

# North American Greenhouse Overview from emerging GH Structure(s), crops to pesticide registration process and products.

## [Part 2]

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# **New GATES construction in Texas – Semi-closed**

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09/25/2011 13:57



07/13/2011 19:37



09/25/2011 15:10



09/24/2011 14:57









09/07/2011 09:06





10/15/2011 14:12









# Photosynthesis 101

**Plants uses solar energy to combine water and carbon dioxide to form sugars**

- **More sunshine, more sugars**
- **Temperature dependent**
  - Too cold and sugars are stored as starch
  - Too hot and the sugars are consumed in respiration
  - Must balance distribution of sugars within the plant
- **Stomata must be open to absorb CO<sub>2</sub>**

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- **Sunshine and/or lighting ?**







- **Sunshine and/or lighting ?**



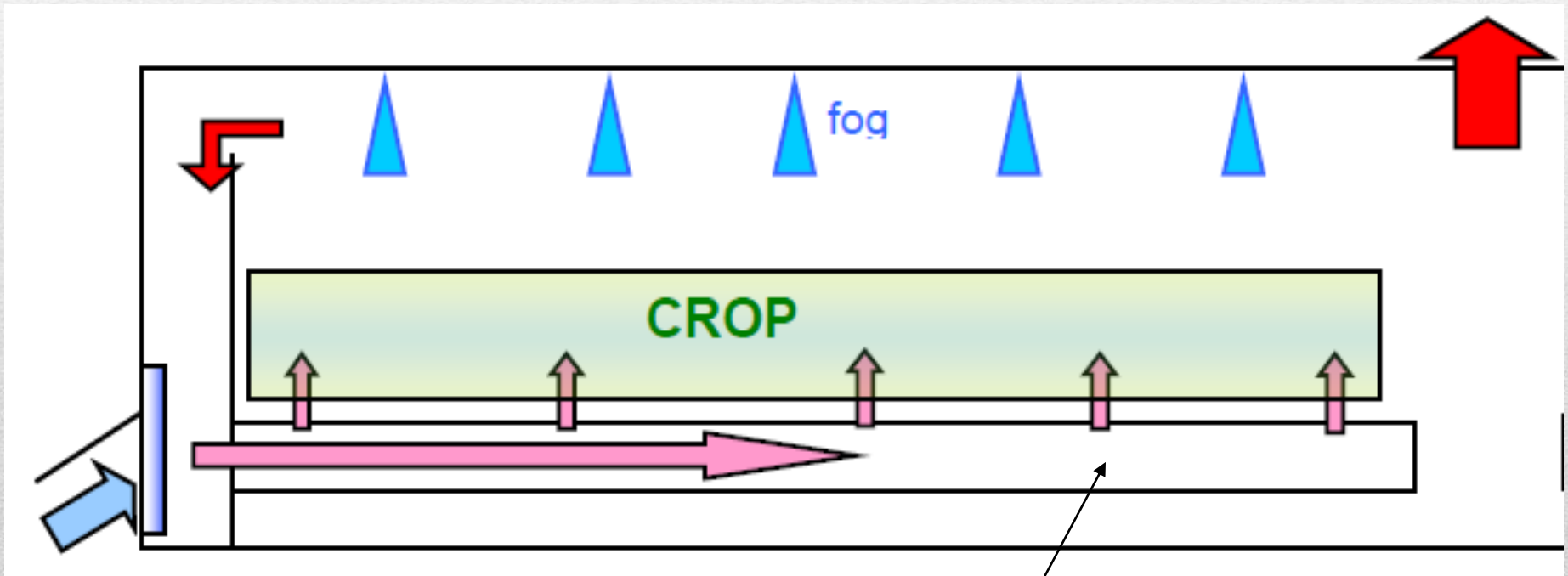








# Air moving systems in new generation greenhouses



the Earth®  
Air mixing tube  
[www.villagefarms.com](http://www.villagefarms.com)





## Why do we move air in this way?

Photosynthesis is temperature dependent  
Stomata must be open to absorb CO<sub>2</sub>

- Precise control of temperature and humidity
- Smaller temperature and humidity gradients
- Recirculation is conserving humidity and CO<sub>2</sub> -> Higher CO<sub>2</sub> levels are possible
- By keeping the stomata open -> higher CO<sub>2</sub> assimilation rates for longer periods
- Higher radiation and CO<sub>2</sub> use efficiency

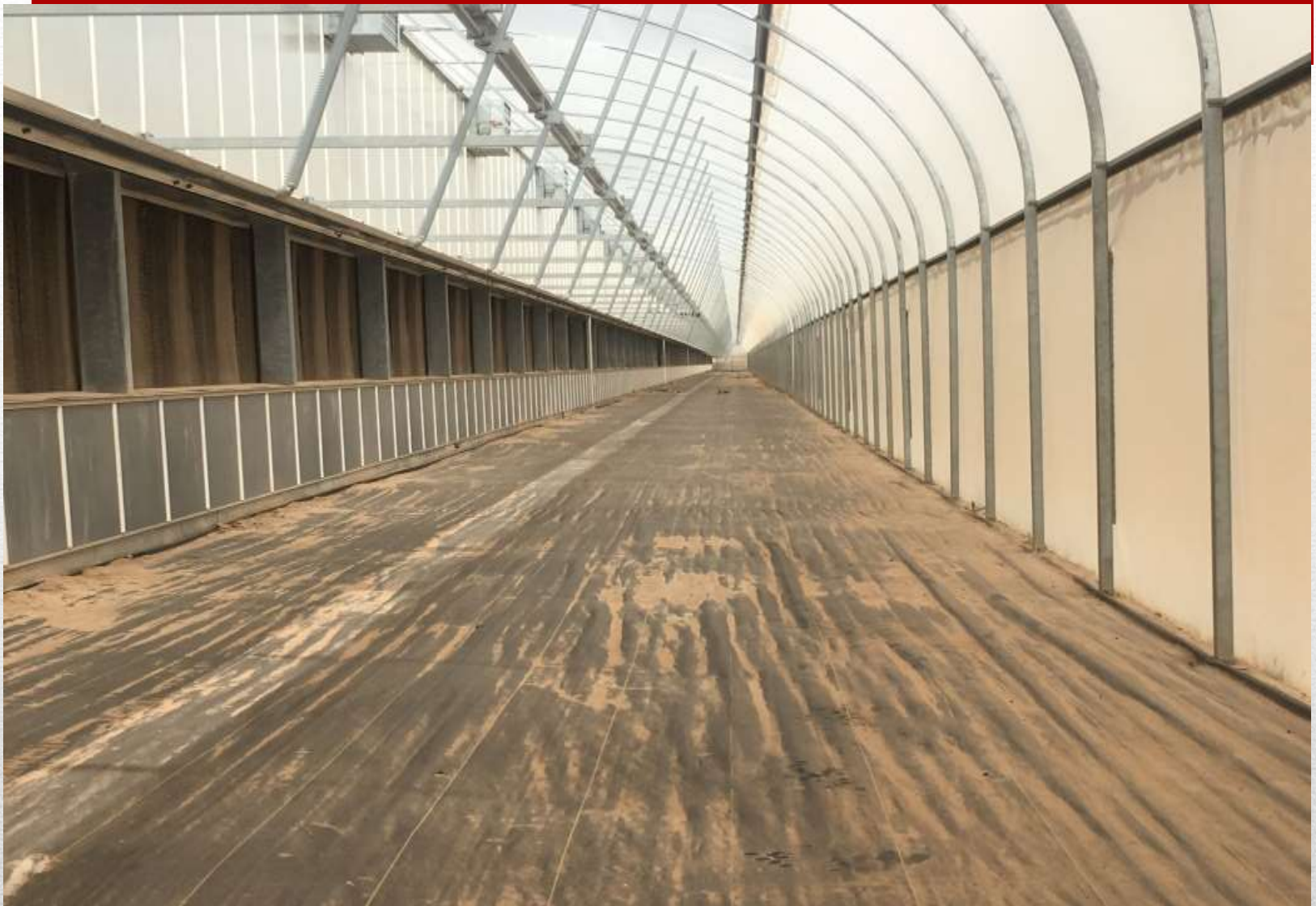
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**Inside screened area**

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Greenhouse Grown

# Evaporative cooling







Greenhouse Grown

# Air moving systems



03/06/2012 12:03







Greenhouse Grown

# Air moving systems



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# **Pesticide Registrations and why Minor Use**

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- Corn: 96.4 M Acres
  - 40M Ha.
- Soybeans 76.1 M Acres
  - 31M Ha
- Wheat 56 M Acres
  - 23M Ha
- Cotton 12.6 M Acres
  - 5M Ha
- Peanut: 1.42 M Acres
  - 0.6M Ha

Minor Use under 300,000 acres  
(121,000 HA)



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- Fresh Market Tomato
    - Field: ~113,000 Acres (4600 Ha)
    - Greenhouse **1500 Acres (607 Ha)**



# Beyond Core US Crop Markets

## USDA 2013 Statistic

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- Take up the challenge of defending and supporting Specialty and minor crops.
- Offer incentives to Basics Pesticide Manufacturers (BPM) for Minor/Specialty Crop registrations.
- Permits minor crops to have a someone to approach Basic Producers (BPs).
- Have helped support many smaller BPs, especially with Biological registrations.

## **IR-4 and PMC Programs**





- 1990: Nothing specifically registered for Greenhouse vegetable in USA.
- Canada had multiple products labeled
- End of Organophosphates, and carbamates
- EPA Registration Program Reorganizing
- New industry needing help
  - Turned to IR-4
  - USEPA (Certification and Worker Protection Branch)
    - Richard Pont – USEPA
- “Based on information provided to me by Jack Neylan, Anne Lindsay and Jim Jones (Deputy Director of OPP), I confirmed that it is now "EPA's" position (and by that I mean management at OPP, OECA and OGC have apparently agreed on this) that **unless use in a greenhouse is expressly prohibited on the label, then it would not be considered use inconsistent with the label to use a product in a greenhouse** as long as the crop site was listed on the label.+



# US Regulatory Challenges for an emerging industry





# USEPA -Richard Pont

## Certification and Worker Protection Branch

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**Developed from IR-4 inquiry and support from USEPA**





- Our US and Canadian industry would not exist today in its current form without the IR-4 and PMC programs.
- Even with the USEPA's letter permitting use of field labels in US, the labels were developed for field and were difficult to use in greenhouses.

# Survival

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- **Largescale GH challenges**

- Pre-Harvest Interval(PHI) Field: (7,14,21,28,32 day)
  - Needed 0-3 day PHI for GH tomato,
  - 0-1 for Cucumber.
- Many Basic Pesticide Manufacturers
  - Concerned over greenhouse use.
  - Generally, over protecting from resistance development
- Monocrop
- 121 mile rule (40 acre – 16 Ha)
  - Chemigation
  - Fogging
  - Dusting
  - Foliar

# **121 mile Rule (1400 Km)**

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- *Bombus* spp.



- *Encarsia formosa* –WF,



- *Eretmocerus* spp. – WF,



- *Amblyseius swirskii*- Cucumber – Thrips, WF



# BENEFICIALS

30 acre Greenhouse can spend up to \$14,000 for beneficials.



## Tomato Disease:

- PepMV: Ch2 and US1 Strains
  - Seed borne
  - DCM PMV-01 (Belgium)
  - Valto V-10 (Dutch)
  - Not yet labeled in NA. Used in Europe under emergency registrations
- Rhizobium radiobacter/ Agrobacterium rhizogenes (Crazy Root)
  - Seed borne
  - Alters plant energy sink
  - Circulates in water (24-48 hours, low levels for 3 weeks)
- Pythium
- Botrytis
- PM
- Fusarium/ Phytophthora
- TYLCV
- Clavibacter (on decline in most NA areas)
  - Seed borne
  - GSPP - Good Seed and Plant Practices
  - Except Michigan (Leamington) -Cmm
    - Areas in Mexico and Central America



# Pest Challenges in NA

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## Tomato Insect

- Psyllids (*Bactericera cockerlli*)
  - 0 tolerance
  - Symptoms similar to Bushy Stunt Virus
  - *Candidatus Liberibacter solanacearum*
    - Zebra stripe in potatoes
- Whitefly
  - Arbovirus transmission
- Leps (Worms)
  - Periodic problem
- Miridae (Plant Bug)
  - Engy Bug:
    - *Engytatus modestus*
- Aphids
- TSSM



# Pest Challenges in NA

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## Cucumber Disease

- CGMMV (Cucumber Green Mottle Mosaic Virus)
- PM
- Botrytis
- Gummy Stem Blight



# Pest Challenges in NA

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## Cucumber Insect

- TSSM
- Broad mite
- Thrips
- Leps (worms)



Female broad mite photographed at extreme magnification.



# Pest Challenges in NA

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## Seed Testing Program for Village Farms

- Started in 2007
  - 2000 Tomato Seeds
  - 500 Cucumber Seeds
- Initially due to Cmm and PepMV on Tomatoes
- 8 positives since start (Cmm and PepMV)
- Expanded
  - pathogens and included Cucumbers

# Seed Testing Prior to Propagation Program

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Pathogen	Symbol
Clavibacter (Bacterial Canker)	Cmm
Pepino Mosaic virus	PepMV
Potato Spindle Tuber Viroid	PSTVd
Columnnea Latent Viroid	CLVd
Ralstonia solanacearum	bacterial wilt or southern wilt of tomato
Agrobacterium rhizogenes	Crazy root

# Seed Testing Prior to Propagation

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## Cucumber Seed Testing Program - 500 seeds

Pathogen	Symbol
Cucumber mosaic virus	CMV
Cucumber green mottle masaic virus	CGMMV
Melon necrotic spot virus	MNSV
Tobacco mosaic virus	TMV
Tomato mosaic virus	ToMV
Zucchini yellow mosaic virus	ZYMU
Squash Mosaic Virus	SqMV
Agrobacterium rhizogenes	Crazy Root
Acidovorax avenae subsp. citrulli	BFB (Seedling PCR)

# Seed Testing Prior to Propagation

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# Questions?

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- **Agrobacterium rhizogenes (Crazy Root)**
- **Pythium**
  - Rootshield
  - Previcur Flex
- **Botrytis**
  - Cease + Milstop
  - Switch
  - Pageant
  - Decree
  - Scala
- **PM**
  - Cease + Milstop
  - Switch
  - Pageant
- **Fusarium/ Phytophthora**
- **TYLCV**
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