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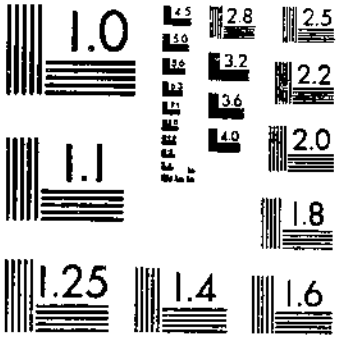

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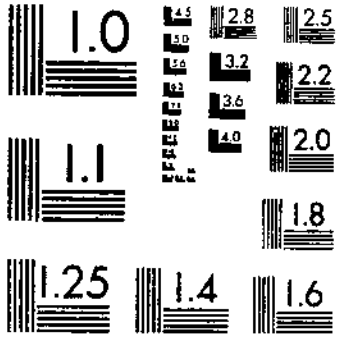

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Cytology of *Saccharum robustum* and Related Sympatric Species and Natural Hybrids

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CONTENTS

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Cytology of *Saccharum robustum* and related sympatric species and natural hybrids[1]

By SAM PRICE, *geneticist, Crops Research Division, Agricultural Research Service*

Dutch sugarcane specialists collected wild *Saccharum* from northern Celebes and southeast Borneo in 1921. In the breeding plots of the Proefstation Oost-Java (POJ), the Tananggé clones from the Celebes and the Teboe Salah (or Tebu Salah) clones from Borneo exhibited features of two distinct species (*10*).[2] In certain minute floral characteristics and in having hard fibrous stalks that lacked sweet juice, they resembled wild *S. spontaneum* L. In having large compound panicles and large exposed stalks and in lacking rhizomes, they resembled "noble" sugarcane, *S. officinarum* L. Bremer (*10, 12, 13*) learned that Tananggé and Teboe Salahs, with one exception, had $2n=60$ chromosomes. The exceptional clone had $2n=89$–90 and probably arose from hybridization. Bremer pointed out that forms with $2n=60$ could not be intermediate hybrids between *S. officinarum*, $2n=80$, and sympatric *S. spontaneum*, $2n=80$, 96, or 112. He concluded that he was dealing with an unnamed species. According to C. L. Rünke,[3] O. Posthumus (POJ), who collected wild *Saccharum* from Borneo and the Celebes in 1930, recalled that the Dyaks of Borneo planted Teboe Salah to ward off evil spirits. Posthumus fully intended to name the new species *Saccharum sanctum*, the holy cane, but his intention remained unfulfilled.

In 1928 a sugarcane-collecting expedition to New Guinea (*6*) also found wild *Saccharum* that agreed with no described species. It grew along the silty banks of several New Guinea rivers. It had large panicles and large exposed stalks and lacked rhizomes. The collectors called these clones *S. robustum*, but this name remained undocumented until Grassl (*19*) described *S. robustum* Brandes & Jeswiet *ex* Grassl. Clone 28 N.G. 251 from the Laloki River near Port Moresby became the type.

J. Jeswiet, first one of the 1928 expedition to find *S. robustum*, later concluded that Tananggé and Teboe Salah clones belonged to the same species (*11*). When $2n=80$ not $2n=60$ was found in Port Moresby *S. robustum* (actually first accounts incorrectly reported $2n=84$) Jeswiet's view became unpopular. Nevertheless, as further expeditions filled sugarcane breeders' collections with clones identified as *S. robustum*, it became increasingly difficult to distinguish 60- from 80-chromosome forms by their morphology. The task was complicated by the existence of many aneuploid derivatives from hydridization. Finally, it seemed advisable to include both 60- and 80-chromosome forms in *S. robostum* and to distinguish groups within the species on the combined

[1] In cooperation with the Hawaiian Sugar Planters' Association.

[2] Italic numbers in parentheses refer to Literature Cited, p. 19.

[3] Personal communication.

basis of morphological and cytological characteristics (*39*). Neither alone would do.

This bulletin describes the cytology and gross morphology of *S. robustum* and of related hybrid derivatives. Cytomorphological groups are documented with a list of clones, their chromosome numbers, and their origins. Their geographical distribution is discussed. The cytology of closely related wild species from the geographic range of *S. robustum* is included.

SOURCES OF MATERIAL

The World Sugarcane Collection of the United States Department of Agriculture (USDA) and the sugarcane-breeding collection of the Hawaiian Sugar Planters' Association (HSPA) were immediate sources of the clones studied. Their original sources are shown in Appendix, table 1. Clones derived from seeds collected in the wild have "U.S." numbers if grown by the USDA; they have "Molokai" numbers if grown by HSPA (Appendix, table 1). Exceptions are the clones N. B. Robustum, 28 N.G. 289, 28 N.G. 290, 28 N.G. 291, and 28 N.G. 292, which also grew from seed collections. All other clones studied were first collected as cuttings.

The clones were assembled for many years by sugarcane specialists from several countries. Sugarcane collecting in the islands of the Pacific began very early (*8*, *7*), but in the geographical range of *S. robustum* wild relatives of sugarcane were ignored. In 1921, however, Ph. van Harreveld (POJ) collected Tananggé clones and Tabongo, a clone of *S. spontaneum*, from the northern Celebes; in the same year J. G. W. Asperslag (POJ) collected Teboe Salahs from southeast Borneo (*10*).

In 1930, O. Posthumas collected Teboe Salahs, *S. spontaneum*, and *Miscanthus* spp. along Borneo's Mahakam River and Teboe Salahs and *S. spontaneum* in the central Celebes near Paloe (*18*). He made these collections for the Java Sugar Industry. Several of the clones eventually reached the USDA's World Sugarcane Collection.

A 1928 sugarcane-collecting expedition to New Guinea (*6*) was sponsored by the USDA and was led by E. W. Brandes (USDA), J. Jeswiet (POJ), and C. E. Pemberton (HSPA). After Jeswiet found the large-stemmed clone, 28 N.G. 251, near Port Moresby, the party collected similar *S. robustum* as well as *S. spontaneum* from the Kemp Welsh River, *S. robustum* from Lae, "red-fleshed" *S. robustum* forma *sanguineum* Grassl from the Sepik River, a hairy-leafed *S. robustum* (a Teboe Salah type?) from the Strickland River, and *Erianthus arundinaceus* (Retz.) Jesw. from Lake Murray. Their collections have "28 N.G." numbers. Representative clones from near Port Moresby, the Kemp Welsh River, and Lake Murray survived. In 1937, after repeated correspondence and through the independent efforts of G. H. Murray, Director of Agriculture, Territory of New Guinea, and Father F. J. Kirschbaum, a missionary in New Guinea, Brandes (*9*) obtained two replacements for the red-fleshed form that had died. These replacements appear in the World Collection as 28 N.G. 219 and 28 N.G. 219A.

In 1929, C. E. Pemberton collected seeds from a wild *Saccharum* plant near Rabaul, New Britain. Germination of these seeds gave rise to HSPA's clone N. B. Ro-

bustum and to the USDA's clones 28 N.G. 289 and 28 N.G. 290. In 1930 Percival H. Leigh, agricultural officer of Port Moresby, New Guinea, sent *S. robustum* seeds collected near Port Moresby to HSPA where they gave rise to clones Molokai 1101–1410. In 1935, he sent *S. spontaneum* seeds to the USDA where they gave rise to 28 N.G. 291 and 28 N.G. 292. Brandes collected *S. robustum* clone N.H. 1 in 1935 from the New Hebrides (*3*, *7*).

The Hawaiian Sugar Planters' Association sponsored a 1937 expedition to New Guinea, New Britain, New Ireland, and New Hanover (*24*). On this expedition, C. G. Lennox and C. E. Pemberton collected seeds from New Britian's Gazelle Peninsula, from New Guinea's eastern goldfields near Wau and Bulolo, from the high plateaus above the goldfields near Aiyura, and from the Ko'mperi Valley at the Purari River headwaters. Seedlings from Lennox and Pemberton's collections have Molokai numbers, and they are identified by "L & P" collection numbers in Appendix, table 1.

The Australian government sponsored a 1951 sugarcane-collecting expedition to New Guinea led by J. H. Buzacott and C. G. Hughes (*18*). J. N. Warner of HSPA accompanied them. This party collected near Port Moresby, near Lae, along the Markham River, near Aiyura, and in the Ko'mperi Valley. More important, they extended their exploration to new areas in New Guinea's high interior around Goroka, Chimbu, Mt. Hagen, and Mendi. Among their collections were *S. robustum*, *S. spontaneum*, *Miscanthus floridulus* (Labill) Warb. *ex* Schum. & Laut., and suspected *Saccharum*×*Miscanthus* hybrids. Clones they collected as cuttings have "51 N.G." numbers. Warner's seed collections were germinated by HSPA and the seedlings have "Molokai" numbers. They are identified by "W" collection numbers in Appendix, table 1.

In 1957 Warner and Grassl (*48*) revisited Melanesia and collected in several areas visited by their predecessors; also, they extended their expedition to new sites in Papua, in the Territory of New Guinea, in Irian Barat (formerly Dutch New Guinea), and in the Solomon Islands. Among their collections were cuttings and seeds of *S. robustum*, *S. spontaneum*, *Miscanthus floridulus*, and suspected hybrids. Clones derived from their cuttings have "57 N.G." numbers. Seedlings from their seed collections (identified by "W & G" collection numbers in Appendix, table 1) were germinated by the USDA and HSPA and have "U.S." or "Molokai" numbers.

CYTOLOGICAL METHODS

Chromosome numbers were determined from mitosis in leaf cells or from meiosis in pollen mother cells. Leaf cell preparations were obtained by treating young shoots (tillers or germinating buds) in aerated 0.2 percent colchicine, fixing in Newcomer's fluid (*28*), macerating in 0.5 N hydrochloric acid, washing, mordanting in 4 percent iron alum, and storing in 70 percent ethyl alcohol. Bits of tissue from the youngest leaf meristems were squashed in iron-aceto-carmine (*36*). For meiosis, inflorescence branches were fixed in a 3:1 mixture of ethyl alcohol and acetic acid and stored after several changes in 70 percent ethyl alcohol. Pollen mother cells were also squashed in iron-aceto-carmine.

CHROMOSOME NUMBERS

Bremer's were the first cytological studies of *S. robustum*, although his clones were not then identified with any species. He studied Tananggé (*10, 12*) and the Teboe Salahs (*13*). He found $2n=60$ or *ca.* 60 in five clones; in a sixth clone, which probably originated through natural hybridization, he found $2n=89$-90. These chromosome numbers and all other accurate numbers from the literature on *S. robustum* cytology are included in Appendix, table 1, along with unpublished observations.

After Bremer's work on Borneo and Celebes clones, the cytology of *S. robustum* was investigated next in HSPA and USDA laboratories. Long lists of chromosome counts were compiled in both laboratories. However, most of the counts were very rough approximations. Unfortunately, these rough approximations often reached the literature unqualified (*1, 2, 8, 9, 19, 25, 26, 27*). Although these inaccuracies already had been discussed (*33*), they were cited without comment in a recent review (*5*). Early reports stated or implied that the type clone for *S. robustum*, 28 N.G. 251, had $2n=84$ and that this number was common in the species. It is necessary, therefore, to reemphasize the fact that 28 N.G. 251 actually has $2n=80$ (*22, 27, 33, 47*) and that $2n=84$ occurs only occasionally in aneuploids. Early reports also indicated that *S. robustum* included a polyploid series ranging in multiples of 10 from $2n=60$ to $2n=120$, when, in fact, $2n=60$ and $2n=80$ are the only euploid numbers that occur in the species Inaccuracies from early literature on the cytology of *S. robustum* are excluded from Appendix, table 1.

Bhat, Subba Rao, and Kandasami (*5*) identified the clones involved in Sundararaghavan's study of *S. robustum*.[4] Sundararaghavan's results, cited by Raghavan (*43, 44*), had been puzzling. According to these accounts, Sundararaghavan determined $2n=64$, 72, 80, 84, and 96 in several clones, from which he suggested (assuming euploidy and despite the number $2n=84$) a polyploid series in multiples of 8. The clones Sundararaghavan studied had been sent to India from the U.S. Department of Agriculture. It was an unfortunate choice of plants. One of the eight clones, 28 N.G. 218, is now recognized as a natural *S. officinarum* X *S. robustum* hybrid (*48*). Another clone, Molokai 5099, is an artifical hybrid produced from crossing two aneuploids (*33*). In the USDA collection[5] four clones were mislabeled, Molokai 4575, 4826, 4972, and 5193 (USDA Importations 1007, 1028, 1011, and 1029, respectively). Sundararaghavan counted $2n=80$, 64, 84, and 84 in these incorrectly identified clones. The mislabeled clones with $2n=64$ and $2n=84$ may correspond with clones recognized elsewhere (*33*) as aneuploids. Sundararaghavan's count $2n=80$ for Molokai 4861 agrees with the writer's; his count $2n=64$ for Molokai 4503 does not (Appendix, table 1). The proposition that a polyploid series occurs in *S. robustum* in multiples of 8 is untenable. Data from mislabeled clones are excluded from Appendix, table 1.

Reliable chromosome counts from

[4] SUNDARARAGHAVAN, R. MORPHOLOGICAL AND CYTOGENETICAL FEATURES OF S. ROBUSTUM BRAND. AND JEWS. (SIC) AND ITS INTERSPECIFIC AND INTERGENERIC HYBRIDS. [Unpublished master's thesis. Copy on file Madras Univ. 1954.]

[5] PRICE, S., and BELCHER, B. A. NOTES ON VARIETIES IN THE USDA COLLECTION. Internatl. Soc. Sugar Cane Technol. Sugar Cane Breeders' Newslet. No. 2, Item 19.

the early literature on *S. robustum* cytology indicated that $2n=60$ was common in clones from the Celebes and Borneo (*10*, *12*, *13*) and that $2n=80$ was common in New Guinea clones (*22*, *27*, *29*, *30*). These early studies dealt with clones that grew at low elevations along the silty banks of tropical rivers. Most of the clones had rather large stems and a habit of dropping their old leaves and leaf sheaths, which left their stalks exposed. Externally, they often resembled noble sugarcane, *S. officinarum*.

An extensive assembly of *S. robustum* and related wild plants gradually accumulated in USDA and HSPA collections until these two collections included most of the surviving clones from the 1951 and preceding expeditions. A cytological study of this large accumulation (*33*) confirmed the preponderance of $2n=60$ and 80 in large-stemmed *S. robustum* and established $2n=60$ in the red-fleshed *S. robustum* forma *sanguineum*. The collections also included many small-stemmed forms whose old leaves and leaf sheaths persisted, giving the plants a "thrashy" appearance. These small-stemmed forms were first obtained (*24*) by Lennox and Pemberton and later by Buzacott and Hughes (*18*) and by Warner. Most of them were found in and above the Wau-Bulolo goldfields of New Guinea. In these small-stemmed clones $2n=60$ and 80 also predominated (*33*). Throughout the collections a few aneuploid plants exhibited simple deviations from euploidy (one- or two-chromosome differences). Others with greater deviations from euploidy appeared to be derived from hybridization. Three small-stemmed aneuploid hybrid derivatives, all from one seed lot, had chromosome numbers intermediate between $2n=60$ and 80. Thirteen large-stemmed aneuploid hybrids, probably all seedlings from one maternal clone, had chromosome numbers that varied between $2n=100$ and 112; one sibling had $2n=ca.$ 160–163. The same study (*33*) revealed very high chromosome numbers, $2n=ca.$ 156–194, in several clones from New Guinea's high interior. These plants with very high chromosome numbers had panicles that resembled the panicles of *S. robustum*. Vegetatively, they ranged from plants very much like *Miscanthus* to "giant *S. robustum*" plants whose drooping leaves were the only suggestion of *Miscanthus* ancestory. *Saccharum* × *Miscanthus* origins were suspected (*20*, *33*).

When Warner and Grassl's 1957 collection became available, new cytological studies confirmed the ubiquity of 60- and 80-chromosome euploids among both large- and small-stemmed *S. robustum* (*39*). Aneuploid hybrid derivatives were found more widespread in nature than was previously supposed, and cytomorphological observations confirmed several suspected *S. robustum* × *S. spontaneum* hybrids. Very high chromosome numbers, $2n=ca.$ 114–205, in certain clones from high elevations in New Guinea confirmed Warner and Grassl's belief that the clones were related to *Saccharum* × *Miscanthus* suspects from the 1951 expedition.

Preceding paragraphs allude to aneuploids as natural hybrid derivatives, but the chromosome numbers of these aneuploids usually exceed the somatic number of either putative parent. This seeming paradox is reconciled by the example of certain experimental crosses. *S. officinarum* transmits its somatic rather than its gametic chromosome number to its hybrid offspring when pollinated by *S. spontaneum*. Thus, the F_1 hybrids have a chromosome number $(2n+n)$ that exceeds the somatic number of either parent. This chromosome

increase occurs consistently in *S. officinarum* × *S. spontaneum* crosses and intermittently in several other interspecific and intergeneric crosses with *Saccharum* (*15, 23, 34, 35, 41*). The peculiarity, accompanied by chromosome losses and gains that lead to aneuploidy, occurs again in certain backcrosses (*15, 16, 38, 40*). This experience with unusual chromosome increases attending artificial hybridization suggests that high-chromosome *Saccharum* found in nature results from hybridization.

Two probable *S. robustum* × *S. officinarum* F_1 hybrids collected in New Guinea have $2n=80$. Another, 28 N.G. 218, was collected as *S. robustum*, but its sweet juice and chromosome number ($2n=70$) mark it as a hybrid.

Appendix, table 1 documents the conclusions reached thus far by showing the chromosome numbers of individual clones. In the table, *S. robustum* and its hybrids are divided into cytomorphological groups described in a later section of this bulletin. The table includes limited observations on related wild species from the geographical range of *S. robustum*. *S. spontaneum* has $2n=80$ in most the range of *S. robustum*, but 96-chromosome euploids from the Celebes are known and Bremer reported 112-chromosome *S. spontaneum* clones from Borneo (*13*). Among the clones listed as *S. spontaneum* (Appendix, table 1), one, M. Moentai, is surely a hybrid derivative. Whether aneuploidy in 51 N.G. 26, U.S. 57–72–2, U.S. 57–77–2, U.S. 57–92–1, and U.S. 57–170–1 and –4 indicates hybridity is still uncertain. The pubescent leaf blades of seedlings in the families U.S. 57–77, U.S. 57–170, and U.S. 57–171 are a pecularity not usually associated with *S. spontaneum* (*21*). The Guadalcanal collection of *S. spontaneum* establishes the easternmost distribution of the species. Reports of indigenous *S. spontaneum* in Fiji (*4, 31, 32*) stem from another mislabeled clone, the USDA'S importation 1532.[6]

Miscanthus floridulus is widely distributed in Melanesia. The few clones from this area that were studied cytologically typically had $2n=38$. Several New Guinea clones also had accessory chromosomes (*37*).

Eulalia fastigiata (Nees *ex* Steud.) Haines may have been recently introduced into New Guinea. One seedling survived from three collections (W & G 593 from Wantoat and W & G 615 and 617 from Bulolo). It had $2n=18$ chromosomes (*42*). N. L. Bor of the Royal Botanical Gardens, Kew, identified a specimen sent to Kew and indicated the species is common in India.

Erianthus arundinaceus clone 28 N.G. 7 was collected from Lake Murray, New Guinea. It has $2n=60$.

Several clones not listed in Appendix, table 1 have special interest. Warner and Grassl (*48*) collected 57 N.G. 24 as *S. robustum*. In the USDA collection (Imp. 2479) it has a striped stalk, sweet juice, and $2n=80$; it is now considered *S. officinarum*. A striped clone, 57 N.G. 77 (Imp. 2478), was collected near Wewak, New Guinea, as *S. officinarum* because natives considered it a primitive chewing cane; in its cytology ($2n=90$) and in the vegetative morphology of its solid dark-purple offshoots it is identical with 57 N.G. 233 (Imp. 2694) collected as *S. edule* Hassk. from the Sepik River, New Guinea. Clone 57 N.G. 249 (Imp. 2710) was collected as *S. robustum* from a garden at Honiara, Guadalcanal. Its chromosome number $2n=70$ mark it as a hybrid. It has small stems, but its leaves are broad. Its place in the classification remains undetermined.

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[6] See footnote 5, p. 4.

MEIOSIS

When pollen mother cells were used to determine chromosome numbers of *S. robustum*, reasonably accurate impressions of meiosis were formed. Similarly, constant or inconstant chromosome numbers among seedlings indicated meiotic stability or instability in parental clones. Recent studies of pollen mother cells, however, were expressly intended to characterize meiosis in *S. robustum* and its relatives. The observations are summarized in Appendix, table 2. An analysis of 10 diakinesis or first metaphase cells, or both, from each clone was attempted; but, for some clones, fewer cells had to suffice. For many clones, crowded nuclei and sticky chromosomes made analysis impossible. Surprisingly, a few cells in Molokai 6081 and several in 51 N.G. 88 (fig. 1, *A*, *B*; 2, *A*, *B*), plants with very high chromosome numbers, could be analyzed. In most difficult clones, however, lagging chromosomes at first anaphase (fig. 3) and micronuclei in the microspore quartets gave the only measures of irregularity. First anaphase bridges occurred so infrequently they are not tabulated here.

Generally 60- and 80-chromosome forms exhibited high frequencies of bivalents and low frequencies of irregularities. This observation agrees with the thesis that 60- and 80-chromosome forms are euploids. Generally clones with other chromosome numbers exhibited meiotic irregularities. This observation agrees with the thesis that they are aneuploid hybrid derivatives. Occasionally hybrid derivatives exhibited relatively undisturbed meiotic divisions. Such is the case with Molokai 6038 and U.S. 57–76–3. Molokai 6038 is a member of a family with variable chromosome numbers. U.S. 57–76–3, in possessing rhizomes, shows definite morphological evidence of *S. robustum* × *S. spontaneum* hybrid ancestry.

CLASSIFICATION

Bremer (*14*) suggested that 60-chromosome euploids should be recognized as a species distinct from 80-chromosome *S. robustum*, but consistent morphological differences do not distinguish 60- from 80- chromosome forms. Bremer (*10*, *14*) reported that ciliate lodicules and long hairs on main panicle axes distinguished 60-chromosome Celebes and Borneo clones, but these features do not characterize all 60-chromosome forms. Pubescent leaf blades and purple callus hairs are common but not ubiquitous among 60-chromosome forms; neither are they confined to clones with $2n=60$. Once, stolons or rhizomes were thought to characterize 80-chromosome *S. robustum* (*9*, *14*, *19*, *33*). This error came from misinterpreting the growth of *S. robustum* along tropical riverbanks. (See illustrations of Brandes (*9*, *fig. 12*) and Grassl (*19*, *pl. III*).) Stalks that fell across flat muddy riverbanks grew erect from their tips, and the erect tips fell again. This process, which may have been repeated, produced prostrate stems that resembled but were not true stolons (*34*). No consistent morphological differences facilitate the separation of all 60- from all 80-chromosome forms.

S. robustum forma *sanguineum* is distinguished by a red pigment in its pith. Gross morphology also betrays the most obvious *S.*

705-193 O—65——2

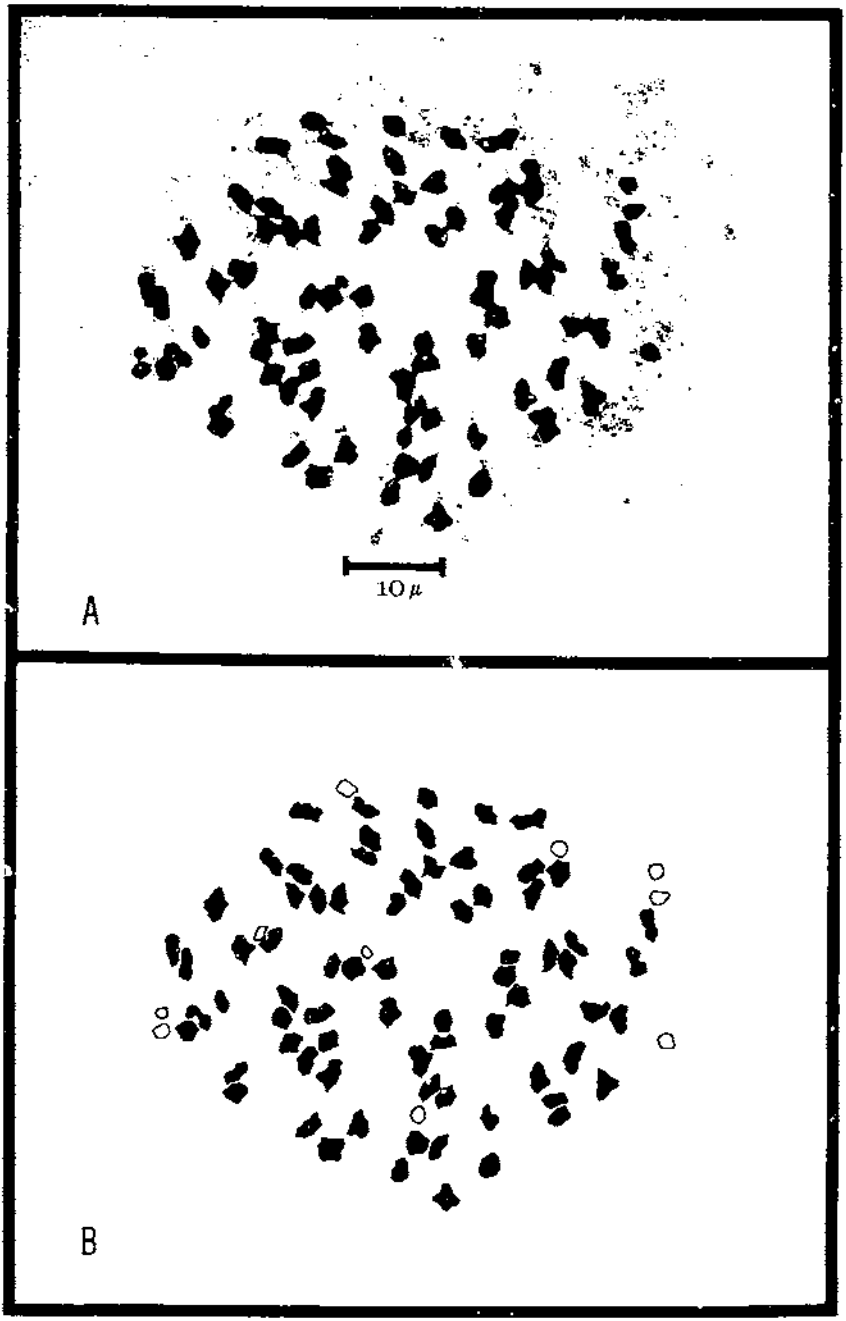

FIGURE 1.—*A*, First meiotic metaphase in *Saccharum* × *Miscanthus*, clone 51 N.G. 88 (Imp. 1970). *B*, Diagrammatic interpretation of configurations in *A*; $73_{II}+10_{I}$.

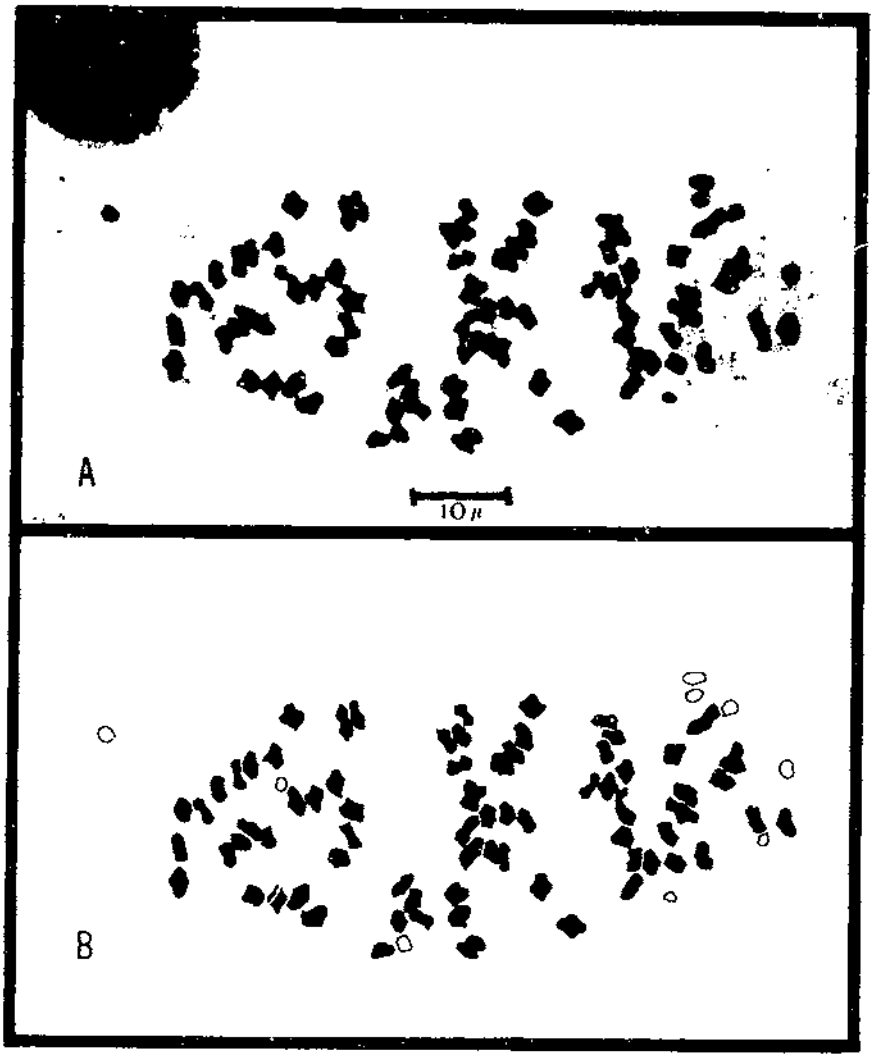

FIGURE 2.—*A*, First meiotic metaphase in *Saccharum* × *Miscanthus*, clone 51 N.G. 88 (Imp. 1970). *B*, Diagrammatic interpretations of configurations in *A*; $73_{II}+9_{I}$.

robustum × *S. spontaneum* and *Saccharum* × *Miscanthus* hybrid derivatives. Meaningful divisions cannot be made among the residue from either morphological or cytological observations alone. To be sure, there is much variation of both kinds, but morphological similarities are not confined within boundaries set by cytological differences. Neither do morphological differences consistently distinguish the cytological types. It is appropriate, therefore, to recognize both 60- and 80-chromosome euploids as *S. robustum* and the aneuploid hybrids that resemble them as *S. robustum* × *S. robustum* derivatives. Gross morphology combined with chromosome

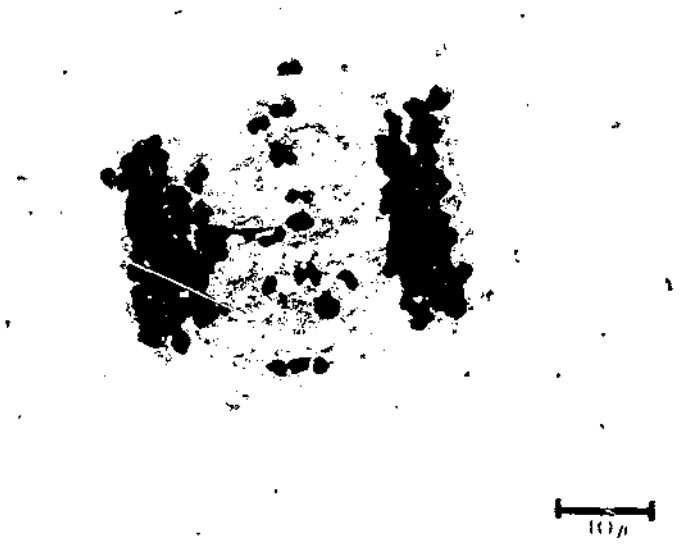

FIGURE 3.—First meiotic anaphase-telophase in *Saccharum* × *Miscanthus*, clone 51 N.G. 88 (Imp. 1970).

numbers, however, makes recognition of several types possible. Brief descriptions of the *S. robustum* types and of hybrid derivatives sometimes collected as *S. robustum* follow.

Port Moresby type.—The Port Moresby type of *S. robustum* includes euploids with $2n=80$ chromosomes and large stalks. The stalks often grow 20 feet high or more, and their diameters range from ¾ to 1¾ inches. The leaf blades are broad, and their surfaces are usually glabrous. The blades and sheaths of old leaves fall; thus, mature stalks are exposed. Inflorescences are large compound panicles. This type of *S. robustum* is usually found below elevations of 300 feet on alluvial riverbanks. The type specimen of *S. robustum* was taken from 28 N.G. 251, a clone collected from a Laloki River bank near Port Moresby, New Guinea.

Goroka type.—The Goroka type of *S. robustum* includes euploids with $2n=80$ chromosomes and small stalks. Stalks rarely grow 20 feet high, and their diameters range from ½ to 1 inch. Leaf blades are correspondingly narrow; and their surfaces are usually glabrous; but, a few clones—Molokai 5193, 51 N.G. 3, 51 N.G. 27, U.S. 57–125–1 and –2—have pubescent blades. Old leaves and leaf sheaths persist; thus, the stalks are hidden and the plants have a trashy aspect. The compound panicles are somewhat smaller than those of the Port Moresby type. Goroka type *S. robustum* is found above 300-foot elevations. Usually it is found between 5,000- and 7,000-foot elevations. It has been collected near rivers, but more often it comes from

drier sites. This type of *S. robustum* was collected extensively from the Goroka-Ko'mperi areas of New Guinea.

Red-fleshed type.—The Red-fleshed type of *S. robustum* (forma *sanguineum*) includes euploids with $2n=60$ chromosomes and large stalks containing red-pigmented pith. The size of stalks, leaves, and panicles are similar to those of Port Moresby type. Old leaves and leaf sheaths fall, which exposes stalks that, perhaps more than those of any other *S. robustum* form, resemble the stalks of *S. officinarum*. Red-fleshed *S. robustum* grows extensively at about 100-foot elevations along the Sepik River, New Guinea, in sites that may be flooded for long periods. It has not been found elsewhere.

Teboe Salah type.—The Teboe Salah type of *S. robustum* includes the original Tananggé and Teboe Salah clones and similar 60-chromosome euploids with large stalks. Stalks, leaves, panicles, and ecological preferences are similar to those of the Port Moresby type, except that pubescent leaf blades are very common in this group. Borneo and Celebes clones reportedly have ciliate lodicules and long hair on the panicle axes. Wild canes of this type were known in a Borneo vernacular as Teboe Salah (or Tebu Salah).

Wau-Bulolo type.—The Wau-Bulolo type of *S. robustum* includes euploids with $2n=60$ chromosomes (fig. 4) and small stalks. Stalk and panicle sizes are similar to those of the Goroka type. The width of the narrow leaf blades correspond with stalk diameters. Pubescent leaf blades are very common in this group. Ecological preferences are similar to those of the Goroka type. Wau-Bulolo type *S. robustum* has been collected below 100-foot and up to 7,000-foot elevations, but it is usually found between 1,000- and 4,000-foot elevations. The type takes its name from the Wau and Bulolo areas of New Guinea, where it occurs extensively.

Large-stemmed S. robustum hybrids.—The aneuploids that resemble one or another of the large-stemmed euploid types (Port Moresby, Red-fleshed, or Teboe Salah types) are considered together as large-stemmed *S. robustum* × S. *robustum* hybrid derivatives. They usually have $2n=$ 73–112 chromosomes (fig. 5), but one clone has $2n=63$ and another $2n=163$. Although there is much variation among these clones, their gross appearance and ecological preferences are similar to those of the large-stemmed euploids. Among them are many clones with and many clones without pubescent leaf blades. Several clones from the lower Sepik River, New Guinea have red or pink pith. Along the lower Sepik River the aneuploid forms that do not have red or pink pith (often collected as the "yellow form") occur only on the better drained sites.

Small-stemmed S. robustum hybrids.—Only a few aneuploids resemble the small-stemmed euploid types (Goroka and Wau-Bulolo types). These few aneuploids are considered together as the small-stemmed *S. robustum* × *S. robustum* hybrids and hybrid derivatives. Their chromosome numbers range from $2n=63$ to $2n=79+1$ fragment. These small-stemmed *S. robustum* hybrids resemble the small-stemmed euploids in gross morphology and ecological perference.

S. robustum × *S. officinarum.*—Only three natural *S. robustum* × *S. officinarum* hybrids are recognized in the collections (Appendix, table 1). They have $2n=70$, 80, and 80, all plausible F_1 chromosome numbers. These plants resemble large-stemmed euploid *S. robustum*,

FIGURE 4.—Mitosis in a leaf cell of Wau-Bulolo type *S. robustum* from Dumpu, New Guinea. Clone U.S. 57–152–3, $2n=60$.

but they have soft stems and sweet juice.

S. robustum × *S. spontaneum.*—*S. robustum* × *S. spontaneum* hybrids and hybrid derivatives are recognized by their gross morphology. Although their stalks, leaves, and ecological preferences resemble those of the small-stemmed *S. robustum* euploids, their panicles are intermediate in compounding and size between those of *S. robustum* and *S. spontaneum*. Furthermore, they possess rhizomes, a characteristic of *S. spontaneum* not *S. robustum*. Their chromosome numbers (fig. 6) range from $2n=80$ (possible F_1's) to 101.

Saccharum × *Miscanthus.*—*Saccharum* × *Miscanthus* hybrid derivatives include aneuploids with very high chromosome numbers (figs. 7, 8, and 9). The range of stalk size is extreme. Some small-stemmed clones with stalks about ¼ inch in diameter hardly differ vegetatively from *Miscanthus floridulus*, but their large compound panicles resemble those of *Saccharum*. Large-stemmed clones with stalks about 1 inch in diameter betray their relation to *Miscanthus*

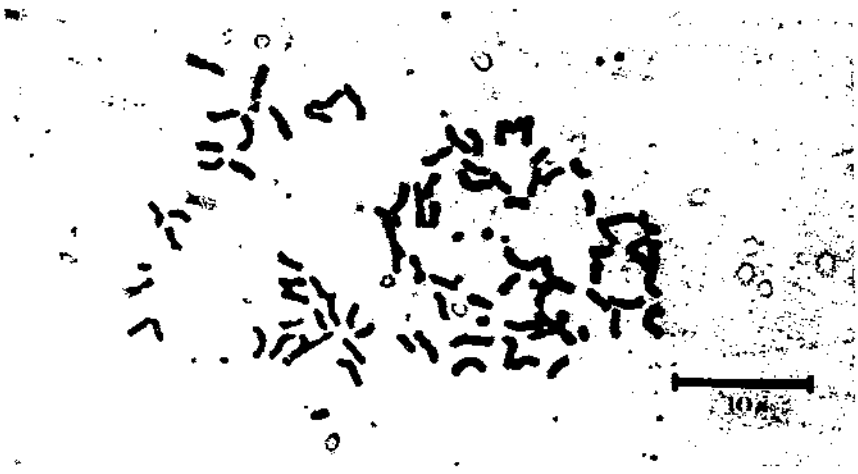

FIGURE 5.—Mitosis in a leaf cell of a large-stemmed *S. robustum* × *S. robustum* derivative from the Sepik River bank near Ambunti, New Guinea. Clone U.S. 57–96–4, $2n=88$.

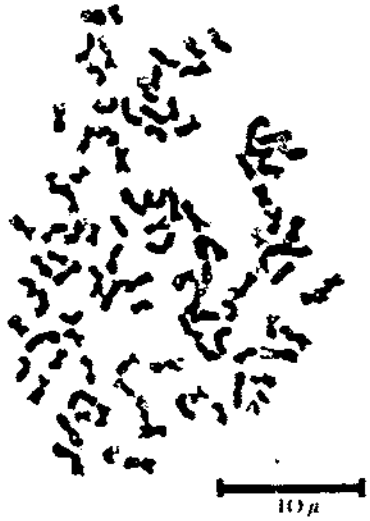

FIGURE 6.—Mitosis in a leaf cell of a *S. robustum* × *S. spontaneum* derivative from near Mumeng, New Guinea. Clone U.S. 57–85–1, $2n=100$.

mainly in their drooping leaves. One clone has $2n=114$–117, another has $2n=140$, and chromosome numbers of the others range from $2n=152$ to *ca.* 205. These high-chromosome *Saccharum* × *Miscanthus* hybrids grow at elevations of 3,800 to 7,000 feet in the interior of New Guinea. Many come from untended sites; others come from gardens or garden fences. (Melanesians use several forms of *S. robustum* and its hybrids to construct buildings and fences.) One small-stemmed clone, 57 N.G. 153, is variegated and another, 57 N.G. 131, has no midrib; they probably were preserved by the Melanesians as curiosities or ornamentals.

Plant size and stalk diameter figure prominently in the forgoing descriptions. Size differences persist under uniform conditions. Nevertheless, repeated reference to "large-stemmed" and "small-stemmed" forms is a convenience that may unduly emphasize an obvious and useful difference at the expense of important associated morphological characters and ecological preferences. The large-stemmed hybrids and the Port Moresby, Red-fleshed, and Teboe

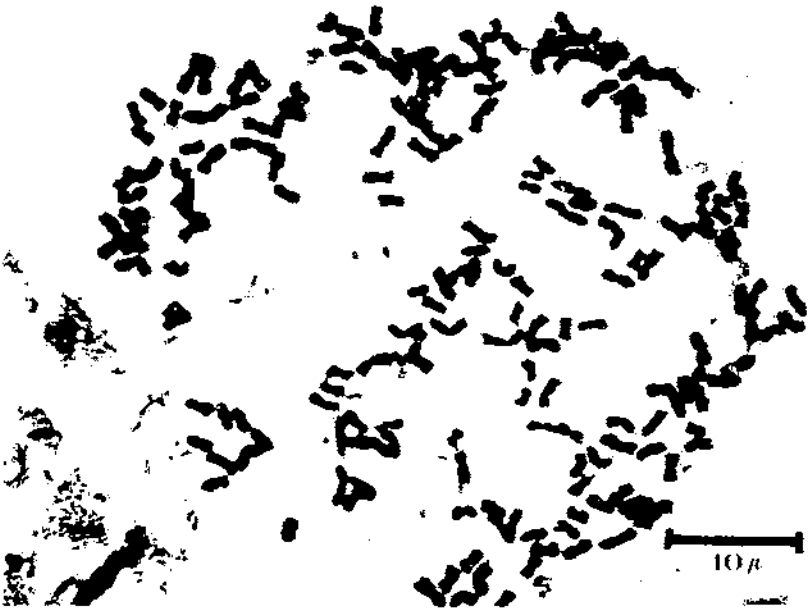

FIGURE 7.—Mitosis in a leaf cell of *Saccharum* × *Miscanthus* from Mendi, New Guinea. Clone 51 N.G. 106 (Imp. 1986), $2n=193$ or 194.

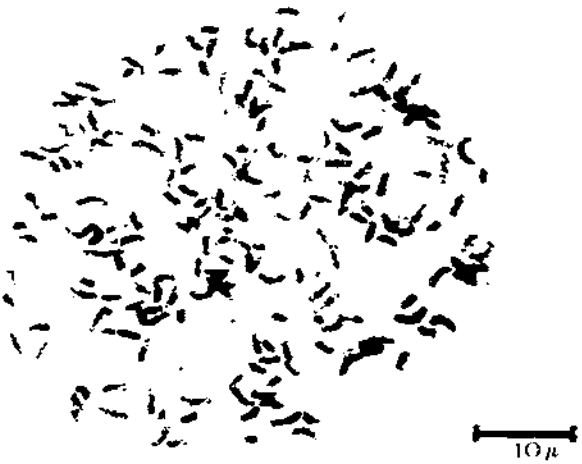

FIGURE 8.—Mitosis in a leaf cell of *Saccharum* × *Miscanthus* with thin albino stripes on stalks and leaves. Clone 57 N.G. 153 (Imp. 2609), $2n=197$–200. From a garden fence at Tari, New Guinea.

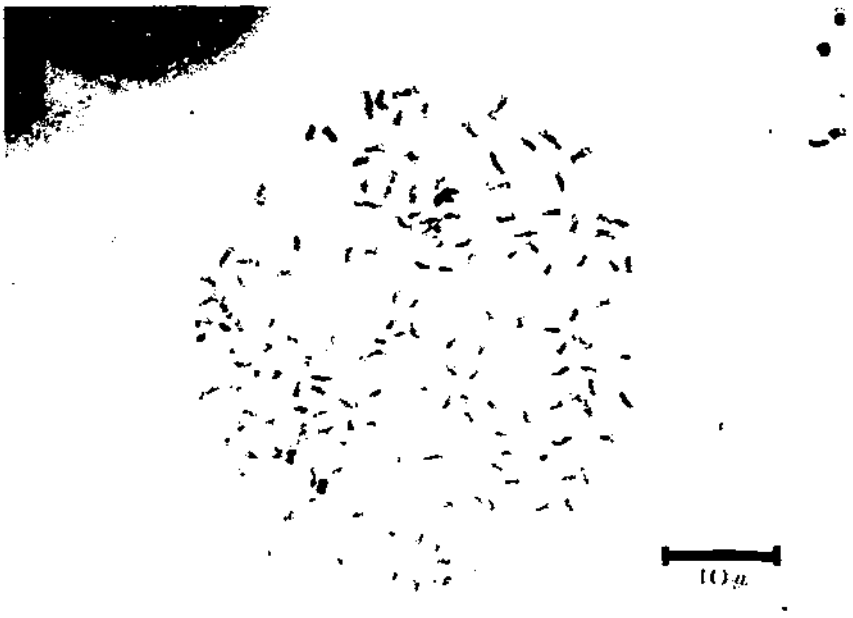

FIGURE 9.—Mitosis in a leaf cell of *Saccharum* × *Miscanthus* from the Wissel Lakes, New Guinea. Clone U.S. 57–145–2, $2n=170$ or 171.

Salah types of *S. robustum* usually come from silty riverbanks or the edges of low meandering rivers. Also, they usually have large compound panicles and are free stripping (old leaves and leaf sheaths drop, which exposes the stalks). The small-stemmed hybrids and the Goroka and Wau-Bulolo types of *S. robustum* usually come from well-drained sites, have medium-sized panicles and are trashy (old leaves and leaf sheaths persist).

As with most biological classifications, there are nonconforming individuals. Some clones with rather meager stems seem to belong in large-stemmed categories, because they have exposed stalks, large inflorescences, and appropriate ecological preferences. Similarly, some clones with medium-large stalks seem to belong in small-stemmed categories, because they are trashy, have small panicles, and come from rather rigorous sites. It is necessary, therefore, to be liberal with the terms large (usually ¾ to 1¾ inch) and small (usually ½ to 1 inch) in describing stalk diameters.

Some of the recalcitrant clones: Intermediacy is illustrated by the 80-chromosome clones 51 N.G. 55, 51 N.G. 63, 57 N.G. 56, 57 N.G. 208, and seedlings in the family U.S. 57–94, which have medium-large stalks but clinging leaves. Clones 51 N.G. 55, 51 N.G. 63, and 57 N.G. 208 were placed in the Goroka group because their leaves are very persistent; the others were placed in the Port Moresby group because their leaves were less persistent. Among 60-chromosome clones U.S. 57–75–1 has large stems, but it was placed in the Wau-Bulolo group because its leaves persist.

Some clones seem to lie beyond the variation of any group. The

extremely thin-stemmed clones 51 N.G. 3 and 51 N.G. 27, despite their pubescent leaf blades and lack of rhizomes, resemble *S. spontaneum*. Because of their 80 chromosomes and small trashy stems, they were placed in the Goroka group. The ellipsoidal rather than conical panicles and white or yellow rather than purple stigmas of seedlings of the families U.S. 57–83 and U.S. 57–84 set them apart, but because of their 60 chromosomes, medium-sized stems, and clinging leaves, they were placed in the Wau-Bulolo group. Certain small 60-chromosome Guadalcanal clones, Molokai 6006–6010 and seedlings of the family U.S. 57–161, differ considerably from any other collection. They flower early and late in Florida and year around in Hawaii. They may well deserve recognition as a distinct botanical form or even species, but to place them in a unique category on the strength of so few collections seems premature. Hence, because of their 60 chromosomes, small stems, and clinging leaves, they were placed in the Wau-Bulolo group.

One other peculiarity in the grouping must be mentioned. Maternal clones in nature are usually exposed to open pollination. Furthermore, since seed lots collected in nature may include seeds from more than one maternal clone, seedlings grown from them may be full or half siblings, but they need not be. Thus, 80-chromosome clones in the family U.S. 57–125 were placed in the Goroka group, but aneuploids in the same family were considered small-stemmed hybrids. Similarly, 60-chromosome clones in the family U.S. 57–120 were placed in the Teboe Salah group, but U.S. 57–120–6 was considered a large-stemmed hybrid.

DISTRIBUTION

A discussion of the geographical range of *S. robustum* is necessarily fragmentary. Most of the collecting in New Guinea has been done in Papua and the Territory of New Guinea. Although Warner and Grassl (*48*) spent a month collecting in Irian Barat, large areas there and also in western Papua remain unsampled. Wild *Saccharum* has not been sought in the Moluccas, and only spotty collecting represents the Celebes, Borneo, and the Solomon and New Hebrides Islands. With these limitations, the geographical distribution of *S. robustum* types and their hybrids is illustrated in figure 10. Sympatric *S. spontaneum* is also shown.

The 80-chromosome Port Moresby type appears concentrated in southeastern New Guinea, but it has been collected also along the northern coast of New Guinea, along the Toriu River on New Britian's Gazelle Peninsula, and at Imera on Efate Island in the New Hebrides. The New Hebrides collection represents the easternmost extension of the species' geographical range. Port Moresby type *S. robustum* is shown on New Guinea's Vogelkop Peninsula (fig. 10) on the strength of Nishiyama's (*29*, *30*) reports of 80-chromosome *S. robustum* clones and his personal communication. The clones probably came from the Japanese agricultural projects (World War II) near Manokwari or the Momi-Ransiki area, in which case their ultimate origin might be elsewhere. Warner and Grassl collected 60-chromosome but no 80-chromosome *S. robustum* near Manokwari. The port Moresby type has been collected no higher than 300-foot elevations.

The 80-chromosome Goroka type

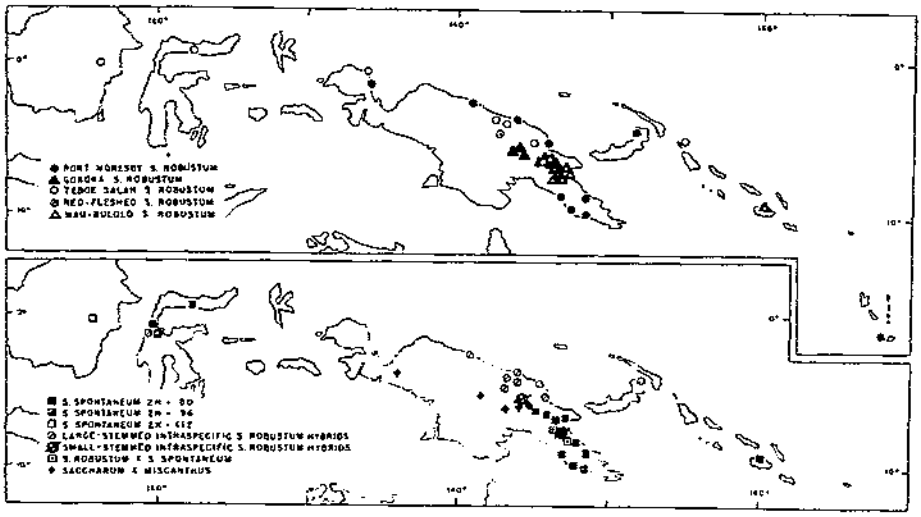

FIGURE 10.—Geographical distribution of *S. robustum* (above) and of natural hybrids and *S. spontaneum* (below).

S. robustum seems to be concentrated in the high eastern plateaus of New Guinea. It was collected extensively near the headwaters of the Purari, Ramu, and Markham Rivers at 5,000- to 7,000-foot elevations. It was also found at 800-foot elevations on the Ramu River and at 300-foot elevations on the Markham River. One collection came from a 3,800-foot elevation on the Baiyer River, a secondary or tertiary tributary of the Sepik River.

Warner and Grassl (*48*) described broad expanses of the Red-fleshed *S. robustum* along the lower Sepik River between Ambunti and Pagwi and near Angoram (the Angoram collection consisted of large-stemmed red-fleshed aneuploids). They suggested that it may be distributed along the Sepik to the mouth of the Yellow River. It has not been collected elsewhere.

Before the 1957 expedition Teboe Salah type *S. robustum* was known only from eastern Borneo and northern and central Celebes. Warner and Grassl's collections from New Guinea's Vogelkop Peninsula, however, belong to this group. Furthermore, several of the large-stemmed *S. robustum* they collected across northern New Guinea also were found to be Teboe Salah types; so was their collection from Buka Island in the Solomon Islands. Usually, this type was found at low elevations along silty stream banks, but one collection came from what appeared to be an abandoned garden at an 1,800-foot elevation (Appendix, table 1).

The Wau-Bulolo type of *S. robustum* occurs mainly in eastern New Guinea near the Francisco River at Salamaua, near Lae, along the Markham River, and especially in the goldfields near Wau and Bulolo above the Markham River. A few collections from outside this area fall in the Wau-Bulolo group, but they seem atypical. The atypical forms are the small clones from Guadalcanal and the larger clones with white or yellow stigmas and peculiarly shaped panicles. A collection of the latter came from the Wau-Bulolo goldfields, but another,

the family U.S. 57–83, came from a drainage separated from the goldfields by a high divide.

Bremer (*13*) reported an 89- or 90-chromosome plant among 60-chromosome Teboe Salahs from the central Celebes. This aneuploid clone surely would fall in the large-stemmed *S. robustum* × *S. robustum* group. Many New Britain clones were also aneuploids (*33*). Similarly, many of the clones Warner and Grassl collected in northern New Guinea as "yellow" or "normal" forms (by which they meant forms that resembled Port Moresby clones) proved to be aneuploids. All the "yellow" forms from the better drained sites along the lower Sepik River were aneuploids. More often than not, large-stemmed forms collected near river mouths along New Guinea's northern coast also proved to be aneuploids. The known distribution of large-stemmed *S. robustum* × *S. robustum* hybrid derivatives, then, is from the Celebes across the northern coastal areas of New Guinea to the Gazelle Peninsula of New Britain.

Small-stemmed *S. robustum* hybrid derivatives were collected infrequently. One seed collection from the Wau-Bulolo goldfields produced several such hybrids. Another seed collection from the Baiyer River, New Guinea, gave rise to a few more small-stemmed hybrids. Clone 57 N.G. 249, a plant from Guadalcanal tentatively listed as a small-stemmed hybrid (Appendix, table 1), may yet prove to be *Saccharum edule*.

Only a few clearly recognized *S. robustum* × *S. spontaneum* hybrids and hybrid derivatives were studied. The origin of the clone Ura is unknown, but its native name "Aiyura" is the name of a New Guinea village at the Ramu River headwaters. One collection of *S. robustum* × *S. spontaneum* hybrids came from Garaina above Morobe, New Guinea, and another from the Wau-Bulolo goldfields. Warner and Grassl (*48*) reported *S. robustum* × *S. spontaneum* derivatives in great numbers on the lower flood plain of New Guinea's Markham River.

Saccharum × *Miscanthus* occurs in New Guinea's high central interior. In the Territory of New Guinea and in Papua it was found both in and out of cultivation from Goroka in the east to Telefomin in central New Guinea. Far to the west near the Wissel Lakes, Warner and Grassl collected *Saccharum* × *Miscanthus* on their only visit to the highlands of Irian Barat.

LITERATURE CITED

(1) ARTSCHWAGER, E.
1942. A COMPARATIVE ANALYSIS OF THE VEGETATIVE CHARACTERISTICS OF SOME VARIANTS OF *SACCHARUM SPONTANEUM*. U.S. Dept. Agr. Tech. Bul. 811, 55 pp.

(2) ———
1948. VEGETATIVE CHARACTERISTICS OF SOME WILD FORMS OF *SACCHARUM* AND RELATED GRASSES. U.S. Dept. Agr. Tech. Bul. 951, 69 pp.

(3) ——— and BRANDES, E. W.
1958. SUGARCANE (*SACCHARUM OFFICINARUM* L.). ORIGIN, CLASSIFICATION, CHARACTERISTICS, AND DESCRIPTIONS OF REPRESENTATIVE CLONES. U.S. Dept. Agr. Handb. 122, 307 pp.

(4) BABU, C. N.
1957. STUDIES IN *SACCHARUM SPONTANEUM*. CONTRIBUTIONS TO AN 'ATLAS' OF CHROMOSOME NUMBER IN *SACCHARUM SPONTANEUM*. All-India Conf. Sugarcane & Devlpmt. Workers Proc. 3 (Pt.II): 44–46.

(5) BHAT, N. R., SUBBA RAO, K. S., and KANDASAMI, P. A.
1962. A REVIEW OF CYTOGENETICS OF *SACCHARUM*. Indian Jour. Sugarcane Res. & Devlpmt. 7: 1–18.

(6) BRANDES, E. W.
1929. INTO PRIMEVAL PAPUA BY SEAPLANE. Natl. Geog. Mag. 56 (3): 253–332.

(7) ———
1956. ORIGIN, DISPERSAL, AND USE IN BREEDING OF THE MELANESIAN GARDEN SUGARCANES AND THEIR DERIVATIVES, *SACCHARUM OFFICINARUM* L. Internatl. Soc. Sugar Cane. Technol. Cong. Proc. 9, V. 1: 709–750.

(8) ——— and SARTORIS, G. B.
1936. SUGARCANE: ITS ORIGIN AND IMPROVEMENT. U.S. Dept. Agr. Yearbook 1936: 561–623.

(9) ——— SARTORIS, G. B., and GRASSL, C. O.
1938. ASSEMBLING AND EVALUATING WILD FORMS OF SUGARCANE AND CLOSELY RELATED PLANTS. Internatl. Soc. Sugar Cane Technol. Cong. Proc. 6: 128–153.

(10) BREMER, G.
1924. DE CYTOLOGIE VAN HET SUIKERRIET. III. DE CHROMOSOMEN BIJ PRIMITIEVE VORMEN VAN HET GESLACHT *SACCHARUM*. Arch. v. Suikerindus. Nederland. Indië., Meded. Proefsta. v. Java-Suikerindus. 1924: 477–508. (English translation in Genetica 7: 293–322. 1925.).

(11) ———
1930. SHORT REMARKS ON THE CYTOLOGY OF *SACCHARUM*. Internatl. Soc. Sugar Cane. Technol. Cong. Proc. 3: 403–408.

(12) ———
1931. DE CYTOLOGIE VAN HET SUIKERRIET. V. EEN ONDERZOEK OVER DE SOMATISCHE CHROMOSOMENAANTALLEN VAN SUIKERRIET. Arch. v. Suikerindus. Nederland. Indië., Meded. Proefsta. v. Java-Suikerindus. 1931: 583–607.

(13) ———
1934. DE CYTOLOGIE VAN HET SUIKERRIET. VII. EEN CYTOLOGISCH ONDERZOEK VAN EEN VIJFTIGTAL IN 1929–1930 OP JAVA GEIMPORTEERDE RIETSOORTEN. Arch. v. Suikerindus. Nederland. Indië., Meded. Proefsta. v. Java-Suikerindus. 1934: 141–166.

(14) ———
1961. PROBLEMS IN BREEDING AND CYTOLOGY OF SUGAR CANE. I. A SHORT HISTORY OF SUGAR CANE BREEDING THE ORIGINAL FORMS OF *SACCHARUM*. Euphytica 10: 59–78.

(15) ———
1961. PROBLEMS IN BREEDING AND CYTOLOGY OF SUGAR CANE. II. THE SUGAR CANE BREEDING FROM A CYTOLOGICAL VIEW-POINT. Euphytica 10: 121–133.

(16) ———
1961. PROBLEMS IN BREEDING AND CYTOLOGY OF SUGAR CANE. III. THE CYTOLOGICAL CROSSING RESEARCH OF SUGAR CANE. Euphytica 10: 229–243.

(17) BUZACOTT, J. H.
1956. DIVISION OF CANE BREEDING. Queensland Bur. Sugar Expt. Stas. Ann. Rpt. 56: 56–67.

(18) ——— and HUGHES, C. G.
1951. THE 1951 CANE COLLECTING EXPEDITION TO NEW GUINEA. Queensland Bur. Sugar Expt. Stas. Cane Growers' Quart. Bul. 25(2): 35–72.

(19) GRASSL, C. O.
1946. *SACCHARUM ROBUSTUM* AND OTHER WILD RELATIVES OF "NOBLE" SUGAR CANES. Arnold Arboretum Jour. 27: 234–252.

(20) ———
1959. INTROGRESSION BETWEEN *SACCHARUM* AND *MISCANTHUS* IN THE NEW GUINEA AND PACIFIC AREA. (Abstract.) Botan. Cong., Montreal, Proc. 9, v. 2: 140.

(21) ———
1964. PROBLEMS RELATING TO THE ORIGIN AND EVOLUTION OF WILD AND CULTIVATED *SACCHARUM*. Indian Jour. Sugarcane Res. & Devlpmt. 8: 106–116.

(22) JANAKI AMMAL, E. K.
1941. INTERGENERIC HYBRIDS OF *SACCHARUM*. Jour. Genet. 41: 217–253.

(23) KANDASAMI, P. A.
1961. INTERSPECIFIC AND INTERGENERIC HYBRIDS OF *SACCHARUM SPONTANEUM* L. I. FUNCTIONING OF GAMETES. Cytologia 26: 117–123.

(24) LENNOX, C. G.
1938. SUGAR CANE COLLECTING IN NEW GUINEA DURING 1937. Hawaii. Planters' Rec. 42: 235–246. (Also in Internatl. Soc. Sugar Cane Technol. Cong. Proc. 6: 171–182.)

(25) MANGELSDORF, A. J.
1950. SUGARCANE—AS SEEN FROM HAWAII. Econ. Bot. 4: 150–176.

(26) MARTIN-LEAK, H.
1935. RESEARCH AND PRACTICE IN HAWAII. Internatl. Sugar Jour. 37: 292–294.

(27) MORIYA, A.
1944. CONTRIBUTIONS TO THE CYTOLOGY OF THE GENUS *SACCHARUM*. II. THE CHROMOSOME NUMBER OF *SACCHARUM ROBUSTUM*, INDIGENOUS TO NEW GUINEA. Cytologia 13: 265–269.

(28) NEWCOMER, E. H.
1952. A NEW CYTOLOGICAL AND HISTOLOGICAL FIXING FLUID. Science 118: 116.

(29) NISHIYAMA, I., FURUSATO, K., YAMADA, I., and KONDO, N.
1947. STUDIES ON SUGARCANE. IV. CHROMOSOME NUMBERS OF WILD SUGARCANES IN MICRONESIA. Seiken Ziho (Kihara Inst. Biol. Res. Rpt.) 3: 63–67. [In Japanese. English summary, pp. 66–67.]

(30) ——— YAMADA, I., and KONDO, N.
1942. STUDIES ON THE SUGAR CANE. I. KARYOLOGICAL OBSERVATIONS ON WILD AND CULTIVATED SUGAR CANES. Seiken Ziho (Kihara Inst. Biol. Res. Rpt.) 1: 10–16. [In Japanese. English summary, p. 15.]

(31) PANSE, R. R.
1956. REPORT OF THE BOTANIST. Sugarcane Breeding Inst. Coimbatore (India) Ann. Rpt. 1955–56: 33–48.

(32) ——— and BABU, C. N.
1960. STUDIES IN *SACCHARUM SPONTANEUM*. DISTRIBUTION AND GEOGRAPHICAL ASSOCIATION OF CHROMOSOME NUMBERS. Cytologia 25: 152–172.

(33) PRICE, S.
1957. CYTOLOGICAL STUDIES IN *SACCHARUM* AND ALLIED GENERA. II. GEOGRAPHICAL DISTRIBUTION AND CHROMOSOME NUMBERS IN *S. ROBUSTUM*. Cytologia 22: 40–52.

(34) ———
1957. CYTOLOGICAL STUDIES IN *SACCHARUM* AND ALLIED GENERA. III. CHROMOSOME NUMBERS IN INTERSPECIFIC HYBRIDS. Bot. Gaz. 118: 146–159.

(35) ———
1961. CYTOLOGICAL STUDIES IN *SACCHARUM* AND ALLIED GENERA. VII. MATERNAL CHROMOSOME TRANSMISSION BY *S. OFFICINARUM* IN INTRA- AND INTERSPECIFIC CROSSES. Bot. Gaz. 122: 298–305.

(36) PRICE, S.
1962. A MODIFIED LEAF-SQUASH TECHNIQUE FOR COUNTING CHROMOSOMES IN SOMATIC CELLS OF *SACCHARUM* AND RELATED GRASSES. Internatl. Soc. Sugar Cane Technol. Cong. Proc. 11: 583–585.

(37) ———
1963. ACCESSORY CHROMOSOMES IN *MISCANTHUS FLORIDULUS*. Jour. Hered. 54: 13–16.

(38) ———
1963. CYTOGENETICS OF MODERN SUGARCANES. Econ. Bot. 17:97–106.

(39) ———
1963. CYTOGEOGRAPHY OF *SACCHARUM ROBUSTUM* AND RELATED PLANTS. (Abstract.) Amer. Jour. Bot. 50:637.

(40) ———
1963. CYTOLOGICAL STUDIES IN *SACCHARUM* AND ALLIED GENERA. VIII. F_2 AND BC_1 PROGENIES FROM 112- AND 136-CHROMOSOME *S. OFFICINARUM* X *S. SPONTANEUM* HYBRIDS. Bot. Gaz. 124: 186–190.

(41) ———
1964. CYTOLOGICAL STUDIES IN *SACCHARUM* AND ALLIED GENERA. IX. FURTHER F_1 HYBRIDS FROM *S. OFFICINARUM* ($2N=80$) X *S. SPONTANEUM* ($2N=96$). Indian Jour. Sugarcane Res. & Devlpmt. 8:131–133.

(42) ———
In press. *In* DOCUMENTED CHROMOSOME NUMBERS OF PLANTS. Madroño.

(43) BAGHAVAN, T. S.
1954. CYTO-GENETICS IN RELATION TO SUGARCANE BREEDING. Cytologia 19:133–143.

(44) ——— and GOVINDASWAMY, S.
1956. THE PHYLOGENY OF *SACCHARUM* AND RELATED GENERA. Internatl. Soc. Sugar Cane Technol. Cong. Proc. 9, v. 1:695–709.

(45) [STEVENSON, G. C.]
1953. REPORT OF CYTOGENETICIST—52–53. Brit. West Indies Central Sugar Cane Breeding Sta., Barbados, Ann. Rpt. 20:53–61.

(46) ———
1954. CYTOGENETICIST'S ANNUAL REPORT. Brit. West Indies Central Sugar Cane Breeding Sta., Barbados, Ann. Rpt. 21:41–45.

(47) ———
1961. RESEARCH WORK. II. LABORATORY WORK. Brit. West Indies Central Sugar Cane Breeding Sta., Barbados, Ann. Rpt. 28:23–24

(48) WARNER, J. N., and GRASSL, C. O.
1958. THE 1957 SUGAR CANE EXPEDITION TO MELANESIA. Hawaii. Planters' Rec. 55: 209–236.

APPENDIX

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum robustum						
Port Moresby type:			New Guinea:			
Molokai 1152	80	(33)	Laloki River bank near Port Moresby.	9°35′ S. 147°10′ E.	<100	L 1930
Molokai 1199	80	(33)	do	9°35′ S. 147°10′ E.	<100	L 1930
Molokai 1227	80	(33)	do	9°35′ S. 147°10′ E.	<100	L 1930
Molokai 1236	80	(33)	do	9°35′ S. 147°10′ E.	<100	L 1930
Molokai 1238	80	(33)	do	9°35′ S. 147°10′ E.	<100	L 1930
Molokai 1290	80	(33)	do	9°35′ S. 147°10′ E.	<100	L 1930
			New Britain:			
Molokai 4782	78–80	(33)	Toriu River	4°40′ S. 151°45′ E.	<100	L & P 42
Molokai 4861, Imp. 1010.	80	[4] (2, 33)	do	4°40′ S. 151°45′ E.	<100	L & P 43
Molokai 4881	80	(33)	do	4°40′ S. 151°45′ E.	<100	L & P 43
Molokai 4922	80	(33)	do	4°40′ S. 151°45′ E.	<100	L & P 43
Molokai 4972	80	(2, 33)	do	4°40′ S. 151°45′ E.	<100	L & P 43
Molokai 5006	80	(33)	do	4°40′ S. 151°45′ E.	<100	L & P 43
Molokai 5044	80	(33)	do	4°40′ S. 151°45′ E.	<100	L & P 43
Molokai 5084	80	(33)	do	4°40′ S. 151°45′ E.	<100	L & P 43
Molokai 5234	80	(33)	do	4°40′ S. 151°45′ E.	<100	L & P 41
			New Guinea:			
Molokai 5852	78–80	(33)	Laloki River bank near Port Moresby.	9°35′ S. 147°10′ E.	<100	W 26
Molokai 5853	80	(33)	do	9°35′ S. 147°10′ E.	<100	W 26
Molokai 5854	80	(33)	do	9°35′ S. 147°10′ E.	<100	W 26
Molokai 5855	80	(33)	do	9°35′ S. 147°10′ E.	<100	W 26
Molokai 5856	80	(33)	do	9°35′ S. 147°10′ E.	<100	W 26

28 N.G. 10½, Imp. 653.	80	(33)	Kemp Weish River at Niuinuka.	9°55′ S. 147°50′ E.	200	
28 N.G. 251, Imp. 496.[5]	80	(22, 27, 33 47)	Laloki River bank near Port Moresby.	9°35′ S. 147°10′ E.	<100	
	84	[4] (9)				
51 N.G. 140, Imp. 2006.	80	(33)	do	9°35′ S. 147°10′ E.	<100	
57 N.G. 1, Imp. 2463.	80	(6)	Stream bank between Brown and Laloki Rivers near Port Moresby.	9°35′ S. 147°10′ E.	<100	
57 N.G. 2, Imp. 2464.	80	(6)	do	9°35′ S. 147°10′ E.	<100	
57 N.G. 3, Imp. 2465.	80	(6)	Brown River bank near Port Moresby.	9°35′ S. 147°10′ E.	<100	
57 N.G. 56, Imp. 2505.	80	(6)	Gogol River bank near Madang.	5°15′ S. 145°40′ E.	200	
57 N.G. 201, Imp. 2657.	80	(6)	Tami River bank near Hollandia.	2°45′ S. 140°45′ E.	<100	
57 N.G. 255, Imp. 2714.	80	(6)	Stream bank at Epo (Mekeo).	8°45′ S. 146°35′ E.	50	
57 N.G. 261, Imp. 2720.	80	(6)	Stream bank at Popondetta, Endesi Creek drainage.	8°45′ S. 148°10′ E.	300	
			New Hebrides:			
N.H. 1	80	(2, 33)	Imera on Efate Island	17°40′ S. 168°20′ E.		
			New Guinea:			
N.W. 1	80	(30)	Vogelkop Peninsula? [7]			
N.W. 2	80	(30)	do			
N.W. 3	80	(29)	do			
N.W. 4	80	(29)	do			
U.S. 57–94–1	80	(6)	Near Dagua	3°25′ S. 143°15′ E.	25	W & G 645
U.S. 57–94–2	80	(6)	do	3°25′ S. 143°15′ E.	25	W & G 645
U.S. 57–94–3	80	(6)	do	3°25′ S. 143°15′ E.	25	W & G 645
U.S. 57–94–4	80	(6)	do	3°25′ S. 143°15′ E.	25	W & G 645
U.S. 57–94–5	80	(6)	do	3°25′ S. 143°15′ E.	25	W & G 645
U.S. 57–149–1	80	(6)	Tami River bank near Hollandia.	2°45′ S. 140°45′ E.	<100	W & G 787 [8]
U.S. 57–149–2	*ca.* 80	(6)	do	2°45′ S. 140°45′ E.	<100	W & G 787 [8]

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum robustum—Continued						
Goroka type:						
Molokai 4349	80	(*33*)	Upper Ramu River near Kainantu.	6°10′ S. 145°55′ E.	5,000	L & P 26
Molokai 4353	80	(*33*)	do	6°10′ S. 145°55′ E.	5,000	L & P 26
Molokai 4357	80	(*33*)	do	6°10′ S. 145°55′ E.	5,000	L & P 26
Molokai 4360, Imp. 1005.	80	(*2, 33*)	do	6°10′ S. 145°55′ E.	5,000	L & P 26
Molokai 5193	80	(*33*)	do	6°10′ S. 145°55′ E.	5,000	L & P 31
Molokai 5248	80	(*33*)	do	6°10′ S. 145°55′ E.	5,000	L & P 25
Molokai 5300	80	(*33*)	do	6°10′ S. 145°55′ E.	5,000	L & P 27
Molokai 5549	80	(*33*)	Ko'mperi Valley, Purari River drainage.	6°15′ S. 145°50′ E.	6,000	L & P 30
Molokai 5573, Imp. 2164.	80	(*33*)	do	6°15′ S. 145°50′ E.	6,000	L & P 30
Molokai 5698, Imp. 1031.	80	(*33*)	Upper Ramu River near Kainantu.	6°10′ S. 145°55′ E.	5,000	L & P 27
Molokai 5701	80	(*33*)	do	6°10′ S. 145°55′ E.	5,000	L & P 27
Molokai 5715	80–84	(*33*)	do	6°10′ S. 145°55′ E.	5,000	L & P 27
Molokai 5803	80	(*33*)	Purari River drainage: Goroka	6°5′ S. 145°25′ E.	5,000	W 3
Molokai 5805	80	(*33*)	Asariufa near Goroka.	6°5′ S. 145°25′ E.	5,000	W 4
Molokai 5806	80	(*33*)	do	6°5′ S. 145°25′ E.	5,000	W 4
Molokai 5807	80	(*33*)	do	6°5′ S. 145°25′ E.	5,000	W 4
Molokai 5809	80	(*33*)	do	6°5′ S. 145°25′ E.	5,000	W 5
Molokai 5812	80	(*33*)	do	6°5′ S. 145°25′ E.	5,000	W 6
Molokai 5813	80	(*33*)	Asaro River near Goroka.	6°5′ S. 145°25′ E.	5,000	W 8

Molokai 5815	80	(33)	----do	6°5′ S. 145°25′ E	5,000	W 8
Molokai 5816	80	(33)	----do	6°5′ S. 145°25′ E	5,000	W 9
Molokai 5817	80	(33)	----do	6°5′ S. 145°25′ E	5,000	W 9
Molokai 5818	80	(33)	Ko'mperi	6°15′ S. 145°50′ E	6,000	W 11
Molokai 5819	80	(33)	Amari in Ko'mperi Valley.	6°15′ S. 145°50′ E	6,000	W 12
Molokai 5820	80	(33)	------do	6°15′ S. 145°50′ E	6,000	W 12
Molokai 5821	80	(33)	------do	6°15′ S. 145°50′ E	6,000	W 12
Molokai 5823	80	(33)	------do	6°15′ S. 145°50′ E	6,000	W 12
Molokai 5824	80	(33)	Niglguma, Chimbu District.	6° S. 145°5′ E	7,000	W 13
Molokai 5825	80	(33)	------do	6° S. 145°5′ E	7,000	W 13
Molokai 5827	80	(33)	Gogme, Chimbu District.	5°55′ S. 145° E	6,000	W 14
Molokai 5828	80	(33)	------do	5°55′ S. 145° E	6,000	W 14
Molokai 5829	80	(6)	------do	5°55′ S. 145° E	6,000	W 14
Molokai 5831	80–82	(33)	------do	5°55′ S. 145° E	6,000	W 14
Molokai 5832	80	(33)	Koronigl, Chimbu District.	5°50′ S. 144°55′ E	6,000	W 15
Molokai 5834	80	(33)	Wahgi River near Mt. Hagen Station.	5°50′ S. 144°10′ E	5,500	W 16
Molokai 5835	80	(33)	Kum River near Mt. Hagen Station.	5°50′ S. 144°10′ E	5,500	W 18
Molokai 5836	80	(33)	------do	5°50′ S. 144°10′ E	5,500	W 18
Molokai 5838	80	(33)	Asariufa near Goroka	6°5′ S. 145°25′ E	5,000	W 20
Molokai 5839	80	(33)	------do	6°5′ S. 145°25′ E	5,000	W 20
Molokai 5842	80	(33)	------do	6°5′ S. 145°25′ E	5,000	W 20
Molokai 5847	80	(33)	Markham River near Gabsonkeke on Nadzab road.	6°35′ S. 146°45′ E	300	W 23
Molokai 5848	80	(33)	------do	6°35′ S. 146°45′ E	300	W 24
Molokai 5849	80	(33)	------do	6°35′ S. 146°45′ E	300	W 24
Molokai 5905	80	(33)	Purari River drainage: Goroka	6°5′ S. 145°25′ E	5,000	W 3
Molokai 5911	80	(33)	Amari in Ko'mperi Valley.	6°15′ S. 145°50′ E	6,000	W 12
51 N.G. 3, Imp. 1915	80	(33)	Goroka	5°5′ S. 145°25′ E	5,000	
51 N.G. 7, Imp. 1919	80	(33)	----do	5°5′ S. 145°25′ E	5,000	
51 N.G. 27, Imp. 1935.	80	(33)	----do	5°5′ S. 145°25′ E	5,000	

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum robustum—Continued						
Goroka type—Con.						
51 N.G. 55, Imp. 1953.	80	(33)	Aiyura, Ramu River drainage.	6°20′ S. 145°55′ E.	6,000	
51 N.G. 63, Imp. 1958.	80	(33)	Ko'mperi, Purari River drainage.	6°15′ S. 145°50′ E.	6,000	
57 N.G. 208, Imp. 2669.	80	(6)	Ramu River bank at Dumpu.	5°50′ S. 145°45′ E.	800	
U.S. 57-125-5	80	(6)	Baiyer River bank, Sepik River drainage.	5°30′ S. 144° E.	3,800	W & G 725
U.S. 57-125-6	80	(6)	do	5°30′ S. 144° E.	3,800	W & G 725
Red-fleshed type:			Sepik River bank:			
Molokai 6103	60	(6)	Below Pagwi	4°5′ S. 143° E.	100	W & G 809
Molokai 6107	60	(6)	do	4 5′ S. 143° E.	100	W & G 809
Molokai 6108	60	(6)	do	4°5′ S. 143° E.	100	W & G 809
28 N.G. 219, Imp. 975.	60	(33)	At Ambunti	4°15′ S. 142°50′ E.	100	
28 N.G. 219A, Imp. 976.	60	(33)	do	4°15′ S. 142°50′ E.	100	
57 N.G. 105, Imp. 2561.	60	(6)	Near Maprik	4°5′ S. 143° E.	100	
57 N.G. 230, Imp. 2854.	60	(6)	At Pagwi	4°5′ S. 143° E.	100	
U.S. 57-158-1	60	(6)	Near Japanout Village opposite Pagwi.	4°5′ S. 143° E.	100	W & G 808
U.S. 57-158-2	60	(6)	do	4°5′ S. 143° E.	100	W & G 808
U.S. 57-158-3	59	(6)	do	4°5′ S. 143° E.	100	W & G 808

U.S. 57–159–3	60	(6)	Below Pagwi	4°5′ S. 143° E	100	W & G 809
U.S. 57–159–4	60	(6)	----do	4°5′ S. 143° E	100	W & G 809
U.S. 57–159–5	60	(6)	----do	4°5′ S. 143° E	100	W & G 809
U.S. 57–159–6	60	(6)	----do	4°5′ S. 143° E	100	W & G 809
U.S. 57–159–7	60	(6)	----do	4°5′ S. 143° E	100	W & G 809
U.S. 57–159–8	60	(6)	----do	4°5′ S. 143° E	100	W & G 809
Teboe Salah type: Molokai 6069	60	(6)	Edge of Ramu River at Atemble.	5°5′ S. 144°45′ E	100	W & G 801
57 N.G. 168, Imp. 2847.	60	(6)	Andai River bank near Manokwari.	0°55′ S. 134° E	20	
57 N.G. 170, Imp. 2626.	60	(6)	Bami River bank near Manokwari.	0°50′ S. 134°5′ E	60	
57 N.G. 217B, Imp. 2678.	60	(6)	Ramu River bank at Atemble.	5°5′ S. 144°45′ E	100	
57 N.G. 250, Imp. 2711.	60	(6)	Solomon Islands: In a garden on Buka Island.	5°15′ S. 154°35′ E	<100	
Tananggé [9]	60	(*10, 12*)	Celebes: On the plain of the Pagoejamin River near Gorontalo.	0°35′ N. 122°35′ E		
Tananggé Lakea,[9] Imp. 1530.	60	(*33*)	------do			
Teboe Salah II Belajan.	60–61	(*13*)	Borneo: Mahakam River	0°15′ S. 116°35′ E	<300	
Teboe Salah Melak	60	(*13*)	Mahakam River near Melak.	0°15′ S. 115°50′ E	300	
Teboe Salah M. Kaman.	59–60	(*13*)	Mahakam River near Ma Kaman (Moara Kaman).	0°10′ S. 116°45′ E	<300	
U.S. 57–95–1	61	(6)	New Guinea: Sepik River drainage: Near Bainyik	3°40′ S. 143° E	500	W & G 650
U.S. 57–95–2	60	(6)	----do	3°40′ S. 143° E	500	W & G 650
U.S. 57–95–4	60	(6)	----do	3°40′ S. 143° E	500	W & G 650
U.S. 57–95–6	60	(6)	----do	3°40′ S. 143° E	500	W & G 650
U.S. 57–95–8	60	(6)	----do	3°40′ S. 143° E	500	W & G 650
U.S. 57–95–9	60	(6)	----do	3°40′ S. 143° E	500	W & G 650

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum robustum—Continued						
Teboe Salah type—Con.						
U.S. 57–120–1	60	(6)	At Lumi [10]	3°35′ S. 142°15′ E.	1,800	W & G 697
U.S. 57–120–2	60	(6)	----do [10]	3°35′ S. 142°15′ E.	1,800	W & G 697
U.S. 57–120–4	60	(6)	----do [10]	3°35′ S. 142°15′ E.	1,800	W & G 697
U.S. 57–144–1	60	(6)	Andai River bank near Manokwari.	0°55′ S. 134° E.	20	W & G 763
U.S. 57–144–3	60	(6)	----do	0°55′ S. 134° E.	20	W & G 763
U.S. 57–144–4	60	(6)	----do	0°55′ S. 134° E.	20	W & G 763
U.S. 57–154–1	60	(6)	Edge of Ramu River at Atemble.	5°5′ S. 144°45′ E.	100	W & G 801
U.S. 57–154–2	60	(6)	----do	5°5′ S. 144°45′ E.	100	W & G 801
U.S. 57–154–4	60	(6)	----do	5°5′ S. 144°45′ E.	100	W & G 801
U.S. 57–154–5	60	(6)	----do	5°5′ S. 144°45′ E.	100	W & G 801
Wau-Bulolo type:						
Molokai 4503, Imp. 1006.	60	(*33*)	Markham River near Kaiapit.	6°15′ S. 146°15′ E.	900	L & P 32–33
	64	(4)	----do	6°15′ S. 146°15′ E.	900	L & P 32–33
Molokai 4515	60	(*33*)	Bulolo River at Wau, Markham River drainage.	7°20′ S. 146°45′ E.	2,000	L & P 35
Molokai 4669	60	(*33*)	Francisco River at Salamaua.	7°5′ S. 147°5′ E.	<100	L & P 39
Molokai 4722	60	(*33*)	----do	7°5′ S. 147°5′ E.	<100	L & P 39
Molokai 4730, Imp. 1027.	60	(*33*)	----do	7°5′ S. 147°5′ E.	<100	L & P 38
Molokai 4826	60	(*33*)	Markham River drainage:			

Molokai 5275	60	(33)	Bulolo River at Wau.	7°20′ S. 146°45′ E	2,000	L & P 37
Molokai 5681	58–60	(33)	----do	7°20′ S. 146°45′ E	2,000	L & P 37
Molokai 5685	60	(33)	----do	7°20′ S. 146°45′ E	2,000	L & P 37
Molokai 5843	60	(33)	Bulolo River at Mumeng.	7° S. 146°40′ E	1,000	W 21
Molokai 5844	60	(33)	----do	7° S. 146°40′ E	1,000	W 21
Molokai 5845	60	(33)	Markham River near Gabsonkeke on Nadzab road.	6°35′ S. 146°45′ E	300	W 22
Molokai 5919	60	(33)	----do	6°35′ S. 146°45′ E	300	W 25
Molokai 6006	60	(6)	Solomon Islands: Lunga River bank near Betekama, Guadalcanal Island.	9°25′ S. 160°2′ E	<100	W & G 818
Molokai 6007	60	(6)	----do	9°25′ S. 160°2′ E	<100	W & G 818
Molokai 6008	60	(6)	----do	9°25′ S. 160°2′ E	<100	W & G 818
Molokai 6010	60	(6)	----do	9°25′ S. 160°2′ E	<100	W & G 818
Molokai 6020	60	(6)	New Guinea: Markham River drainage: Snake River near Mumeng.	7° S. 146° 40′ E	2,000	W & G 626
57 N.G. 11, Imp. 2466.	60	(6)	Rumu River bank	6°35′ S. 146°35′ E	400	
57 N.G. 12, Imp. 2467.	60	(6)	Between Erap and Rumu Rivers, Markham River Road.	6°35′ S. 146°40′ E	400	
57 N.G. 21, Imp. 2476.	60	(6)	In a garden fence at Wantoat.	6°20′ S. 146°35′ E	3,700	
57 N.G. 22, Imp. 2477.	60	(6)	Stream bank at Wantoat.	6°20′ S. 146°35′ E	3,700	
57 N.G. 44, Imp. 2522.	60	(6)	Snake River near Mumeng.	7° S. 146°40′ E	2,000	
57 N.G. 246, Imp. 3177.	60	(6)	Solomon Islands: Stream bank at Tenaru, Guadalcanal Island.	9°25′ S. 160°5′ E	<100	

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum robustum—Continued						
Wau-Bulolo type—Con.			New Guinea:			
U.S. 57-75-1	60	(5)	Near Lae	6°40′ S. 147° E	100	W & G 566
U.S. 57-75-3	60	(5)	----do	6°40′ S. 147° E	100	W & G 566
U.S. 57-75-5	60	(5)	----do	6°40′ S. 147° E	100	W & G 566
U.S. 57-75-6	60	(5)	----do	6°40′ S. 147° E	100	W & G 566
U.S. 57-75-7	60	(5)	----do	6°40′ S. 147° E	100	W & G 566
U.S. 57-83-3	60	(5)	Korlte River edge at Menyamya, Tauri River drainage.	7°10′ S. 146° E	7,000	W & G 616
			Markham River drainage:			
U.S. 57-84-2	60	(5)	Snake River near Mumeng.	7° S. 146°40′ E	2,000	W & G 626
U.S. 57-84-3	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 626
U.S. 57-84-4	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 626
U.S. 57-84-5	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 626
U.S. 57-84-6	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 626
U.S. 57-86-1	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 629 [11]
U.S. 57-86-2	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 629 [11]
U.S. 57-86-3	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 629 [11]
U.S. 57-86-5	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 629 [11]
U.S. 57-86-6	60	(5)	----do	7° S. 146°40′ E	2,000	W & G 629 [6 11]
U.S. 57-91-1	60	(5)	Yalu River near Lae.	6°35′ S. 146°45′ E	300	W & G 586
U.S. 57-91-3	60	(5)	----do	6°35′ S. 146°45′ E	300	W & G 586
U.S. 57-91-4	60	(5)	----do	6°35′ S. 146°45′ E	300	W & G 586
U.S. 57-91-5	60	(5)	----do	6°35′ S. 146°45′ E	300	W & G 586

U.S. 57-152-1	60	(6)	Ramu River bank at Dumpu.	5°30′ S. 145°45′ E	800	W & G 795
U.S. 57-152-2	60	(6)	do	5°30′ S. 145°45′ E	800	W & G 795
U.S. 57-152-3	60	(6)	do	5°30′ S. 145°45′ E	800	W & G 795
U.S. 57-152-4	60	(6)	do	5°30′ S. 145°45′ E	800	W & G 795
U.S. 57-152-5	60	(6)	do	5°30′ S. 145°45′ E	800	W & G 795
U.S. 57-161-1	60	(6)	Solomon Islands: Lunga River bank near Betekama, Guadalcanal Island.	9°25′ S. 160°2′ E	<100	W & G 818
U.S. 57-161-2	60	(6)	do	9°25′ S. 160°2′ E	<100	W & G 818
U.S. 57-161-4	60	(6)	do	9°25′ S. 160°2′ E	<100	W & G 818
U.S. 57-161-5	60	(6)	do	9°25′ S. 160°2′ E	<100	W & G 818
U.S. 57-161-6	60	(6)	do	9°25′ S. 160°2′ E	<100	W & G 818
Saccharum robustum × *S. robustum*						
Large-stemmed hybrids:			New Britain:			
Molokai 4155	100–112	(33)	Near Rabaul	4°10′ S. 152°12′ E		L & P 19
Molokai 4165	100–110	(33)	do	4°10′ S. 152°12′ E		L & P 19
Molokai 4169	100–110	(33)	do	4°10′ S. 152°12′ E		L & P 19
Molokai 4178	100–104	(33)	do	4°10′ S. 152°12′ E		L & P 19
Molokai 4189	*ca.* 104	(33)	do	4°10′ S. 152°12′ E		L & P 19
Molokai 4200	103–106	(33)	do	4°10′ S. 152°12′ E		L & P 19
Molokai 4274	100–110	(33)	do	4°10′ S. 152°12′ E		L & P 19
Molokai 4404	*ca.* 160–163	(33)	do	4°10′ S. 152°12′ E		L & P 20
Molokai 4439	103–112	(33)	do	4°10′ S. 152°12′ E		L & P 20
Molokai 4702	102–110	(33)	do	4°10′ S. 152°12′ E		L & P 19
Molokai 5099 [12]	86–92	(33)				
Do	96	(4)				
Molokai 5220	104–110	(33)	Near Rabaul	4°10′ S. 152°12′ E		L & P 18
Molokai 5472	63	(33)	Warangoi River	4°30′ S. 152°20′ E		L & P 3
Molokai 6036	88	(6)	New Guinea: Sepik River edge near Ambunti.	4°15′ S. 142°50′ E	100	W & G 668

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum robustum × *S. robustum*—Con.						
Large-stemmed hybrids—Continued						
Molokai 6038	100	(6)	Gogol River bank near Madang.	5°15′ S. 145°40′ E.	200	W & G 633
Molokai 6044	97–98	(6)	do	5°15′ S. 145°40′ E.	200	W & G 633
Molokai 6068 [13]	73	(6)	Sepik River bank at Pagwi.	4°5′ S. 143° E.	100	W & G 806
Molokai 6075	100	(6)	Jabau River near Kota Nica, Hollandia.	2°35′ S. 140°45′ E.	<100	W & G 755
			New Britain:			
N.B. Robustum	100–110	(33)	Near Rabaul	4°10′ S. 152°12′ E.		P 1929
28 N.G. 289, Imp. 677.	108–110	(2)	do	4°10′ S. 152°12′ E.		P 1929
	108	(33)	do	4°10′ S. 152°12′ E.		P 1929
28 N.G. 290, Imp. 622.	116–118	(2)	do	4°10′ S. 152°12′ E.		P 1929
	110	(33)	do	4°10′ S. 152°12′ E.		P 1929
			New Guinea:			
57 N.G. 54, Imp. 2514.	100	(6)	Stream bank at Madang.	5°15′ S. 145°45′ E.	50	
57 N.G. 55, Imp. 2496.	101	(6)	do	5°15′ S. 145°45′ E.	50	
57 N.G. 83, Imp. 2542.	98–100	(6)	Stream bank at Maprik, Sepik River drainage.	3°40′ S. 143° E.	500	
57 N.G. 202, Imp. 2658.	100	(6)	Stream bank at Hollandia.	2°35′ S. 140°45′ E.	50	
57 N.G. 231, Imp. 2692.	90	(6)	Sepik River bank at Angoram.	4° S. 144°5′ E.	50	

57 N.G. 238, Imp. 2698.	110	(6)	New Britain: Kerevat River bank	4°15′ S. 152°5′ E	50	
Teboe Salah Toewa	89–90	(13, 14)	Celebes: South of Paloe	1°55′ S. 119°55′ E	1,000	
U.S. 57–87–1	81	(6)	New Guinea: Bigeas River bank north of Madang.	5°10′ S. 145°45′ E	<100	W & G 631
U.S. 57–87–5	88–90	(6)	——do	5°10′ S. 145°45′ E	<100	W & G 631
U.S. 57–87–7	79	(6)	——do	5°10′ S. 145°45′ E	<100	W & G 631
U.S. 57–88–1	*ca.* 87	(6)	Gum River bank near Madang.	5°15′ S. 145°45′ E	100	W & G 632
U.S. 57–88–3	92	(6)	——do	5°15′ S. 145°45′ E	100	W & G 632
U.S. 57–88–4	89	(6)	——do	5°15′ S. 145°45′ E	100	W & G 632
U.S. 57–88–5	86	(6)	——do	5°15′ S. 145°45′ E	100	W & G 632
U.S. 57–88–6	*ca.* 91	(6)	——do	5°15′ S. 145°45′ E	100	W & G 632
U.S. 57–88–8	89	(6)	——do	5°15′ S. 145°45′ E	100	W & G 632
U.S. 57–88–9	*ca.* 99	(6)	——do	5°15′ S. 145°45′ E	100	W & G 632
U.S. 57–88–10	80–82	(6)	——do	5°15′ S. 145°45′ E	100	W & G 632
U.S. 57–89–1	99	(6)	Gogol River bank near Madang.	5°15′ S. 145°40′ E	200	W & G 633
U.S. 57–89–2	97–98	(6)	——do	5°15′ S. 145°40′ E	200	W & G 633
U.S. 57–89–3	*ca.* 97	(6)	——do	5°15′ S. 145°40′ E	200	W & G 633
U.S. 57–89–5	97–98	(6)	——do	5°15′ S. 145°40′ E	200	W & G 633
U.S. 57–89–7	99–100	(6)	——do	5°15′ S. 145°40′ E	200	W & G 633
U.S. 57–90–1	97–100	(6)	Brandi River bank east of Wewak.	3°35′ S. 143°45′ E	<100	W & G 642
U.S. 57–90–2	101	(6)	——do	3°35′ S. 143°45′ E	<100	W & G 642
U.S. 57–90–3	97	(6)	——do	3°35′ S. 143°45′ E	<100	W & G 642
U.S. 57–90–5	*ca.* 101	(6)	——do	3°35′ S. 143°45′ E	<100	W & G 642
U.S. 57–90–6	101–102	(6)	——do	3°35′ S. 143°45′ E	<100	W & G 642
U.S. 57–90–7	93	(6)	——do	3°35′ S. 143°45′ E	<100	W & G 642
U.S. 57–96–1	82	(6)	Sepik River edge near Ambunti.	4°15′ S. 142°50′ E	100	W & G 668
U.S. 57–96–2	85	(6)	——do	4°15′ S. 142°50′ E	100	W & G 668
U.S. 57–96–3	88–89	(6)	——do	4°15′ S. 142°50′ E	100	W & G 668
U.S. 57–96–4	88	(6)	——do	4°15′ S. 142°50′ E	100	W & G 668
U.S. 57–96–6	89	(6)	——do	4°15′ S. 142°50′ E	100	W & G 668
U.S. 57–96–8	95	(6)	——do	4°15′ S. 142°50′ E	100	W & G 668
U.S. 57–96–14	85	(6)	——do	4°15′ S. 142°50′ E	100	W & G 668

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum robustum × *S. robustum*—Con.						
Large-stemmed hybrids—Continued						
U.S. 57-97-1	89	(6)	Sepik River between Pagwi and Ambunti.	4°5′ S. 142°55′ E.	100	W & G 669
U.S. 57-97-2	*ca.* 85	(6)	do	4°5′ S. 142°55′ E.	100	W & G 669
U.S. 57-97-3	88	(6)	do	4°5′ S. 142°55′ E.	100	W & G 669
U.S. 57-97-4	87	(6)	do	4°5′ S. 142°55′ E.	100	W & G 669
U.S. 57-97-5	73	(6)	do	4°5′ S. 142°55′ E.	100	W & G 669
U.S. 57-97-6	72	(6)	do	4°5′ S. 142°55′ E.	100	W & G 669
U.S. 57-97-7	87	(6)	do	4°5′ S. 142°55′ E.	100	W & G 669
U.S. 57-97-9	86	(6)	do	4°5′ S. 142°55′ E.	100	W & G 669
U.S. 57-120-6	79	(6)	Sepik River drainage at Lumi.[10]	3°35′ S. 142°15′ E.	1,800	W & G 697
U.S. 57-141-1	100	(6)	Stream bank at Kota Nica, Hollandia.	2°35′ S. 140°45′ E.	<100	W & G 741
U.S. 57-141-2	101	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 741
U.S. 57-141-3	98	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 741
U.S. 57-141-4	97	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 741
U.S. 57-141-5	*ca.* 102	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 741
U.S. 57-141-9	100	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 741
U.S. 57-141-10	99	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 741
U.S. 57-142-1	98–100	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 742
U.S. 57-142-2	100	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 742
U.S. 57-142-3	99	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 742
U.S. 57-142-4	101	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 742
U.S. 57-142-6	100	(6)	do	2°35′ S. 140°45′ E.	<100	W & G 742

U.S. 57-142-8	95+frag. or 96.	(6)	------do	2°35′ S. 140°45′ E	<100	W & G 742
U.S. 57-142-10	97-100	(6)	------do	2°35′ S. 140°45′ E	<100	W & G 742
U.S. 57-143-1	99-100	(6)	Jabau River near Kota Nica, Hollandia.	2°35′ S. 140°45′ E	<100	W & G 755
U.S. 57-143-2	98	(6)	------do	2°35′ S. 140°45′ E	<100	W & G 755
U.S. 57-143-3	100	(6)	------do	2°35′ S. 140°45′ E	<100	W & G 755
U.S. 57-143-4	98-101	(6)	------do	2°35′ S. 140°45′ E	<100	W & G 755
U.S. 57-143-6	*ca.* 101	(6)	------do	2°35′ S. 140°45′ E	<100	W & G 755
U.S. 57-143-7	99-102	(6)	------do	2°35′ S. 140°45′ E	<100	W & G 755
U.S. 57-155-1	98	(6)	Edge of Awar airstrip	4°5′ S. 144°50′ E	<100	W & G 802
U.S. 57-155-2	100-101	(6)	------do	4°5′ S. 144°50′ E	<100	W & G 802
U.S. 57-155-3	101	(6)	------do	4°5′ S. 144°50′ E	<100	W & G 802
U.S. 57-155-4	100	(6)	------do	4°5′ S. 144°50′ E	<100	W & G 802
U.S. 57-155-5	97-100	(6)	------do	4°5′ S. 144°50′ E	<100	W & G 802
U.S. 57-155-6	100	(6)	------do	4°5′ S. 144°50′ E	<100	W & G 802
U.S. 57-156-1	70	(6)	Sepik River bank at Pagwi.	4°5′ S. 143° E	100	W & G 806
U.S. 57-156-3	73+frag. or 74.	(6)	------do	4°5′ S. 143° E	100	W & G 806
U.S. 57-156-4	73	(6)	------do	4°5′ S. 143° E	100	W & G 806
U.S. 57-156-5	75+frag. or 76.	(6)	------do	4°5′ S. 143° E	100	W & G 806
U.S. 57-156-6	76	(6)	------do	4°5′ S. 143° E	100	W & G 806
U.S. 57-156-7	77	(6)	------do	4°5′ S. 143° E	100	W & G 806
U.S. 57-160-1	72-74	(6)	Sepik River Bank at Angoram.[13]	4° S. 144°5′ E	50	W & G 812
U.S. 57-160-2	93	(6)	------do	4° S. 144°5′ E	50	W & G 812
U.S. 57-160-5	85-86	(6)	------do	4° S. 144°5′ E	50	W & G 812
U.S. 57-160-6	82-84	(6)	------do	4° S. 144°5′ E	50	W & G 812
U.S. 57-160-7	90	(6)	------do	4° S. 144°5′ E	50	W & G 812
U.S. 57-160-8	73	(6)	------do	4° S. 144°5′ E	50	W & G 812
Small-stemmed hybrids:						
Molokai 5198	65-66	(33)	Bulolo River at Wau, Markham River drainage.	7°20′ S. 146°45′ E	2,000	L & P 34
Molokai 5208	63-64	(33)	------do	7°20′ S. 146°45′ E	2,000	L & P 34
Molokai 5210	70-73	(33)	------do	7°20′ S. 146°45′ E	2,000	L & P 34

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum robustum × *S. robustum*—Con.						
Small-stemmed hybrids—Continued						
Molokai 6077	79+frag	(6)	Baiyer River bank, Sepik River drainage.	5°30′ S. 144° E	3,800	W & G 725
U.S. 57–125–1	77	(6)	do	5°30′ S. 144° E	3,800	W & G 725
U.S. 57–125–2	79+frag. or 80.	(6)	do	5°30′ S. 144° E	3,800	W & G 725
U.S. 57–125–3	78	(6)	do	5°30′ S. 144° E	3,800	W & G 725
Saccharum robustum × *S. officinarum*						
28 N.G. 218, Imp. 663.	70	(33)	Sepik River at Ambunti.	4°15′ S. 142° 50′E	100	
	72	(4)				
51 N.G. 82, Imp. 1968.	80	(33)	Chimbu District	6° S. 145° E	6,000	
51 N.G. 142, Imp. 2007.	80	(33)	Fly River [14]			
Saccharum robustum × *S. spontaneum*						
Ura, Imp. 1581 [15]	80	(6)	Department of Agriculture, Port Moresby.			

U.S. 57–76–1	80+frag	(6)	Bubu River edge near Garaina, Waria River drainage.	7°55′ S. 147°15′ E	2,000	W & G 571
U.S. 57–76–3	80	(6)	do	7°55′ S. 147°15′ E	2,000	W & G 571
U.S. 57–76–4	80	(6)	do	7°55′ S. 147°15′ E	2,000	W & G 571
U.S. 57–85–1	100	(6)	Snake River near Mumeng, Markham River drainage.	7° S. 146°40′ E	2,000	W & G 627
U.S. 57–85–2	100	(6)	do	7° S. 146°40′ E	2,000	W & G 627
U.S. 57–85–3	100–101	(6)	do	7° S. 146°40′ E	2,000	W & G 627
U.S. 57–85–4	97+frag	(6)	do	7° S. 146°40′ E	2,000	W & G 627
U.S. 57–85–5	98	(6)	do	7° S. 146°40′ E	2,000	W & G 627
Saccharum × *Miscanthus*						
Molokai 6081	*ca.* 171	(6)	Near Ara River mouth, Wissel Lakes.	3°55′ S. 136°15′ E	5,700	W & G 783
Molokai 6083	166–170	(6)	do	3°55′ S. 136°15′ E	5,700	W & G 783
57 N.G. 6, Imp. 1918	156–157	(33)	Purari River drainage: Goroka	6°5′ S. 145°25′ E	5,000	
51 N.G. 28, Imp. 1936.	*ca.* 156	(6)	In a garden fence at Goroka.	6°5′ S. 145°25′ E	5,000	
51 N.G. 70, Imp. 1963.	*ca.* 162	(6)	On a hillside, Chimbu District.	6° S. 145° E	6,000	
51 N.G. 71, Imp. 1964.	164	(33)	do	6° S. 145° E	6,000	
51 N.G. 88, Imp. 1970.	[16] 152–159	(6)	Chimbu District	6° S. 145° E	6,000	
	158	(17)				
51 N.G. 91, Imp. 1973.	164	(33)	On a gully wall near Gogme, Chimbu District.	5°55′ S. 145° E	6,000	
	162	(17)				
51 N.G. 91A, Imp. 1974.	164–165	(33)	Near Mt. Hagen Station.	5°50′ S. 144°10′ E	5,500	
51 N.G. 106, Imp. 1986.	193–194	(33)	Mendi	6°10′ S. 143°40′ E	5,500	

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum × *Miscanthus*—Continued						
57 N.G. 131,[17] Imp. 2587.	158–171	(6)	In a garden fence at Nondugl.	5°50′ S. 144°40′ E.	5,700	
57 N.G. 132, Imp. 2588.	169–170	(6)	do	5°50′ S. 144°40′ E.	5,700	
57 N.G. 133, Imp. 2835.	163–164	(6)	do	5°50′ S. 144°40′ E.	5,700	
57 N.G. 134, Imp. 2590	140	(6)	do	5°50′ S. 144°40′ E.	5,700	
57 N.G. 145, Imp. 2601.	*ca.* 190	(6)	In a garden fence at Tari, Kikori River drainage.	5°50′ S. 142°45′ E.	5,200	
57 N.G. 153,[18] Imp. 2609.	197–200	(6)	do	5°50′ S. 142°45′ E.	5,200	
57 N.G. 193, Imp. 2649.	176	(6)	Keneapa, Wissel Lakes.	3°55′ S. 136°15′ E.	5,700	
57 N.G. 194, Imp. 2650.	164	(6)	Ara River bank, Wissel Lakes.	3°55′ S. 136°15′ E.	5,700	
U.S. 57–98–2	*ca.* 154	(6)	Stream bank at Telefomin, Sepik River drainage.	5°10′ S. 141°35′ E.	4,800	W & G 686
U.S. 57–98–3	*ca.* 154	(6)	do	5°10′ S. 141°35′ E.	4,800	W & G 686
U.S. 57–98–5	154–155	(6)	do	5°10′ S. 141°35′ E.	4,800	W & G 686
U.S. 57–98–6	*ca.* 152	(6)	do	5°10′ S. 141°35′ E.	4,800	W & G 686
U.S. 57–98–7	150–152	(6)	do	5°10′ S. 141°35′ E.	4,800	W & G 686
U.S. 57–98–8	*ca.* 154	(6)	do	5°10′ S. 141°35′ E.	4,800	W & G 686

U.S. 57–119–2	158	(6)	Upper Sepik River near Telefomin.	5°10′ S. 141°35′ E	4,600	W & G 690
U.S. 57–119–4	152–154	(6)	do	5°10′ S. 141°35′ E	4,600	W & G 690
U.S. 57–119–5	152–154	(6)	do	5°10′ S. 141°35′ E	4,600	W & G 690
U.S. 57–119–7	152	(6)	do	5°10′ S. 141°35′ E	4,600	W & G 690
U.S. 57–119–8	164–166	(6)	do	5°10′ S .141°35′ E	4,600	W & G 690
U.S. 57–122–1	114–117	(6)	Cultivated at Nondugl, Purari River drainage.	5°50′ S. 144°40′ E	5,700	W & G 713
U.S. 57–124–3	180+2 frags–184+2 frags.	(6)	In an old garden near the Baiyer River, Sepik River drainage.	5°30′ S. 144° E	3,800	W & G 724
U.S. 57–124–4	182	(6)	do	5°30′ S. 144° E	3,800	W & G 724
U.S. 57–124–6	*ca.* 179	(6)	do	5°30′ S. 144° E	3,800	W & G 724
U.S. 57–124–7	176–179	(6)	do	5°30′ S. 144° E	3,800	W & G 724
U.S. 57–124–8	184–185	(6)	do	5°30′ S. 144° E	3,800	W & G 724
U.S. 57–124–10	*ca.* 183	(6)	do	5°30′ S. 144° E	3,800	W & G 724
U.S. 57–126–4	195–205	(6)	Kikori River drainage: Swamp near Tari	5°50′ S. 142°45′ E	5,200	W & G 733
U.S. 57–126–5	*ca.* 196	(6)	do	5°50′ S. 142°45′ E	5,200	W & G 733
U.S. 57–126–7	196	(6)	do	5°50′ S. 142°45′ E	5,200	W & G 733
U.S. 57–127–1	187	(6)	Kamba near Tari	5°50′ S. 142°45′ E	5,200	W & G 734
U.S. 57–127–2	*ca.* 182	(6)	do	5°50′ S. 142°45′ E	5,200	W & G 734
U.S. 57–127–3	188–189	(6)	do	5°50′ S. 142°45′ E	5,200	W & G 734
U.S. 57–145–1	172	(6)	Ara River bank, Wissel Lakes.	3°55′ S. 135°15′ E	5,700	W & G 783[19]
U.S. 57–145–2	170–171	(6)	do	3°55′ S. 135°15′ E	5,700	W & G 783[19]
U.S. 57–145–3	171	(6)	do	3°55′ S. 135°15′ E	5,700	W & G 783[19]
Saccharum spontaneum						
Biroh Bewoeloeh Koelawi.	96–97	(*13*)	Celebes: River bank in mountains of northwest central Celebes.	2° S. 120° E		
	96	(*32*)				
Biroh Goenoeng Torimanoe.	96	(*13*)	do	2° S. 120° E		
Biroh Koelawi A	*ca.* 96	(*13*)	do	2° S. 120° E		
Biroh Soengi Moepanga.	95–96	(*13*)	do	2° S. 120° E		
	95	(*32*)				

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum spontaneum—Continued						
I Djantoer	112	(*13*)	Borneo: High places on Mahakam River banks.	0°20′ S. 116°30′ E		
Kinggoerang Oewis	*ca.* 112	(*13*)	do	0°20′ S. 116°30′ E		
Koelawi A	96–97	(*13*)	Celebes: River bank in the mountains of northwest central Celebes.	2° S. 120° E		
Koelawi B	94	(*13*)	do	2° S. 120° E		
Koelawi C	96–98	(*13*)	do	2° S. 120° E		
M. Moentai, Imp. 1537.	*ca.* 112	(*13*)	Borneo: High places on Mahakam River bank near Ma Moentai (Moara Moentai).	0°20′ S. 116°25′ E	<300	
	105 or 105+ frag.	(6)				
Molokai 5801	80	(*33*)	New Guinea: Near Port Moresby	9°25′ S. 147°10′ E	<100	W 1
Molokai 5802	80	(*33*)	do	9°25′ S. 147°10′ E	<100	W 2
Molokai 5903	*ca.* 80	(*33*)	do	9°25′ S. 147°10′ E	<100	W 1
Molokai 5904	80	(*33*)	do	9°25′ S. 147°10′ E	<100	W 2
Molokai 6000	80	(6)	Solomon Islands: Edge of roads and airfield at Honiara, Guadalcanal Island.		<100	W & G 819

28 N.G. 101, Imp. 652.	80	(33)
	76	(4)
28 N.G. 291, Imp. 875.	80	(33)
28 N.G. 292, Imp. 876.	80	(4, 33)
51 N.G. 2,[20] Imp. 1914.	80	(17, 32, 33)
51 N.G. 25, Imp. 1933.	80	(17, 33)
51 N.G. 26, Imp. 1934.	80–82	(17)
	82	(33)
Paloe	80–81	(18)
Tabongo	80	(10, 32, 45)
U.S. 57–68–1	80	(6)
U.S. 57–68–2	80	(6)
U.S. 57–68–3	80	(6)
U.S. 57–68–4	80	(6)
U.S. 57–69–1	80	(6)
U.S. 57–69–2	80	(6)
U.S. 57–69–3	80	(6)
U.S. 57–69–4	80	(6)
U.S. 57–69–5	80	(6)
U.S. 57–70–1	80	(6)
U.S. 57–70–2	80	(6)
U.S. 57–70–3	80	(6)
U.S. 57–70–4	80	(6)
U.S. 57–70–5	80	(6)

See footnotes at end of table.

New Guinea:			
Kemp Welsh River at Niuinuka.	9°55′ S. 147°50′ E	200	
Eriana Swamp near Port Moresby.	9°25′ S. 147°10′ E		L 1935
Rouna Falls Road, 8 miles from Port Moresby.	9°25′ S. 147°10′ E		L 1935
Near Port Moresby	9°25′ S. 147°10′ E		
Goroka, Purari River drainage.	6°5′ S. 145°25′ E	5,000	
——do	6°5′ S. 145°25′ E	5,000	
Celebes:			
On a slope near the Bay of Paloe.	0°55′ S. 119°50′ E		
Near Gorontalo	0°30′ N. 123° E		
New Guinea:			
Roadside between Brown and Laloki Rivers near Port Moresby.	9°25′ S. 147°10′ E	<100	W & G 555
——do	9°25′ S. 147°10′ E	<100	W & G 555
——do	9°25′ S. 147°10′ E	<100	W & G 555
——do	9°25′ S. 147°10′ E	<100	W & G 555
Rouna Falls Road:			
9 miles from Port Moresby.	9°25′ S. 147°10′ E	800	W & G 556
——do	9°25′ S. 147°10′ E	800	W & G 556
——do	9°25′ S. 147°10′ E	800	W & G 556
——do	9°25′ S. 147°10′ E	800	W & G 556
——do	9°25′ S. 147°10′ E	800	W & G 556
8 miles from Port Moresby.	9°25′ S. 147°10′ E		W & G 557
——do	9°25′ S. 147°10′ E		W & G 557
——do	9°25′ S. 147°10′ E		W & G 557
——do	9°25′ S. 147°10′ E		W & G 557
——do	9°25′ S. 147°10′ E		W & G 557

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Saccharum spontaneum—Continued						
U.S. 57-71-1	80	(6)	15 miles from Port Moresby.	9°25′ S. 147°10′ E	450	W & G 558
U.S. 57-71-2	80	(6)	do	9°25′ S. 147°10′ E	450	W & G 558
U.S. 57-71-3	80	(6)	do	9°25′ S. 147°10′ E	450	W & G 558
U.S. 57 71-4	80	(6)	do	9°25′ S. 147°10′ E	450	W & G 558
U.S. 57-71-5	80	(6)	do	9°25′ S. 147°10′ E	450	W & G 558
U.S. 57-72-2	77	(6)	Saidor Coast? [21]			W & G 565
U.S. 57-73-1	80	(6)	Open field at Lae	6°40′ S. 147° E	<100	W & G 567
U.S. 57-73-2	80	(6)	do	6°40′ S. 147° E	<100	W & F 567
U.S. 57-73-3	80-81	(6)	do	6°40′ S. 147° E	<100	W & G 567
U.S. 57-73-4	80	(6)	do	6°40′ S. 147° E	<100	W & G 567
U.S. 57-73-5	80	(6)	do	6°40′ S. 147° E	<100	W & G 567
U.S. 57-74-1	80	(6)	Busa Loop, Lae	6°40′ S. 147° E	<100	W & G 568
U.S. 57-74-2	80	(6)	do	6°40′ S. 147° E	<100	W & G 568
U.S. 57-77-2	79	(6)	Bubu River edge near Garaina, Waria River drainage. [22]	7°55′ S. 147° E	2,400	W & G 572
U.S. 57-77-3	80	(6)	do	7°55′ S. 147° E	2,400	W & G 572
U.S. 57-77-5	80	(6)	do	7°55′ S. 147° E	2,400	W & G 572
U.S. 57-92-1	81 or 80+frag.	(6)	Between Erap and Rumu Rivers, Markham River drainage.	6°35′ S. 146°40′ E	350	W & G 587
U.S. 57-92-2	80	(6)	do	6°35′ S. 146°40′ E	350	W & G 587

U.S. 57-118-1	80	(6)	Edge of Gusap airfield on the divide between Markham and Ramu River headwaters.	6°4′ S. 145°58′ E.	1,600	W & G 634
U.S. 57-118-2	80	(6)	——do——	6°4′ S. 145°58′ E.	1,600	W & G 634
U.S. 57-118-4	80	(6)	——do——	6°4′ S. 145°58′ E.	1,600	W & G 634
U.S. 57-163-1	80	(6)	Solomon Islands: Edges of roads and airfield at Honiara, Guadalcanal Island.		<100	W & G 819
U.S. 57-163-2	80	(6)	——do——		<100	W & G 819
U.S. 57-163-3	*ca.* 80	(6)	——do——		<100	W & G 819
U.S. 57-163-4	80	(6)	——do——		<100	W & G 819
U.S. 57-163-5	*ca.* 80	(6)	——do——		<100	W & G 819
U.S. 57-170-1	84	(6)	New Guinea: Roadside near Epo (Mekeo).	8°45′ S. 146°35′ E.	50	W & G 831
U.S. 57-170-4	83	(6)	——do——	8°45′ S. 146°35′ E.	50	W & G 831
U.S. 57-171-1	80	(6)	Near airfield at Epo (Mekeo).	8°45′ S. 146°35′ E.	<100	W & G 832
U.S. 57-172-1	*ca.* 80	(6)	Grassy plain near Popondetta, Endesi Creek drainage.	8°45′ S. 148°10′ E.	300	W & G 835
U.S. 57-172-2	80	(6)	——do——	8°45′ S. 148°10′ E.	300	W & G 835
U.S. 57-172-3	80	(6)	——do——	8°45′ S. 148°10 E.	300	W & G 835
U.S. 57-172-4	80	(6)	——do——	8°45′ S. 148°10′ E.	300	W & G 835
U.S. 57-172-5	80	(6)	——do——	8°45′ S. 148°10′ E.	300	W & G 835
Warentoewa Tosale, Imp. 1534.	96	(*33*, *41*)	Celebes: South of Paloe	1°55′ S. 119°55′ E.	1,000	
Miscanthus floridulus						
51 N.G. 24, Imp. 1932.	38	(*17*, *33*)	New Guinea: Goroka, Purari River drainage.	6°5′ S. 145°25′ E.	5,000	
U.S. 57-82-2	38	(*37*)	Near Edie Creek Road above Wau.	7°25′ S. 146°45′ E.	6,100	W & G 623
U.S. 57-82-3	38	(*37*)	——do——	7°25′ S. 146°45′ E.	6,100	W & G 623

See footnotes at end of table.

TABLE 1.—*Chromosome numbers and origins of* Saccharum robustum *clones and related sympatric species and hybrids excluding* S. officinarum *and* S. edule—Continued

Species, type, and clone [1]	2n [2]	Authority	Origin			Collection number [3]
			Place	Latitude and longitude	Elevation, feet	
Miscanthus floridulus—Continued						
U.S. 57–209–1	38+accessory chromosomes.	(*37*)	Nondugl, Purari River drainage.	5°50′ S. 144°40′ E	5,700	W & G 716
U.S. 57–210–1	do	(*37*)	Tari, Kikori River drainage.	5°50′ S. 142°45′ E	5,200	W & G 735
U.S. 57–210–2	do	(*37*)	do	5°50′ S. 142°45′ E	5,200	W & G 735
U.S. 57–210–3	do	(*37*)	do	5°50′ S. 142°45′ E	5,200	W & G 735
Unnamed clone [23]	38	(*13*)	Celebes: Near Koelawi	2° S. 120° E		
Eulalia fastigiata						
U.S. 57–79–3	18	(*42*)	New Guinea: Near airstrip at Wantoat.	6°20′ S. 146°35′ E	3,700	W & G 593
Erianthus arundinaceus						
28 N.G. 7	60	(*33, 46*)	Near Lake Murray, Fly River drainage.	7° S. 141°35′ E		

[1] Authorities are given in text. All clones studied were in the Hawaiian Sugar Planters' Association collection or in the U.S. Department of Agriculture collection. The latter are identified by their "U.S." numbers or by appended "Imp." (USDA importation) numbers.

[2] Preferred chromosome counts are shown in boldface, i.e., **78–80**; frag., fragment.

[3] P, Pemberton; L, Leigh; L & P, Lennox and Pemberton; W, Warner; and W & G, Warner and Grassl.

[4] See footnote 4, p. 4.

[5] The type species.

[6] Previously unpublished.

[7] Possibly not indigenous on the Vogelkop Peninsula. See text.

[8] Seed from 57 N.G. 201.

[9] Tananggé and Tananggé Lakea are probably one and the same clone.

[10] In occasional clumps as if in old gardens.

[11] Seed from 57 N.G. 44.

[12] Hybrid from artificially crossing a Rabaul clone with one from the Warangoi River (*33*).

[13] Pink flesh.

[14] Collected near Port Moresby but said to be from the Fly River.

[15] Native name is "Aiyura."

[16] $2n=152–159$ is considered more accurate than $2n=161–164$ previously reported (*33*).

[17] No midrib.

[18] Thin albino stripes in stalk and leaf.

[19] Seed from 57 N.G. 194.

[20] Perhaps the same as 28 N.G. 292.

[21] Seed from a plant in the Lae Botanical Garden said to have come from the Saidor Coast east of Madang.

[22] Collected as a "primitive" form.

[23] Reported as *Miscanthus japonicus*.

TABLE 2.—*Meiosis in* Saccharum robustum *and related plants*

Species, type, and clone	2n [1]	Cell frequency with indicated number of univalents at diakinesis and first metaphase												Lagging first anaphase chromosomes, per cell [2]	Micronuclei in microspores, per quartet [3]
		0	1	2	3	4	5	6	7	8	9	10	10+		
Saccharum robustum															
Port Moresby type:															
Molokai 1236	80	9	0	1	0	0	0	0	0	0	0	0	0	----------	----------
Molokai 4881	80	10	0	0	0	0	0	0	0	0	0	0	0	----------	----------
Molokai 5855	80	10	0	0	0	0	0	0	0	0	0	0	0	----------	----------
28 N.G. 251	80	10	0	0	0	0	0	0	0	0	0	0	0	----------	----------
N. H. 1	80	15	0	1	0	0	0	0	0	0	0	0	0	1.10	----------
Goroka type:															
Molokai 5248	80	9	0	1	0	0	0	0	0	0	0	0	0	----------	----------
Molokai 5829	80	10	0	0	0	0	0	0	0	0	0	0	0	.05	0
Molokai 5842	80	10	0	0	0	0	0	0	0	0	0	0	0	----------	----------
Molokai 5905	80	8	0	1	0	1	0	0	0	0	0	0	0	----------	----------
Red-fleshed type:															
Molokai 6103	60	9	0	1	0	0	0	0	0	0	0	0	0	.30	0
Molokai 6107	60	10	0	0	0	0	0	0	0	0	0	0	0	.10	.05
Molokai 6108	60	10	0	0	0	0	0	0	0	0	0	0	0	.15	.05
28 N.G. 219	60	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Teboe Salah type:															
Molokai 6069	60	9	0	1	0	0	0	0	0	0	0	0	0	.05	0
Wau-Bulolo type:															
Molokai 4730	60	10	0	0	0	0	0	0	0	0	0	0	0	.25	.05
Molokai 4826	60	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Molokai 5685	60	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Molokai 6006	60	10	0	0	0	0	0	0	0	0	0	0	0	----------	----------
Molokai 6007	60	10	0	0	0	0	0	0	0	0	0	0	0	----------	----------
Molokai 6008	60	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Molokai 6010	60	8	0	2	0	0	0	0	0	0	0	0	0	----------	----------
Molokai 6020	60	6	0	0	0	0	0	0	0	0	0	0	0	----------	----------
U.S. 57-75-3	60	10	0	0	0	0	0	0	0	0	0	0	0	.10	.05

S. robustum × *S. robustum*															
Large-stemmed hybrids:															
Molokai 6036	88	0	0	1	0	4	0	3	0	1	0	1	0	4.00	.50
Molokai 6038	100	7	0	3	0	0	0	0	0	0	0	0	0	.15	0
Molokai 6068	73	0	1	0	4	0	3	0	2	0	0	0	0	5.90	1.90
Molokai 6075	100	1	0	0	0	1	0	0	0	0	0	0	0	2.10	.45
Small-stemmed hybrid:															
Molokai 6077	[4] 79	0	6	0	4	0	1	0	0	0	0	0	0	1.20	.20
S. robustum × *S. spontaneum*															
U.S. 57-76-3	80	1	0	0	0	0	0	0	0	0	0	0	0	.15	.25
U.S. 57-85-1	100	5	0	5	0	0	0	0	0	0	0	0	0	.35	.35
U.S. 57-85-3	100-101	---	---	---	---	---	---	---	---	---	---	---	---	2.10	.35
U.S. 57-85-5	98	---	---	---	---	---	---	---	---	---	---	---	---	---	.15
Saccharum × *Miscanthus*															
Molokai 6081	*ca.* 171	0	0	0	0	0	0	1	1	0	0	0	0	---	---
Molokai 6083	166-170	---	---	---	---	---	---	---	---	---	---	---	---	5.50	2.25
Molokai 6135	(195-205)	---	---	---	---	---	---	---	---	---	---	---	---	.30	.50
51 N.G. 6	156-157	---	---	---	---	---	---	---	---	---	---	---	---	2.70	.45
51 N.G. 28	156-159	---	---	---	---	---	---	---	---	---	---	---	---	3.55	1.80
51 N.G. 70	*ca.* 162	---	---	---	---	---	---	---	---	---	---	---	---	4.05	---
51 N.G. 88	152-159	0	0	0	0	0	0	0	2	1	1	3	3	7.65	.60
U.S. 57-122-1	114-117	---	---	---	---	---	---	---	---	---	---	---	---	6.26	1.15
U.S. 57-124-7	176-179	---	---	---	---	---	---	---	---	---	---	---	---	6.70	9.00
U.S. 57-124-8	184-185	---	---	---	---	---	---	---	---	---	---	---	---	2.00	4.55
U.S. 57-126-2	(195-205)	---	---	---	---	---	---	---	---	---	---	---	---	.20	.10
U.S. 57-126-3	(195-205)	---	---	---	---	---	---	---	---	---	---	---	---	---	.20

[1] Assumed chromosome numbers shown in parentheses are the somatic numbers of siblings.
[2] 20 first-anaphase cells each.
[3] 20 microspore quartets each.
[4] Plus one fragment in each diakinesis-first-metaphase cell.

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