New Trends in Minimizing Postharvest Disease Losses

Nancy Jung Chen
Tropical Plant & Soil Sciences
University of Hawaii at Manoa

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Postharvest Losses (%) Fresh Produce - Estimated

Location	Developed Countries		Developing Countries	
	Range	Mean	Range	Mean
From Production to Retail	2 - 23	12	5 – 50	22
At Retail, Food service and Consumer	5 – 30	20	2 – 20	10
Cumulative Total	7 – 53	32	7 - 70	32

Postharvest Losses

- Range from 7 to 70%
- Quantity losses - not Quality losses
- Causes
  - Mechanical injury
  - Physiological – Chilling
  - Disease

Non-Technical Causes of Losses

- Lack of facilities
  - Temperature / Handling
- Lack of appreciation for proper product handling

Shipper → Wholesaler → Retailer → Consumer
Product & Information →
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Papaya Postharvest Losses

- Upwards of 70% in some retail settings
- Average losses around 25%
- Losses often reported as due to disease but frequently related to mechanical injury and chilling injury

Paull et al., 1997

Commercial Concerns

Papaya

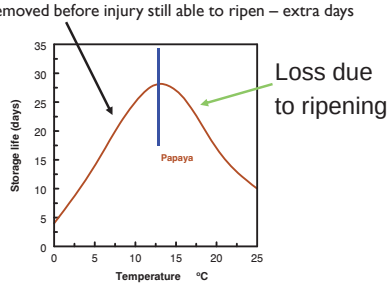
- Need to harvest at color break
  - Determines harvest schedule
  - Harvest & handling major cost
- Storage limitation
  - Chilling injury & rapid ripening
- Disorders
  - Low sugars
  - Ca deficiency
  - Freckling
- Disease – Pre & postharvest
- Insect disinfestation
  - Vapor heat and irradiation

Disorders

- Low sugars <11.5% TSS
  - Variety Line #801 – 8%, SunUp 13%
  - Harvesting immature fruit
  - Loss of leaf area
    - 2 kg fruit per mature leaf
- Freckling of skin
  - Non pathogenic, burst latifiers
  - Associated late stage fruit development
    - Rain two months before harvest
  - Varies with variety and season
- Ca^{2+} deficiency – rapid fruit softening
  - Drought followed by rain 2 to 3 months before harvest, low fruit mesocarp Ca^{2+}

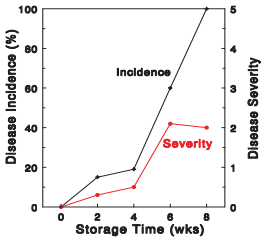
Storage limitations

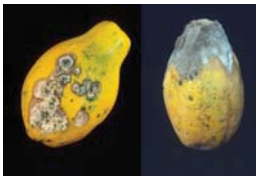
- Chilling Injury
  - Chilling temperatures
    - Loss during to chilling injury
    - If removed before injury still able to ripen – extra days



Diseases

- Preharvest
  - Anthracnose
  - *Phytophthora*
- Postharvest
  - Stem end rots
  - Body rots



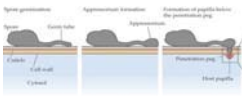


Postharvest Disease Organisms

- Stem End Rots
  - *Ascochyta caricae-papaya, Botryodiplodia theobromae, Fusarium* sp., *Mycosphaerella* sp., *Phomopsis* sp., *Rhizopus stolonifer*
- Anthracnose & Chocolate Spot
  - *Colletotrichum gloeosporioides*
- Other Rots
  - *Alternaria alternata, Fusarium* sp., *Guignaria* sp., *Rhizopus stolonifer*, *Stemphyllium* sp.,

Disease Control

- Preharvest Disease Control
  - Resistant Varieties
  - Field sanitation
  - Pesticide program
    - Anthracnose – Infects and waits for fruit ripening.
- Harvest and Handling – avoid mechanical injury
  - Stem End Rots associated broken peduncle
  - Body Rots often associated mechanical injury.
- Postharvest Disease Control



Postharvest Disease Control

- Handling to avoid injury & sanitation
- Physical
  - Hot water immersion – 20 minutes at 49°C
  - Hot water sprays – 3 minutes at 54°C
  - Storage Environment – temperature and RH
- Chemicals
  - Synthetic Chemicals – Fungicides – Pathogen Resistance, Public Concern of Residues and Cost
  - Natural Chemicals – Neem, Mint, Acetic acid,
  - Salts & Other Chemicals – bicarbonate, ozone
- Biocontrol

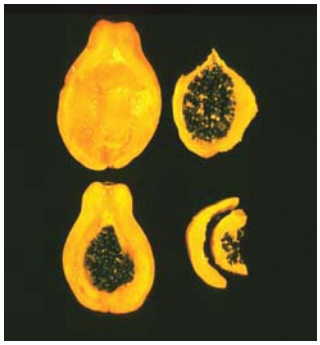
Postharvest Disease Control

Treatment	Disease Free %	Stem End Rots %	Anthracnose %
No Fungicide	3	92	34
Fungicide	54	16	23
Spray 3 min. 54°C	73	0	19
Immersion 20 min. 49°C	84	1	6

Couey et al., 1984. Plant Disease 68:436

Hot water treatment of papaya.

Heat Induced Hard Lumps in Fruit



Biocontrol

- Postharvest Fungicides
  - Loss Benomyl, Thiabendazole
  - Need to reduce residues
  - Increased resistance to fungicides
  - Cost of fungicides
- Alternatives generally not as effective
- Need is use a systems approach that integrates a number of approaches including biocontrol

Pineapple – Black Rot

- Disease Control
  - Minimize fungicide usage
  - Biocontrol for organic production.

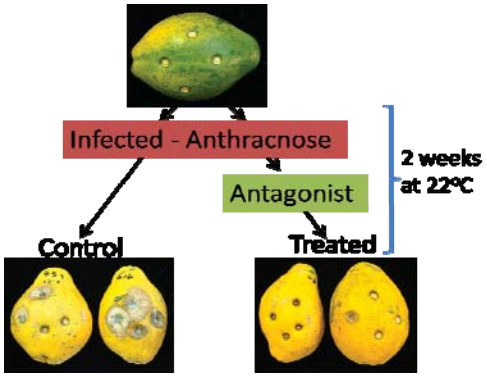
Pineapple Yeast Isolate and Incidence of Black Rot

Treatment	Incidence %
Control	0 c
Chalara inoculated	38 a
Pichia then Chalara 0.5 hr later	21 b

Reyes et al., 2004 Postharvest Biology & Technology 33:193

Papaya - Biological Control

- Seventy epiphytic yeasts and two bacteria isolated.
- Assayed their antagonistic action against Anthracnose
- Applied antagonistics
  - Same day
  - Two and three days after pathogen



Biocontrol Effectiveness

	Incidence (%)					Severity (mm)				
Days	Control	#581	#1061	#1801	#YB	Control	#581	#1061	#1081	#YB
7	73	38	50	58	37	11	5	7	11	7
9	87	38	58	58	62	21	8	14	17	14
11	92	50	66	66	75	30	12	19	22	23

Yeast isolates applied the same day and evaluated 7, 9 and 11 days after pathogen inoculation.

Biocontrol Application Time

	Control		Yeast #581		Bacteria (Yellow)	
Application	Incidence	Severity	Incidence	Severity	Incidence	Severity
Same day	58	14	42	7	8	1
2 days after	78	16	38	10	63	14
3 days after	92	22	75	15	83	20

Yeast and bacteria antagonists applied on the same day and four days after pathogen. Evaluated 9 days after pathogen application.

Application Time on Effectiveness of Biocontrol

	Incidence (% reduction)			Severity (% reduction)		
Application	YB	#581	#1061	YB	#581	#1061
Same day	57	37	34	74	34	44
2 days after	32	41	23	40	25	26
3 days after	10	19	37	5	26	33
4 days after		0			18	

Effectiveness of the biocontrol was the % reduction of incidence and severity from control evaluated 9 days after pathogen application. Antagonists was applied different days after pathogen application.

Conclusions

- Three yeast isolates show possibility
- Delayed application of antagonist reduce the effectiveness
- Variation in pathogen susceptibility among population
  - Difference in tree characteristics?
  - Antagonist population on the fruit?
- Different application method
- Combined with other biocontrol agents

Interventions to Reduce Postharvest Losses

- New cultivars with longer postharvest-life and increased disease resistance
- Improved temperature and humidity management
- Improved packaging
- Improved postharvest sanitation and disease control – including biocontrol as part of an integrated system
- More frequent deliveries to retail markets
- Increased training of produce handling personnel

Strategies for Improving Postharvest Handling

- Application of current knowledge to improve the handling systems of horticultural perishables and assure their quality and safety
- Removing the socio-economic constraints, such as inadequacies of infrastructure, poor marketing systems, and weak R&D capacity.
- Overcoming the limitations of small-scale operations by encouraging consolidation and vertical integration among producers and marketers of each commodity or group of commodities.

Acknowledgements

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Questions?