December 2019



www.musanet.org



Collecting Pacific bananas in 2019: Cook Islands, Samoa and West New Britain (Papua New Guinea)

In 2019, the Crop Trust funded several collecting missions targeting mandate crop cultivars and/or regions that were underrepresented in international genebanks. In banana, the project identified Pacific landraces, and in particular Fe'i bananas, as major gaps in ex situ collections. Thanks to the essential support of the Pacific Community (SPC), three Pacific Islands Countries (PICs) volunteered to host banana collecting missions: The Cook Islands, Samoa and Papua New Guinea. A core team composed of Dr. Julie Sardos and Mr. Gabriel Sachter-Smith from the Alliance of Bioversity and CIAT visited the three countries between May and October 2019. It was quite an intense schedule, but it resulted into a lot of exciting discoveries and also a few new members for MusaNet. Welcome to William Wigmore from the Cook Islands and to Parate Matalavea and Tolo Iosefa from Samoa!

In search of the Fe'i

With their orange flesh and purple sap, tasty Fe'i bananas are well known to Polynesians. However, they are difficult to grow, slow to produce fruits and not appreciated so much by younger generations. As a result, in some countries they are progressively being abandoned. It is therefore becoming urgent to efficiently conserve these unique resources. In total, the teams collected 15 accessions of Fe'i bananas this year, including seven in the Cook Islands. A few redundancies are suspected but there is no doubt that unique genotypes were found. And as a bonus, a new population of *Musa maclayi*, one of the likely ancestors of the Fe'i bananas, was described in New Britain, Papua New Guinea. Genotyping results are upcoming and should provide new insights on the story of the Fe'i.



Fig 1. Collecting erected Fe'i bananas in Cook Islands and Samoa. Fe'i bananas have a purple sap that is commonly used as dye. The wild *Musa maclayi* found in PNG and that also has orange fruits is one of the potential ancestors of the Fe'i. Photos by J. Sardos and G. Sachter-Smith.

AABs of the Pacific

Of course, while talking of Pacific bananas, it is hard not to think of the Pacific AAB. In total, the teams collected 16 Maoli / Popoulu accessions and 2 Iholenas. Among these AAB was 'Fa'i Samoa Lanu Viole", a Maoli banana that, according to grower, exhibits reddish young fruits. Interestingly, male flowers of this variety are also very red, which is not a common feature for the Maoli bananas. In West New Britain, the team also found a horn type of Maoli that has a degenerating male bud, and an Iholena with slightly variegated leaves. More surprisingly, three Plantains were collected in the Cook Islands and Samoa. SSR genotyping has already confirmed that they have the exact same genotypes as the ones found in Africa.



Fig 2. Pacific AAB bananas are increasingly popular outside of their region of origin. This is the case of the sausage shaped Maoli and of the massive Popoulu. Interestingly, Plantain similar to the one found in Africa were also collected in Cook Islands and Samoa. Photos by J. Sardos and G. Sachter-Smith.

Edible AAs and their ancestor

The big amount of different varieties collected in West New Britain was not a surprise, neither was the high number of edible AAs that were found (more than 40). The team found highly selected genotypes, such as 'Pagal' or 'Gneing' ('Spiral') and a surprising diploid with red fruits. Two new populations of *M. acuminata* ssp. *banksii* will be studied thanks to these collecting missions as a few individuals of the Upolu population in Samoa, including some that were partly parthenocarpic, were sampled along with a population that was discovered in West New Britain. The extent of their genetic connections with the mainland New Guinea populations will be studied later which may help reveal how these wild types traveled as far as Samoa. Especially when knowing that Samoa is the only PIC where it can be found out of PNG.



Fig 3. A lot of edible AA were collected in West New Britain (WNB). The Papuan *M. acuminata* ssp. *banksii* is the wild ancestor of most of them and was collected in Samoa and WNB. The genitors of the cooking AAB most probably hide in the wide diversity of the cooking diploids cultivated in PNG. Is 'Pagal' and its massive fruits one of them? Photos by J. Sardos and G. Sachter-Smith.

The reports for all three collecting missions can be found on the MusaNet website <u>here</u>. Catalogues of the collecting missions are in prep and will be published on MusaNet in 2020.

On the hunt for seeds in Papua New Guinea

Several MusaNet members also conducted a 12-day seed collecting mission in PNG in October, funded by the Crop Wild Relative Project. The collecting team included Janet Paofa from NARI, Steven Janssens from the Meise Botanic Garden, Sebastien Carpentier and Bart Panis from the Alliance of Bioversity and CIAT and David Eyland, a PhD student funded by the CWR Project.

They visited Lae in the North, Madang in the Northeast, and Vanimo in the Northwest. Within each region, they looked at very different environments - from lowland to highland rain forests - to see if they could find species that might have interesting traits for breeders.

Highlights were the discovery of *Musa banksii* growing in contrasting environments and a very rare species, *Musa ingens*, which can grow as tall as 15 meters and is in danger of extinction - most probably due to forest clearing and agricultural expansion.

Seeds were collected from 9 species to supply pre-breeding activities back in Belgium: *M. banksii* (167), *M. schizocarpa* (96), *M. ingens* (46), *M. maclayi* (1), *M. balbisiana* (3), hybrids between *M. banksii* and *M. schizocarpa* (2), *M. peekelii* (49), *M. lolodensis* (3) and *M. boman* (51). The most promising individuals per species will be selected and might become parents in the breeding project.



Fig 4. Left: Sebastien Carpentier and the tallest banana in the world, *Musa ingens*, top right: a farmer from Lae with a *Musa maclayi* bunch and bottom right: from left to right Bart Panis, Steven Janssens and David Eyland visiting a Lae market. Photos by S. Carpentier and D. Eyland.

BAPNET Steering Committee Meeting

A Banana Asia Pacific Network (BAPNET) Steering Committee meeting was held in Guangzhou, Guangdong, China, from May 7-9, 2019. The meeting was attended by the majority of members of the BAPNET committee Asia-Pacific countries: India, China, Philippines, Papua New Guinea, Taiwan, Malaysia, Bangladesh, Vietnam etc. Also in attendance were MusaNet members Altus Viljoen, Nicolas Roux, Inge van den Bergh, Guy Blomme, and Sijun Zheng. In addition, various scientists and researchers from Guangdong Academy of Agricultural Sciences (GDAAS) participated.

The group set out priorities for the next two years regarding plant genetic resource management and *Foc* TR4. On the second day of the meeting, all the steering committee members were taken for a field visit to see the facilities ,research and field genebank at GDAAS. The meeting was jointly organized by Alliance of Bioversity and CIAT in India and GDAAS, China under the chairmanship of N. K. Krishna Kumar and Yi Ganjun.



The meeting report is available <u>here</u> on the MusaNet website.

Fig 5. Discussions at the BAPNET meeting in Guangzhou, China, 7-9 May 2019

New release of MGIS

Following the results of a user survey that was carried out earlier this year, a new release of <u>MGIS</u> was launched in November 2019 with the following new and improved features:

- New passport data from Agrosavia (Colombia), the latest collection to sign the Data Sharing Agreement.
- Data from 41 new accessions in the ITC collection, which were collected from the Autonomous Region of Bougainville, PNG, in 2016
- New Evaluation Trait filter on accession search page
- Reorganised menu for more clarity and to promote new features such as the Studies tab on published genotyping and phenotyping studies that reference ITC accessions (see fig 6 below).
- Verification of geo reference data points for accessions; over 2,000 points were checked, of which 156 were corrected.
- Collection update feature. It is now possible for curators/managers of collection to update or add their collection's accession passport data.
- Update of publication lists citing specific accessions

Home > Studies

List of phenotyping studies stored in MGIS

Title	Year	Evaluation traits
Assessing Variations in Host Resistance to Fusarium oxysporum f sp. cubense Race 4 in Musa Species, With a Focus on the Subtropical	2019	Fusarium wilt (TR4)
Race 4		
Effects of In Vitro Polyploidization on Agronomic Characteristics and Fruit Carotenoid Content; Implications for Banana Genetic	2019	Pro-vitamin A
Improvement		
Evaluation of banana germplasm and genetic analysis of an F1 population for resistance to Fusarium oxysporum f. sp. cubense race 1	2019	Fusarium wilt (Race 1)
Host Response to Black Leaf Streak and Agronomic Performance of Banana Genotypes in Puerto Rico	2019	Agronomic performance, Black Leaf Streak
Imbalanced expression of stay-green 1 alleles in banana AAB/ABB cultivars prevents high-temperature-induced green ripening as in AAA Cavendish fruit	2019	Agronomic performance
Sources of resistance in Musa to Xanthomonas campestris pv. musacearum, the causal agent of banana xanthomonas wilt	2019	Xanthomonas wilt
Transcriptomic analysis of resistant and susceptible banana corms in response to infection by Fusarium oxysporum f. sp. cubense tropical race 4	2019	Fusarium wilt (TR4)
Using Growth and Transpiration Phenotyping Under Controlled Conditions to Select Water Efficient Banana Genotypes	2019	Water stress
Variability of carotenoids in a Musa germplasm collection and implications for provitamin A biofortification	2019	Pro-vitamin A
Identification and evaluation of resistance to Fusarium oxysporum f. sp. cubense tropical race 4 in Musa acuminata Pahang	2018	Fusarium wilt (TR4)
The 'Plantain-Optim'dataset: Agronomic traits of 405 plantains every 15 days from planting to harvest	2018	Agronomic performance
Agronomic performance of local and introduced plantains, dessert, cooking and beer bananas (Musa spp.) across different altitude and	2016	Agronomic performance
soil conditions in eastern Democratic Republic of Congo		
A Genome-Wide Association Study on the Seedless Phenotype in Banana (Musa spp.) Reveals the Potential of a Selected Panel to Detect	2016	Parthenocarpy
Candidate Genes in a Vegetatively Propagated Crop.		
How endogenous plant pararetroviruses shed light on Musa evolution.	2016	Banana Streak Virus (BSV)
Marker-assisted breeding of Musa balbisiana genitors devoid of infectious endogenous Banana streak virus sequences	2016	Banana Streak Virus (BSV)
Provitamin A carotenoid content of unripe and ripe banana cultivars for potential adoption in eastern Africa	2015	Pro-vitamin A
Phenotyping Banana Germplasm with Fusarium oxysporum f.sp. cubense Tropical Race 4	2014	Fusarium wilt (TR4)
Evaluation of banana hybrids for tolerance to black leaf streak (Mycosphaerella fijiensis Morelet) in Puerto Rico	2013	Black Leaf Streak
Evaluation of pollen fertility of diploid and doubled-diploid clones of Mlali and their potential use for banana breeding	2013	Pollen Fertility
Screening Musa germplasm for resistance to burrowing nematode populations from Uganda	2013	Burrowing nematode
Growth, Yield and Quality of Banana (Musa sapientum L) influenced by Different Banana Varieties/Lines and Planting Time	2012	Agronomic performance
Screening the banana biodiversity for drought tolerance: can an in vitro growth model and proteomics be used as a tool to discover	2012	Water stress
tolerant varieties and understand homeostasis.		
beta-Carotene content of selected banana genotypes from Uganda	2011	Pro-vitamin A

Fig 6. Phenotyping studies linked to accessions in MGIS

B Reference Genome

Scientists from the Chinese Academy of Tropical Agricultural Sciences (CATAS), along with several MusaNet members, recently published the first draft genome sequence of the B genome - Musa balbisiana in the



journal Nature Plants.

The authors sequenced the double haploid of the wild diploid genotype Pisang Klutuk Wulung, a Musa balbisiana. They then compared the B- and A-genomes to investigate subgenome evolution, genetic diversity and the functional divergence of subgenomes in polyploid bananas. The paper provides insights into the evolution and regulation of fruit-ripening processes in bananas and highlights a significant contribution of the B-genome towards ethylene biosynthesis and starch metabolism during fruit ripening.

The MusaNet members involved in the study are CIRAD / Alliance of Bioversity and CIAT scientists. They provided the accession (double haploid) that was sequenced and helped build the genetic map that was used to anchor the sequence on the chromosomes

Full citation:

Zhuo Wang, Hongxia Miao, Juhua Liu, Biyu Xu, Xiaoming Yao, Chunyan Xu, Shancen Zhao, Xiaodong Fang, Caihong Jia, Jingyi Wang, Jianbin Zhang, Jingyang Li, Yi Xu, Jiashui Wang, Weihong Ma, Zhangyan Wu, Lili Yu, Yulan Yang, Chun Liu, Yu Guo, Silong Sun, Franc-Christophe Baurens, Guillaume Martin, Frederic Salmon, Olivier Garsmeur, Nabila Yahiaoui, Catherine Hervouet, Mathieu Rouard, Nathalie Laboureau, Remy Habas, Sebastien Ricci, Ming Peng, Anping Guo, Jianghui Xie, Yin Li, Zehong Ding, Yan Yan, Weiwei Tie,

Angélique D'Hont, Wei Hu, Zhiqiang Jin. *Musa balbisiana genome reveals subgenome evolution and functional divergence*, Nature Plants 5 (8), 810-821 Link here.

Upcoming Events

<u>Plant and Animal Genome (PAG) XVIII</u>, 11-15 January 2020, San Diego, CA, USA <u>International Conference on Banana</u>, 22-25 February 2020, Tiruchirappalli, India <u>Acorbat XXIII International Congress</u> 29 April - 1 May 2020, Miami, FL, USA <u>ProMusa Symposium</u>, 19-24 October 2020, Kunming, China

