CHALLENGES IN PROTECTED AGRICULTURE IN TRINIDAD & TOBAGO

Identifying the Issues
Proposing the Solutions
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Background

- Pioneered in Europe in 1850s
  - Protect exotic tropical plants from the cold
- Brought across to New World (North America)
- Developments driven by Horticulture Industry($$)
- Israel Pioneered Desert PA
- Humid Tropics: Infancy / Little Information
Our PA Structures
Common Types

- Single Arch
- Gable
- Raised Tunnel
Our PA Structures
Common Types

- Gutter Connected
- Split Gable
- Split Arch
Split Arch
Spanish Design

- Structural Material: Galvanized Tubing with bolted brackets
- Trusses 2m (6.6’) + Wire / Nylon Support
- Low sides 2 -2.5m (7- 8’)
- Apex 4.5 – 5m (15 -17’)
Split Arch
Spanish Design

- Ventilation: Growing Area Ratio: 1.35

- Length 30 m – 60m (100 – 200’)
  Width 10m -13m (32.8 – 42.65’)

- Insect Proof Mesh
- Plastic top (Woven gives strength at the expense of light)
Concept design Function

- Passive Ventilation
- Convection Air Movement - good orientation with prevailing wind for passive extraction
- Reduce Pest and disease management
- Protection from tropical weather
Problems

- High temperatures >40°C (104°F)
- High humidity
- High CO₂ concentration
- Low O₂
- Reduced light especially below minimum threshold level in cloudy / rainy days
- Flower Fertilization, Fruit set and Fruit impedance
Understanding HEAT Buildup

LIGHT
NON HEAT LIGHT (Wavelength)
HEAT (Wavelength)
RADIATIVE HEAT (Wavelength)
Understanding HEAT Buildup

- Radiative Heating
- Convection Movement (Hot air rises)
Increase severity of problems

- Low level of maintenance and management of exterior of structure
- Low / no maintenance of vegetation surrounding environment
- Lack of guttering Sun / Rain / Moss Algae
- Bad orientation / Site selection: Lack of prevailing wind
Characteristics of the External Environment

- High Annual Rainfall 2400 mm (7.87’)
- High Humidity (>75% for Seven months)
- Changes in the prevailing wind according to weather systems
- High Temperatures 33 - 35°C (91.4 – 95° F) July – September
- Highest Rainfall June and November
Micro Climates

- Know your micro climate
  - Valley areas
  - Open plains
  - Maritime influenced micro climates
  - Man made e.g Buildings, Trees, Roads etc

- Max. / Min Temperature
- Prevailing wind / wind speed
- Light duration
- Rainfall
Solutions

- Increase passive ventilation efficiency
- Modification for increased passive ventilation
- Modification of structure for forced ventilation
Solutions: Increasing Passive Ventilation Efficiency

- Good Management Practices. These include:
  - Yearly cleaning of plastic covering
  - Yearly cleaning of insect mesh
- Installation of Guttering
- Good routine maintenance of surrounding vegetation
Solutions: Increasing Passive Ventilation Efficiency

- Reorientation of existing structure perpendicular to the prevailing wind
- Increased inter house spacing
Solutions: Modification of Structure

- Increasing Ventilation Surface Area
  - increasing height
  - increasing size of top vent opening

  Increasing mesh size

Limitation: Reduced Structural integrity
Modification for Forced Ventilation

- Extract hot air replace with cooler air
- Size of fan determined by:
  - Size of house
  - Rate of extraction
  - Efficiency and placement dynamics
- Design modification
- Additional support and bracing
Modification of structure for forced ventilation

- Where to place extractor fans for the most effective use?
Materials

- Increase production by providing AND MANAGING the abundance of the following

  - WATER / NUTRIENTS
  - AIR
  - LIGHT: UV Plastic / Reflective ground cover
VISION FOR FUTURE

- Maximum 36 - 38°C (96.8 – 100.4°F)
- Retrofit kits for farmers with Split Roof / Umbrella design
- New structures with new design features
Basics are the basics
Keep it Simple
Think before you act
Keep Records