Cultural practices, postharvest practices and IPM in mango

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Department of Primary Industries and Fisheries – Northern Territory.

4th March, 2015
Presentation Overview

1. Global Picture of Mango Production and export
2. The Australian Mango Industry
3. Challenges
   a. Disease
   b. Productivity
   c. Market access
Global Mango production

Top 12 Mango Producers - 2005

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World Total: 3,870,200

Source: UN Food & Agriculture Organisation (FAO)[1]
Major Mango Varieties in Australia

Kensington Pride

Honey Gold

R2E2

Calypso
NT Production over Past 22 years

NT Mango Industry 1990-2012

Value

$0

$10,000,000

$20,000,000

$30,000,000

$40,000,000

$50,000,000

$60,000,000

$70,000,000

$80,000,000

$90,000,000

40,000

35,000

30,000

25,000

20,000

15,000

10,000

5,000

0

Tonnes

Year

1990

1991

1992

1993

1994

1995

1996

1997

1998

1999

2000

2001

2002

2003

2004

2005

2006

2007

2008

2009

2010

2011

2012
Significant influences over past 10 years

• Increased plants of new varieties
• Smaller growers moving out – larger growers becoming more professional.
• Improved infra-structure to attract and retain producers. Eg roads, transport, labour accommodation, agribusiness suppliers.
• Change of attitude of industry players.
Trends into the next 10 years
## Current status of exports

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Common Issues.
Common Issues.
Common Issues.
Common Issues.
Common Issues.
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This is not the Targeted Markets for Australian mangoes
This is Targeted Markets for Australian mangoes
First Challenge – Disease.

The good  The bad  The ugly
First Challenge – Disease.

The traditional approach.

- Pre-harvest fungicide treatments
- Post harvest fungicide dip
First Challenge – Disease.
First Challenge – Disease.
First Challenge – Disease.

Concerns.
- Only focused on the disease post flowering.
- Increased pressure on the fungicide.
- Fungicide resistance
- Fungicide residues in fruit.
- Some fungicides do not meet CODEX standards.
- Consumers.
First Challenge – Disease.

Progress

Demonstrate the role of inoculum reduction in disease management.

Integrate inoculum reduction.

Strategies with fungicide sprays in an integrated system.

Improve the efficiency of current postharvest fungicide dips by a reduction on orchard fruit infection.
First Challenge – Disease. Progress
First Challenge – Disease. Progress

Inoculum Reduction Strategies.
- Pruning
- Alternative treatments in the vegetative stage
First Challenge – Disease. Progress

Pathologist and Breeders working together
First Challenge – Disease. Progress

Natural stalk-end rot developments during ripening, in fruits harvested from plants grown under different soil K levels

Pathologist and Agronomists working together
First Challenge – Disease. Progress

Focus on how the plant is functioning.

- Understand the aetiology of the pathogen at all stage of the plants phenology.
- Target fertiliser programs that impact on the plants defence mechanisms when the pathogen is weakest.
- Utilise plant activators to compensate for the impact of fertilise on defence mechanisms.

Pathologist and Plant Physiologists working together
First Challenge – Disease. Progress

Thinking about the SYSTEM and not the issue.

Fruit quality can not be improved after it has been harvested.

All “ologists” need to understand
• how the plant is reacting to interventions to active maximum performance.
• What the consumer is looking for.
Challenge Two: Improve on Farm Productivity.

- Low Productivity
- Biennial Bearing
- Uniformity of:
  - Flowering,
  - Fruit set
  - Fruit Retentions
- Efficiency in Harvest
  - One past harvest v’s 3 passes
  - Mechanisation of harvest
Challenge Two: Improve on Farm Productivity.

- Orchards design
  - Higher density
  - Wider production window on individual farms
  - Netted farms
  - Alternative harvesting and packaging systems
- Wider geographic production region
## NT RD&E Strategies

### Expanded production window:

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Challenge Two: Improve on Farm Productivity.

- New varieties - NMBP plus others
  - Potentially an additional 100,000 trees.
    - Greater yields, higher pack out

- New Rootstocks.
  - Stocks impacted on yield, growth rates, canopy & profit
  - Opportunity with selected stocks to enhance new scion varieties and orchard systems
  - Link key production & market parameters' with selected stock attributes - as for other mature fruit industries!
Challenge 2: Alternative On Farm Production Options.

Approximate weekly volumes, 2009 NT Mango season

- Darwin Actual
- Katherine Actual

Date:
- 11 August
- 17 August
- 24 August
- 31 August
- 7 September
- 14 September
- 21 September
- 28 September
- 5 October
- 12 October
- 19 October
- 26 October
- 2 November
- 9 November
- 16 November
- 23 November
- 30 November
- 7 December

Trays:
- 0
- 50000
- 100000
- 150000
- 200000
- 250000
1. Expanded production window:
   - Climate.

The Madden-Julian Oscillation (MJO) is the major fluctuation in tropical weather on weekly to monthly timescales. The MJO can be characterized as an eastward moving "pulse" of cloud and rainfall near the equator that typically recurs every 30 to 60 days.
1. Expanded production window:
   - Agronomic practices
     • Investigate the role of N in flower induction
   - Crop Modeling.
     • Develop of a growth model for mango to predict plant responses to various interventions to manipulate flushing, flowering and fruit maturity.
   - Vegetation Inhibitors.
     • Evaluate and understand the modes of action of the various synthetic promoters and critical factors influencing performance of vegetative initiation and inhabitation.
1. Expanded production window:
   - Floral Induction.
     • Evaluate and understand the modes of action of the various synthetic promoters and critical factors influencing performance of floral induction.
   - Development of molecular tools
     • to detect FT expression and confirm the role of this gene in mango. This work will be conducted at Berrimah Research Farm, in collaboration with research teams in China.
Vegetative Inhibitors

Ethephon for hardening off vegetative growth.
Floral Induction

Potassium Nitrate for floral induction
1. Expanded production window:
   Development of molecular tools

Potential Influences on Fruit Maturity

- Synthetic Promoters
  - PBZ
  - KNO3

- Genetic
  - Regional Rootstock x Scion Trails
    - Rootstock germplasm

- Physical
  - Canopy Management (pruning)
  - Cincturing

- Agronomic
  - Role of Nitrogen
  - Role of irrigation

- Climatic Factors
  - Heat units
    - MJO

- Environmental
  - Soil
  - Aspect
  - Rain

Mango Phenological Cycle

Management Decision Tools

FT gene Expression?

Manipulating Harvest Window
### Challenge 3 Improve Market Access

#### Country | Fruit Fly Treatments | Notes
---|---|---
New Zealand | VHT |  
Japan | √ |  
Korea | √ |  
China | √ | Property Freedom for MSW  
USA | √ | No other insects  
Hong Kong | √ |  
Singapore | √ |  
UAE | √ |  
Vietnam | | Post-harvest dip with dimethoate for FF
Commercial harvest of mangoes in Australia

Mature Firm Green
- Dry matter >14% <16.5%
- Flesh colour as per industry standard

Defects
- NO defects

Class 1
- Export grade
## Steps in the logistics of Mango

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<td>Day 1</td>
</tr>
<tr>
<td>Package fruit</td>
<td>Day 2</td>
</tr>
<tr>
<td>Cool fruit to 14°C</td>
<td>Day 3</td>
</tr>
<tr>
<td>Transport fruit to Disinfestation Facility</td>
<td>Day 8</td>
</tr>
<tr>
<td>Disinfestation process</td>
<td>Day 10</td>
</tr>
<tr>
<td>Sea freight to China at 14°C</td>
<td>Day 31</td>
</tr>
<tr>
<td>Ripening on arrival</td>
<td>Day 35</td>
</tr>
<tr>
<td>Distribution to supermarket</td>
<td>Day 36.</td>
</tr>
</tbody>
</table>
Fruit Fly Market Access

Summary of export requirements from Australia

Vapour Heat Treatment (VHT) for fruit fly is mandatory for all mangoes being exported to China, Korea and Japan.

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Innermost fruit pulp temperature (°C)</th>
<th>Treatment period (consecutive minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>47 °C or above</td>
<td>• 15 minutes</td>
</tr>
<tr>
<td>2</td>
<td>46 °C or above</td>
<td>• 20 minutes</td>
</tr>
</tbody>
</table>

New Zealand.
Irradiation dose rates
- ICA 55 recommends
  - 150 Gy for Fruit fly only
  - 300 Gy for Mango Seed Weevil plus fruit fly.
- All mango varieties.
Fruit Fly Market Access

Does this actually happen with mature hard green mangoes?
What research data is this market access protocol based on?
The evidence that mangoes are a host of Fruit Fly!
Fruit Fly Market Access
Fruit Fly Market Access
An Alternative Option

Researchable Questions.

1. Are mature hard green mangoes a host of fruit fly?
2. At what stage of maturity do mangoes become susceptible to fruit fly?
3. What is the correlation between fruit fly pressure and fruit maturity?
Fruit Fly Market Access
An Alternative Option

Testing the accepted

- Two pest species
- Mangoes 4 Varieties
- Four production areas
- Fruit fly trapping program to determine populations pressure.
- Fruit collection at harvest.
- No field treatments to manage fly populations.
- Caged trails
Jarvisi FF numbers – 2010-12
Single KP orchard
Method: fruit assessments

- So far assessed over 110,000 commercially harvested fruit
- Collect untreated fruit at shed
- Measure maturity / fruit quality on sub-sample
- Hold 12-14 days at 22°C
Method: fruit assessments

Fruit quality assessments for each batch of fruit collected
Method: fruit assessments

Cutting fruit to assess presence/absence of fruit fly larvae
Conclusions

Total fruit assessed over four years. >110,000

The evidence to date;

When mangoes are harvested at the mature hard green stage, without any skin damage (cuts, cracks, scratches), the two Fruit Fly species within Northern Territory, appear not to favour the fruit at this stage or the eggs are not able to develop.
Commercial harvest of mangoes in Australia

Mature Firm Green
- Dry matter >14% <16.5%
- Flesh colour as per industry standard

Defects
- NO defects

Class 1
- Export grade
What have we learned?

Market access principles need to be based on commercial practices.
Key Learnings

Think of the production system and not the issue.

All participants in the research team need to understand the production systems and how the plant is functioning.
Systems Research

Thanks to the research teams in
• Pakistan, Sri Lanka, Philippines, Indonesia, Cambodia and Australia.
• Australian Centre for International Agricultural Research (ACIAR).
Thank you