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Integrated Management of Soilborne Diseases of Field Grown Tomato and Strawberry

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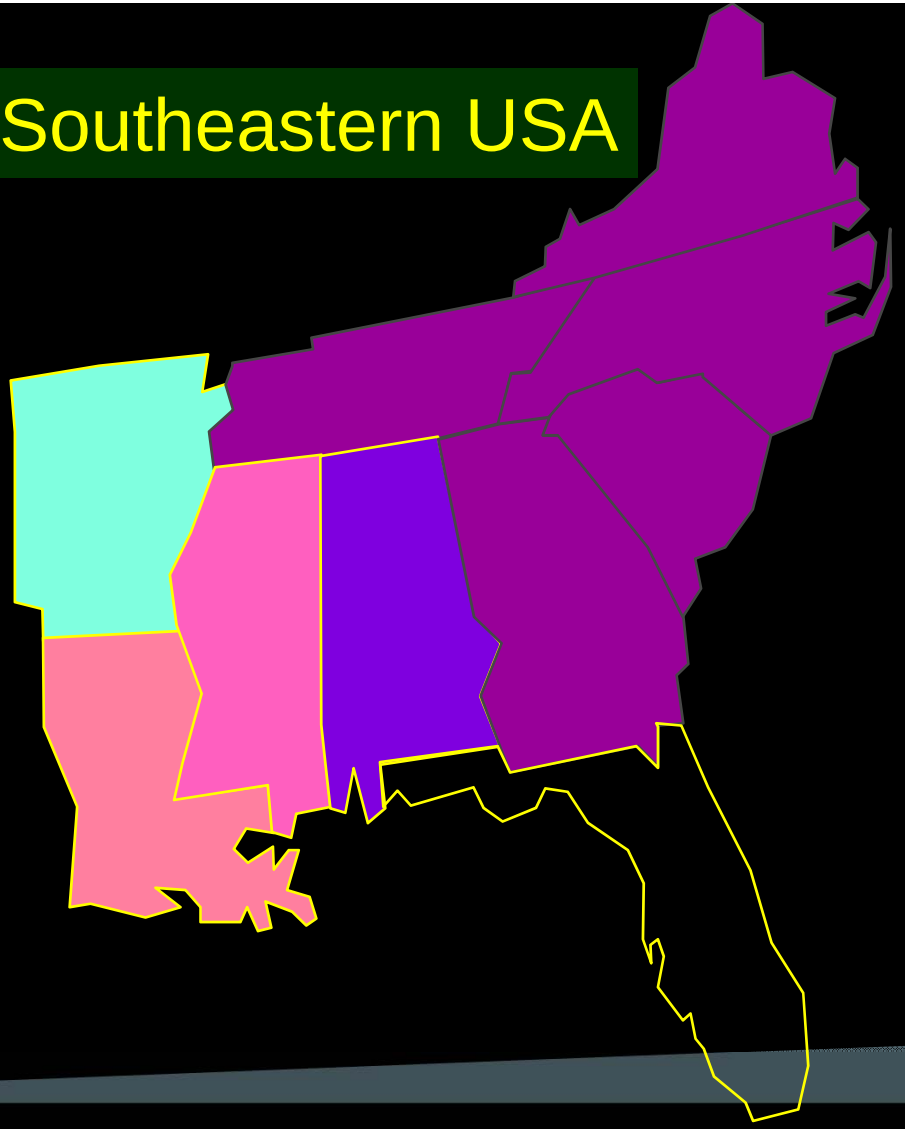
NSF-Center for Integrated Pest Management
North Carolina State University
October 4, 2012

IPM 2.0
Towards future-proof crop protection in Europe

Methyl Bromide Use in the Southeastern USA

- **20,000 ha of vegetables; 1200 ha of strawberries**
- **85% strawberries; 85% tomatoes; 75% cantaloupe; 50% watermelon; 25% peppers;**
- **23% of methyl bromide consumption**
- **$215 million dollars for growers; $14 million loss per year**



Prepare land and fumigate (15 Aug – 15 Sep)

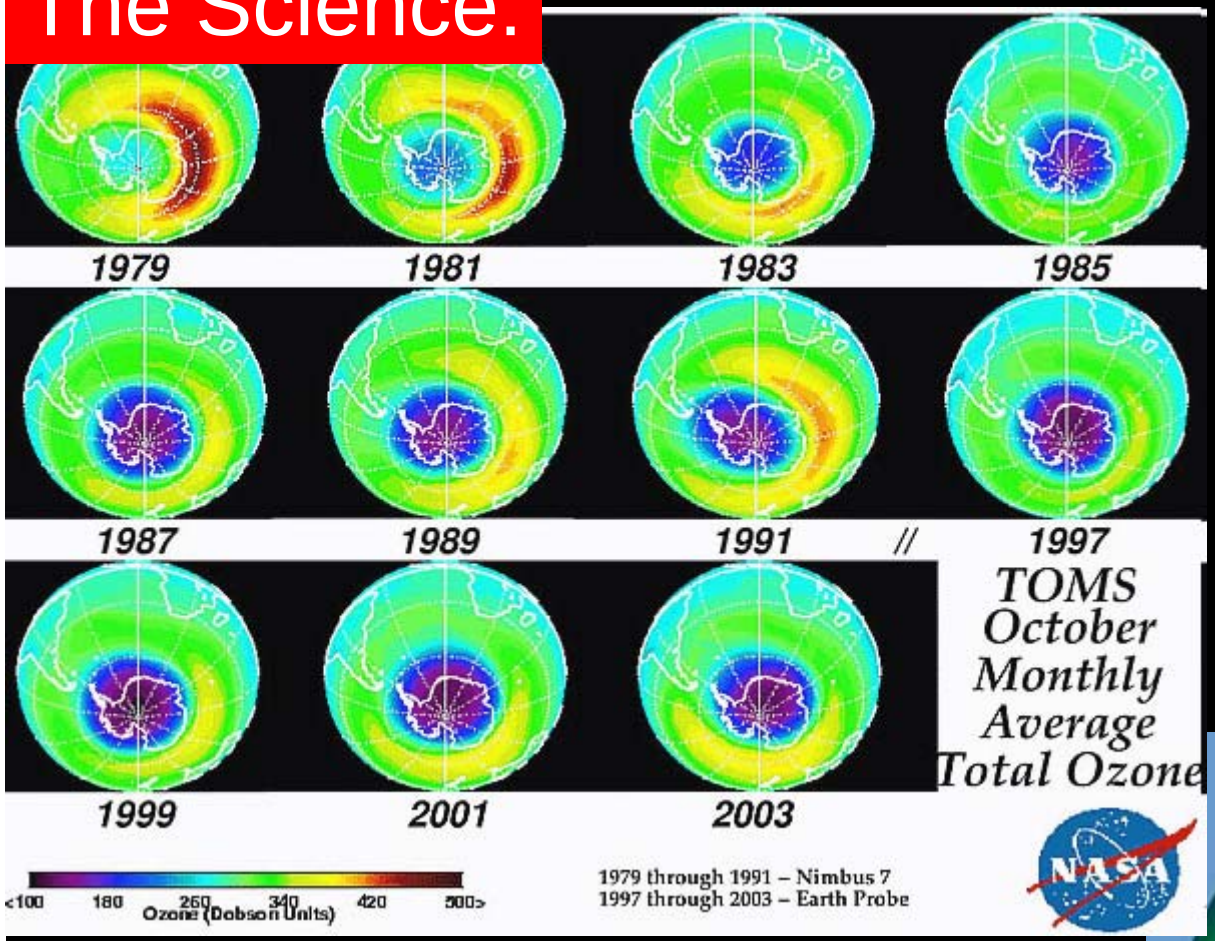
Plant 15 Sep – 15 Oct

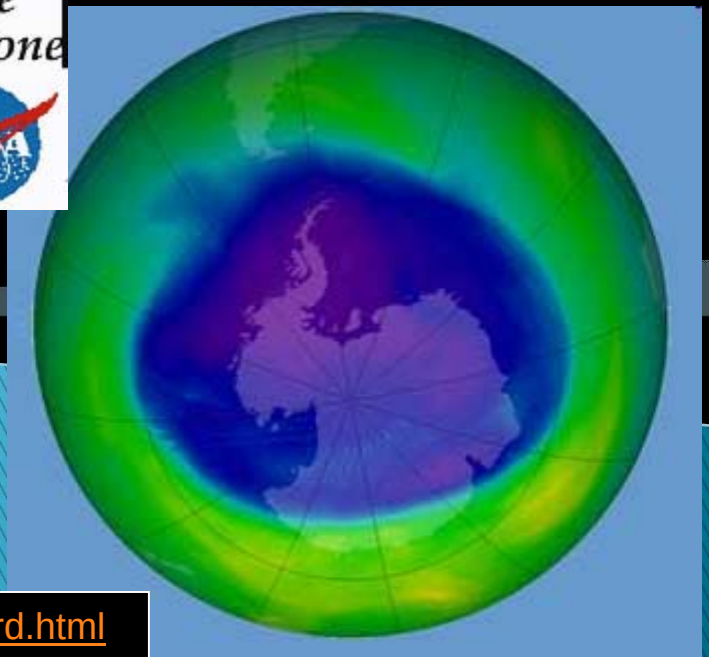
Manage Oct - Mar

Harvest Apr – Jun
And start over….

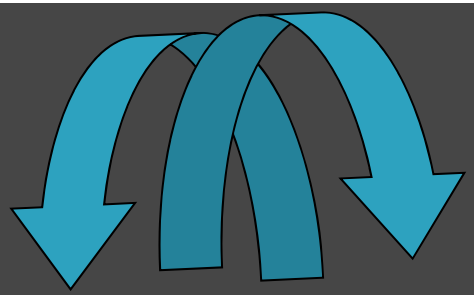
20,000 – 30,000 lb/A
22,000 - 32,000 kg/ha

The Science:





NASA -http://www.nasa.gov/vision/earth/lookingatearth/ozone_record.html



MB Alternatives research
Development of IPM programs

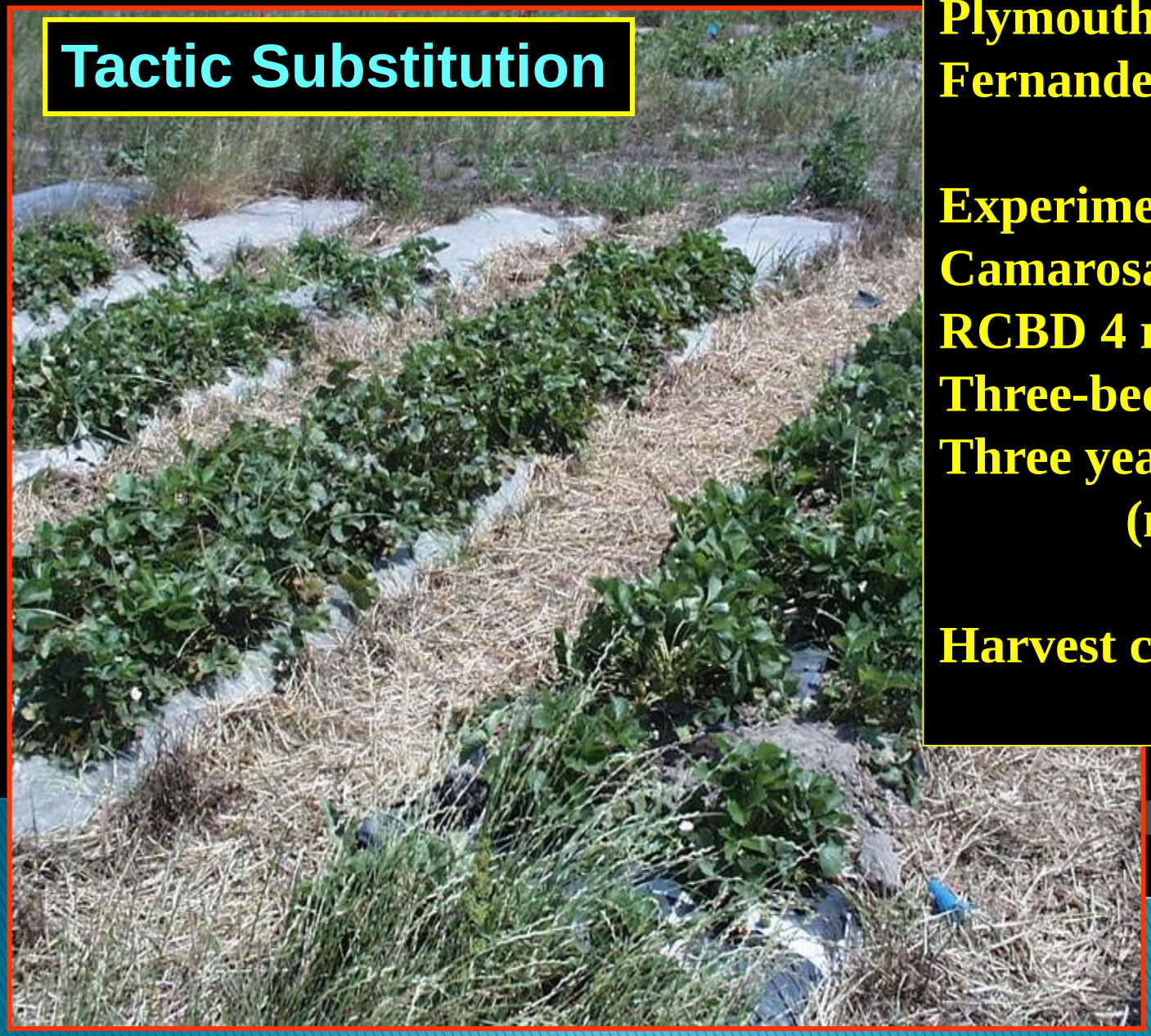
Generation 4 –
SUSTAINABLE SYSTEMS

Generation 3
TACTIC DEVELOPMENT:
microbial ecology and farming systems research

Generation 2 – TACTIC DIVERSIFICATION:
finding non-fumigant tactics and focus on IPM tactics

Generation 1 – TACTIC SUBSTITUTION:
finding non-ozone depleting fumigant alternatives

Tactic Substitution



Plymouth
Fernandez and Louws

Experimental Design
Camarosa
RCBD 4 replications
Three-bed plots
Three year study
(no rotation)

Harvest center row

Data Collected:

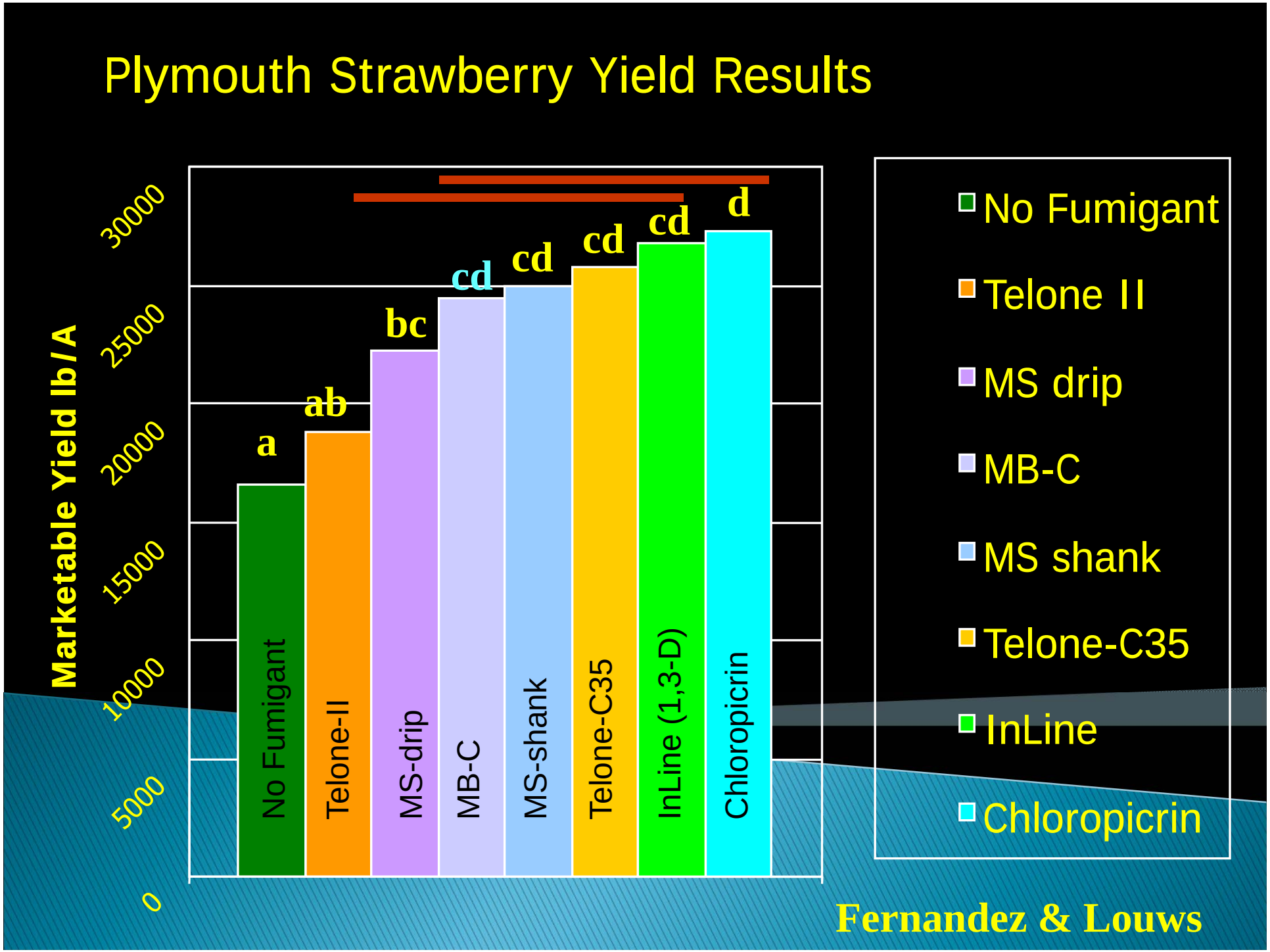
Total, Marketable, Diseased Yield (1-2x/wk)
Weed Populations (2-3 ratings)
Soil Sampling e.g. nematodes (2x)
Microbial Community analysis

WHOLE PLANT HARVESTS (1x/month)

- Plant Growth Data
- Root Hair Rating
- Root Disease Rating

Pathogen Isolations
Economic data

Plymouth Strawberry Yield Results



Economic Evaluation of Methyl Bromide Alternatives for the Production of Strawberries in the Southeastern United States

Olha Sydorovych[1], Charles D. Safley[2], Lisa M. Ferguson[3], E. Barclay Poling[4], Gina E. Fernandez[5], Phil M. Brannen[6], David M. Monks[7], and Frank J. Louws[8]

HortTechnology 16:118-128, 2006

Realistic and Detailed Enterprise budget:
Partial Budgeting
(negative effects; positive effects; net effects)

Economically Feasible Alternatives
Estimated Returns per Acre (Piedmont & Coastal Plain)

Based on up to 15 trials over 10 years and multiple locations

Fumigant	Additional NET Returns/A	Gross Returns/A
Chloropicrin	+ $1670	$30,269
Telone-C35	+ $277	$28,593
Metam Sodium (Shank)	+ $25	$28,378
Methyl Bromide*	$0	$28,451
Non-fumigated (check)	-$6,450	$ 21,344

***Net Return for MB = $14,895/A**
= $36,806/ha

1 EUR/ha ~ $3.6/A

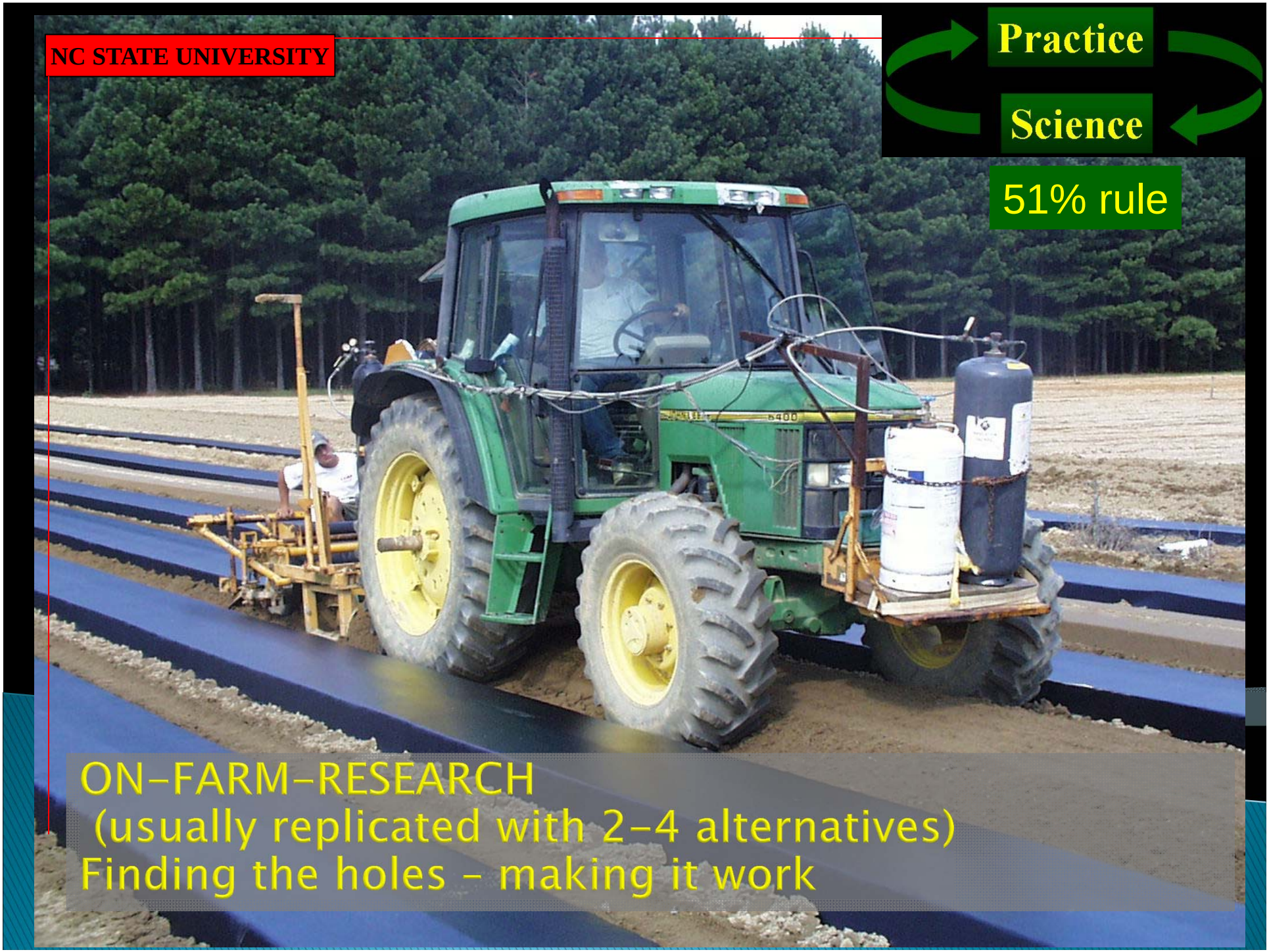
WHO IS THE ENEMY? (WHY DO WE FUMIGATE?)
Black Root Rot Complex

Advancing the Science: Who is the enemy?

- *Isolated and characterized over 1300 fungi using a hierarchical sampling scheme*
  - *Fungal complex varies with crop production site*
  - *Clean plants are difficult to obtain*

- *Rhizoctonia fragariae* : AG-G, AG-A, AG-I
- *Pythium irregulare, Pythium spinosum, Pythium artotrogus, Pythium HS*
- *Fusarium solani* and *Fusarium oxysporum*
- Phytophthora crown rot*: Phytophthora cactorum* (a plant killer)

- *Phytophthora bisheria* Abad, Abad and Louws sp. nov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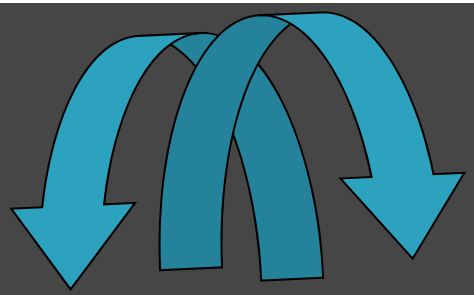
Practice
Science
51% rule
ON-FARM-RESEARCH
(usually replicated with 2-4 alternatives)
Finding the holes - making it work

Tactic Substitution

Conclusions:

Economically Feasible Best Alternatives:

T-C35 (Pic-Clor 60) +/- herbicides (+VIF);
Chloropicrin +/- herbicides,
Metam Sodium;
Midas (iodomethane + pic) (voluntarily removed 2012)



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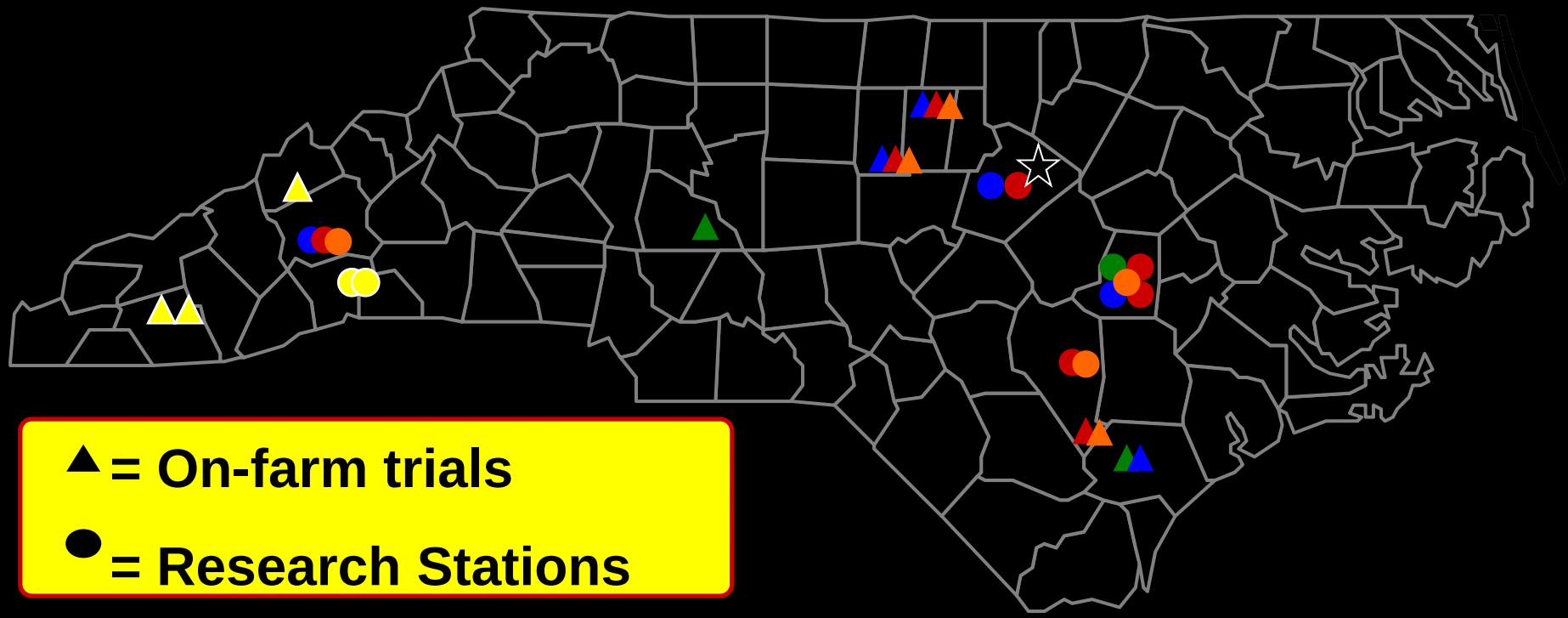
Diversity of Tomato Production Systems:

Tomatoes: Tactic Diversification

Grafting



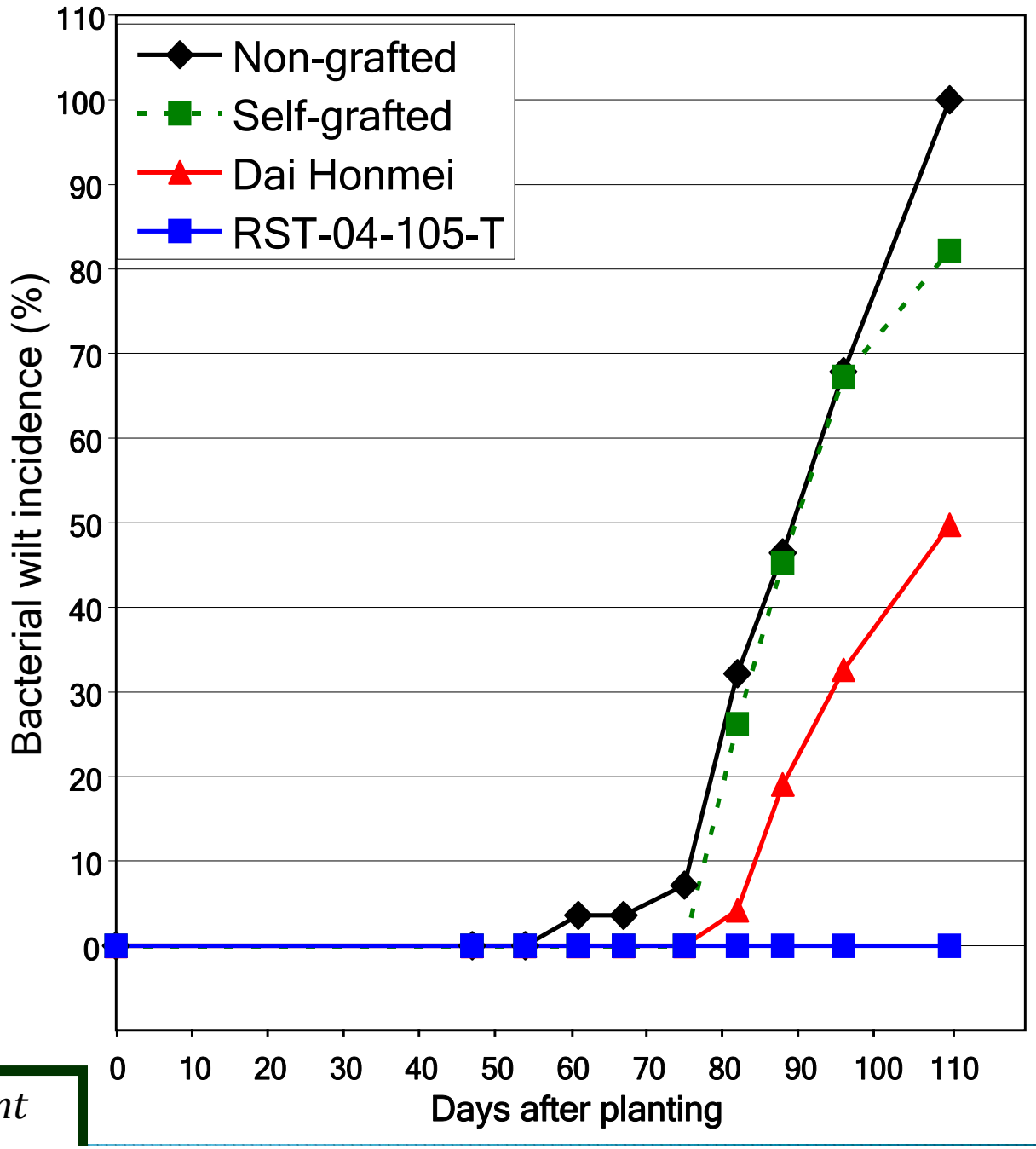
▲ = On-farm trials

● = Research Stations

Ecological Zones

- *Ralstonia solanacearum*
  - Southern Bacterial Wilt
  - Colonizes Vascular tissue
  - Tropical Environments
  - Soil Inhabitant
  - Wide host range

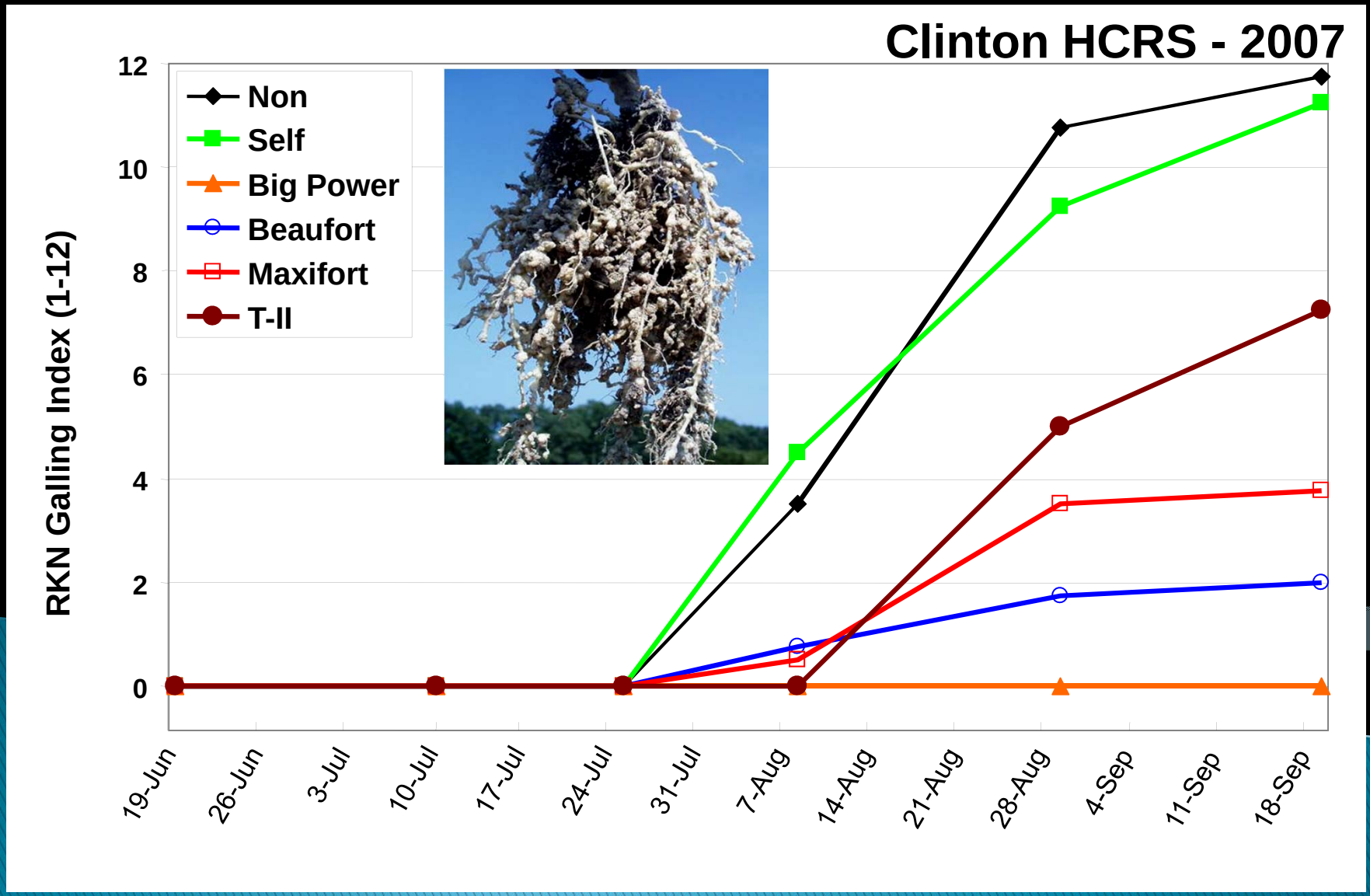
100%



(Rivard and Louws Plant

Root Knot Nematode

Meloidogyne incognita race 1



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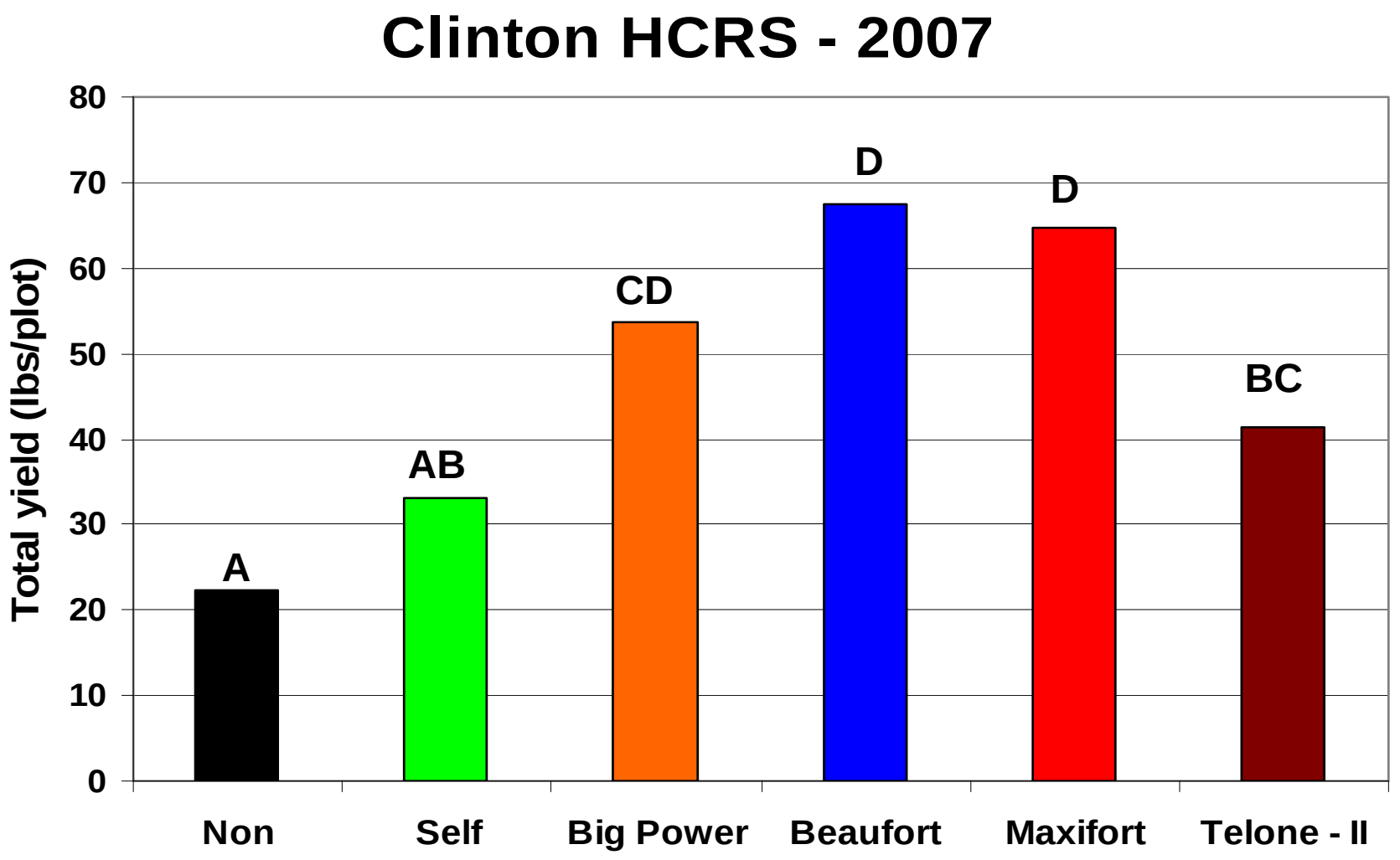


Least Significant Difference at P=0.05

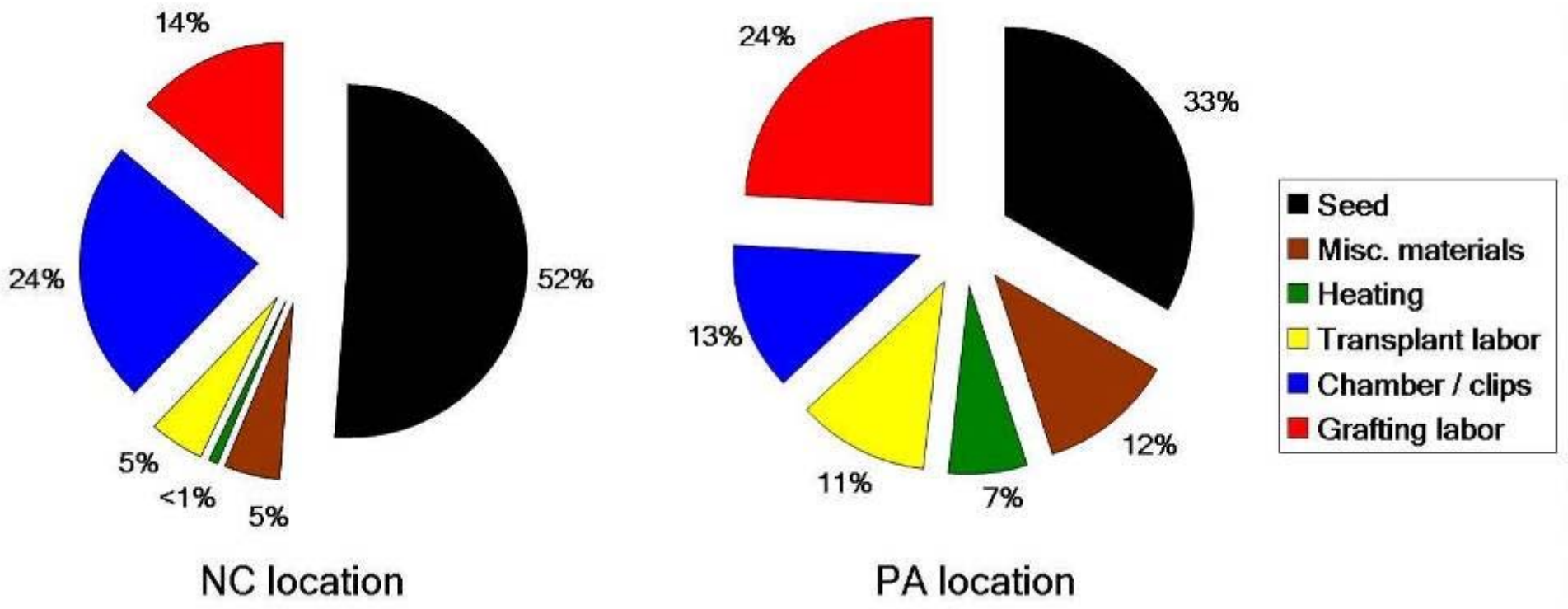
RKN Populations

Root-knot nematode soil populations / 500 cc soil		
	First Harvest	Terminal Harvest
Non-grafted	8357 D	1964 Y
Self-grafted	8751 D	1228 Y
Telone II	379 B	1260 Y
Big Power	77 A	40 Z
Beaufort	2680 C	2542 Y
Maxifort	3091 C	1251 Y

LSD based on P = 0.01

Propagation Costs

- Proportion of added costs
  - e.g. seed costs (%) = $(SEED_{graft} - SEED_{non}) / (TOTAL_{graft} - TOTAL_{non})$



$0.46 / plant **$0.74 / plant = Added cost**

(Rivard et al., 2010)

MethylBromideAlternativesHighlighted408.pdf (application/pdf Object) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.smallfruits.org/SRSFC_News/2008/MethylBromideAlternativesHighlighted408.pdf

small fruits.org

MyLibrary@NCState

The Southern Region Small Fr... | MethylBromideAlternative...

2 / 3 129% Sign Find

A field day was held at each of these on-farm tests in April, each led by a local Cooperative Extension Agent or Regional Agronomist; Pow Garwood in Pinnacle, NC and Rick Morris in Tar Heel, NC. and the alternative work were led by Rob Welker from NC S presented strawberry production information at the Pinnacle good at each location, and over 70 growers, Cooperative Ext Agronomists and industry representatives attended these fiel current outlook for using methyl bromide in 2008 and beyon alternatives including personal protective equipment, Virtual associated with alternatives. Very good discussions were hel

Done

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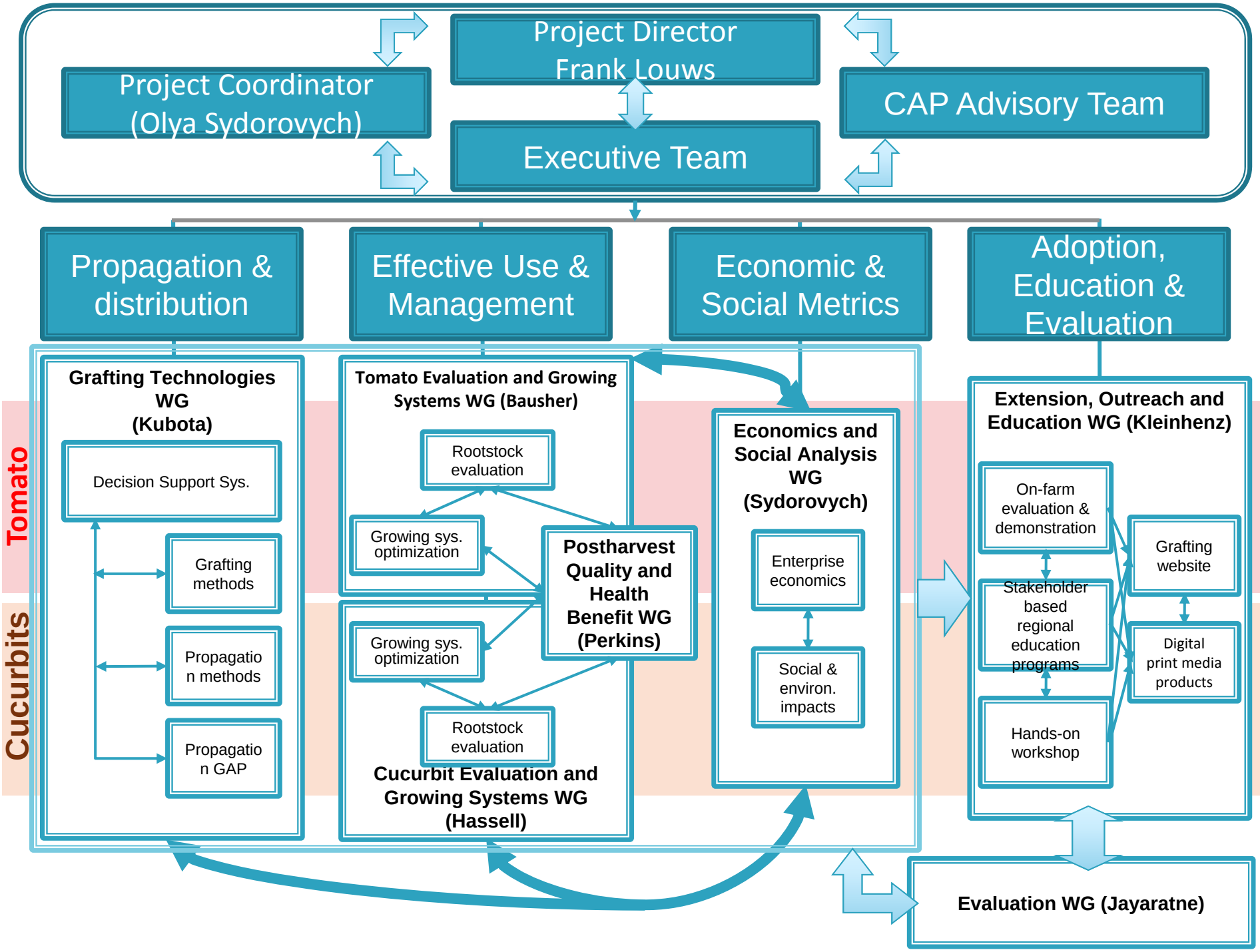
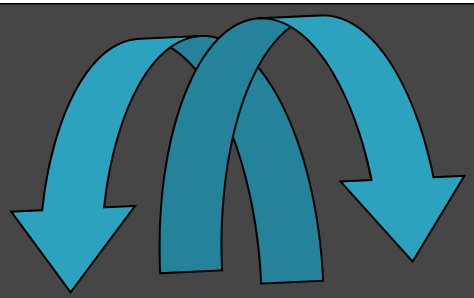
SMALLFRUITS.ORG

S-RIPM

Train-the-Trainer
For broad impact


Project Director
Frank Louws
Project Coordinator
(Olya Sydorovych)
Executive Team
CAP Advisory Team
Propagation & distribution
Effective Use & Management
Economic & Social Metrics
Adoption, Education & Evaluation
Tomato
Cucurbits
Grafting Technologies WG (Kubota)
Decision Support Sys.
Grafting methods
Propagation methods
Propagation GAP
Tomato Evaluation and Growing Systems WG (Bausher)
Rootstock evaluation
Growing sys. optimization
Postharvest Quality and Health Benefit WG (Perkins)
Growing sys. optimization
Rootstock evaluation
Cucurbit Evaluation and Growing Systems WG (Hassell)
Economics and Social Analysis WG (Sydorovych)
Enterprise economics
Social & environ. impacts
Extension, Outreach and Education WG (Kleinhenz)
On-farm evaluation & demonstration
Stakeholder based regional education programs
Hands-on workshop
Grafting website
Digital print media products
Evaluation WG (Jayaratne)



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Strawberries - Tactic development:

Can we implement a compost-based production system as an alternative to methyl bromide fumigation?

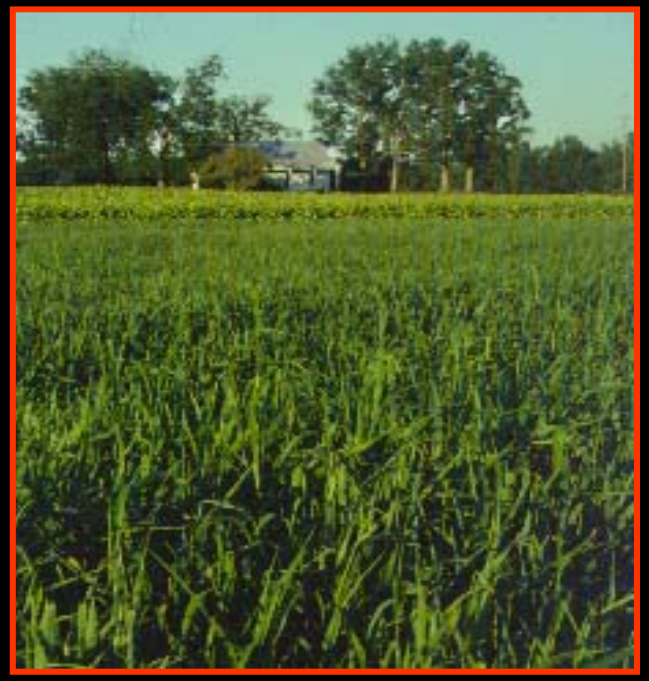
John Vollmer

- on farm research
- organic transition

Michelle Grabowski
MS student

Practice

Science



Legume-Grass Cover Crop

Rotary Spader

Raising of the Beds

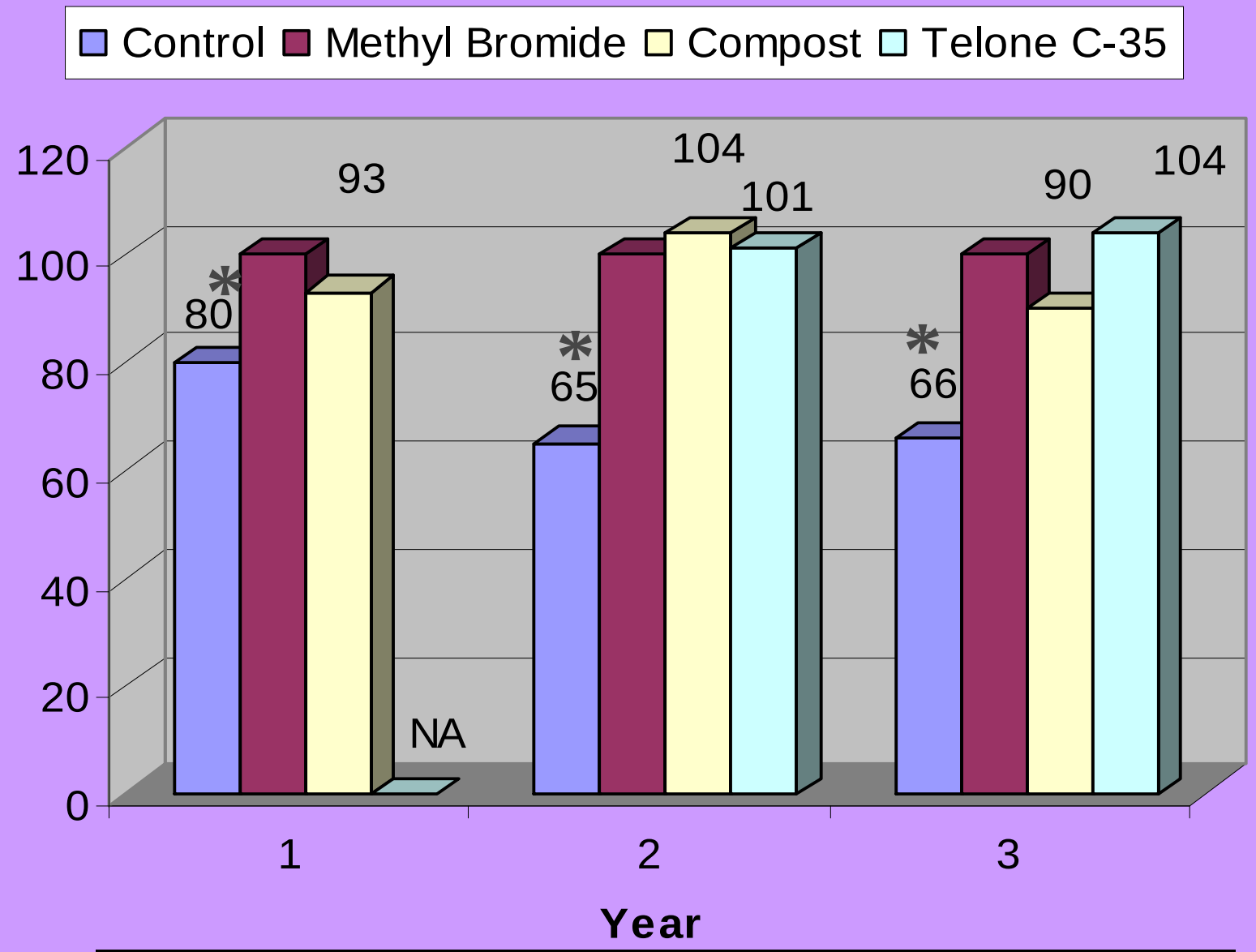
Crop Establishment

Treatments

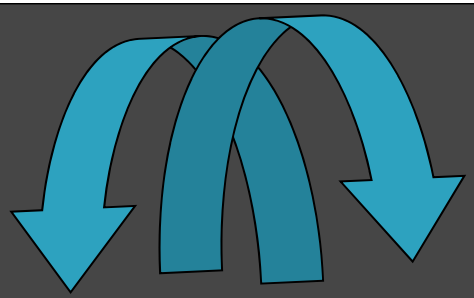
Compost
Methyl Bromide
Telone C35
Non fumigated

- **Plots (4 beds 15m long)**
- **Latin Sq. design (4*4)**
- **Same location for 3 consecutive years (i.e. no crop rotation)**

Marketable Yield



*** Indicates yield is significantly different than MB**



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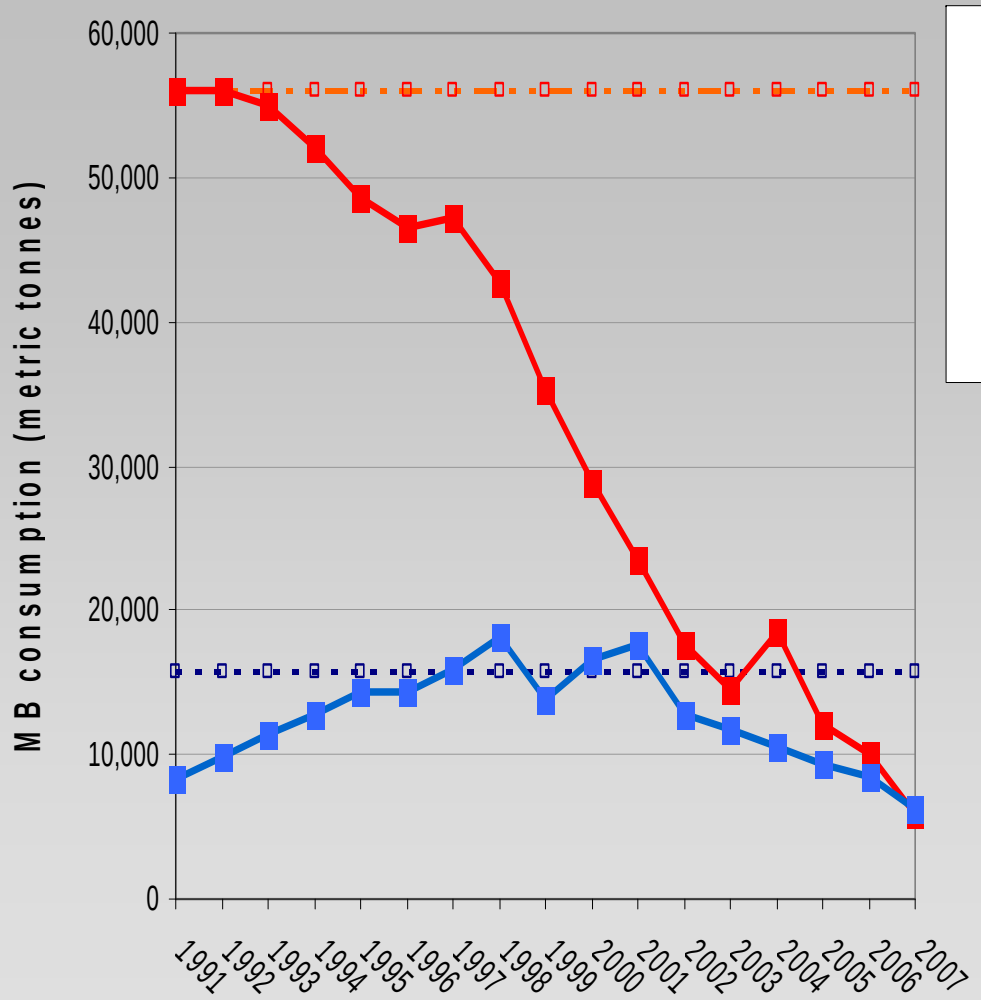
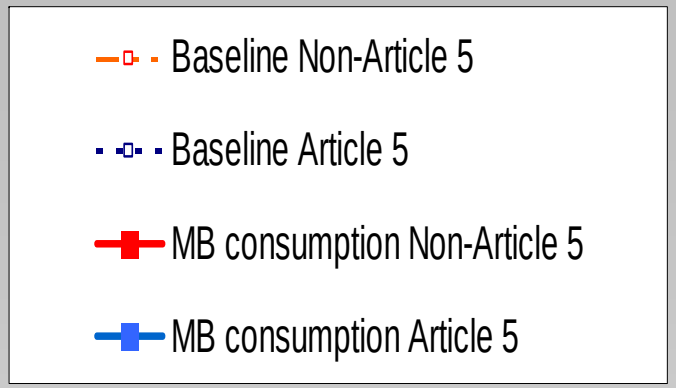
Methyl Bromide Phase Out
Local Programs– Global Impact
MB Global Consumption 1991–2007

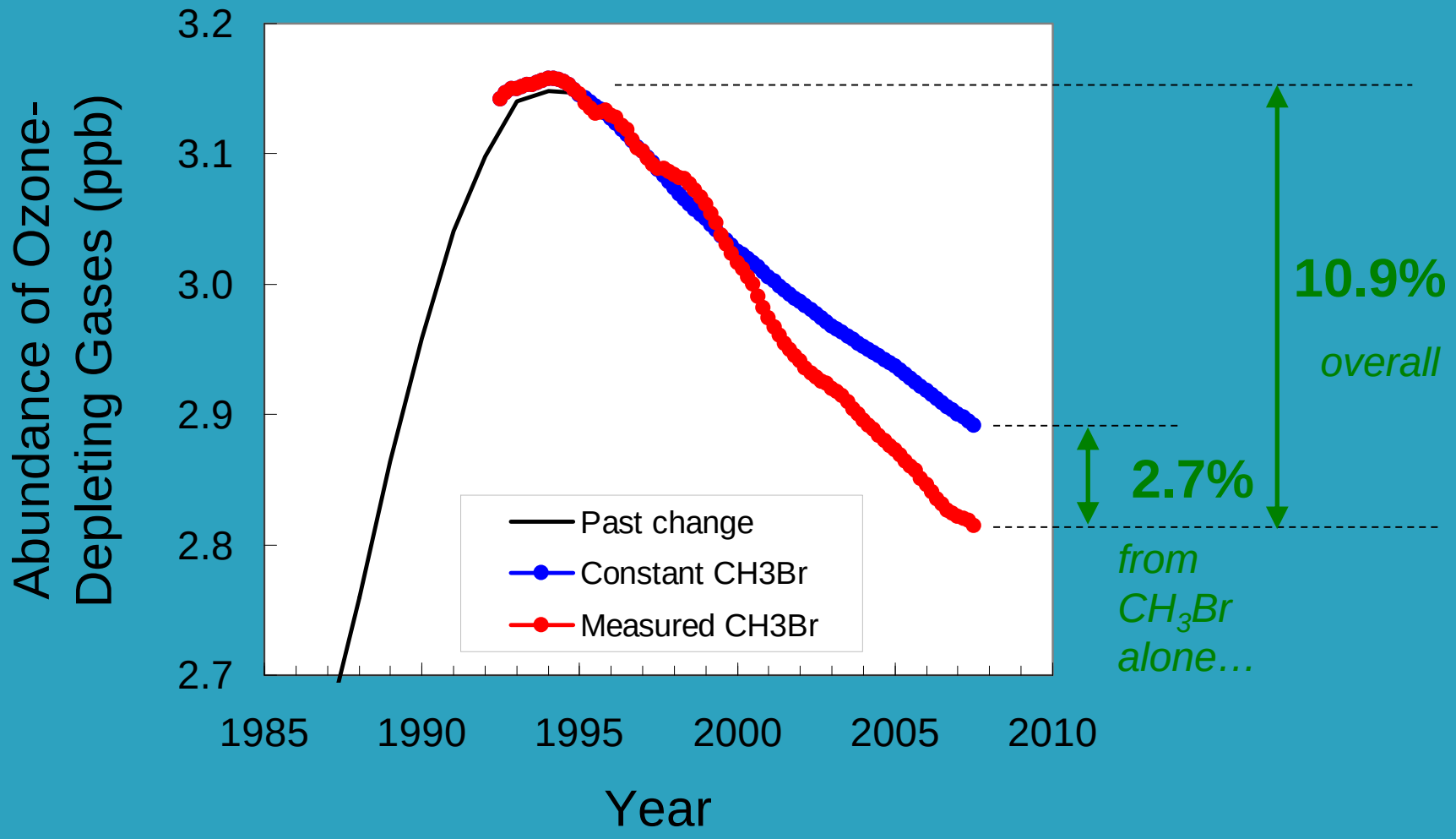




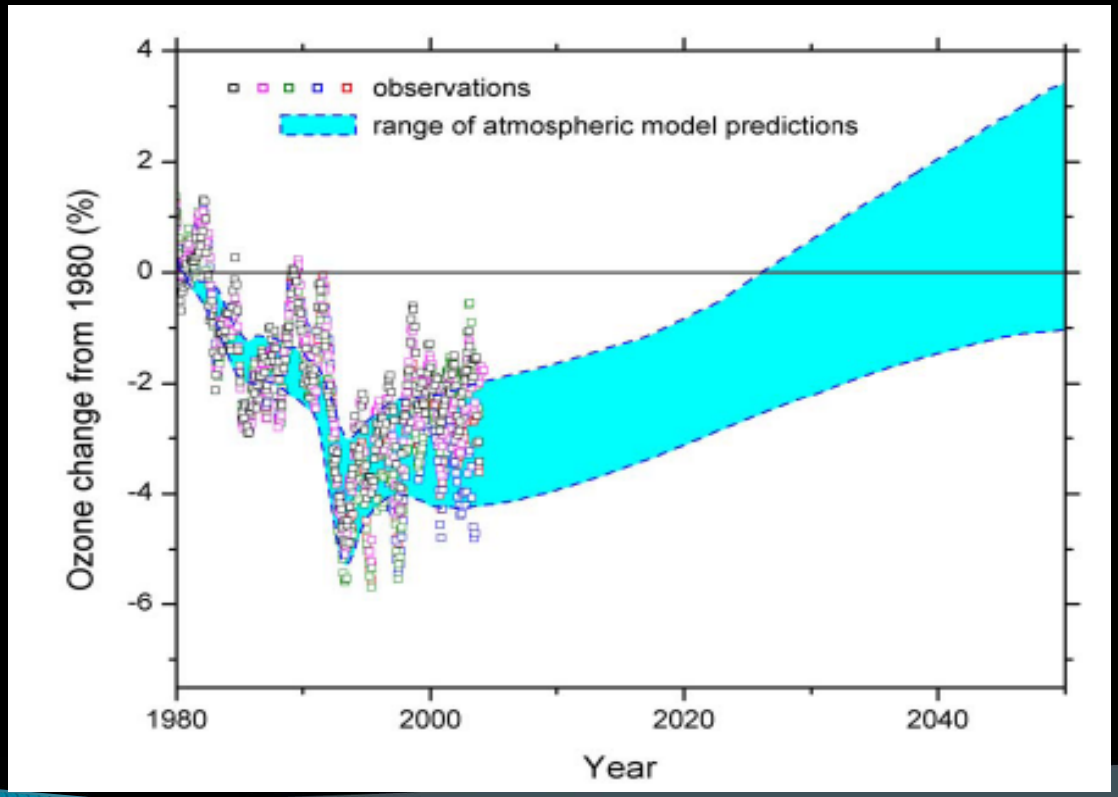
Courtesy Dr. Ian Porter
DPI-Australia
Co-Chair - MBTOC

Courtesy Dr. Jim Butler, Director
Earth System Research Laboratory's Global Monitoring Division
NOAA - National Oceanic and Atmospheric Administration

Tropospheric declines in CH_3BR account for ~25% of the overall decline



Summary: Benefit of The Montreal Protocol



Full compliance with the Montreal Protocol will see concentrations of stratospheric ozone return to baseline levels towards the middle of this century.

Sustainable Ag/ IPM Systems

Process Oriented and Problem Solving

vs.

Product Orientation

Information, Management, Knowledge

vs.

Energy Intensive Inputs

$$A + B = X$$

$$\left\{ \begin{matrix} A & & C \\ & D\ E & \\ F & & B \end{matrix} \right\} X$$

IPM 2.0

Towards future-proof crop protection in Europe