# TECHNOLOGY TRANSFER: TRAINING IN DEVELOPING NATIONS FOR COMMERCIAL HTFA QUARANTINE EXPORT OPERATIONS -THE COOK ISLANDS SUCCESS STORY.

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Prior to 1 January 1994, exports of Cook Islands papaya to New Zealand required fumigation with ethylene di-bromide (EDB) to kill fruit fly. Reduced residue limits imposed by the New Zealand Department of Health became effective on this date, effectively banning the use of EDB as a quarantine treatment. Heat treatment of potentially infested fruit using high temperature forced air (HTFA) is a viable alternative to fumigation with either EDB or methyl bromide (MB). Experimental data acquired in 1992-93 determined the time-temperature combination required to kill the most tolerant species and lifestage of fruit fly found in the Cook Islands (*Bactrocera melanotus*-mature eggs). In October 1993, a commercial HTFA unit designed by University of Hawaii engineers, was installed at Rarotonga Airport, Cook Islands. The HTFA unit consists of a large stainless steel rectangular container, slightly longer and wider than a shipping container. An internal wall divides the container into two longitudinal chambers each holding 4 treatment bins of papaya (approximately 400 kg per bin). The chamber air is heated via internal heat exchangers and circulated through the perforated bins of fruit by internal chamber fans. The process is computer controlled.

What follows is a brief description of the economic and social factors encountered in the process of introducing this new, unfamiliar technology and the training techniques used. The following issues were encountered:

- **Centralized packing**

Fumigation with EDB was performed with the fruit already packed into export cartons by the individual grower. As each carton was labeled with the grower's name, this system allowed easy trace-back of fruit. The new HTFA treatment required all fruit to be treated in bulk bins and packed into export cartons after treatment, thereby losing individual grower identity. This was of concern to those growers who had already established a reputation in the market. However, the new system did allow a more streamlined approach for growers in getting their fruit to the market. The tasks of washing and grading the fruit were now performed at the HTFA plant. Growers simply delivered their fruit to the HTFA premises, where it was weighed, inspected and any rejects returned. The financial return to growers was determined by the current market price in New Zealand, the costs of treating the fruit and maintaining the HTFA plant, airfreight and labor costs. The purchase price of fruit from the grower was pre-determined, thus growers knew immediately what their earnings would be. The new system has allowed for more part-time growers to enter the market.

- **Increased costs and complexity**

Fumigation with EDB was relatively simple. The cartons of fruit were palletized, placed into the fumigation chamber and fumigated for 2 hours, after which the chamber was aerated for a further 1 hour. The Cook Islands Quarantine Authorities then issued a phytosanitary certificate. The cartons of fruit were then ready to be airfreighted. In contrast, quarantine treatment with the HTFA plant involves the following:

**1.** Forklift removes grower's field bin from truck and places it on scales to obtain weight. Forklift then places field bin into a water dump. Fruit separate from the bin, are washed and placed onto an inspection conveyor belt. The conveyor belt then deposits the fruit onto a rotary grader.

**2**. Staff remove small and large fruit and hand place them into special treatment bins. Staff use pallet lifters to move the filled treatment bins to the HTFA chamber loading doors.

**3.** Quarantine staff insert HTFA chamber temperature probes into the largest fruit of the consignment to be treated. This fruit is placed on the top layer of fruit of each bin- the "cold spot". The forklift is then used to place the bins of fruit into the treatment chambers.

**4**. The plant operator then initiates the treatment by computer. Treatment takes about 5.5 hours, after which all the fruit must have obtained a core temperature of 47.2°C and have held that temperature for at least 20 minutes. The fruit are then cooled with an internal water shower for 1.5 hours. Fruit are left in the chamber overnight and unloading and packing into cartons takes place the following day.

- **Education and training of staff in the new procedures**

Given the increased complexity of HTFA treatment over that of fumigation, and the subsequent increase in risk of failure of the system, great attention was paid to training plant operators and developing a HTFA plant Operations Manual. Topics discussed and documented in the manual are outlined in Table 1.

**Plant Operators.** Three plant operators, two men and one woman, were selected for training, each with a different level of education and work experience. One was educated in New Zealand, the other two in the Cook Islands. All spoke excellent English. The age range varied from 26 to mid 40's. Employment backgrounds were as a Freight Company clerk, a Quarantine Officer and a local Ministry of Agriculture field worker. As plant operators they had to be aware of the quarantine treatment conditions, computer operation of the HTFA unit, basic operation of the diesel generator that supplied power to the unit, the actual operating principles of the unit, and the procedures required in receiving the fruit from the growers.

**Teaching the computer basics.** All three trainees had little or no experience of computers. Hands-on training in such tasks as copying files from the hard drive to a floppy disk, connecting printers, data acquisition units and calling up the relevant control software were performed. The hands-on training was supplemented through the use of simple check lists.



**Principles of HTFA Operation.** All training was conducted on-site with the HTFA unit for 2 months leading up to the first HTFA export treatment. Basic operating principles of the plant were explained using pen and paper, portable blackboard and chalk, question and answer sessions and most valuable of all, practice sessions with

the unit using reject fruit. All major switches, valves and controllers were clearly labeled. Significant time was spent in performing the calibration procedure for the HTFA chamber probes, a procedure vital to the integrity of the quarantine treatment. The trainees also took part in the formal certification of the HTFA facility under the presence of the New Zealand Ministry of Agriculture Regulatory Authority (NZMAF-RA), and once trained, ran the first export treatment, again in the presence of NZMAF-RA.

**Breakdown contingency procedures.** Potential faults that could be experienced during treatment, such as a printer malfunction, faulty temperature probe, power failure etc. were examined. Malfunctions were simulated to practice the appropriate contingency procedure, and to generate operator confidence in recovering from problematic runs.

**HTFA plant Operations Manual.** A comprehensive HTFA plant Operations Manual was written describing all facets of the operation; from receiving fruit to issuing International Phytosanitary Certificates. This became the documented procedure allowing treatment auditing by NZMAF-RA.

**Observation of actual export treatment runs.** The first month of commercial exports, January 1994, was spent overseeing the export treatments to ensure the operators had a smooth transition from the training situation to the real life export conditions.

- **Additional crops**

The heat treatment approved by the NZMAF-RA can be applied to any Cook Islands export crop which is a host to either fruit fly species. Mangoes are now treated and exported. Future crops may include eggplant and capsicum. Previously, export of these crops would have necessitated fumigation with EDB or MB.

**Table 1: Summary of training topics**

| Main topic | Details discussed |
|---|---|
| INTRODUCTION | • Description of HTFA operation |
| GENERAL QUARANTINE PROCEDURES | • Quarantine Area/Post treatment fly-free zone<br>• General Pest Control |
| FRUIT RECEIVING AND GRADING | • Grower Fruit Receipt and Weighing<br>• Quarantine Inspection<br>• Fruit Grading<br>• Filling Treatment bins |
| STARTUP PROCEDURES FOR HTFA TREATMENT | • Operator Startup Procedures<br>• Pre-Loading Quarantine Checks<br>• Loading the Chambers<br>• Starting the Treatment from the Computer |
| PROCEDURES DURING THE TREATMENT RUN | • Monitoring the Treatment<br>• Filling in logbook |
| OPERATOR TREATMENT CONTINGENCY PROCEDURES | • Examples of Treatment Contingencies<br>• Breakdown Contingency Procedures |
| ENDING THE TREATMENT RUN | • Confirmation of Quarantine conditions<br>• Ending the Treatment from the Computer |
| POST-TREATMENT PROCEDURES | • Unloading the Chamber<br>• Operator Shutdown Procedures<br>• Packing after Treatment<br>• Inward movement control of Airline Containers<br>• Loading of Containers<br>• Outward movement control of Airline Containers<br>• Issue of International Phytosanitary Certificates (IPC) |
| MAINTENANCE SCHEDULE | • HTFA unit, diesel generator, handling equipment |
| GLOSSARY OF TECHNICAL TERMS | • Definitions of technical terms, e.g. heat exchanger |
| EXAMPLES OF FORMS | • Grower register, IPC, logbook format, “coldspot” map for bins (see text) |