# Project Final Report

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# Project Title:

***Introduction, Evaluation and Adoption of Improved and Superior Landraces of Banana for Food and Income Alleviation***

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With effect from **1 December 2006**, IPGRI and INIBAP operate under the name **"Bioversity International", Bioversity** for short. This new name echoes our new strategy which focuses on improving people's lives through biodiversity research.

# EXECUTIVE SUMMARY

Two National Repositories, Multiplication and Distribution Centres (NRMDCs) were established in the country: one at the University of the Philippines Los Baños (UPLB) and another at the Bureau of Plant Industry (BPI). The Centres maintained the 23 cultivars introduced from the International Transit Centre in cultures and in the greenhouse. These centres also serve as the source of introduced and local cultivars for distribution to researchers, students and farmers. A total of 18,459 tissue-culture derived plantlets were distributed to interested users.

The introduced cultivars were evaluated in terms of their agronomic and yield performance and the results were published in a Catalogue. Assessment for their resistance to major diseases (banana bunchy top, black sigatoka, Fusarium wilt and nematodes) was also conducted. Sensory evaluation to determine the acceptability of the introduced cultivars was done in three (3) sites and during the farmers' field day. Among the introduced cultivars, FHIA 17 and FHIA 21 are being promoted as cultivars with potential for processing.

Farmers' field trials were also set up in selected areas in Luzon to promote the utilization of introduced cultivars. In addition, four (4) training courses on the nursery and field management of banana were conducted involving farmers and technicians of the local government units.

The results of the trials were presented in various symposia and meetings, as oral and poster presentations. One (1) oral presentation and nine (9) poster presentations were presented. One of the posters won the Best Poster (Agricultural Science Category) in the National Academy of Science and Technology Annual Scientific Meeting in 2007. Eight (8) draft manuscripts of the different studies were also written and five (5) exhibit materials were produced.

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## ACRONYMS

| | |
|---|---|
| BAP | Benzyl amino purine |
| BPI | Bureau of Plant Industry |
| DNCRDC | Davao National Crop Research and Development Centre |
| ELISA | Enzyme-linked immuno-adsorbent assay |
| IPB | Institute of Plant Breeding |
| ITC | International Transit Centre |
| NRMDC | National Repository, Multiplication and Dissemination Centre |
| TSS | Total Soluble Solids |
| UPLB | University of the Philippines Los Baños |

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# 1 Introduction and background

Banana (*Musa* spp.) is an important crop in the Philippines. It is of many different types of sweet dessert bananas as well as cooking bananas and plantains. The country is the second largest banana producer and the number one banana exporter in Asia. Except for the export banana, which is a significant source of foreign exchange, the crop is grown largely by smallholder farmers, traded by local entrepreneurs, and consumed by locals. Thus, it plays a major role in food security and income generation for the rural poor. The Philippines, being in the region considered as the centre of origin of bananas, boasts of many famous cultivars such as *Lakatan, Latundan, Saba, Bungulan* and the export quality Cavendish. Undoubtedly, banana is an important food for Filipinos, source of income for local farmers and an important source of foreign exchange from export.

Small-scale production of non-export bananas has in the past been largely neglected in terms of research and development. Average yields on smallholdings are below 10 tons/hectare/year while commercial plantation farms produce more than 40 tons/ha/year. The major production constraints and threats to the banana industry in the Philippines come from pests and diseases. Being the centre of origin of the genus, many serious pests and diseases are also found ravaging the crop. Recent surveys and field visits indicate that many smallholder banana farmers are seriously devastated by epidemic of diseases such as Banana Bunchy Top Virus, *Bugtok, Fusarium wilt*, as well as Black Sigatoka. The impact of these diseases is most severe for smallholder farmers who do not have the economic and technical capabilities to manage these problems. While large plantation owners can control pests and diseases through the use of chemicals, the intensive use of pesticides can adversely affect the environment and human health. The seriousness of the problem is indicated by the fact that most of the *Lakatan* and *Latundan* fruits sold in Luzon and Visayas come from Mindanao, mostly produced by big commercial growers. This resulted to higher banana consumer price and had removed the traditional source of income to many smallholder banana farmers.

***Opportunities for Development***

In the last ten years, *Musa* researchers worldwide have made several important breakthroughs and an increasing number of new, high yielding, and disease-resistant varieties are being produced. These varieties include both cooking and dessert types, a number of which are considered to hold good potential for small-holder production in Asia. These improved varieties are being made available for testing and distribution to farmers by INIBAP. It is believed that the introduction of these new varieties as part of an integrated crop management strategy, involving also the use of clean planting materials, could have a rapid and significant impact on production levels in the Philippines.

However, there is a major constraint to the wide-scale distribution and adoption of improved varieties, and this is the lack of planting materials at the national level. Due to the heavy demand for germplasm, INIBAP is only able to supply 5 replicates of each accession per request. Further multiplication of planting materials for the establishment of trials and onward distribution to farmers is therefore a national responsibility. Moreover, due to the transmissibility of banana viruses through planting materials including tissue culture, virus indexing to ensure disease-free planting materials becomes essential prior to dissemination of planting materials.

INIBAP, through its International *Musa* Testing Program (IMTP) has identified superior banana hybrids and superior landraces that are now ready to be tested in the farmers' field and eventually disseminated and adopted by farmers. The Philippines has participated in this global varietal *Musa* evaluation. These may now be accessed by the Philippine government for its banana rehabilitation program. In addition, disease management techniques have been identified and made available for packaging and field testing. The tissue culture technology, coupled with virus indexing can play a vital role in the disease management system that may be the key to the rehabilitation of the disease-ravaged smallholding banana farms.

The availability to the Philippine banana industry of the improved germplasm as well as superior landraces from breeding programs elsewhere is a short cut to a long, tedious and expensive national banana breeding program.

This project aims to equip small-scale banana farmers with capabilities to be competitive and self sustaining in banana production by making available planting materials of promising, disease-free, improved, and superior landraces of banana, train farmers and stakeholders on proper nursery and field management, generate basic knowledge on the efficiency and benefits of *in vitro* and *in vivo* maintenance, establish farmers' field trials of promising cultivars, and sustain the source of disease-free planting materials.

The general objective of the project was to enhance the availability of improved, high-yielding and disease-resistant cultivars through the establishment of an NRMDC at UPLB. Specifically, the project aims to (1) introduce improved, disease-free cultivars that are high yielding and resistant to pests and diseases, (2) establish an NRMDC at UPLB and BPI, and (3) establish demonstration trials to showcase availability of improved cultivars and evaluate introduced cultivars as to their agronomic and yield characters, and reaction to common diseases and pests

# 2 Establishment of a National Repository, Multiplication and Dissemination Centre (NRMDC)

NRMDCs have been established to conserve and multiply improved, high yielding, and disease-resistant *Musa* cultivars. These cultivars are to be made available to national researchers for evaluation and promotion, and to commercial and small-holder banana growers for adoption. The establishment of the centres is part of an integrated banana production development strategy.

Two institutions were identified as the NRMDCs in the Philippines. These are:

(1) National Plant Genetic Resources Laboratory at the Institute of Plant Breeding (IPB) of the University of the Philippines Los Baños (UPLB), and
(2) Davao National Crop Research and Development Centre (DNCRDC) of the Bureau of Plant Industry (BPI) located in Davao City, Southern Philippines.

Bioversity International provided the NRMDCs with shoot cultures of improved cultivars and landraces from the *Musa* Germplasm International Transit Center (ITC) in Belgium for conservation and testing. The *in vitro* collection serves as a duplicate stock for the screen-house conservation of *in vivo* foundation-stock for mass multiplication and distribution. These materials were monitored by the Quarantine Unit of BPI during early establishment of the cultures.

## 2.1 In vitro conservation

The introduced cultivars were established *in vitro* following the micro-propagation protocol as described by Damasco and Barba in 1984. All materials were indexed for the presence of banana virus before culture initiation.

Thirty banana cultivars- 23 introduced and 7 local cultivars- are being maintained *in vitro* (Appendix Table 1). Five to ten *in vitro* cultures per cultivar are being maintained in the rooting (MS basal medium) and multiplication mediums (MS basal medium + 3 mg/L Benzyl amino purine (BAP) (Figure 1). Cultures are regularly sub-cultured onto fresh media every two to three months. The cultures are currently maintained at the two NRMDCs, the UPLB and BPI.


**Figure 1: *In vitro* collection of introduced and local bananas maintained at National Plant Genetic Resources Laboratory, UPLB**

## 2.2 In vivo maintenance

**Figure 3: Foundation stocks of introduced and local banana cultivars maintained inside insect-proof greenhouse at UPLB**

Introduced and local banana cultivars were planted in 14" diameter-plastic pots filled with a sterilized potting medium composed of garden soil, coconut coir dust, and 1:1v/v, and were kept inside an insect-proof greenhouse. These materials served as the foundation stocks for conservation and subsequent micro-propagation. Each cultivar is composed of 2-4 plants grown individually in plastic pots (at UPLB) or large clay pots (at BPI). The plants are given optimum care to ensure normal growth and development, and

**Figure 2: Foundation stocks of introduced and local banana cultivars maintained inside insect-proof greenhouse at BPI**

monitored for morphological changes or somaclonal variation. All materials maintained in the screenhouses are indexed regularly for the presence of banana viruses (Figure 2 &3).

An experiment determining the appropriate conditions for continuous maintenance of foundation stocks inside the greenhouse was conducted. Pseudostems of 20 introduced and local banana cultivars were cut at 2 different heights (15 cm and 30 cm) above soil level. Cutting was done when the longest leaf was 3 meters high. Results indicate that cutting the pseudostem at a lower portion (15 cm) promoted slower growth but allowed for more vigorous re-growth, resulting in longer cutting time. Suckering ability was affected by genotype, not by cutting, .

In BPI, pruning was done once a year. When the banana plant reaches 180cm in height, they were cut down to 30cm from the base. This method of maintaining foundation stocks provides maintenance of more number of cultivars, and allows for easier implementation of cultural practices, particularly preventing infestations of pests and diseases. In addition, time spent and cost of labor were minimal.

To date, ELISA[1] indexing of test plants showed negative results, indicating that the screenhouse conservation is effective in keeping the foundation stocks virus-free, even after almost 5 years of screenhouse conservation.

# 3 Evaluation of introduced cultivars

## *3.1 Agronomic and yield performance*

### 3.1.1 On-station trial at IPB, UPLB

Agronomic and yield performance of introduced banana cultivars under local growing conditions was assessed from October 2002 to December 2004 at the IPB Experimental Farm in Bay, Laguna. Nineteen introduced hybrids and landraces were planted together with 8 local cultivars. Morphological characterization followed the descriptors for Banana.

Significant differences were observed among cultivars in all plant characters. In general, yields of some introduced cultivars were higher than the local cultivars (Appendix Table 4). In particular, FHIA-17, FHIA-23, and SH 3436-9 produced heavier bunches than the highest yielding local cultivar (Cardaba), while FHIA-17 produced heavier individual fruits. However, based on Total Soluble Solids (TSS) reading, local cultivars were sweeter than the introduced cultivars. The higher yield of suckers of FHIA-17 and FHIA-23 suggests that they may also possess resistance to common pests and diseases.

The result of this trial is published as the “Catalogue of introduced and local banana cultivars in the Philippines” in 2006. It is available both in hard and electronic copies.

[1] *enzyme-linked immuno-adsorbent assay*- A sensitive immunoassay that uses an enzyme linked to an antibody or antigen as a marker for the detection of a specific protein, especially an antigen or antibody

A second demonstration site was established at the Central Experiment Station of UPLB in February 2005. Six introduced and six local cultivars were evaluated for agronomic and yield characters.

Significant differences were observed among cultivars in six parameters (Appendix Table 5). Generally, the introduced cultivars performed better than the local cultivars in terms of the different yield components. FHIA 25 took the longest time from planting to flowering, planting to harvesting, and from flowering to harvesting. Grand Naine, on the other hand, exhibited the shortest time to flower from time of planting. Cuarenta Dias took the shortest time between time of planting and harvesting, and from flowering to harvesting. FHIA 25 produced the heaviest bunch (47.49 kg) followed by FHIA 17 (36.61 kg), while Cuarenta Dias (a local cultivar) produced the lowest bunch weight (8.51 g). FHIA 25 also produced the most number of hands (15.03), and the heaviest individual finger (277.86 g).

## *3.2 Evaluation of local and introduced banana cultivars for resistance to major diseases*

### 3.2.1 Evaluation for resistance to banana bunchy top disease (BBTD) under field conditions

Resistance to BBTD was assessed by the time of onset of infection and disease incidence (%). Nineteen introduced hybrids and landraces, and 8 local cultivars were assessed for BBTD under natural infection. Among the introduced cultivars, percentage BBT incidence was highest on SH 3436-9 (59.7%), followed by Pisang Jari Buaya (37.0%) and FHIA 02 (33.3%) . Among the local cultivars, Cuarenta Dias had the highest percentage incidence (88.0%), followed by Lakatan Mindoro (50.7%) and Cavendish (45.3%).

Two introduced cultivars had low percentage incidence of BBTD, namely TMB X 1378 (1.7%) and TMB X 5259-1 (9.0%). Regarding the rate of disease increase, TMB x 1378, Cachaco and CRBP 39, TMB X5259-1, Pisang Ceylan, had lower rates than the other introduced cultivars. It was also worthy to note that seven introduced cultivars got infected 23 months after planting, while the rest of the varieties were infected earlier. Among the local cultivars, only Bungulan became infected at 20 months after planting, while the rest were infected earlier. All local cultivars displayed rapid BBTD increases. Some plants showed symptoms at flowering, and on suckers.

In another trial, rating for BBTD incidence was taken from the six introduced and six local banana cultivars. Of the local cultivars, Cuarenta Dias had the highest incidence (69%) followed by Lakatan Cavite (62%), and Cardaba (7%). It was noted that the spread of BBTV is fastest on Lakatan-Cavite. However on Cuarenta Dias, BBT incidence was noted as early as nine months after planting, while BBT incidence on Cardaba was noted at 14 months after planting.

On introduced FHIA cultivars, FHIA 18 was disease-free, while FHIA 17 and FHIA 25 had 30% and 33% incidences, respectively although disease onsets were at later stages of plant development. FHIA lines, except FHIA 18, and Saba showed symptoms of the disease at flowering stage. Local cultivars such as Lakatan and Cuarenta Dias showed BBTD infection as early as 2-3 months after transplanting. Lower incidence of BBTD

was observed in the second trial compared to the first trial due to the removal of BBTV-infected plants as soon as the symptoms appeared.

### 3.2.2 Evaluation for resistance to black Sigatoka under field conditions

Six local and six introduced cultivars (FHIA hybrids) were evaluated for resistance to black Sigatoka under field conditions. Resistance was evaluated by measuring the youngest leaf spotted (YLS) and disease severity index at harvest stage.

FHIA cultivars were resistant to black Sigatoka. Resistant lines had a higher YSL, and a lower disease severity index. Five local cultivars were found to be very susceptible to black Sigatoka. Among the local cultivars, only Cardaba was Sigatoka resistant. The response of Cardaba to black Sigatoka was comparable to the FHIA lines.

### 3.2.3 Evaluation for resistance to Fusarium wilt under field conditions

One local variety (Latundan) and 20 introduced varieties were evaluated for resistance to Fusarium wilt under field conditions. Fusarium wilt infection was observed on three different stages after planting on the tested varieties. These infections were observed at three months on FHIA 17 and FHIA 23; at seven months on Williams, Gros Michel, FHIA 18, and Latundan; and at fifteen months on Pisang Jari Buaya, CRBP 39, Pisang Ceylan, and Cachaco. External symptoms were observed, such as chlorosis in older leaves progressing to younger leaves, wilting, pseudostem splitting, and petiole buckling,. Internal symptoms were likewise observed on the vascular tissues of the corm, pseudostem and in the petioles of the varieties' Williams, FHIA 18 and Latundan.

Highest percentage infection was observed on the local cultivar Latundan at 55%. The lowest incidence was observed on Williams, Pisang Jari Buaya, FHIA 23, CRBP 39. At the time of observation, no disease infection was observed on the following varieties: FHIA 2, FHIA 3, AACV Rose, Yangambi Km5, SH 3436-9, TMBX1378, TMBX5295-1, SH 3640, FHIA 21, TMB3X15108-6 and FHIA 25 at BPI Davao field conditions.

### 3.2.4 Evaluation for resistance to nematodes

## Field Survey

The field survey used the collection technique described by Speijer and De Waele in 1997. Based on the field survey conducted in Davao City, *Helicotylenchus* sp. was identified to be present on six FHIA accessions (FHIA 1, FHIA 2, FHIA 3, FHIA 18, FHIA 21 and FHIA 25) at shooting and harvesting stages, while *Meloidogyne* sp. was present only on FHIA 2 accession at shooting stage (Figure 4).

**Figure 4: Collected root samples assessed for root damage**

## Screenhouse Experiment

*Nematode reproduction*
Highest nematode density was observed on Grand Naine (2353/g), while the lowest nematode density was observed on Yangambi Km 5 (232/g). Based on Dunnetts test, four FHIA varieties (FHIA 3, 5, 18 and 23) were susceptible to nematodes. FHIA 4 gave inconclusive results. Nematode counts observed from the FHIA varieties increased after initial inoculation but nematode counts observed were lower than that of the susceptible check (Grand Naine). Highest nematode count was observed on FHIA 23.

*Root damage assessment*
Percent dead roots (PDR) of Yangambi Km 5 (4.5%) and Grand Nain (54.1%) were significantly different. FHIAs 4, 18 and 23 had the lowest PDR similar to Yangambi Km 5, the resistant reference material. Reaction of FHIA 3 and 5 was the same as that of Grand Naine with high PDR. Based on the root damage assessment, FHIA 4, 18 and 23 were observed to be relatively resistant to nematodes, while FHIA 3 and 5 were observed to be susceptible to nematodes.

FHIA hybrids had low root necrosis (RN) ranging from 27.8 -37. However, they were not significantly different from Yangambi Km 5 and Grand Nain, the resistant and susceptible checks respectively. Grand Naine obtained the highest RN at 45.8%.

## *3.3 Sensory evaluation*

### 3.3.1 Sensory evaluation in three testing sites

A total of 168 participants from three sites participated in the sensory evaluation (Figure 5 & 6). Sample bananas were allowed to ripen to eating stage and brought to the testing sites. The ratings were entered in evaluation sheets bearing 10 qualities to describe the banana sample.

**Figure 5: Sensory evaluation held in (a) Calamba, (b) Bay , Laguna**

Among the FHIA hybrids, FHIA-23 was the most preferred, while FHIA-18 was the least preferred (Table 7). Among the local cultivars, Lakatan Davao was the most preferred in terms of pulp texture, taste, flavour, and sweetness, followed by Lakatan Cavite, which was the preferred cultivar in terms of finger shape, peel colour and finger size.

Among all hybrids and cultivars, Lakatan Cavite was the most preferred, based on finger shape and peel colour, while FHIA-18 was preferred the least. Cavendish was preferred least among the local cultivars. FHIA-23 was preferred among the FHIA hybrids. Considering all the introduced bananas only, Pisang Ceylan was the most preferred, while FHIA-18 was still the least preferred.

In terms of finger size, TMB x 52-95-1 was the most preferred while AACV Rose was least. Among the local cultivars, Lakatan Cavite was the most preferred while Cuarenta Dias was the least preferred.

Lakatan Mindoro is most preferred in terms of pulp colour while that of FHIA-18 was the least. For the introduced cultivars, SH 3640 was the most preferred while FHIA-18 was the least preferred. The pulp colour of Latundan was the least liked among the local cultivars.

For pulp size, TMB x 5295-1 was the most preferred while that of AACV Rose was the least. Among the local cultivars, Lakatan MIndoro-1 was the most preferred while Cuarenta Dias was the least.

For pulp texture, FHIA-21 was the most preferred among introduced cultivars while Lakatan Davao was preferred among the local cultivars. Williams and Lakatan Cavite had the lowest rating among the introduced and local cultivars, respectively.

When the bananas were ranked according to taste, Lakatan Davao and FHIA 23 were the most preferred among the local and introduced cultivars, respectively. Cavendish and FHIA-18 were rated last among the local and introduced cultivars. The same trend was observed in terms of pulp flavour, banana pulp sweetness and overall acceptability.

### 3.3.2 Taste test of the different preparations of Banana conducted during the Farmers' Field Day

**Table 1: Variety preference ranking**

| Variety | | Banana preparation | | | | |
|---|---|---|---|---|---|---|
| | | ripe | | cake | chips | |
| | | boiled | raw | | salt | honey |
| Hybrids | FHIA 01 | 4 | 2 | 1 | 1 | 4 |
| | FHIA 02 | 3 | 4 | 3 | 6 | 3 |
| | FHIA 17 | 6 | 5 | 4 | 5 | 2 |
| | FHIA 18 | 2 | 6 | 2 | 3 | 1 |
| | FHIA 23 | 7 | 7 | 6 | 2 | 5 |
| | FHIA 25 | 5 | 9 | 7 | 4 | 7 |
| Local | Bungulan | - | - | 5 | - | - |
| | Cuarenta Dias | - | 8 | - | - | - |
| | Lakatan Cavite | - | 1 | - | - | - |
| | Lakatan Davao | - | 3 | - | - | - |
| | Saba | 1 | - | - | 7 | 6 |

Another sensory evaluation was conducted (March 2006) involving 99 participants during the farmers' field day. Five different types of banana preparations were used in the test: ripe-boiled, ripe-uncooked, cake, salted chips and honeyed chips. Six FHIA hybrids were used in the different preparations while different local banana cultivars were used as control or reference in various preparations.

Saba was more preferred as boiled followed by FHIA 18 and FHIA-17. FHIA 23 was the least liked as boiled banana.

Among the introduced banana hybrids prepared as cake, FHIA 01 was the most preferred while FHIA 25 was the least liked. All FHIA hybrids except FHIA 23 and FHIA 25 surpassed Buñgulan as the preferred raw material for cake.

All FHIA hybrids, except FHIA 25, were preferred over Saba as honeyed chips. FHIA 18 and FHIA 17 were preferred as honeyed chips followed by FHIA 01 and FHIA 02.

FHIA-01 was best liked as salted chips while FHIA 02 was the least. All of the FHIA hybrids were more preferred than Saba as salted chips.

Lakatan Cavite and Lakatan Davao were preferred as ripe uncooked cultivars although all hybrids but FHIA 25, were more preferred over Cuarenta Dias (a local table-type cultivar). FHIA 25 was comparable to Cuarenta Dias.

# 4 Farmers' Dissemination

## *4.1 Farmers' yield trial*

Farmers' field trials were set up in selected areas in Luzon. The trials consisted of introduced cultivars (FHIA 17, FHIA 21 or FHIA 25 and FHIA 23) and two local cultivars (Cardaba and Lakatan Davao) with 20 plants per replication.

Results indicate that the introduced cultivars were comparable, if not better, in terms of yielding ability when grown under farmers' fields. In Isabela, the yield of FHIA 23 is better than the high yielding local cultivar (Cardaba) while FHIA 17 gave similar yield. In Nueva Vizcaya, both FHIA 17 and FHIA 21 produced higher bunch weights than Cardaba.

A farmers' field day was conducted in Nueva Vizcaya to evaluate the performance and utilization potential of the different banana cultivars. Fifty-two participants comprised the sensory evaluation panel. FHIA 17 and FHIA 21 were preferred as banana cake while the two cultivars were comparable to Cardaba as raw material for banana chips.

## *4.2 Distribution of planting materials to farmers*

Based on the results of in-house evaluations at IPB and BPI, nine selected varieties consisting of six FHIA accessions (FHIA 01, 02, 17, 18, 21 and 23) and three local varieties (Lakatan Davao, Cardaba, Cuarenta Dias) were multiplied for distribution to farmers and interested growers. The remaining 21 varieties were multiplied in limited quantities for research purposes.

In the project's duration, 18,459 tissue-cultured plantlets, consisting of 9,171 *in vitro* plantlets (rooted and proliferated cultures), and 9,288 established plantlets, were distributed to state colleges and universities, Department of Agriculture units, non-government organizations, farmers and interested growers (Appendix Table 2). The i*n vitro* proliferated cultures were distributed to institutions with tissue culture capability for further multiplication of materials. Rooted plantlets, on the other hand, were given to organizations and individuals trained on handling tissue cultured plantlets for nursery establishment. Established seedlings ready for fields planting were given to farmers and growers.

In terms of number of plantlets distributed per cultivar (Appendix Table 3), FHIA 17 had the most number of plantlets distributed (3,607) for the introduced varieties, followed by FHIA 23 (1,678) and FHIA 21 (1,533) and FHIA 02 (1,197). With the local cultivars, Lakatan Davao had the most number of plantlets distributed (2,908) followed by Cardaba (1,674) and Cuarenta Dias (617). In addition, BPI distributed 40 plantlets each of GCTCV

119, 106 and 247 to Stanfilco, 10 plantlets each were given to Lapanday and 5 plantlets each were distributed to Unifruiti.

# 5 Monitoring of Planting Materials Distributed to Commercial Plantations

Three cultivars identified to be resistant to Fusarium wilt were distributed to three commercial banana plantations (Lapanday, Stanfilco and Unifruiti), and to the demo plot of BPI-DNCRDC at in Davao City. The plantlets were already established in the fields, and at present have not exhibited symptoms suggesting incidence of Fusarium wilt.

One of the recipient plantations was observed regarding the performance of GCTCV 119. The plants were planted on a Fusarium wilt-infected farm. At present (fruiting stage) it has not exhibited infection from Fusarium wilt. The adjacent area planted to Cavendish, however, was observed to be severely infected with Fusarium wilt as early as the vegetative stage.

# 6 Trainings Conducted

1. Nursery and Field Management of *In-Vitro* Propagated Bananas. September 18 – 20, 2007. Bioversity International Philippine Office, IRRI, Los Baños, Laguna.
   Participants: National Tobacco Administration (NTA) Researchers and Research Technicians

2. Field Management of *In-Vitro* Propagated Cardava. February 2008. PGMA Multiline Food Processing Plant, Santa, Ilocos Sur.
   Participants: Tobacco farmers from 7 Ilocos Sur municipalities; NTA Research Technicians

3. Field Management of *In-Vitro* Propagated Cardava. May 6 – 8, 2008. Candon City Municipal Hall, Candon City, Ilocos Sur
   Participants: Tobacco farmers from 6 Ilocos Sur municipalities; NTA Research Technicians

4. Field Management of *In-Vitro* Propagated Cardava. May 6 – 8, 2008. Vigan City, Ilocos Sur
   Participants: Tobacco farmers and NTA Research Technicians

# 7 Recommendations

1. Scaling-up of the utilization of selected varieties, particularly in Northern Luzon, where the introduced cultivars have gained acceptability in terms of yield, resistance to major diseases and potential as fresh fruit (FHIA 17) and as banana chips (FHIA 21).

2. Bioversity to propose a second phase project to develop a scaling-up model elucidating the components of both social-cultural and economical elements of a sustainable integration of these new cultivars in a crop diversification model for food and income alleviation of small-scale farmers.

3. Publication of handbook/manual/monograph on the agronomic and yield performance, and reaction of the introduced varieties to common diseases as well as publication of draft manuscripts in refereed journals or as popular articles.

4. The current model on the establishment of National Repository, Multiplication and Distribution Centres (NMRDC) may be recommended for further validation in other countries.

# 8 APPENDICES:

## *8.1 Table 1. List of banana varieties introduced from the Musa Germplasm Transit Center and local varieties maintained in vitro at the National Plant Genetic Resources Laboratory and Bureau of Plant Industry.*

| ITC Code | Accession Name | Classification (Genome) | Type |
|---|---|---|---|
| ITC 0312 | Pisang Jari Buaya | Landrace (AA) | Dessert |
| ITC 0504 | FHIA-01 | Hybrid | Dessert/Cooking |
| ITC 0505 | FHIA-02 | Hybrid | Dessert/Cooking |
| ITC 0506 | FHIA-03 | - | - |
| ITC 0570 | Williams | Ref. Clone | Dessert |
| ITC 0643 | Cachaco | Landrace (ABB) | Dessert/Cooking |
| ITC 0712 | AAcv Rose | - | - |
| ITC 1123 | Yangambi KM5 | Ref. Clone (AAA) | Dessert/Cooking |
| ITC 1264 | FHIA-17 | Hybrid | Dessert/Cooking |
| ITC 1265 | FHIA-23 | - | Dessert/Cooking |
| ITC 1282 | GCTCV-119 | Somaclonal Variant (AAA) | Dessert |
| ITC 1283 | SH 3436-9 | Somaclonal variant | Dessert |
| ITC 1296 | TMBx 1378 | Hybrid | Cooking |
| ITC 1297 | TMBx 3295-1 | Hybrid | Dodo |
| ITC 1307 | SH 3640 | Hybrid | Dessert/Cooking |
| ITC 1319 | FHIA-18 | Hybrid | Dessert |
| ITC 1332 | FHIA-21 (#68) | Hybrid | Plantain/Cooking |
| ITC 1344 | CRBP 39 | Hybrid | Plantain/Cooking |
| ITC 1418 | FHIA-25 | - | - |
| ITC 1441 | Pisang Ceylan | Primitive cv. (AAB) | Dessert |
| ITC 1122 | Gros Michel | Ref. Clone (AAA) | Dessert |
| ITC 1442 | GCTCV 106 | - | - |
| ITC 1443 | GCTCV 247 | - | - |
| - | Cavendish | AAA | Dessert |
| - | Cardaba | BBB | Cooking |
| - | Bungulan | AAA | Dessert |
| - | Lakatan Davao | AA | Dessert |
| - | Lakatan Cavite | AA | Dessert |
| | Quarenta Dias | AA | Dessert |
| - | Latundan | AAB | Dessert |

## *8.2* *Table 2: Banana tissue cultured planting materials distributed to different end-users for research, field trials and field plantings.*

| End-user/Recipient | *In vitro* plantlet | | | Established plantlet | | | TOTAL 3 years |
|---|---|---|---|---|---|---|---|
| | Year 1&2 | Year 3 | Total | Year 1&2 | Year 3 | Total | |
| Municipal/provincial agriculture office (LGU) | | 660 | 660 | 331 | 266 | 597 | 1,257 |
| DA and other government agencies | 60 | 1,973 | 2,033 | 272 | 770 | 1,042 | 3,075 |
| Farmers and farmer groups | 50 | 535 | 585 | 1,297 | 2,482 | 3,779 | 4,364 |
| State Colleges and Universities (SCU) | 1,220 | 2,743 | 3,963 | 884 | 761 | 1,645 | 5,608 |
| Interested private individuals | 20 | 360 | 380 | 155 | 415 | 570 | 950 |
| Project research | 1,050 | 500 | 1,550 | 1,255 | 400 | 1,655 | 3,205 |
| TOTAL | 2,400 | 6,771 | 9,171 | 4,194 | 5,094 | 9,288 | 18,459 |

## *8.3 Table 3 Total number of in vitro & established plantlets distributed / cultivar*

| Cultivar | Type of Material | | TOTAL |
|---|---|---|---|
| | *In vitro* | Established Plantlets | |
| A. Introduced cultivars | | | |
| FHIA-01 | 150 | 442 | 592 |
| FHIA-02 | 535 | 662 | 1,197 |
| FHIA-03 | 50 | 57 | 107 |
| FHIA-17 | 2,383 | 1,224 | 3,607 |
| FHIA-18 | 495 | 185 | 680 |
| FHIA-21 | 909 | 674 | 1,533 |
| FHIA-23 | 499 | 1,179 | 1,678 |
| FHIA-25 | 59 | 356 | 415 |
| Williams | 40 | 126 | 166 |
| Cachaco | | 31 | 31 |
| AACv Rose | | 32 | 32 |
| KM 5 | 100 | 106 | 206 |
| Pisang Jari Buaya | 370 | 120 | 490 |
| GCTV-119 | 100 | 41 | 141 |
| SH-3436-9 | 32 | 40 | 72 |
| TMBX3295-1 | 35 | 57 | 92 |
| TMBX 1378 | 33 | 32 | 65 |
| Pisang Ceylan | 50 | 50 | 100 |
| CRBP 39 | 400 | 38 | 438 |
| GCTV-106 | 350 | 129 | 479 |
| GCTV-247 | 105 | 37 | 142 |
| SH-3640 | 54 | 42 | 96 |
| Gros Michel | 54 | 36 | 100 |
| B. Local cultivars | | | |
| Lakatan Davao | 1,041 | 1,867 | 2,908 |
| Lakatan Cavite | | 81 | 81 |
| Bungulan | 245 | 83 | 328 |
| Cardaba | 420 | 1,259 | 1,674 |
| Quarenta Dias | 507 | 110 | 617 |
| Cavendish | 145 | 122 | 267 |
| Latundan | | 70 | 70 |
| Sub Total | 9,171 | 9,288 | 18,459 |

## *8.4 Table 4. Yield performance of the plant crop of local and introduced banana cultivars grown at the IPB Experiment Station in Bay, Laguna.*

| Cultivars | Bunch weight (kg) | | No. of hands per bunch | | No. of fingers per bunch | | Fruit weight* (g) | | TSS ($^{o}$Brix)** | |
|---|---|---|---|---|---|---|---|---|---|---|
| A. Introduced | | | | | | | | | | |
| Cachaco | 11.92 | defg | 4.74 | fg | 49.56 | i | 183.01 | ab | 22.37 | bcdef |
| CRBP39 | 15.60 | bcdef | 6.84 | cde | 91.69 | cdefgh | 150.12 | bcd | 28.23 | a |
| Cv. Rose | 2.40 | j | 7.76 | abcd | 86.31 | efghi | 21.43 | i | 23.10 | bcd |
| FHIA-01 | 9.46 | ghi | 7.82 | abcd | 103.32 | bcdefg | 86.24 | efgh | 19.24 | defg |
| FHIA-02 | 6.12 | hij | 7.15 | bcde | 94.06 | cdefgh | 67.45 | fghi | 18.83 | efg |
| FHIA-17 | 22.36 | a | 8.98 | ab | 117.67 | abcdef | 169.89 | abc | 18.54 | efg |
| FHIA-18 | 9.52 | ghi | 6.56 | cdef | 87.78 | efgh | 75.98 | efghi | 17.33 | g |
| FHIA-21 | 17.24 | abcd | 7.10 | bcde | 92.85 | cdefgh | 161.79 | | 23.79 | |
| FHIA-23 | 22.07 | a | 9.41 | a | 134.56 | ab | 126.27 | bcdef | 18.07 | g |
| GCTCV-119 | 8.62 | ghi | 4.25 | g | 60.32 | hi | 124.52 | bcdef | 24.70 | |
| Gros Michel | 17.13 | abcd | 6.94 | cde | 103.06 | bcdefg | 135.05 | bcde | 21.38 | cdefg |
| Pisang Ceylan | 10.54 | fghi | 9.37 | a | 128.72 | abc | 65.68 | fghi | 22.33 | bcdef |
| Pisang Jari Buaya | 8.88 | ghi | 7.35 | bcde | 105.25 | bcdefg | 78.96 | efghi | 24.65 | abc |
| SH 3436-9 | 20.14 | ab | 7.76 | abcd | 127.87 | abcd | 128.60 | bcde | 20.87 | cdefg |
| SH 3640 | 11.21 | efgh | 5.95 | defg | 73.57 | ghi | 153.90 | abcd | 21.53 | cdefg |
| TMBx 1378 | 15.36 | bcdef | 7.45 | abcde | 123.49 | abcde | 86.33 | efgh | 24.56 | abc |
| TMBx 5295-1 | 18.52 | ab | 6.87 | cde | 89.87 | efgh | 212.03 | a | 23.17 | bcd |
| Williams | 9.11 | ghi | 6.56 | cdef | 93.07 | cdefgh | 95.09 | defgh | 19.07 | defg |
| Yangambi Km 5 | 8.42 | ghi | 6.99 | cde | 147.84 | a | 40.67 | hi | 24.23 | abc |
| B. Local | | | | | | | | | | |
| Bungulan | 15.17 | bcdef | 6.55 | cdef | 103.80 | bcdefg | 109.62 | cdefg | 22.40 | bcdef |
| Cardaba | 19.50 | ab | 8.17 | abc | 134.92 | ab | 129.53 | bcde | 24.91 | abc |
| Grand Naine | 16.21 | bcde | 7.73 | abcd | 117.43 | abcdef | 106.17 | defg | 22.69 | bcde |
| Cuarenta Dias | 5.06 | ij | 6.91 | cde | 90.50 | defgh | 55.47 | ghi | 18.43 | fg |
| Lakatan Cavite | 12.59 | cdefg | 6.17 | defg | 96.44 | cdefgh | 115.22 | cdefg | 26.20 | ab |
| Lakatan Davao | 17.93 | abc | 7.14 | bcde | 123.81 | abcde | 112.98 | cdefg | 26.20 | ab |
| Lakatan Mindoro I | 12.87 | cdefg | 5.54 | efg | 80.38 | fghi | 121.07 | cdef | 26.40 | ab |
| Lakatan Mindoro II | 8.68 | ghi | 4.84 | fg | 58.60 | hi | 123.60 | bcdef | 27.98 | a |

Means in the same column followed by the same letter do not differ significantly according to Tukey's Honestly Significant Difference Test for $\alpha = 0.05$.

* FHIA-21 was not included in the statistical analysis because there was not enough valid observation

** FHIA-21 and GCTCV-119 were not included in the statistical analysis because there were not enough valid observations

## *8.5 Table 5. Yield performance of the plant crop of local and introduced banana cultivars grown at the IPB Experiment Station in Bay, Laguna.*

| Cultivars | Bunch weight (kg) | | No. of hands per bunch | | No. of fingers per bunch | | Fruit weight* (g) | | TSS ($^{o}$Brix)** | |
|---|---|---|---|---|---|---|---|---|---|---|
| A. Introduced | | | | | | | | | | |
| Cachaco | 11.92 | defg | 4.74 | fg | 49.56 | i | 183.01 | ab | 22.37 | bcdef |
| CRBP39 | 15.60 | bcdef | 6.84 | cde | 91.69 | cdefgh | 150.12 | bcd | 28.23 | a |
| Cv. Rose | 2.40 | j | 7.76 | abcd | 86.31 | efghi | 21.43 | i | 23.10 | bcd |
| FHIA-01 | 9.46 | ghi | 7.82 | abcd | 103.32 | bcdefg | 86.24 | efgh | 19.24 | defg |
| FHIA-02 | 6.12 | hij | 7.15 | bcde | 94.06 | cdefgh | 67.45 | fghi | 18.83 | efg |
| FHIA-17 | 22.36 | a | 8.98 | ab | 117.67 | abcdef | 169.89 | abc | 18.54 | efg |
| FHIA-18 | 9.52 | ghi | 6.56 | cdef | 87.78 | efgh | 75.98 | efghi | 17.33 | g |
| FHIA-21 | 17.24 | abcd | 7.10 | bcde | 92.85 | cdefgh | 161.79 | | 23.79 | |
| FHIA-23 | 22.07 | a | 9.41 | a | 134.56 | ab | 126.27 | bcdef | 18.07 | g |
| GCTCV-119 | 8.62 | ghi | 4.25 | g | 60.32 | hi | 124.52 | bcdef | 24.70 | |
| Gros Michel | 17.13 | abcd | 6.94 | cde | 103.06 | bcdefg | 135.05 | bcde | 21.38 | cdefg |
| Pisang Ceylan | 10.54 | fghi | 9.37 | a | 128.72 | abc | 65.68 | fghi | 22.33 | bcdef |
| Pisang Jari Buaya | 8.88 | ghi | 7.35 | bcde | 105.25 | bcdefg | 78.96 | efghi | 24.65 | abc |
| SH 3436-9 | 20.14 | ab | 7.76 | abcd | 127.87 | abcd | 128.60 | bcde | 20.87 | cdefg |
| SH 3640 | 11.21 | efgh | 5.95 | defg | 73.57 | ghi | 153.90 | abcd | 21.53 | cdefg |
| TMBx 1378 | 15.36 | bcdef | 7.45 | abcde | 123.49 | abcde | 86.33 | efgh | 24.56 | abc |
| TMBx 5295-1 | 18.52 | ab | 6.87 | cde | 89.87 | efgh | 212.03 | a | 23.17 | bcd |
| Williams | 9.11 | ghi | 6.56 | cdef | 93.07 | cdefgh | 95.09 | defgh | 19.07 | defg |
| Yangambi Km 5 | 8.42 | ghi | 6.99 | cde | 147.84 | a | 40.67 | hi | 24.23 | abc |
| B. Local | | | | | | | | | | |
| Bungulan | 15.17 | bcdef | 6.55 | cdef | 103.80 | bcdefg | 109.62 | cdefg | 22.40 | bcdef |
| Cardaba | 19.50 | ab | 8.17 | abc | 134.92 | ab | 129.53 | bcde | 24.91 | abc |
| Grand Naine | 16.21 | bcde | 7.73 | abcd | 117.43 | abcdef | 106.17 | defg | 22.69 | bcde |
| Cuarenta Dias | 5.06 | ij | 6.91 | cde | 90.50 | defgh | 55.47 | ghi | 18.43 | fg |
| Lakatan Cavite | 12.59 | cdefg | 6.17 | defg | 96.44 | cdefgh | 115.22 | cdefg | 26.20 | ab |
| Lakatan Davao | 17.93 | abc | 7.14 | bcde | 123.81 | abcde | 112.98 | cdefg | 26.20 | ab |
| Lakatan Mindoro I | 12.87 | cdefg | 5.54 | efg | 80.38 | fghi | 121.07 | cdef | 26.40 | ab |
| Lakatan Mindoro II | 8.68 | ghi | 4.84 | fg | 58.60 | hi | 123.60 | bcdef | 27.98 | a |

Means in the same column followed by the same letter do not differ significantly according to Tukey's Honestly Significant Difference Test for $\alpha = 0.05$.

* FHIA-21 was not included in the statistical analysis because there was not enough valid observation

** FHIA-21 and GCTCV-119 were not included in the statistical analysis because there were not enough valid observations

***8.6 Table 6. Yield and yield data of introduced and local banana cultivars planted at the Central Experiment Station, UP Los Banos.***

| Cultivar | Days to Flowering | Days to Harvest | Flowering to harvest (days) | Bunch Weight (kg) | No. of Hands | No. of Fingers (g) |
|---|---|---|---|---|---|---|
| FHIA 01 | 230.33 ab | 363.92 cd | 133.58 d | 22.22 d | 8.70 de | 125.96 ef |
| FHIA02 | 245.59 abc | 343.72 bc | 98.13 b | 24.30 d | 9.05 d | 129.88 ef |
| FHIA17 | 320.37 de | 419.52 ef | 99.15b | 36.61 b | 12.25 b | 200.56 c |
| FHIA18 | 274.29 bc | 400.13 de | 125.85 cd | 21.38 d | 8.42 de | 133.17 e |
| FHIA 23 | 353.23 ef | 448.89 fg | 95.66 b | 31.79 c | 11.28 c | 217.72 b |
| FHIA 25 | 380.29 f | 521.29 h | 141.00 d | 47.49 a | 15.03a | 277.86 a |
| Cuarenta Dias | 231.65 ab | 279.35 a | 47.70 a | 8.51 g | 7.24 f | 110.00 h |
| Grand Naine | 213.67 a | 306.81 ab | 93.14 b | 23.44 d | 8.08 e | 128.45 ef |
| Latundan | 258.52 abc | 354.04 c | 95.51 b | 12.39 f | 7.18 f | 101.07 h |
| Cardaba | 338.77 ef | 479.39 g | 140.62 d | 23.19 d | 8.61 de | 149.98 d |
| Lakatan Davao | 289.21 cd | 382.35 cde | 93.14 b | 17.24 e | 6.84 f | 115.71 gh |
| Lakatan Cavite | 273.10 bc | 379.37 cde | 106.26 bc | 18.03 e | 6.70 f | 109.80 h |

***8.7 Table 7. Ranking of banana cultivars based on sensory evaluation in 3 sites involving 141 participants***

| Cultivar | Finger Shape | Peel Color | Finger Size | Pulp Color | Pulp Size | Pulp Texture | Pulp Taste | Pulp Flavour | Pulp Sweetness | Over-all Acceptability |
|---|---|---|---|---|---|---|---|---|---|---|
| AACV Rose | 27 | 26 | 28 | 27 | 28 | 2 | 26 | 26 | 26 | 27 |
| Cachaco | 13 | 11 | 5 | 21 | 9 | 27 | 21 | 21 | 16 | 21 |
| CRBP39 | 17 | 22 | 3 | 11 | 6 | 3 | 24 | 24 | 22 | 14 |
| FHIA-01 | 24 | 25 | 20 | 25 | 20 | 15 | 25 | 25 | 24 | 25 |
| FHIA-02 | 23 | 23 | 14 | 24 | 17 | 22 | 15 | 18 | 21 | 19 |
| FHIA-17 | 15 | 16 | 12 | 12 | 8 | 25 | 14 | 10 | 14 | 10 |
| FHIA-18 | 28 | 28 | 21 | 28 | 25 | 13 | 22 | 28 | 18 | 25 |
| FHIA-21 | 12 | 10 | 10 | 14 | 12 | 1 | 28 | 22 | 23 | 24 |
| FHIA-23 | 7 | 6 | 4 | 10 | 3 | 19 | 8 | 8 | 7 | 8 |
| Gros Michel | 16 | 18 | 19 | 23 | 21 | 23 | 9 | 9 | 8 | 9 |
| GTCCV 119 | 20 | 21 | 18 | 18 | 18 | 5 | 11 | 12 | 17 | 12 |
| Pisang Ceylan | 4 | 3 | 15 | 9 | 15 | 26 | 20 | 20 | 19 | 22 |
| Pisang Jari Buaya | 26 | 24 | 25 | 16 | 26 | 18 | 17 | 17 | 13 | 23 |
| SH 3436-9 | 6 | 5 | 9 | 13 | 4 | 17 | 19 | 16 | 20 | 15 |
| SH 3640 | 10 | 12 | 2 | 8 | 2 | 8 | 23 | 23 | 27 | 20 |
| TMB X 1378 | 25 | 27 | 24 | 26 | 23 | 16 | 16 | 1 | 11 | 17 |
| TMB X 5295-1 | 9 | 13 | 1 | 19 | 1 | 21 | 27 | 27 | 25 | 26 |
| Williams | 18 | 19 | 16 | 17 | 10 | 28 | 18 | 13 | 18 | 18 |
| Yangambi Km5 | 19 | 15 | 27 | 20 | 27 | 11 | 12 | 14 | 10 | 16 |
| Bungulan | 14 | 17 | 8 | 7 | 13 | 10 | 7 | 7 | 9 | 6 |
| Cavendish | 22 | 20 | 22 | 15 | 19 | 20 | 13 | 15 | 15 | 13 |
| Lakatan | 5 | 8 | 13 | 5 | 14 | 6 | 6 | 5 | 5 | 4 |
| Lakatan Cavite | 1 | 1 | 6 | 4 | 7 | 24 | 3 | 4 | 2 | 5 |
| Lakatan Davao | 3 | 4 | 11 | 2 | 16 | 4 | 1 | 1 | 1 | 1 |
| Lakatan Mindoro | 11 | 7 | 17 | 1 | 11 | 9 | 4 | 2 | 3 | 3 |
| Lakatan Mindoro-1 | 2 | 2 | 7 | 3 | 5 | 14 | 2 | 3 | 4 | 2 |
| Latundan | 21 | 14 | 23 | 22 | 22 | 12 | 10 | 11 | 12 | 11 |
| Cuarenta Dias | 8 | 9 | 26 | 6 | 24 | 7 | 5 | 6 | 6 | 7 |

## *8.8 Publications*

### 8.8.1 Draft manuscripts

1. Agronomic and yield performance of introduced and popular local banana cultivars (*Musa* spp.) in the Philippines *(submitted to the Phil. Jour. Crop Sci.)*
2. Sensory evaluation of local and introduced banana cultivars
3. Taste test of the different preparations of introduced banana and local cultivars
4. Resistance of local and introduced banana cultivars to banana bunchy top
5. Evaluation of Local and Introduced Banana Cultivars to Nematodes
6. Reaction of local and introduced banana cultivars to black Sigatoka
7. Role of Asymptomatic Banana Plants and Alternate Hosts on the Spread of Banana Bunchy-top Disease
8. Mechanism of Resistance to banana bunchy top virus (BBTV)

### 8.8.2 Catalogue/Brochure

dela Cruz, FS, Jr., LS Gueco, OP Damasco, VC Huelgas, IG Banasihan, RV Lladones, I Van den Bergh and AB Molina. 2007. *Catalogue of introduced and local banana cultivars in the Philippines: Results of a demonstration trial by the Institute of Plant Breeding*, University of the Philippines Los Baños. IPB-UPLB, Bioversity International and DA-BAR, Philippines. (63 pp).

*Growing different kinds of bananas* (a brochure)

### 8.8.3 Oral presentations

dela, Cruz, FS Jr, LS Gueco, OP Damasco, VC Huelgas, FM dela Cueva, TO Dizon, IG Banasihan, JT Oliver, VGO Sinohin and AB Molina, Jr. 2007. *New Cultivars, New Options: The Potential of Introduced Bananas.* Paper presented during the Annual Scientific of the Crop Science Society of the Philippines. Grand Hotel, Iloilo City. May 2008

### 8.8.4 Poster presentations

dela, Cruz, FS Jr, LS Gueco, OP Damasco, VC Huelgas, FM dela Cueva, TO Dizon, IG Banasihan, VGO Sinohin and AB Molina, Jr. 2007. *Introduced Banana: New Cultivars, More Options for Banana Growers*. 30th Annual Scientific Meeting of the National Academy of Science and Technology (NAST). The Manila Hotel, Philippines. 10 July 2008

dela, Cruz, FS Jr, LS Gueco, OP Damasco, VC Huelgas, FM dela Cueva, TO Dizon, IG Banasihan, JT Oliver, VGO Sinohin and AB Molina, Jr. 2007. *New Cultivars, New Options: The Potential of Introduced Bananas.* 15th National Fruit Symposium.

Sponsored by the Philippine Fruit Association (PFA). Bureau of Soils and Water Management, Diliman, Quezon City. 6-8 November 2007

dela Cruz, FS, Jr., LS Gueco, VC Huelgas,, FM dela Cueva, OP Damasco, IG Banasihan and AB Molina. 2007. *Performance of introduced banana hybrids and landraces in the Philippines*. Poster paper presented during the Annual Scientific Conference of the Crop Science Society of the Philippines held at DAP, Tagaytay City, Cavite, Philippines. 13-15 January 2007.

dela Cueva, FM, TO Dizon, FS dela Cruz, Jr., and AB Molina, Jr. 2006. *Comparative reactions of introduced and local varieties of banana to banana bunchy top disease*. 37th PMCP Anniversary and Scientific Meeting. Grand Regal Hotel, Davao City. 2-5 May 2006

Dizon, TO, FM dela Cueva, FS dela Cruz, Jr., OP Damasco and AB Molina Jr. 2007. *Reactions of local and introduced banana cultivars and hybrids to black Sigatoka and banana bunchy top virus*. 38th PMCP Anniversary and Scientific Conference, Bohol Tropics Resort, Tagbilaran City, Bohol. Pest Management Council of the Philippines (PMCP). 20-23 March 207

Herradura, L.E., Ma A. Lobres, I. Van Den Vergh, D. De Waele and R. Davide.2008. *Sources of Resistance to Radopholus Similis*. Presented in the Pest Management Council in the Philippines. Puerto Princesa City, Palawan.

Arcelo, M.M., M.A. Alforque, C.E. Soguilon and A.G. Yebes. 2008. *Banana Pseudostem Weevil Infestation in Region XI*. Presented in the Pest Management Council in the Philippines. Puerto Princesa City, Palawan.

Herradura, L.E., M. A. Alforque and Ma A. Lobres.2003 *Banana Streak Badnavirus in the Philippines*. Presented during the 17th regional Symposium on RDE Highlights. SMARDEC Annual review. USEP, Bo. Obrero, Davao City

Huelgas, VC, dela Cruz, FS Jr., LS Gueco, TO Dizon, FM dela Cueva, OP Damasco, IG Banasihan and AB Molina. 2007. *Can bananas be replaced*? Poster paper presented during the 37th Annual Scientific Conference of the Crop Science Society of the Philippines held at DAP, Tagaytay City, Cavite, Philippines on 13-15 January 2007.

#### 8.8.5 Exhibition Materials

1. New Cultivars, New Options for the Banana Farmer: FHIA 17
2. New Cultivars, New Options for the Banana Farmer: FHIA 21
3. New Cultivars, New Options for the Banana Farmer: FHIA 23
4. New Cultivars, New Options for the Banana Farmer: FHIA 25
5. Diversity of Local Banana Varieties: Cardaba

## *8.9 Awards received*

1. Poster on "*Introduced Banana: New Cultivars, More Options for Banana Growers*" won the Best Scientific Poster Award (Agricultural Sciences category) during the

recently held 30th Annual Scientific Meeting of the National Academy of Science and Technology (NAST) at The Manila Hotel, Philippines last July 10, 2008

2. Poster on "*New Cultivars, New Options: The Potential of Introduced Bananas*" won 2nd Best Poster Award 15th National Fruit Symposium sponsored by the Philippine Fruit Association held at the BSWM, Diliman, Quezon City 6 November, 2007