Sweet Potato Workshop **28–29 June 2006**

Research & Development Projects on Sweet Potato by National Agricultural Research Institute (NARI)

Summary **Sergie Bang**

Sweet potato features prominently in NARI Strategic Plan due to its importance in PNG. There are currently 6 research projects and 3 development projects being undertaken. Current projects are on-farm variety testing and dissemination, crop improvement through cleaning of planting materials (in tissue culture), management of major pest and diseases and management of soil / water for improved productivity. Improved marketing opportunities through improved post harvest management and product development remains the priority now for NARI, to maximize benefits to farmers.

1.0 Introduction

Sweet potato features within four programmes in the NARI Strategic Programme implementation Plan. The four projects are:

1/ Improving Sweet potato productivity under excess soil moisture – Agronomy programme
2/ Improving productivity and quality of Sweet potato through breeding and bio-technology– Crop Improvement programme
3/ Management of Pests and Diseases in Sweet potato – Crop Protection programme
4/ Improving post harvest management and product development through Processing - Post Harvest Programme
5/ Enhance demand for Sweet potato – Marketing Programme

These projects are currently being pursued. The recently signed ACIAR project CP/2004/071 aims to improve the yield of sweet potato by managing weevil and diseases (viruses). This will be achieved by cleaning planting materials through heat treatment and *in vitro* micro-propagation.

The proposed project on Management of Soil Fertility in the Highlands will address productivity under excess soil moisture conditions.

2.0 Current Projects

2.1 Research –

There are five research projects NARI runs at present. They are:

2.1.1 Farmer evaluation and multiplication of sweet potato varieties in North coast of PNG. (Elick Guaf – WLMP)

NARI collaborates as a partner to World Vision in this project. The main objective of the project is to "Evaluate and disseminate appropriate sweet potato varieties to the rural farming communities in Madang. The sub-objectives are to understand better how farmers select sweet potato varieties to grow, to analyse variety yield across environments, to determine sweet potato yields under farmer conditions and management and to test whether the strategy is an effective method of disseminating varieties under farmer conditions.

Sixteen sweet potato varieties (lowlands) B 11, Kinabakab, SI 85, SI 172, SI 108, L 46, L 43, L781, L942, L949, DOY 2, MAS 2, K9, K142, KAV 61 and RAB 36, were intended for the project. However, only fourteen (14) varieties were used due to non-availability of the L949 in the field and a wrong variety sent from Kerevat in place of SI 172.

The Madang Province was divided into two major zones Distinct Dry and Non-Distinct Dry. This was further sub-divided according to the six District administrative boundaries, Yawar, Almami, Sumkar, Madang, Austrolobe Bay and Usino/Bundi. Six Field Extension Technicians were allocated responsibilities to these locations.
The sweet potato varieties were multiplied at two locations in each at these six sites to generate sufficient planting material for the planting of twelve, Technician Controlled On farm Trail 1 (TCOFT 1) at each site. Included in the multiplication plots were two local (Madang) varieties and are labelled Farmer Variety 1 (FV 1) and FV 2. In total, 16 varieties are included for distribution in the project.

Harvests of TCOFT 1 were completed at end of 2005. Data is being analysed for interpretation. Planting material from TCOFT 1 was used to plant TCOFT 2. Planting of TCOFT 2 commenced in November 2005. Harvest of TCOFT 2 at all sites will be completed by mid June 2006. Data will be compiled, analysed and reported.

Participatory Technology Development (PTD) field days were conducted at four of the six sites. During this field day, the farmers do Agronomic and Sensory evaluation of the sweet potato varieties, however on pre-established qualitative characteristics of the varieties. PTDs were conducted at Malala x2, Sumkar, Waput, Barum and Karkar x 2.

1. **Record and Understand better criteria used by farmers to select sweet potato varieties to grow.**

Although PTDs are being conducted, the results are summarised and provided as feed back to the farmers at the end of the day. No further analysis has been done on the PTD data.
Training on PTD method was conducted based on the ***User's Perspective with Agricultural Research and Development*** (UPWARD) for project staff, Manager and FETs. This dissemination method has been developed in the Philippines. However, observations at the Barum PTD are that the design of the agronomic evaluation may not produce good result.

2. **Compare variety yield across environments**

Yield data of 50 TCOFT 1 is being analysed. The average tuber yield across all sites is 15.72 t/ha. The varieties performing poorly across all sites are KAV 61. The poor yielding varieties are K 142, L 942 and MAS 2 (7.78 – 7.91 t/ha). Average yielding varieties are: B 11, DOY 2, FV 1, FV 2, K 9, KINABAKAB, L 43 and RAB 36 (12.38 – 19.74 t/ha). Good yielding varieties are L 781, SI 85 and SI 108. The was a high interaction across site and variety.

3. **Determine sweet potato variety under farmer conditions and managements**

The next phase of the project is Farmer Controlled On Farm Trial (FCOFT). All the 16 varieties (14 NARI and 2 Farmer/Local checks) will be planted in farmers fields. The six FETs will each plant between 25 and 30 FCOFTs. Farmers have been selected and planting will commence in August 2006.

4. **Test whether the strategy is effective method of dissemination varieties to the rural farming communities**

The means to measure the effectiveness of the method of dissemination would be in part the project out put; however, an Impact Assessment would provide the evidence of this.
Early signs are that people take time to appreciate the technology transferred and the success of adoption would depend on project time and budget. Examples, times to harvest of TCOFT 1 was 22 weeks, however, some of the varieties mature at 14 weeks but were left in the soil to be harvested at 22 weeks resulting in losses of tubers due to rat, rot and weevil. This has led to farmers not trusting the Dissemination Team.

2.1.2 Evaluation of Early maturing Sweet potato varieties in the High Altitude Highlands (Kud Sitango – HAHP Kandep)

A. Objective:

The main objective of the trial is to identify early maturing sweet potato varieties for cultivation in the high altitude areas of the highlands of Papua New Guinea.

B. Project Outputs

Make available early maturing sweet potato varieties for cultivation in the High Altitude Highlands provinces and ensure their food security is sustained, especially during post frost period. Planting materials of suitable varieties to be made available for farmers.

C. Project Activities

- Collection of promising early maturing sweet potato varieties from high altitude areas and evaluation to identify early maturing sweet potato varieties for high altitude areas.
- Initially 60 sweet potato varieties were multiplied and screened in a series of trials at Kandep and Tambul
- Trials 1, 2 & 3 in Tambul and Kandep NARI stations have been completed. The draft reports are being compiled. Twenty high yielding varieties selected.
- On-farm trials established in six sites, Kandep and Taluma DPI Stations, Malke, Tomba, Kekla and Kegesugo. Harvest completed at Kandep and Taluma DPI Stations, Taluma, Malke, Tomba and data being analysed while trials in Gembogl still in progress.
- From the on-farm trials, 12 early maturing varieties have been selected based on high marketable tuber yield at 6, 8 and 10 months, in Western Highlands, Chimbu and Enga Provinces. The average marketable yield at 6 months is 8 tonnes / ha for all varieties.

- The multiplication plots established at Kandep Agricultural Experimental Station, NARI-Tambul and Kegesugo (Mt. Wilhelm. High School and are being maintained. Materials yet to be distributed to farmers

- Two field days have been conducted and farmers invited to see the varieties, displayed at the 2005 Enga Show and Minj Show.

2.1.3 Improving the yield of SP through the use of in-vitro micro-propagated plantlets (Dorcas Homare – Aiyura MHP)

The objectives of the project are threefold:

1. To assess the propagation methodologies of producing clean Sweet Potato Plantlets
2. Evaluate varietal performance on yield and Pest and Disease incidence from planting materials raised *in vitro* on station.
3. Evaluate varietal performance on yield and Pest and disease incidence from planting materials raised *in vitro* on farmers' field

Activities and output to date

There are basically 2 phases to this project. The first is the micro-propagation phase and the second is the Field experimentation phase. The first phase has 5 stages. The 3 stages completed successfully are; surface sterilization and initiation, pre-propagation, and rooting and shooting. Currently the project is in the 4th stage which is subculturing. Sufficient plantlets are now available, but will have to wait a month for the plantlets to fully establish before they are hardened in the screen house (Stage 5).

During the first phase of the work, contamination information has been collected on the type, source etc. Furthermore; data has also been collected on growth parameters for each variety.

2.1.4 Improvement to the Traditional Compost Mounding systems in the High Altitude Highlands.

Adaptive trials are being conducted on adding various quantity and type of material to the compost mounds, and data to be collected on quantity of plant nutrients added to mounds and their effects on nutrient uptake by crops. Trials will also be done to assess the benefits of adding inorganic fertilizers to mounds (especially phosphate fertilizer).

2.1.5 Analysis of biophysical and socio-economic constraints to soil fertility management in the PNG Highlands. Focus is on sweet potato as this is the dominant crop in highland agricultural systems.

The scoping study showed that highland soils where sweet potato was cultivated had high levels of organic matter and favourable CN ratios. This indicates high soil fertility but the study recorded low yields of only 10t/ha (average) in gardens cultivated after fallow (fertile soil) and 6t/ha in gardens which were going into a fallow (run-down soil). Farmers perceive a decline in soil fertility.

It is hypothesised that the soil's fertility, *i.e.* ability to release nutrients, does not match plant nutrient demand due to an imbalance in organic matter components of varying abilities to mineralise or types clay minerals present (volcanic ash soils), or both. Climate is also an important variable as mineralised nutrients may be leached in high rainfall regimes before plant roots are able to take them up. The aims of this project are to delineate production constraints and utilise our improved understanding of nutrient/water dynamics through process studies to develop and test *best bet* production options appropriate for farmer adoption. An improved understanding of the complex interaction between crop, soil and nutrient management is necessary to underpin the development of technologies to enhance the production and productivity of current and emerging SP based cropping systems (Project CP 2004/071).

The objectives for this study are:

1. To assess and quantify soil and water processes in Highland soils
2. To develop and implement improved nutrient and water management options for sweet potato based cropping systems
3. To enhance soil research capacity in PNG

A preliminary project (phase 1) titled 'Management of equatorial Highland soils in PNG' has been approved by ACIAR.

2.1.6 Reducing pest and disease impact on Yield in Selected PNG Sweet Potato production systems (to start in July)

The objectives are:

The overall aim of the project is to improve sweet potato yields and quality through the implementation of control strategies targeting the main sweet potato pests and diseases. Application of existing technology to the PNG production system will minimise yield decline in sweet potatoes. The successful linkage of the PT scheme with an IPM strategy in Queensland will benefit the local industry. The overall aim will be achieved through two objectives:

1. To develop and test sweet potato pest and disease control strategies

Outputs:
- An IPM strategy, incorporating a pathogen- tested (PT) scheme with other pest control measures in PNG and Australia

2. To increase dissemination and adoption of the PT scheme in an IPM strategy for pest and disease control

Outputs:
- Adoption of the PT and IPM approach
- Sweet potato extension capacity using participatory technology development approaches enhanced

3.0 Development –

3.1 Variety Dissemination

There are two AIGF projects implemented in Bubia and Aiyura. The project in Bubia involved the dissemination of Improved Agricultural Technologies in Morobe and Madang–Bubia. Nine high yielding varieties selected for the lowlands were distributed.

The project in Aiyura multiplied and distributed improved crop varieties in the Highlands. Nine varieties tolerant to drought under highland conditions are distributed. A total of 33, 000 cuttings were put out in the Project.

3.2 Processing

NARI has sought information on product development and appropriate technology from Dr. Xie Chiang from the Sichuan Academy of Agricultural Science of China. Following the visit by Dr Chiang last year, Joel Waraboi (post harvest scientist, NARI Bubia) has developed a project on value – addition through processing. Economic studies need to go hand in hand with the aim to promoting feasible products with entrepreneurs. Some product development (noodle, balls and candies) is being initiated by Rita Tomda in NARI Aiyura.

4.0 Proposed Projects

There are four priority projects identified for 2006–2007. They are:

1/ Improvement of Sweet Potato Post Harvest Handling for Fresh Marketing and Value Addition (ACIAR EOI).
2/ The Management of Soil Fertility in the Highlands (following the scoping study).
3/ Improving informal seed systems for sustainable sweet potato production.
4/ Management of Sweet potato weevil using Neem tree leaves as mulch in the Dry Lowlands.

Yield at 6 months of the 12 selected early maturing varieties (t/ha)

Variety	Kandep	Taluma	Malke	Tomba	Total	Mean
Altitude (masl)	2,600	2,500	2,500	2,500		
Argo	13.4	7.9	3.5	5.1	29.9	**7.5**
Baim	12.0	10.4	5.2	8.0	35.6	**8.9**
Baru	10.7	8.7	3.5	7.5	30.4	**7.6**
Lipulipu	7.2	6.4	7.1	6.8	27.5	**6.9**
Naga mapu	13.6	12.9	3.6	3.4	33.5	**8.4**
PRAP 469	8.6	11.6	4.5	6.5	31.2	**7.8**
PRAP 506	10.4	11.6	3.9	7.6	33.5	**8.4**
PRAP546	12.2	9.3	5.1	6.8	33.4	**8.4**
Simb	9.3	8.6	4.5	6.5	28.9	**7.2**
WBS 010	9.3	12.1	4.11	6.7	32.21	**8.1**
WHCK 005	11.3	12.2	6.3	6.7	36.5	**9.1**
WHCK 007	6.3	11.0	2.6	4.7	24.6	**6.2**