of 13 panicles only 51 seedlings germinated, none of which could be accepted. In 1919 many panicles were sown, of which none germinated; in 1920 only 7 panicles germinated and gave 125 plants, which all had to be rejected, while finally in 1921 with good weather conditions out of 32 panicles 2266 seedlings were obtained, of which great amount the numbers 2872—2883 P.O.J. were selected and kept. Among these numbers there was one plant 2878 P.O.J. with the desired characteristics: quick growth, good tillering, straight stalks with long internodes, hence very long and with a high product, hardly not lowering, with a strong root-system, not too broad leaves, practical immunity against sereh and mosaic disease, a high sugar-content, solid and juicy inside, hardly not blooming, high germination percentage of the buds planted. The descent of this sugar-cane is as follows:[1])

Banjermasin hitam ♀ x Loethers ♂ ? = 100 P.O.J. ♀
× = 2364 P.O.J. ♀ = 2714, 2722, 2725, 2878, 2883
Cheribon ♀ ? x S. spontaneum L ♂ = Kassoer ♂
E. K. 28 ♂ Descent unknown, presumably 100 P. O. J. x E. K. 2

2878 P.O.J. gave high figures of production in almost all comparative experiments already from the very first beginning of the tests till now. Besides some planters and

[1]). Full details about my work done during the period 1912—1925 is to be found in a publication by J. P. Bannier: De rietveredeling aan het Suikerproefstation te Pasoeroean 1893—1925, issued in the Mededeelingen van het Proefstation voor de Java-Suiker-Industrie 1926

companies who at once began to propagate the new form there were also who would wait and see first more results. Notwithstanding the latter the vegetative propagation has had a very quick development and of one full-grown plant in 1922 there were 30.000 bahoes in cultivation in 1926/1927 whereas in 1927/1928 about 12½ % of the cane surface and probably in 1928/1929 from 70 to 80 % of the cane to be planted on Java will be 2878 P.O.J.

The provisional results of the field tests with this variety in 1926/1927 are as follows:

2878 P.O.J. was tried 257 times in field experiments against the other Java-varieties, won in 241 cases, was in 14 cases equal to — and only 2 times inferior in production to its competitors. It showed (Archief v. d. S. Ind. N. Indië 1927 p. 89). „So overwhelming superiorty to *all* other varieties on all soil types in all sugar districts of Java as not any species of cane had ever done before." I will illustrate this encomium by quoting from the table on page 90 of that publication, that the percentage of the surplus production by this species in those experiments is to an average of 42 picols per bahoe or 35 % of the existing production. By this augmentation the costprice per weight unit of sugar is enormously decreased, so the profit per unit is increased; moreover this form needs not be propagated in the mountain districts, as it is free from sereh and so a decrease of the costs of planting is the consequence. Selection for mosaic-disease is also practically unnecessary, as the form shows a high resistance. Further it gives the convenience that per factory practically only one sugar-caneform is to be planted, as it appears from experiments that 2878 cut unripe always produces as much or even more than early ripening species which have been cut in time and which till now are not yet of immune blood. If it should be allowed in future to make ratoonings, than the cost of production could be decreased considerably more, but the chance of infection bij diseases and insects would increase.

Summarising the cross-fertilisation with immune, wild growing, sugarless Sacch. spontaneum L. has produced quite new, strong, immune types with a much higher production, a simplification of the cultivation and together with it a curtailing of the cost-price, by which our beautiful intensive Java sugar cane culture is founded on a still sounder basis than it was already. So by building further on the work of Soltwedel, Moquette, Wakker, Kobus and Wilbrink we have obtained what Wakker once expressed so very well: more sugar and immunity combined in one variety by crossing.

Wageningen, October 1927.