

Horticulture CRSP Project Report

Biological-Based Postharvest Quality Maintenance and Disease Control for Mango and Papaya

Researching biologically based controls of diseases to maintain postharvest papaya and mango quality in Sri Lanka.

Lead Project Investigators:

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Project Summary

This project brought together two parallel research programs: the use of natural coating and herbal extracts in Sri Lanka and efforts in Hawaii to use natural epiphytic microorganisms to control postharvest diseases. Essential oils are complex volatile compounds produced in various plant parts such as leaves, flowers, bark and roots. Volatile compounds from plants can inhibit the growth of fungal pathogens and evaporate without leaving residues and are considered

benign from a health perspective. Epiphytic microorganisms isolated from papaya fruit are being evaluated for their ability to control postharvest disease by their actions as antagonistic microorganisms to pathogens. This Hawaii research follows from successful isolation of a yeast for pineapple postharvest disease control. The project developed and evaluated a biological-based, nontoxic, environmentally suitable approach for postharvest disease control. The output from this project provides an alternative postharvest disease control approach to fungicide in conventional and organic mango and papaya production. The technology developed in this research was introduced to extension officers via workshops held at the Vidhatha collection and distribution centers in Sri Lanka.

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Project Objectives

1. Determine the effectiveness of different coating and essential oils in controlling postharvest disease of mangoes and papaya while maintaining fruit quality.
2. Isolate and evaluate epiphytic microbial antagonists *in vitro* against papaya postharvest pathogens.
3. Evaluate integrated postharvest disease protocol from harvest through storage using coatings, essential oils and selected microorganism in simulated shipping.
4. Transfer the findings of this research via a minimum of two sets of training of trainers workshops.

Project Report Narrative

--Submitted by Robert E. Paull

Anthraco-nose and stem rot pathogens of mango and anthracnose pathogen of papaya were isolated from host tissue in accordance with Koch's postulates, and pure cultures maintained. Cultures have been submitted to Gene Tech Ltd., for confirmation of the identification and genetic sequence of the pathogens. Six herbal extracts were obtained from Link Natural Pvt. Ltd. and screened against the pathogens. Two extracts were selected as being effective in inhibiting growth of the 3 respective organisms.

Selected herbal extracts were blended with the Industrial Technology Institute (ITI) edible wax coatings at different concentrations and tested for *in vivo* control of growth of the respective pathogens. Determination of the shelf life of the combined wax formulation was completed.

Having secured adequate supplies from our Industry partner Link Natural Pvt Ltd. - of the selected herbal extracts, we preceded with the scheduled larger scale *in vivo* trials on mango and papaya. Success was achieved with *in vivo* trials using a new wax formulation where cinemaldehyde was incorporated in place of the herbal extracts into the original ITI wax formulation.



Papaya held for 14 days at 13°C.

Clockwise from upper left: New wax formulation (wax and essential oil), Control (no treatment), Wax formulation alone

Three yeast isolates that were earlier shown to have potential biological activity were further tested *in vivo* on papaya fruit obtained from commercial grower. Half the treated and inoculated fruit were stored at 10°C for 10 days before ripening at ambient temperature. In addition to the yeast isolates,

0.5% thyme oil, 1.5% medium molecular weight chitosan and Sri Lankan wax were also tested for their postharvest disease control activities.

When the biological agents were applied on the same day as the pathogen inoculation, the antagonistic activity was not noticeable in papaya ripened at ambient temperature without cold storage. Neither thyme oil nor yeast isolates reduced the infection of *Collectotrichum*. The yeast isolates #581 and #1061 effectively reduced the Anthracnose development in papaya after cold storage. Initial studies indicated that the application time of the control agent influenced the effectiveness its antagonist activity. The biocontrol agent was more effective if applied later, if cold storage was not involved. All three yeast isolates tested, #581, #961 and #1061 showed antagonistic activity against *Collectotrichum* when applied one day after pathogen inoculation in papaya ripened at ambient temperature. However, when the papaya were stored at 10°C before ripening, only yeast isolate #1061 was effective in reducing the *Collectotrichum* infection.

Introductory workshops were conducted in three mango and papaya production areas. The team established links with growers Vidhatha Officers in Borrugodawatte, Thambuthegamma and Palagala in Kallawawe and took this opportunity to introduce the concepts of good postharvest handling procedures. A Stakeholder Workshop was also held in Colombo to introduce the project objectives to exporters and larger growers of these commodities. The latter program was timed to coincide with the visit of the US collaborators.

Scheduled workshops were conducted to demonstrate the effectiveness of the new cinemaldehyde incorporated formulation to Vidhatha Officers and samples were given to 20 officers to take back to their respective locations for further trials with growers and collection agents. As a consequence of this, a distribution agent / supplier of mangoes and papaya to exporters is interested in manufacturing the new wax formulation and using it in his operations and negotiations are in progress at present.

Two members of the Sri Lankan team participated in the 2010, Postharvest Short Course conducted by the University of California Davis from 14th – 25th June 2010. Besides updating their knowledge on current postharvest treatments and procedures, and the experience of visiting large scale postharvest operations as practiced in developed countries, they also brought back valuable training materials. The materials were used in the training of trainers program and the Stakeholder workshop held at the Industrial Technology Institute (ITI) and attended by 40 participants. These materials will be used in future training and stakeholder programs.

About Horticulture CRSP

Horticulture CRSP (funded by USAID under Award EPP-A-00-09-00004) provides funding to realize the opportunities of horticultural development, improve food security, improve nutrition and human health, provide opportunities for diversification of income, and advance economic and social conditions of the rural poor, particularly women. Horticulture CRSP is managed by the University of California, Davis and has 30 projects in over 20 countries. For more information, visit: <http://hortcrsp.ucdavis.edu/>.

Project Performance Indicators

4.5.1 Agriculture Enabling Environment	Project Achievements
Number of individuals who have received USG supported short-term agricultural enabling environment training - Female	3
Number of individuals who have received USG supported long-term agricultural enabling environment training - Female	2
Number of individuals who have received USG supported long-term agricultural enabling environment training - Male	2
4.5.2 Agriculture Sector Productivity	Project Achievements
Number of rural households benefiting directly from USG interventions - Female Headed Household	35
Number of rural households benefiting directly from USG interventions - Male Headed Household	125
Number of producers organizations receiving USG assistance.	5
Capacity Building (Horticulture CRSP Indicators)	Project Achievements
Number of host country institutions, agencies and organizations in direct cooperation or collaboration	2
Number of workshops conducted for host country institution, agency, and organization personnel	2
Number of host country professionals attending workshops, training conferences, or similar - Female	16
Number of host country professionals attending workshops, training conferences, or similar - Male	23
Number of certificate training programs conducted	3
Number of U.S. faculty providing training or instruction in host country - Female	1
Number of U.S. faculty providing training or instruction in host country - Male	1
Number of host country extension workers, university faculty or other host country professionals involved in providing training to other host country professionals - Female	32
Number of host country extension workers, university faculty or other host country professionals involved in providing training to other host country professionals - Male	35
Number of host country professionals directly involved in conduction Hort CRSP research activities - Female	3
Number of host country professionals directly involved in conduction Hort CRSP research activities - Male	1