the Southern Region small fruit consortium

## 2005 Agent Training on Methyl Bromide Alternatives

### *February 24, 2005*

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# Biofumigant crops

Doug Sanders, and Luz Reyes

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# WHAT ARE THEY?

- Crops that produce secondary plant products that might have beneficial affect in managing plant pests.
- Brassicas or sorghums
- Produce isothiocyanate=Vapam

# BIOFUMIGANT CROPS

- BOTH TOPS AND ROOTS CAN BE EFFECTIVE
- SAMS AT UT HAS DONE CONSIDERABLE WORK WITH VARIOUS BRASSICAS
- HE HAS SETTLED ON MUSTARD SEED MEAL AS A WAY TO STANDARDIZE THINGS

# *AUSTRALIAN WORK 1992 WITH Brassica spp.*

- Total isothiocyanate (ITC) conc. from roots is 3.0 micro mol ITC/g soil.
- At a standard rate of application to soil 7,000 lbs dry weight/A.
- Which is equivalent to 156 nmol/g soil.

# *AUSTRALIAN WORK 1992 WITH Brassica spp.*

- This is much less than the estimated ITC conc. released by metham sodium of 2060 nmol methyl ITC/g soil,
- Brassica would produce at a rate much lower = 320 lb methyl ITC/A.

# OIL SEED RADISH AND SUDEX

# IMPORTANT SUDEX IS NOT TO BIG  3 FEET IS IDEAL

# SUDEX READY TO CUT 30 DAS

# DISK MOWER FOR FIRST CUTTING

# SMALL PIECES IMPORTANT

# SMALL AND SOFT STEMS BREAKDOWN SOONER

# SUDEX SECOND GROWTH 10 DAYS POST CUT

# 20 DAYS POST CUT

# AFTER 2 CUT LOOSES COMPETIVE ADVANTAGE

# OIL SEED RADISH

# EXCELLENT SMOTHER CROP

# COVERS FOLLOWING SNAP BEANS IN MI

| Treatments | Rate (lbs/A) | Biomass (lbs/A) | WBiomass (lbs/A) |
|---|---|---|---|
| OS radish | 15 | 3683* a | 34 a |
| Hairy vetch | 25 | 2233 b | 975 ab |
| Oats | 48 | 2619 b | 551 ab |
| Crimson clover | 12 | 2923 ab | 1470 bc |
| C mammoth red clover | 12 | 1000 c | 2083 c |
| Control | | 0 | 3966 d |
| LSD(0.05) | | 1020 | 988 |
| | | | |

# OSR NEEDS N TO GROW

# OSR HAS SMALL ROOTS

# FALL AND SPRING FLOWER FORMATION LIMITED

# SEED OSR AT 10 LBS/A

# FLIAL MOWER BEST

# SMALL PIECE ALLOW MORE FUMIGANT RELEASE

# OSR over winter 2003-4

# RYE COVER SHOWING SIGNS OF CROP RESIDUE

# COMPOSTS

COOP WITH FRANK LOUWS, DAVID MONKS

# COMPOST AN ALTERNATIVE

# SPREADER AT RATES OF 15 TO 30 YARDS/A

# SPREADER CALIBRATION AND UNIFORMITY IMPORTANT

# A LOOK AT 30 YARDS/A

# TOMATO YIELD 2004, CLINTON, NC

| TREAT | TOTAL | MARK | XL | Plt DW |
|---|---|---|---|---|
| **CMC** | 2903a | 2697a | 1006 | 257 |
| **CMC+T382** | 3131ab | 2873abc | 961 | 239 |
| **CMC+Telo** | 3341abc | 3123abc | 980 | 247 |
| **Compost2** | 2743a | 2493a | 804 | 262 |
| **Compost3** | 3130ab | 2790ab | 1369 | 191 |
| **Telone-C35** | 3984bc | 3737bc | 1107 | 194 |
| **Telone-C35+F** | 4262c | 3870c | 1291 | 236 |
| **Control** | 2496a | 2213a | 920 | 157 |
| LSD .05 | 1031* | 1034 * | 529ns | 87ns |

# WE HAVE HAD FALL STAND PROBLEMS LIKE THESE COLLARDS

# Telone + Xtra Fert

# McGill Compost

# Telone

# EC compost

# McGill Compost

# EC Compost

# USEFUL WEB SITES

- http://www.publish.csiro.au/index.cfm
- http://www.egr.msu.edu/age/extension_outreach/AEIS671.pdf
- http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E2907.pdf
- http://info.ag.uidaho.edu/pps/toc.pdf
- http://www.publish.csiro.au/nid/72/paper/EA02150.htm
- http://www.ento.csiro.au/research/pestmgmt/biofumigation/Images/BiofumigationUpdate14.pdf
- http://www.google.com/u/washingtonstateuniversity?q=biofumigant+crops&submit=Submit

# Economic Evaluation of Methyl Bromide Alternatives for Strawberry Production in Eastern North Carolina

- Cooperative effort between the Departments of Horticulture, Plant Pathology and Agricultural Economics
- Purpose: Evaluate the economic feasibility of various chemical alternatives that can be substituted for methyl bromide (MB) in strawberry production.
- Companion study focuses on tomatoes

# Methodology & Assumptions

- The base cost model was developed for a 5 acre strawberry planting using MB as the fumigant.
- Production practices were based on the management practices recommended by research & extension specialists and reviewed by growers.
- Input prices were obtained from local dealers who regularly supply NC strawberry producers.

# Methodology & Assumptions

- Machinery & equipment was purchased new at 2001 prices.
- Labor cost estimates reflected the true costs of labor and not just wage rates.
- 2/3's of the strawberries were sold through PYO operations @ \$0.90/lb and 1/3 were sold at a fruit stand @ \$1.40/lb.
- Partial budget analysis was used evaluate alternate fumigants relative to MB.

# Strawberry Cost Estimates

| Production Stage | Cost Estimate |
|---|---|
| Land Preparation | $ 516 |
| Pre-Plant Operations | 4,399 |
| Trans/Post-Plant Ops | 2,035 |
| Dormant Period | 939 |
| Pre-Harvest Operations | 2,115 |
| Harvest Operations | 3,528 |
| Total Cost Estimate | $13,532 |

# Partial Budgeting

| | |
|---|---|
| **Negative Effects:** | |
| Added Costs | $ ________ |
| Reduced Returns | $ ________ |
| Total Negative Effects | $ ________ |
| **Positive Effects:** | |
| Reduced Costs | $ ________ |
| Added Returns | $ ________ |
| Total Positive Effects | $ ________ |
| **Total Effects** (+/-) Returns | $ ________ |

# Estimated Fumigation Costs per Acre

| Fumigant | Total Costs | Reduced Costs |
|---|---|---|
| Methyl Bromide | $1,267 | $ 0 |
| Metam Sodium (Shank) | $1,196 | $ 71 |
| Chloropicrin | $1,175 | $ 92 |
| Telone-C35 | $1,107 | $160 |
| InLine (drip) | $1,059 | $208 |
| Telone II | $ 988 | $279 |
| Metam Sodium (drip) | $ 904 | $363 |
| Non-fumigated (check) | $ 767 | $500 |

# Estimated Average Yields per Acre

| Fumigant | Avg. Yld. | Years |
|---|---|---|
| Chloropicrin | 28,377 lbs | 2000 - 01 |
| Telone-C35 | 26,806 lbs | 1996 – 01 |
| Methyl Bromide | 26,673 lbs | 1996 – 01 |
| Metam Sodium (Shank) | 26,604 lbs | 1996 – 01 |
| InLine (drip) | 24,193 lbs | 2000 - 01 |
| Metam Sodium (drip) | 24,103 lbs | 2000 - 01 |
| Telone II | 22,253 lbs | 2000 - 01 |
| Non-fumigated (check) | 20,010 lbs | 1996 – 01 |

# Estimated Returns per Acre

| Fumigant | Additional Returns | Net Returns |
|---|---|---|
| Chloropicrin | $1,768 | $16,687 |
| Telone-C35 | $291 | $15,210 |
| Metam Sodium (Shank) | $3 | $14,922 |
| Methyl Bromide | $0 | $14,919 |
| Metam Sodium (drip) | -$2,164 | $12,755 |
| InLine (drip) | -$2,230 | $12,689 |
| Telone II | -$4,167 | $10,752 |
| Non-fumigated (check) | -$6,052 | $ 8,867 |

# Conclusions:

- There are economically feasible alternatives to MB in strawberry production in the southeastern U.S. Technical issues may remain.
- Chloropicrin showed the “best” potential for growing conditions in eastern N.C. relative to MB ($1,768/A).
- Telone C35 showed a modest improvement relative to MB ($291/A)under low pressure conditions.
- Shank-applied Metam Sodium showed virtually the same total effects as MB ($3/A).

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NC STATE UNIVERSITY

# EFFICACY OF MB ALTERNATIVES FOR VERTICILLIUM AND WEED MANAGEMENT IN TOMATOES


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Dreama Milks
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Department of Plant Pathology and Horticulture
North Carolina State University

# Tomato Research

# PRIMARY SOILBORNE DISEASES

## Verticillium wilt race 2

**OBJECTIVE:**

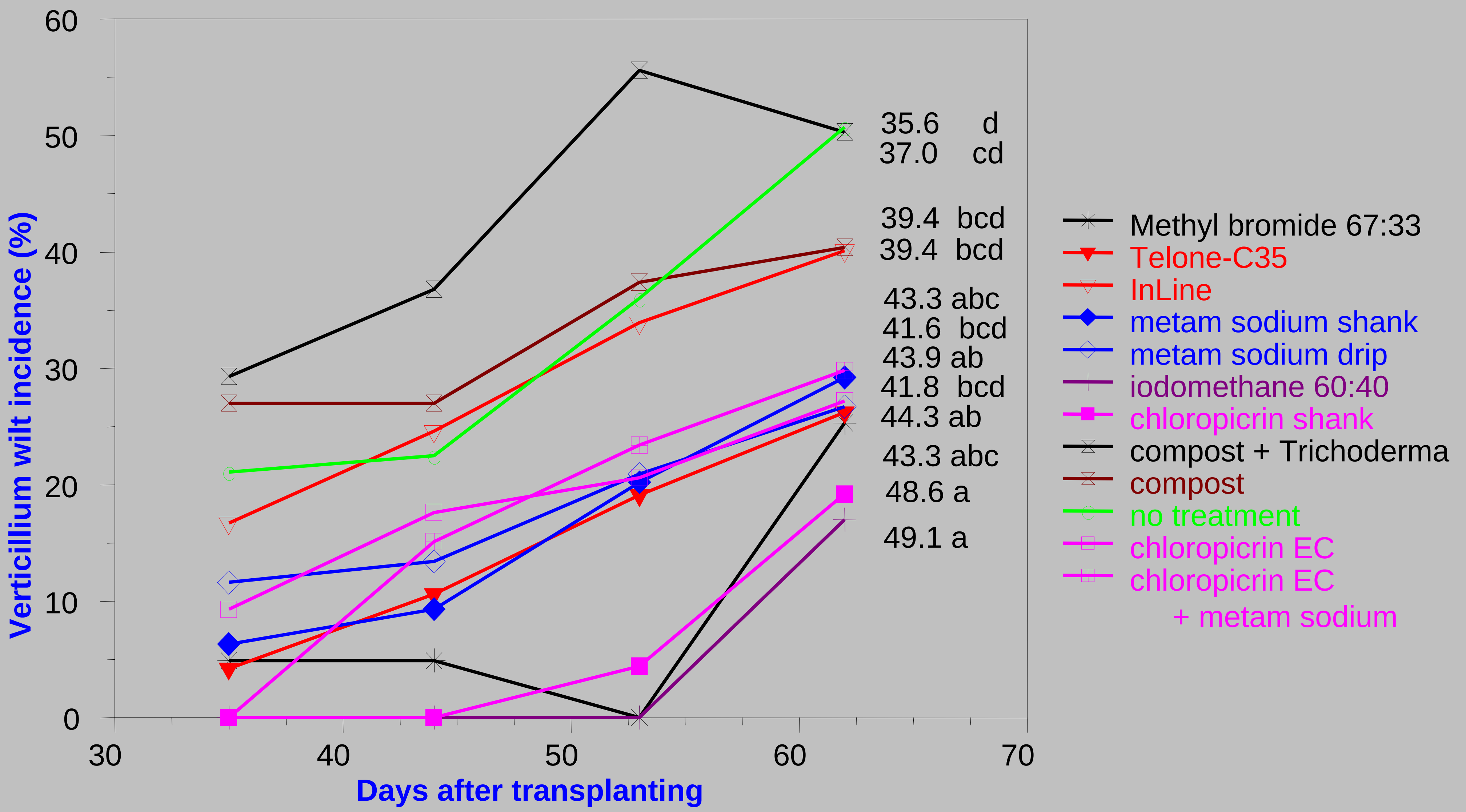
**To compare shank applied and drip applied products to manage Verticillium wilt of tomatoes in Western North Carolina.**

| Treatment | Application Method | Rate (broadcast) |
|---|---|---|
| Non-fumigated | | |
| MB: chloropicrin (67:33) | Shank | 400 lbs/A |
| Telone-C35 | Shank | 35 gal/A |
| InLine | Drip | 26 gal/A |
| Metam sodium | Sprayed + Till | 75 gal/A |
| Metam sodium drip | Drip | 75 gal/A |
| MI: Chloropicrin (60:40)<br>(50:50)<br>(33:67 - Shank & EC) | Shank | 300 lb/A<br>250 lb/A<br>300 lb/A |
| Chloropicrin (96%)<br>Chloropicrin Plus (75%) | Shank | 113-195 lb/A<br>256 lb/A |
| Chloropicrin EC | Drip | 200 lb/A |
| Chloropicrin EC<br>+ Metam sodium | Drip + 1 week delay | 200 lb/A<br>75 gal/A |

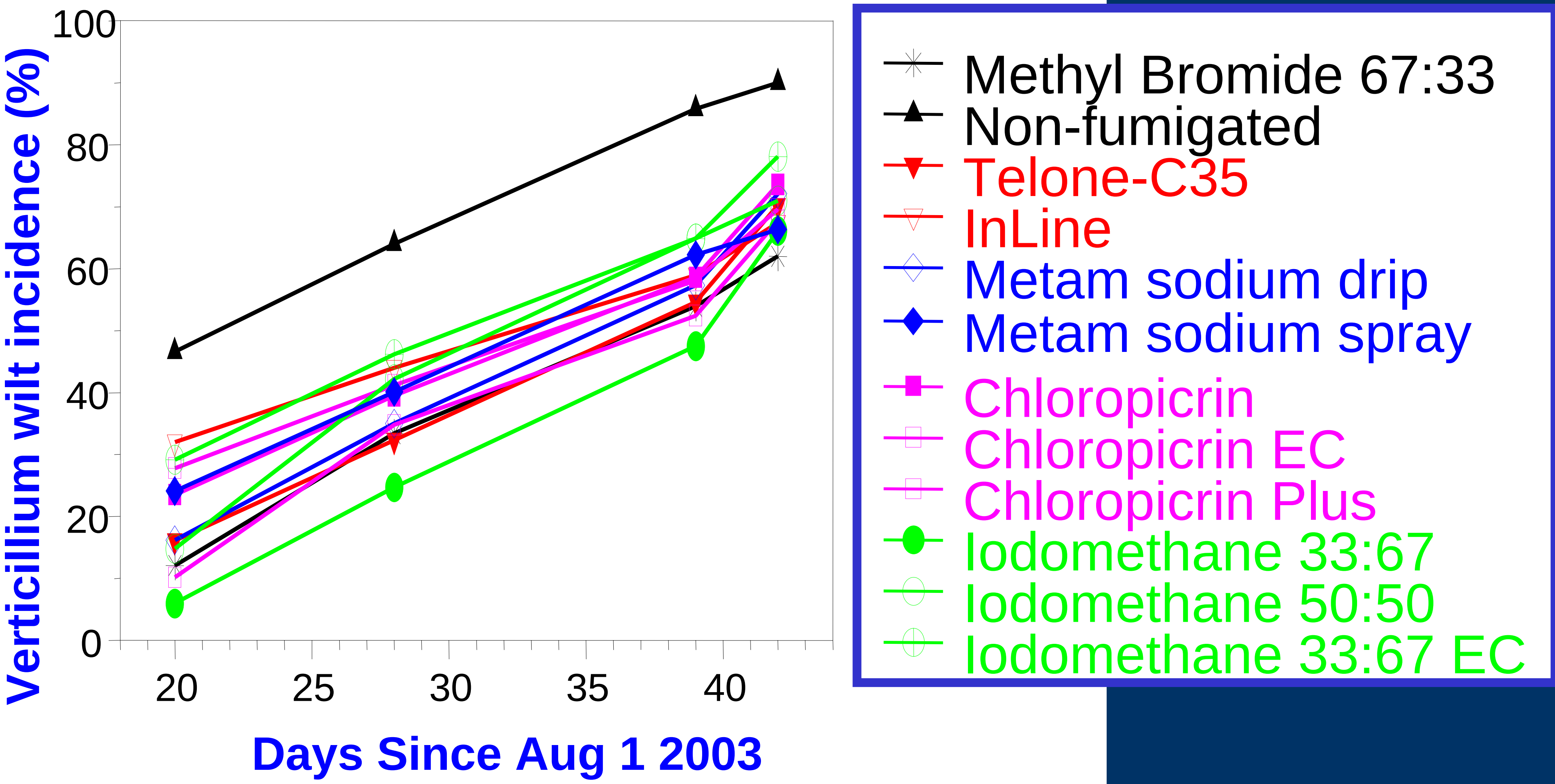
# Experimental Design

- 100 ft plots, planted and harvested inner 15 plants
- RCBD with 4 replications in a field with a history of Verticillium pressure
- Weekly evaluations for Verticillium wilt incidence
- Weekly (6-8) harvests
- 3 year trial

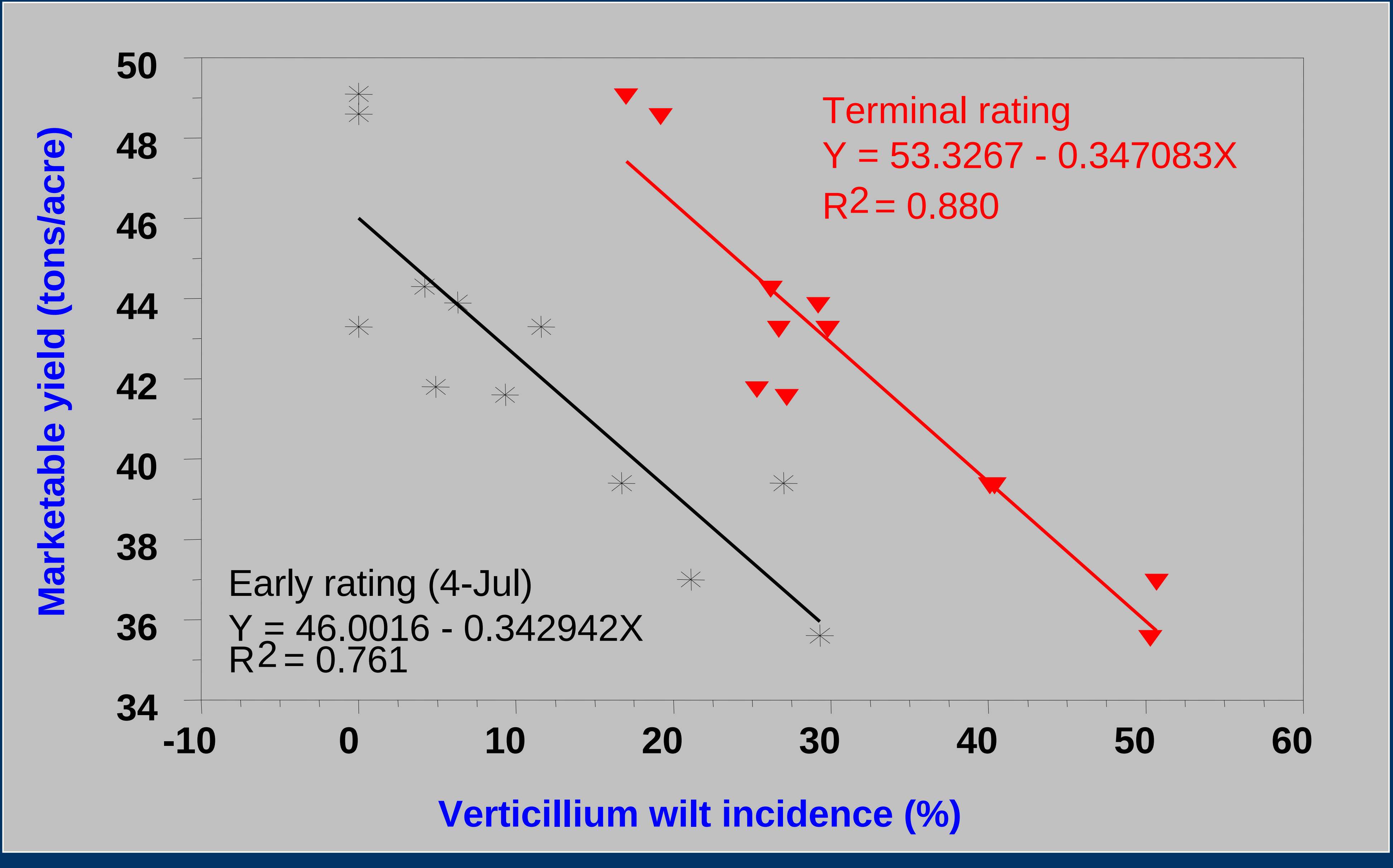
# 2002 Incidence of Verticillium Wilt



# 2003 Incidence of Verticillium Wilt



# 2002 Verticillium Wilt Incidence and Yield

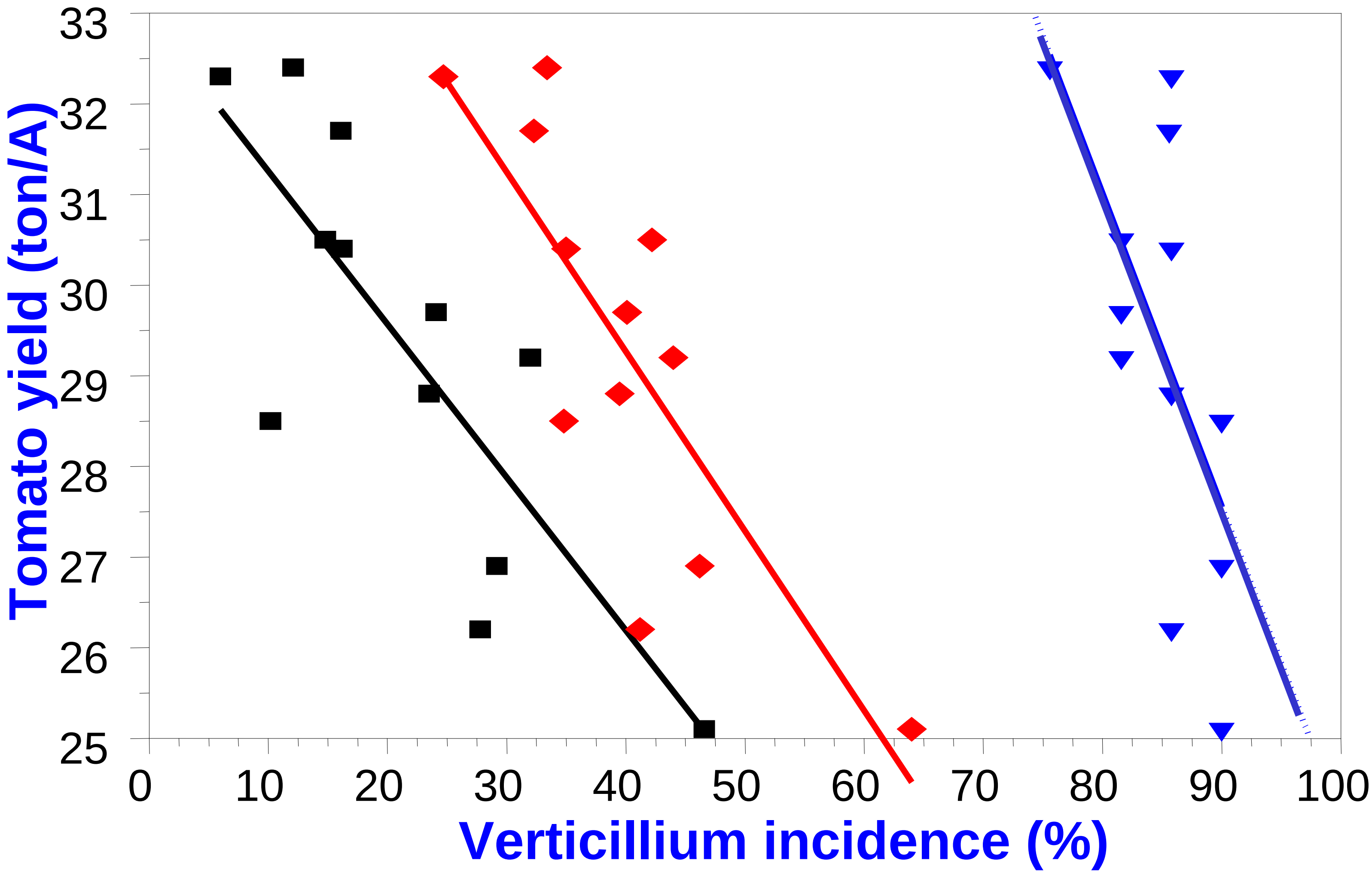


# 2003 Verticillium Wilt Incidence and Yield

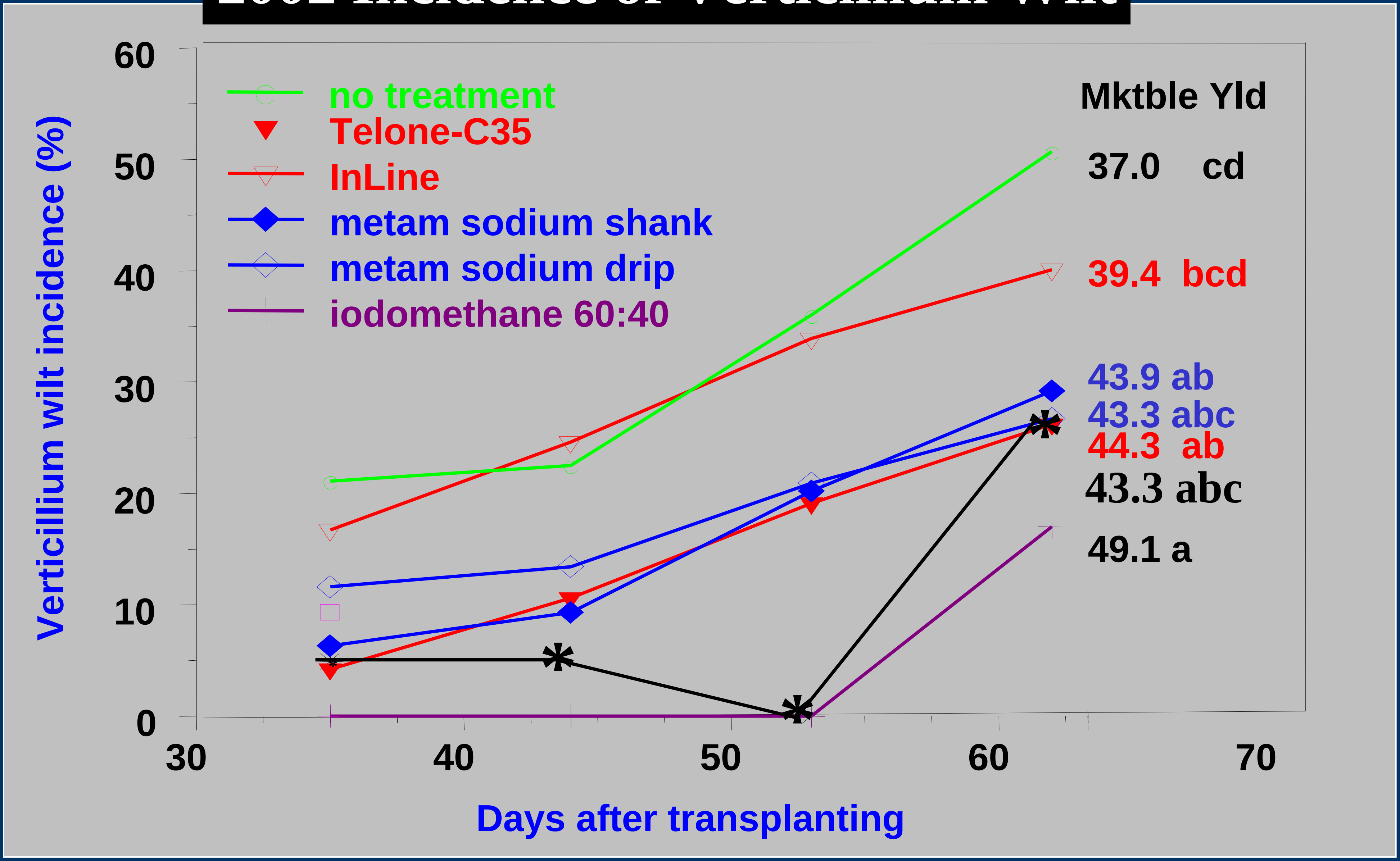
Y = 32.948 - 0.168896X
EMS = 2.0913
$R^2$ = 0.658

Y = 37.1854 - 0.198X
EMS = 2.08896
$R^2$ = 0.658

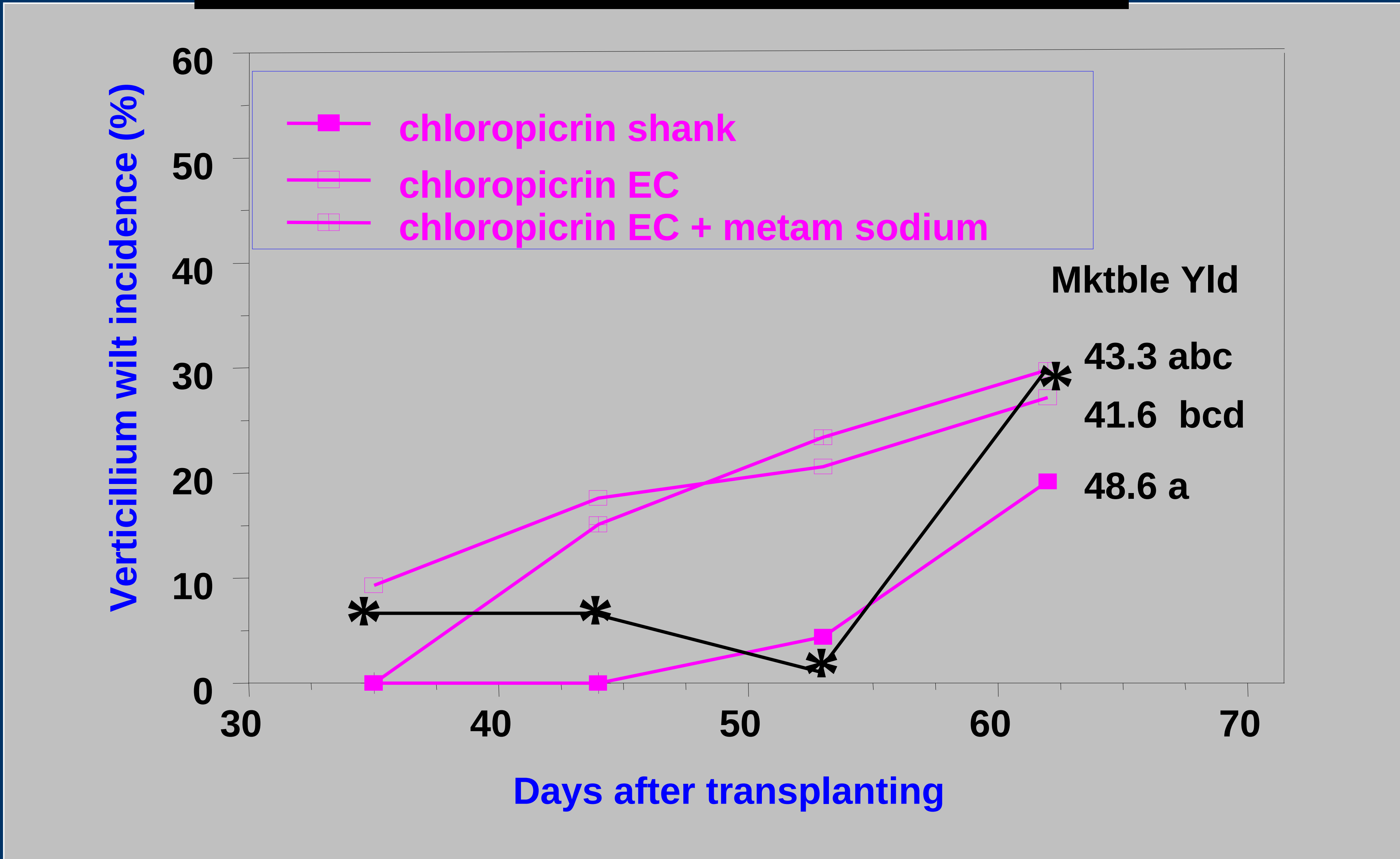
Y = 58.6444 - 0.345401X
EMS = 3.71207
$R^2$ = 0.392



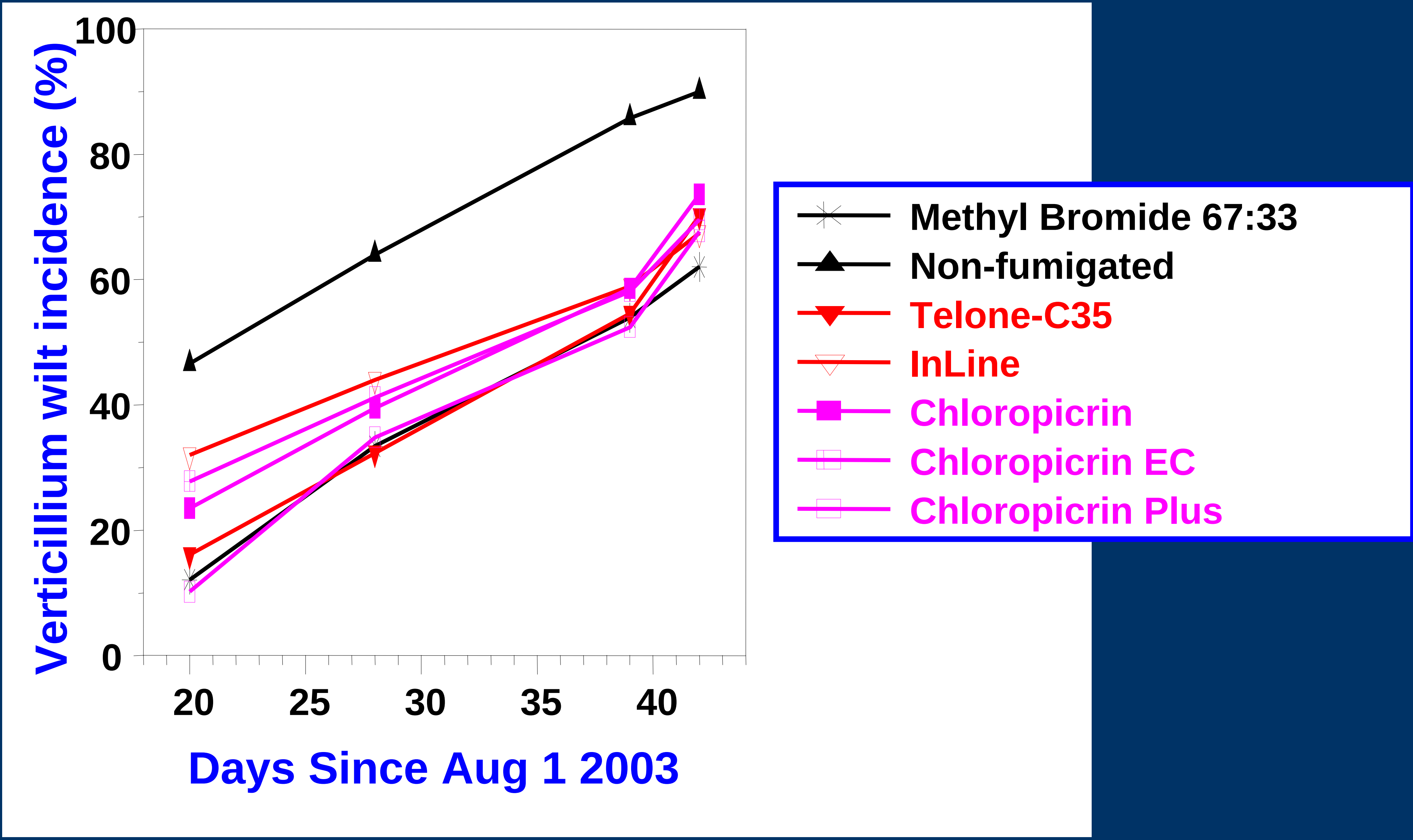
# 2002 Incidence of Verticillium Wilt



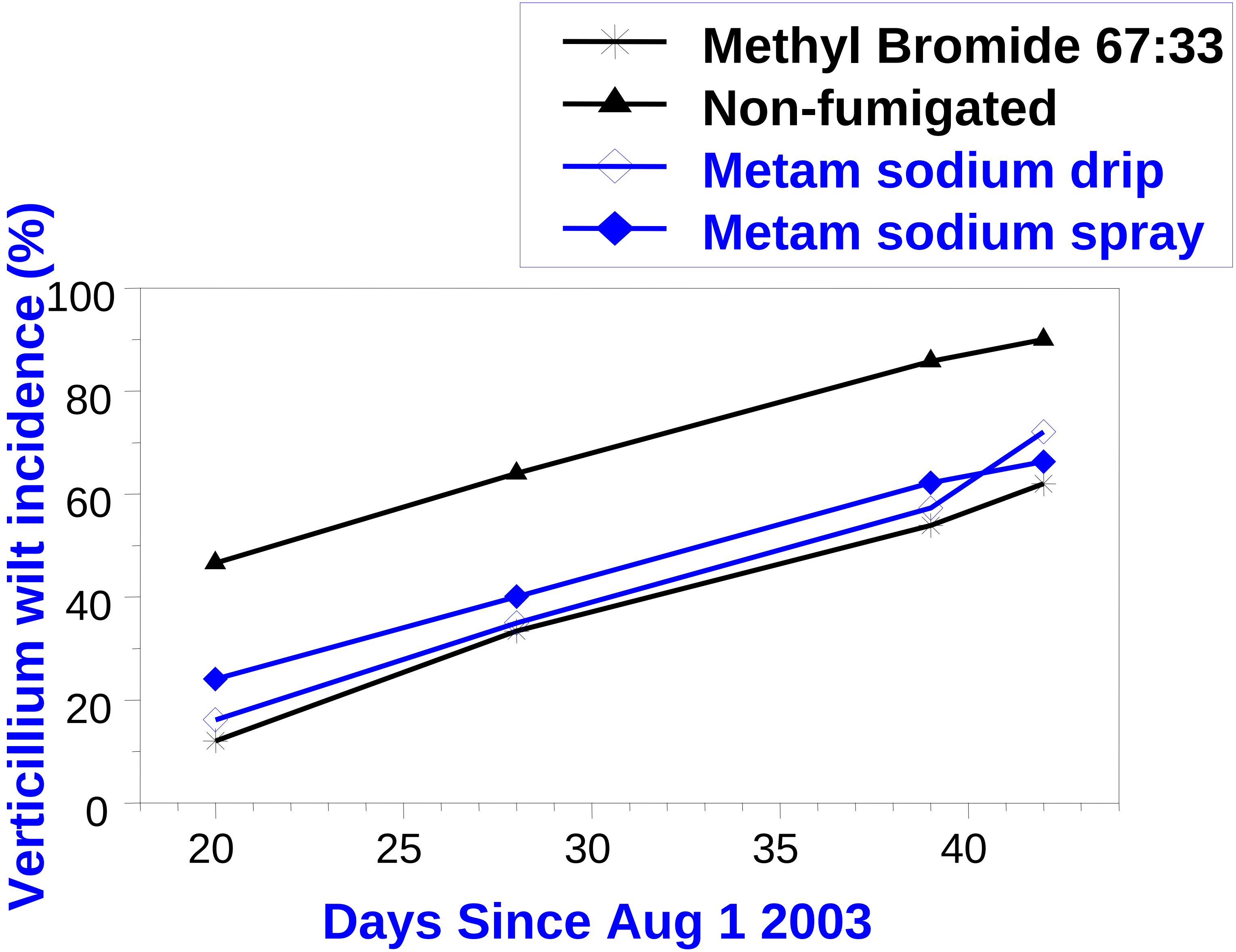
# 2002 Incidence of Verticillium Wilt



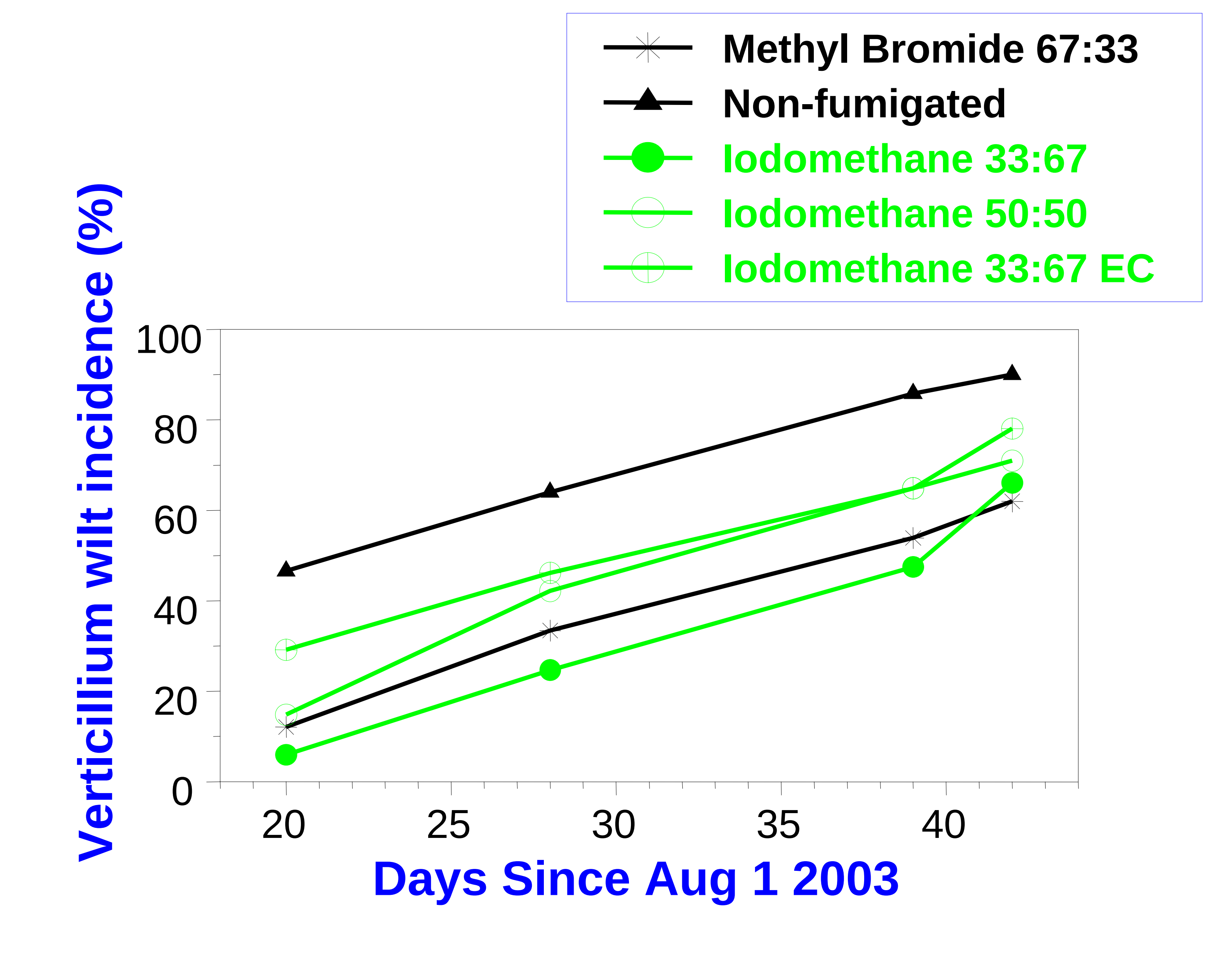
# 2003 Incidence of Verticillium Wilt

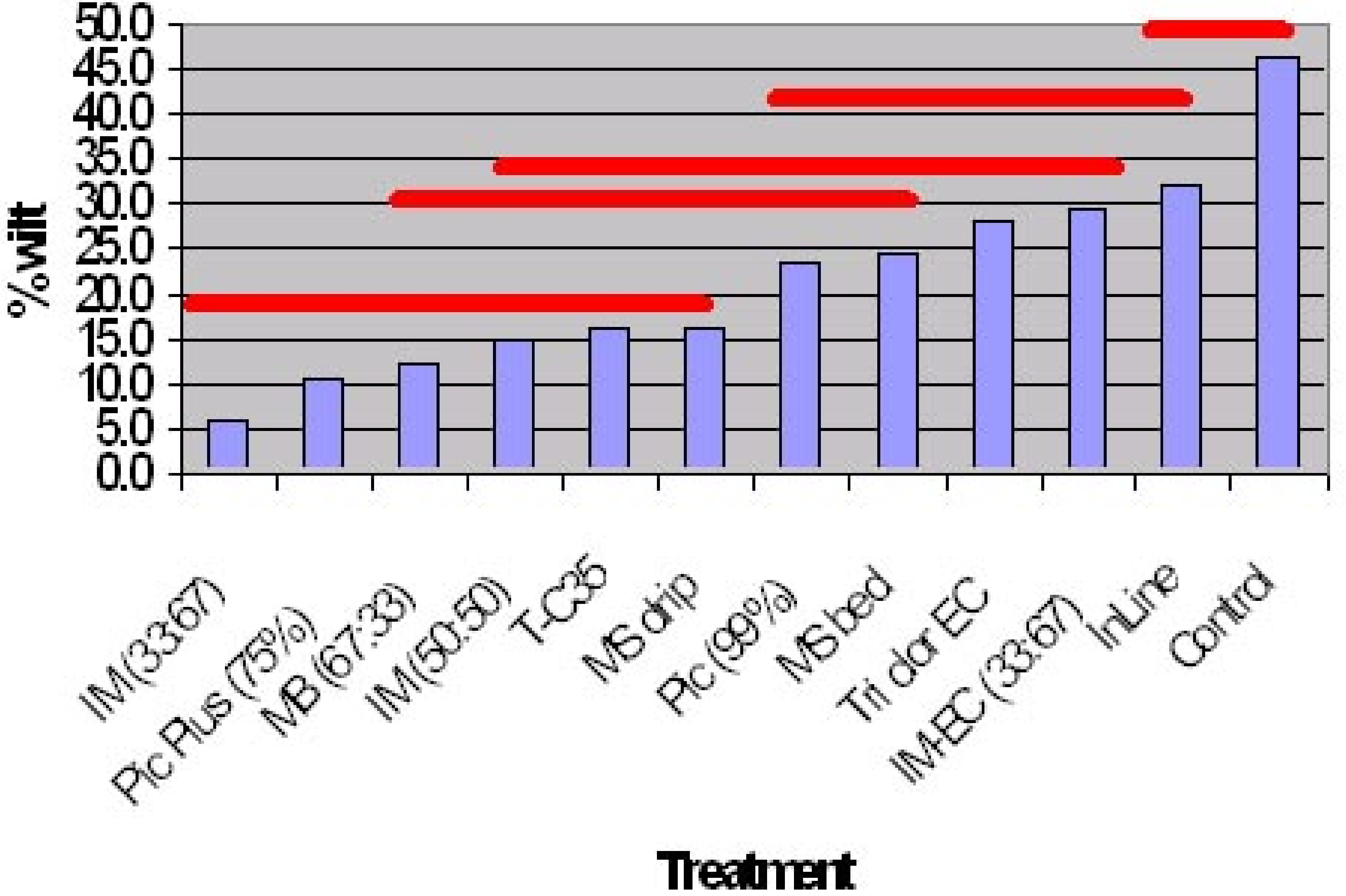


# 2003 Incidence of Verticillium Wilt



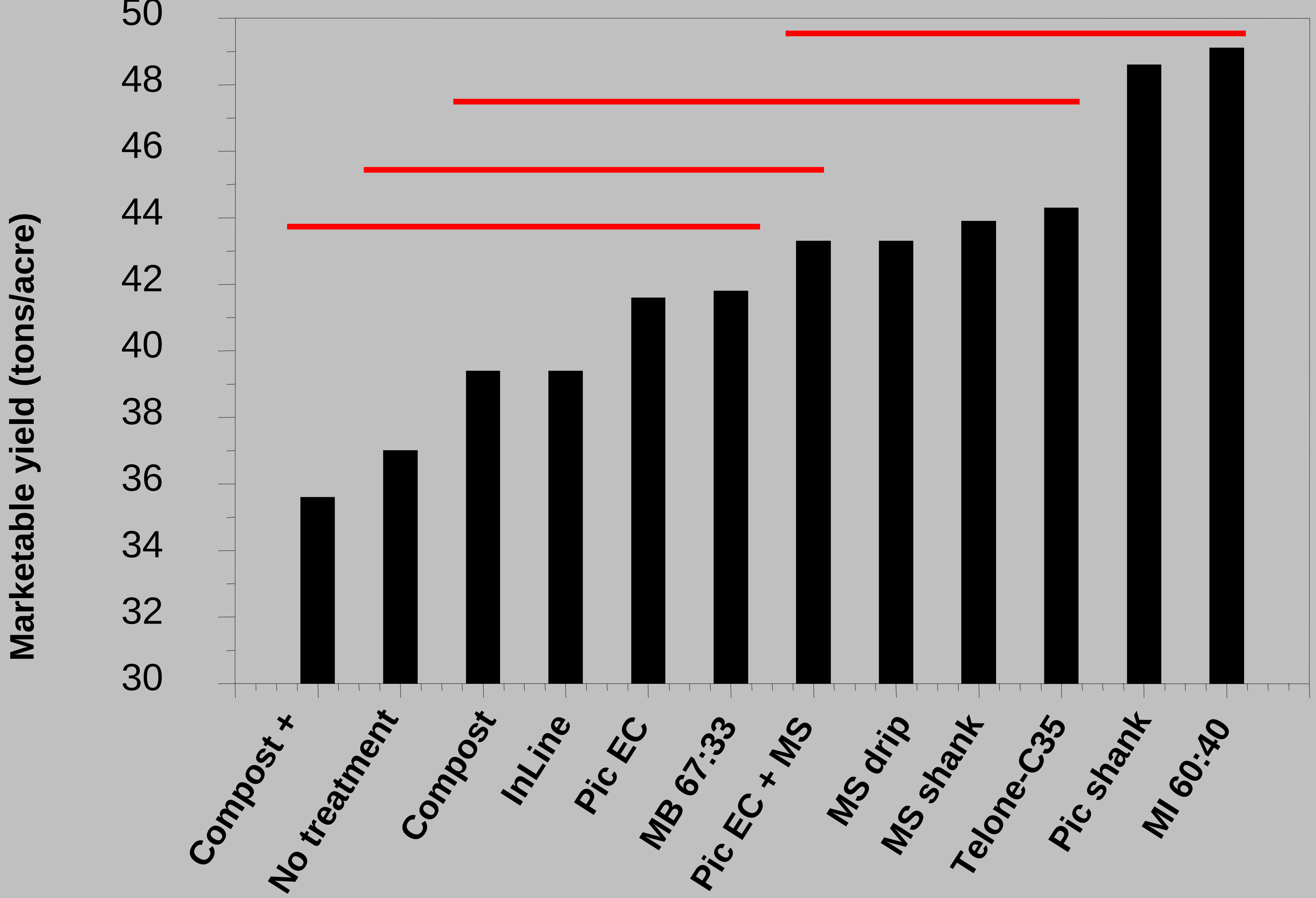
# 2003 Incidence of Verticillium Wilt

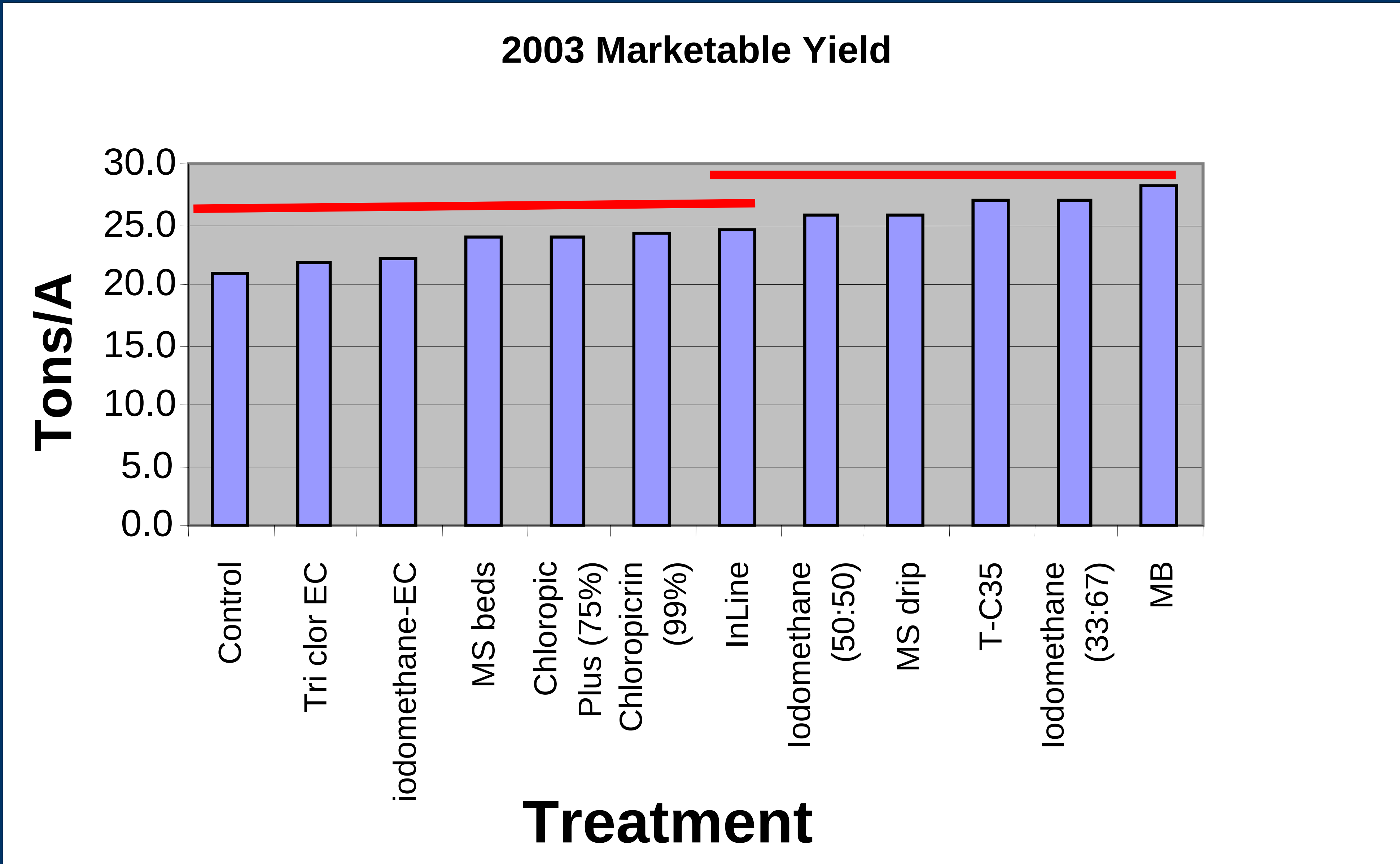


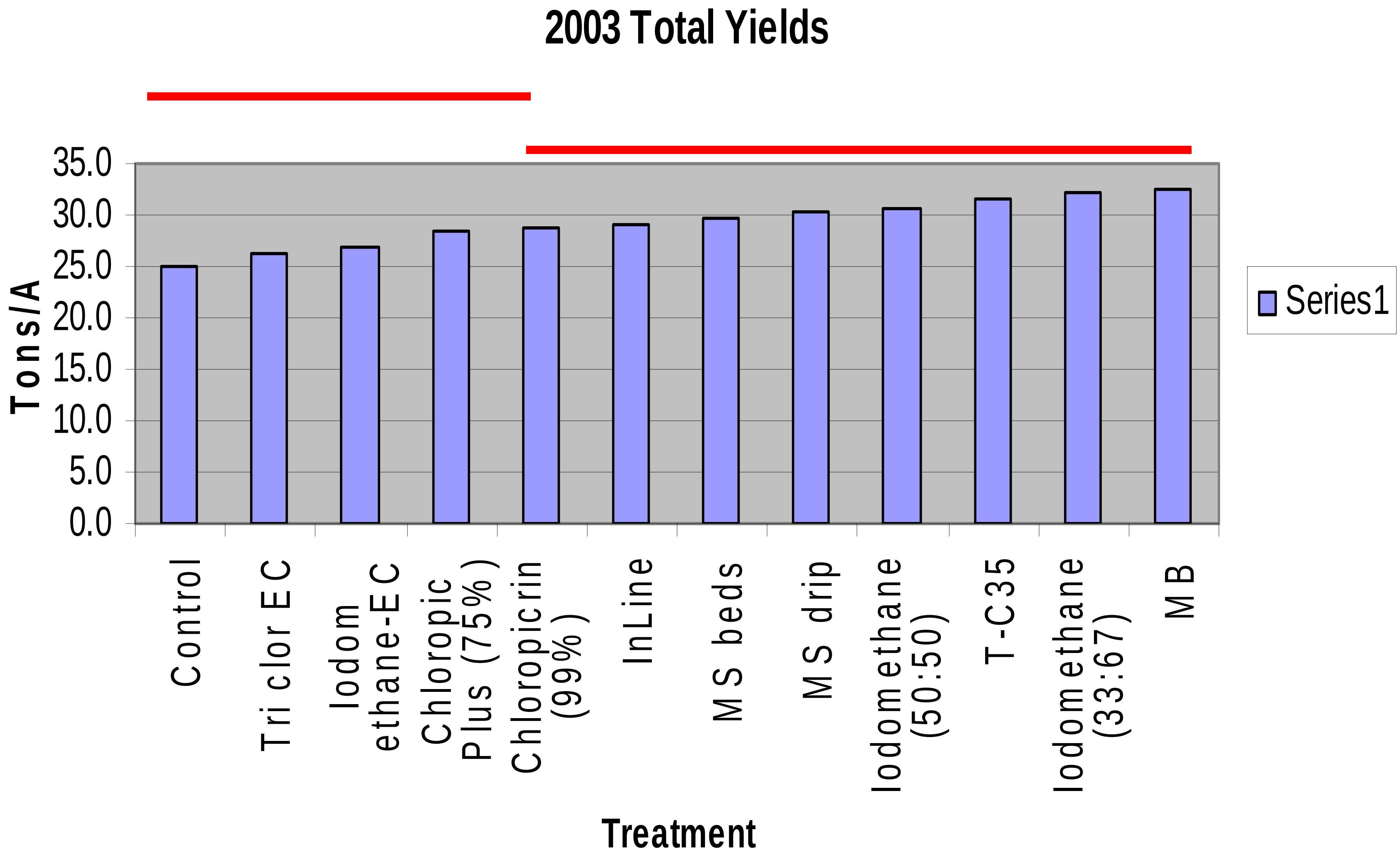


50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
% wilt
IM(33:67)
Pic Plus (75%)
MB (67:33)
IM(50:50)
T-C35
MS drip
Pic (99%)
MS bed
Tri dor EC
IM-EC (33:67)
InLine
Control
Treatment

# 2002 Marketable Yield




2003 Marketable Yield
Tons/A
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Control
Tri clor EC
iodomethane-EC
MS beds
Chloropic Plus (75%)
Chloropicrin (99%)
InLine
Iodomethane (50:50)
MS drip
T-C35
Iodomethane (33:67)
MB
Treatment



2003 Total Yields
Tons/A
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Control
Tri clor E C
Iodom ethane-E C
Chloropic Plus (75%)
Chloropicrin (99%)
InLine
M S beds
M S drip
Iodomethane (50:50)
T-C35
Iodomethane (33:67)
M B
Treatment
Series1

# IR-4 Trial s 2004

| | |
|---|---|
| 1 | Non Fumigated |
| 2 | Non Fumigated (hand Weeded |
| 3 | MB 67:33 (400 lb/A) |
| 4 | SEP 100 (75 lb a.i.) |
| 5 | Propozone (60 gal/A) |
| 6 | Telone C35 (35 gal/A) |
| 7 | Propozone drip (6 0 gal) |
| 8 | Chloropicrin (150 lb/A) |
| 9 | Chloropicrin (150 lb/A) + Kapam (75 gal/A 1 wk later) |
| 10 | Chloropicrin Plus (256 lb/A) |

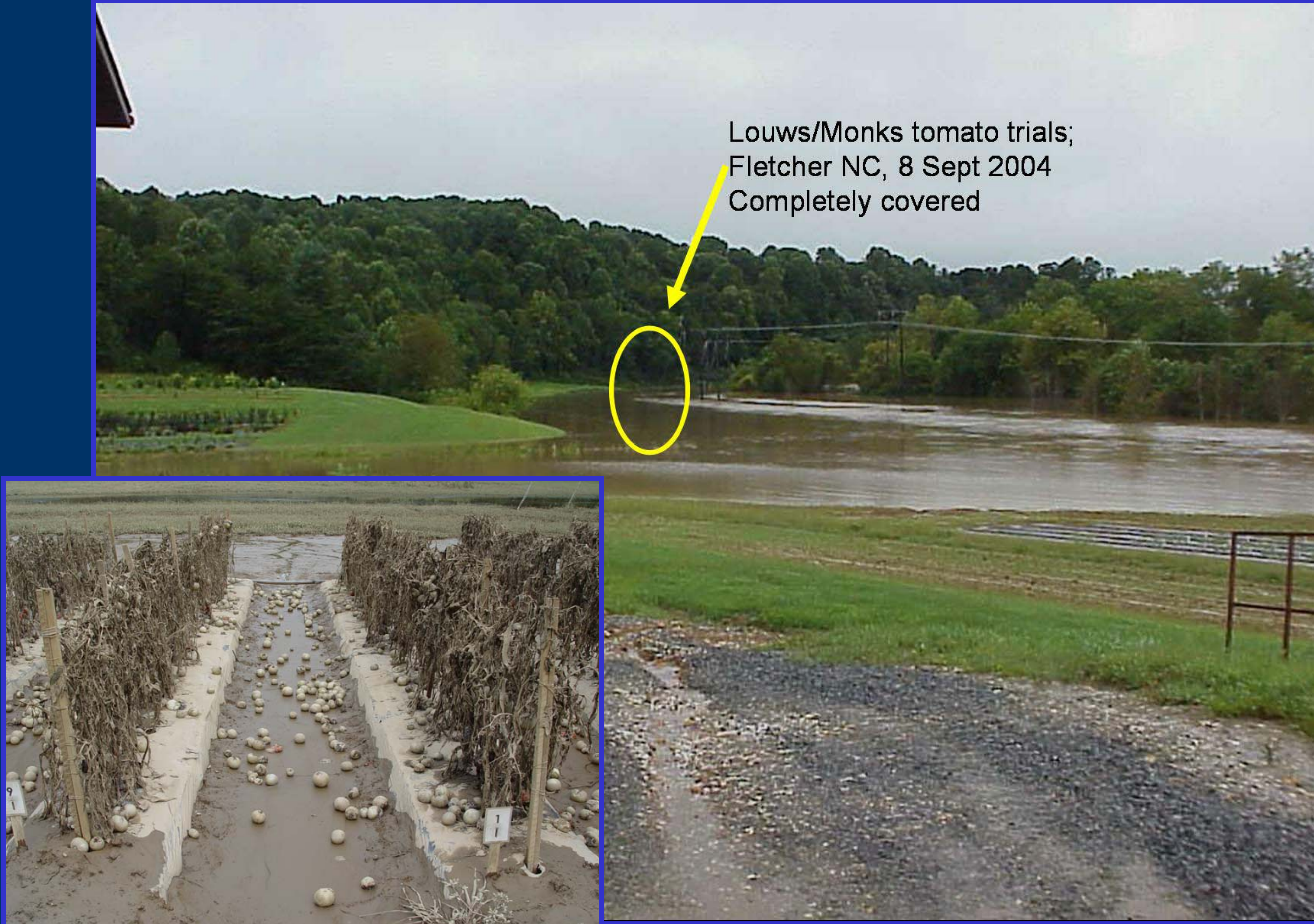
| Pre-plant Treatment | Rate (broadcast equiv) | Total weed count/ plot 19 Jul | | 19 Aug | |
|---|---|---|---|---|---|
| Propozone (Drip applied) | 60 gal/A | 0.3 | a | 0.0 | bc |
| Methyl bromide: chloropicrin (67:33) | 400 lbs/A | 0.5 | a | 0.0 | a |
| SEP 100 | 75 lbs a.i./A | 0.5 | a | 0.8 | a |
| Propozone (Shank applied) | 60 gal/A | 1.0 | a | 2.5 | a |
| Control (hand-weeded) | ---------- | 2.5 | a | 3.0 | a |
| Telone-C35 | 35 gal/A | 5.5 | a | 5.8 | a |
| Chloropicrin (99%) + K-Pam (7 days later) | 150 lb/A 75 gal/A | 14.3 | ab | 12.5 | ab |
| Chloropicrin (99%) | 150 lb/A | 27.8 | bc | 26.5 | bc |
| Chloropicrin Plus (75%) | 256 lbA | 36.8 | c | 34.8 | c |
| Control (non-weeded) | ------------ | 37.8 | c | 25.0 | bc |

1. Non Fumigated
2. Non Fumigated (hand Weeded
3. MB 67:33 (400 lb/A)
4. Chloropicrin (150 lb/A)
5. Chloropicrin (150 lb/A) + Sulfentrazone
6. Chloropicrin (150 lb/A) + Pre Dual + Post TSS
7. Chloropicrin (150 lb/A) + Pre Dual + Post Halsosulfuron
8. Chloropicrin (150 lb/A) + Pre Dual
9. Chloropicrin (150 lb/A) + Pre Goal
10. Chloropicrin (150 lb/A) + K-pam (drip after 1 wk 75 gal/A)
11. Telone C35 (35 gal/A)
12. K-pam (Broadcast - 75 gal/A 1 wk later)

# WEED INCIDENCE 19 AUG 2004 (Weeds/plot)

| | |
|---|---|
| 1. Non Fumigated | 32.0 c |
| 2. Non Fumigated (hand Weeded) | 0.5 a |
| 4. Chloropicrin (150 lb/A) | 22.0 bc |
| 5. Chloropicrin (150 lb/A) + Sulfentrazone | 1.0 a |
| 8. Chloropicrin (150 lb/A) + Pre Dual | 0.5 a |
| 9. Chloropicrin (150 lb/A) + Pre Goal | 1.5 a |
| 10. Chloropicrin (150 lb/A) + K-pam (drip after 1 wk 75 gal/A) | 0 a |
| 11. Telone C35 (35 gal/A) | 3.0 ab |
| 12. K-Pam (Broadcast - 75 gal/A 1 wk later) | 0.5 a |


09/15/99 09:46 AM EDT
06:46 AM PDT
13:46 GMT

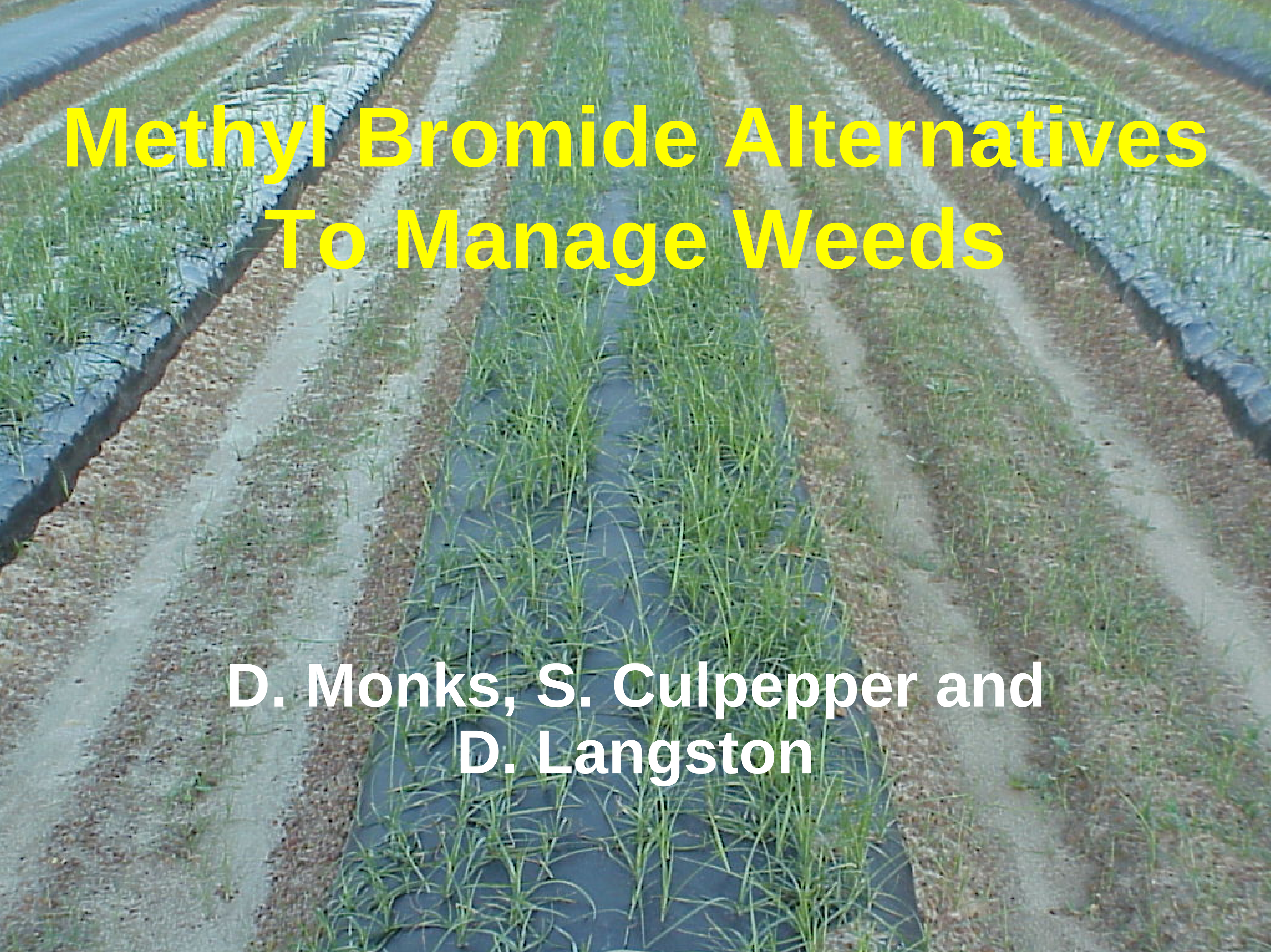

Louws/Monks tomato trials;
Fletcher NC, 8 Sept 2004
Completely covered

## CONCLUSIONS:

**Short term: Leading chemical alternatives include:**

- **Telone-C35 + herbicides**
- **chloropicrin (alone) + herbicides**
- **metam sodium/potassium**
- **iodomethane:pic (when registered).**

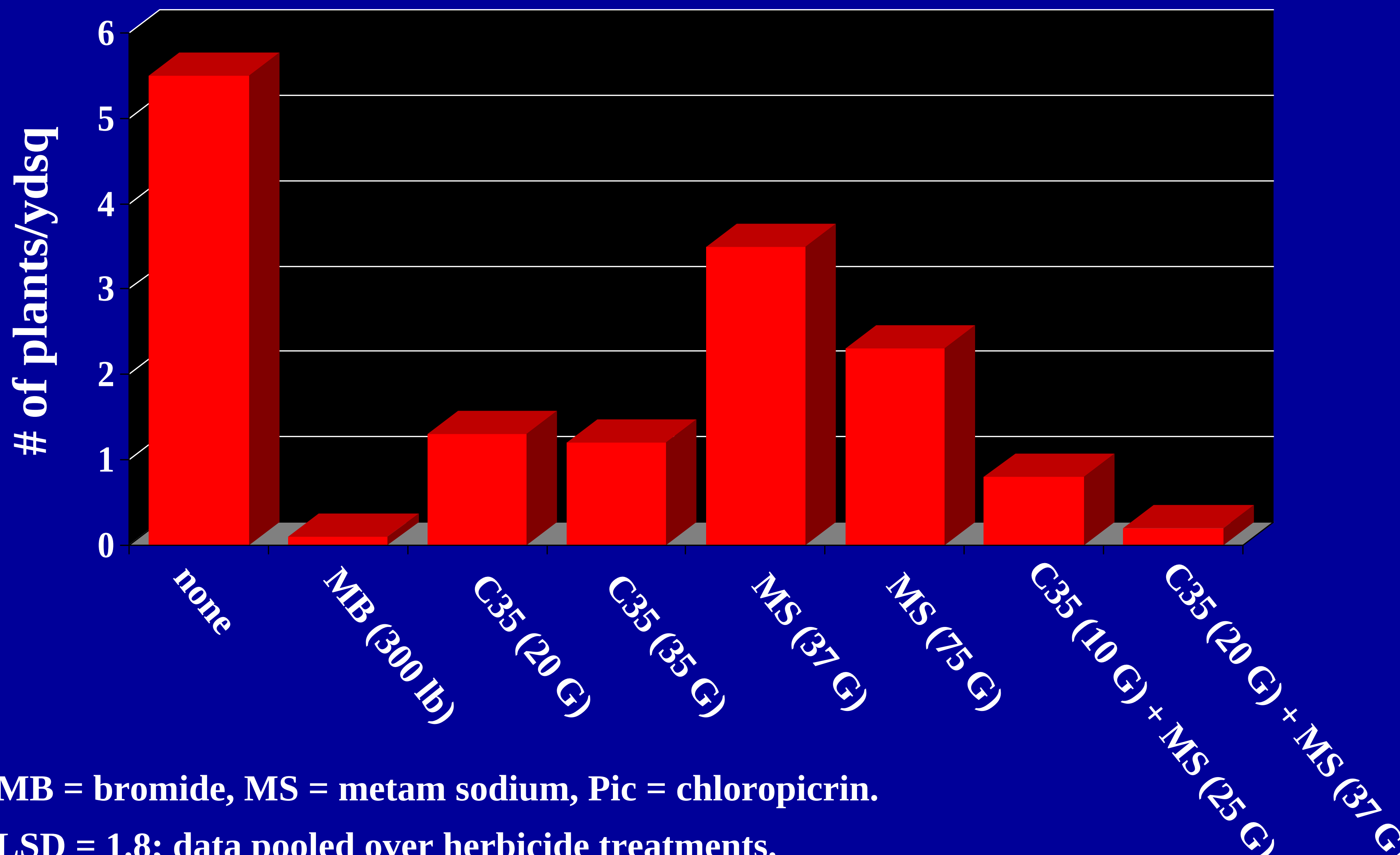
**Shank applied products tended to perform better than the drip applied products.**


Methyl Bromide Alternatives
To Manage Weeds
D. Monks, S. Culpepper and
D. Langston

# Options to Improve Weed Control

- Herbicide(s) preplant under plastic
- Herbicide(s) banded over top of crop and plastic
- Hand removal

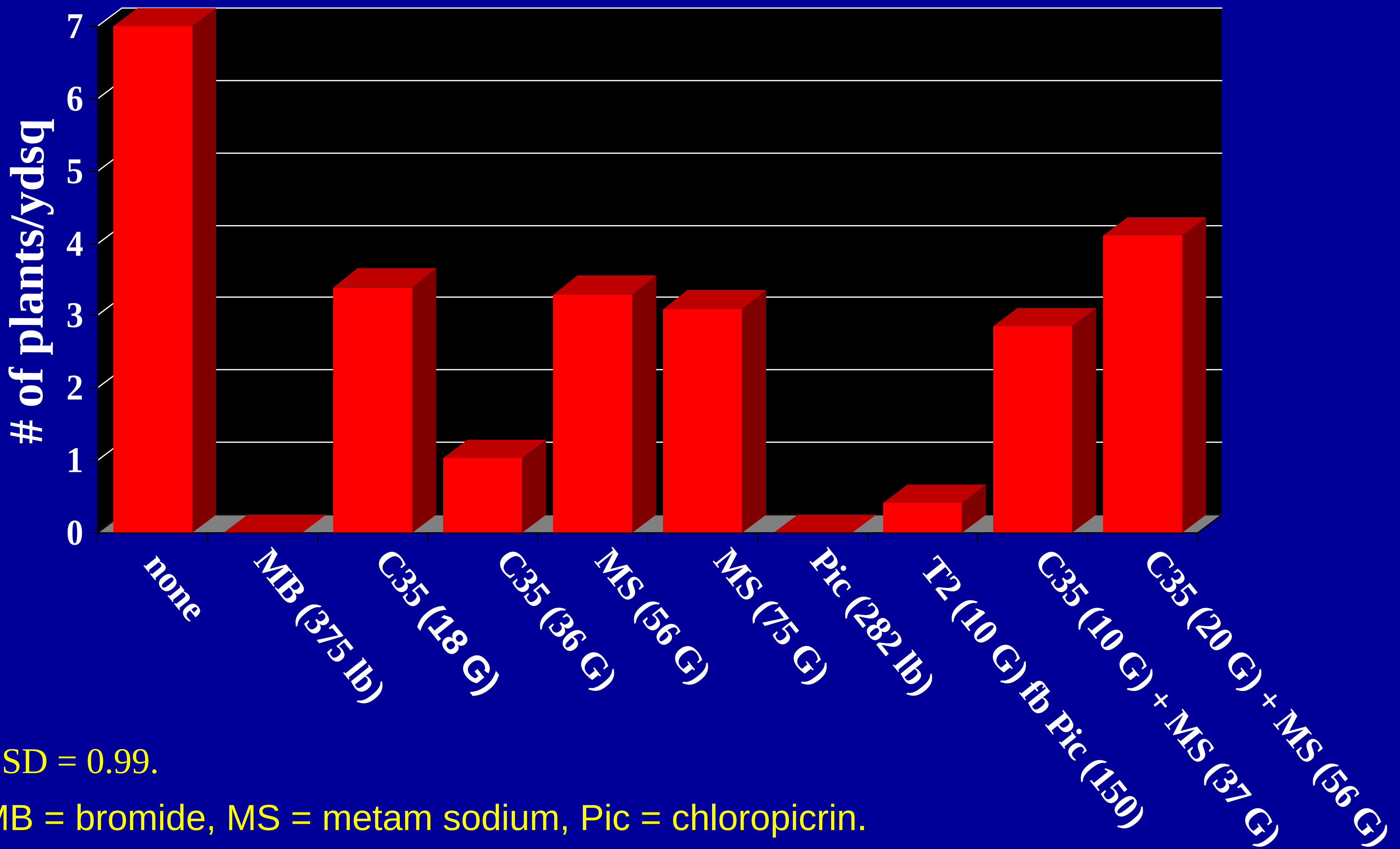
# Yellow Nutsedge Response to Fumigants in Pepper. Lewis Taylor Farm. 2001.




MB = bromide, MS = metam sodium, Pic = chloropicrin.

LSD = 1.8; data pooled over herbicide treatments.

# Yellow Nutsedge Response to Fumigants in Tomato. Coffee County. 2002.



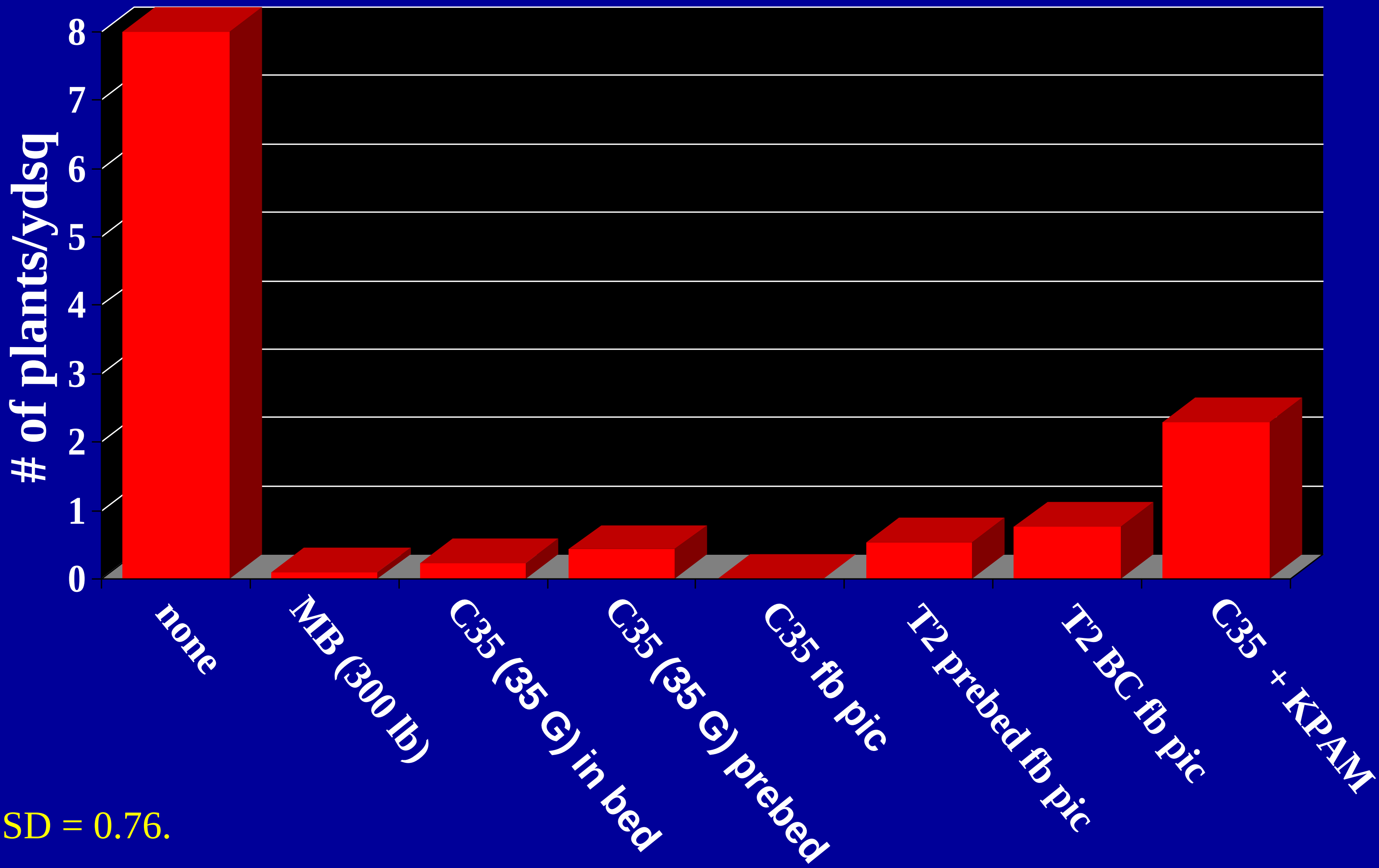

LSD = 0.99.

MB = bromide, MS = metam sodium, Pic = chloropicrin.

Non-treated | C-35 Broadcast 25 GPA | C-35 In Bed 35 GPA

Photos taken from Florida Field Day.  Bill Stall, 2000.

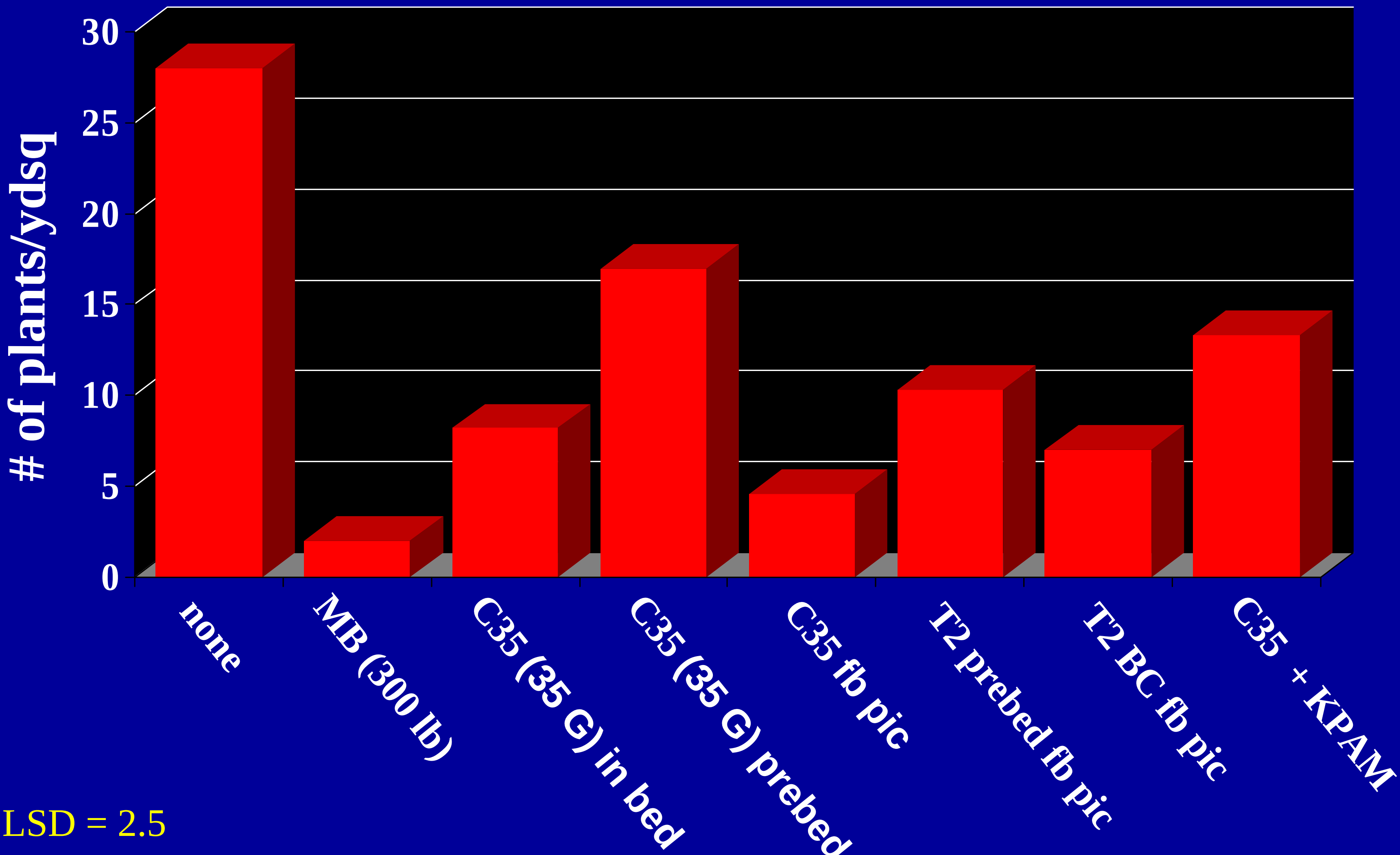
# Nutsedge Response to Fumigants in Pepper. 33 d After Fumigating. TyTy, 2002.*




LSD = 0.76.

MB = bromide, BC = broadcast, C35 = Telone C35, Pic = chloropicrin.

# Nutsedge Response to Fumigants in Pepper. 81 d After Fumigating. TyTy, 2002.*

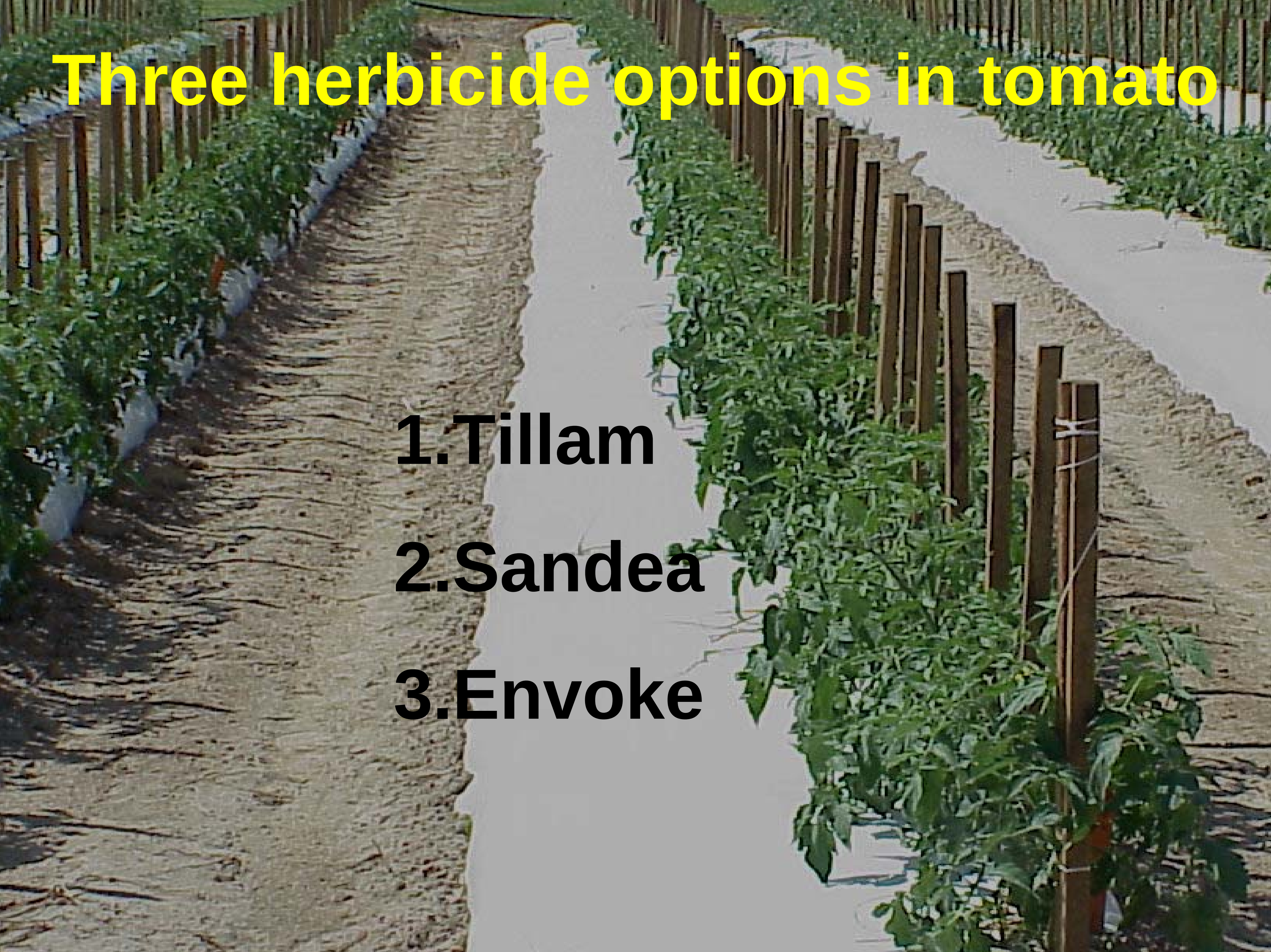



LSD = 2.5

MB = bromide, BC = broadcast, C35 = Telone C35, Pic = chloropicrin.

# Acceptable LONG-TERM Methyl Bromide Alternatives will likely Require Herbicide Input

# Three herbicide options in tomato



1. Tillam
2. Sandea
3. Envoke

# Sandea - Tomato

- 0.5 to 0.75 oz following final bed shaping and just prior to laying plastic. Do not transplant for at least 7 d after treatment.

- 0.5 to 0.75 oz POST no sooner than 14 d after transplant. Directed application suggested.

# Tomato and Nutsedge Response to Sandea Applied Topically. TyTy, 2002.

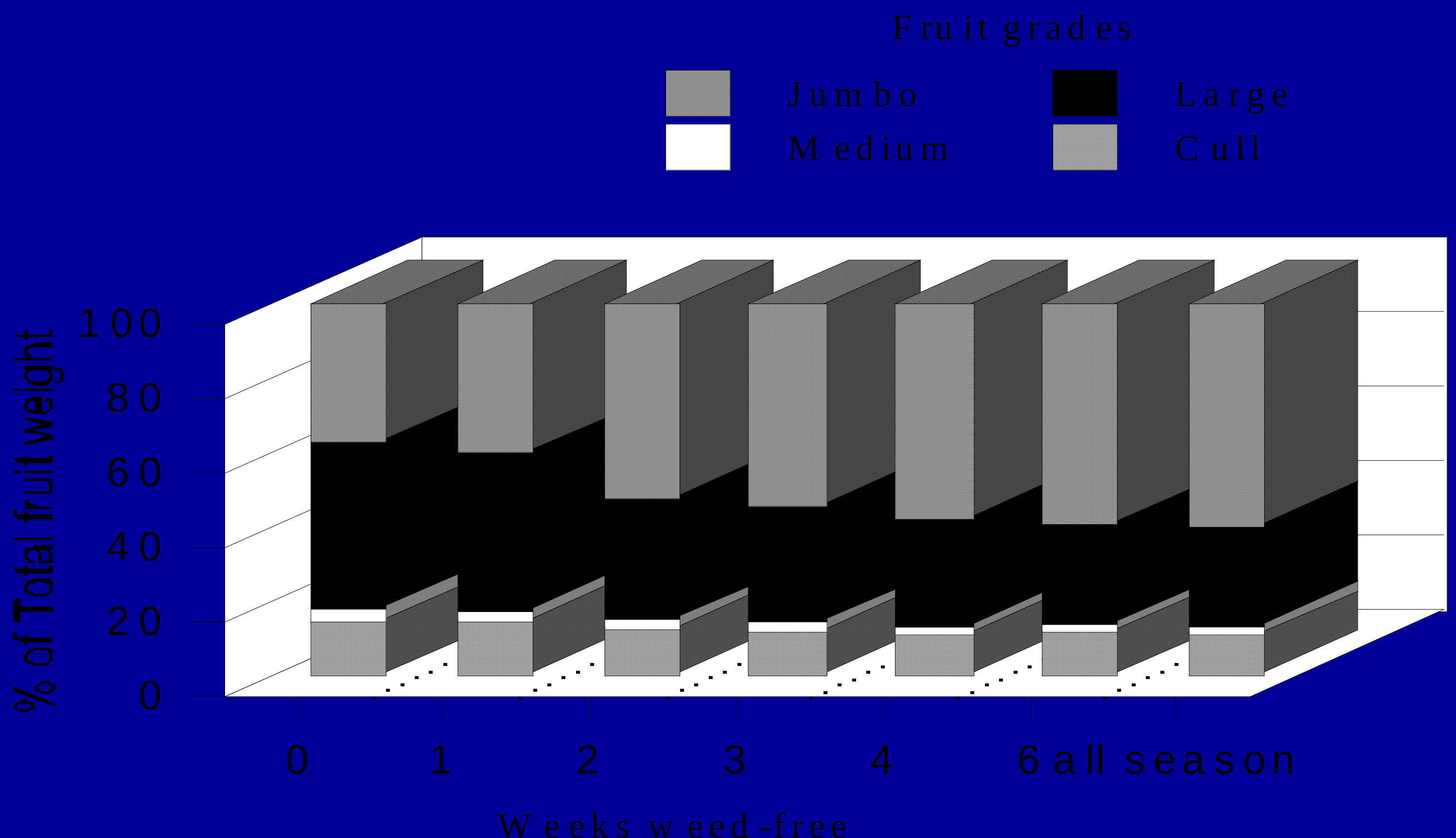

Sandea 0.67 oz/A POST


Non-treated

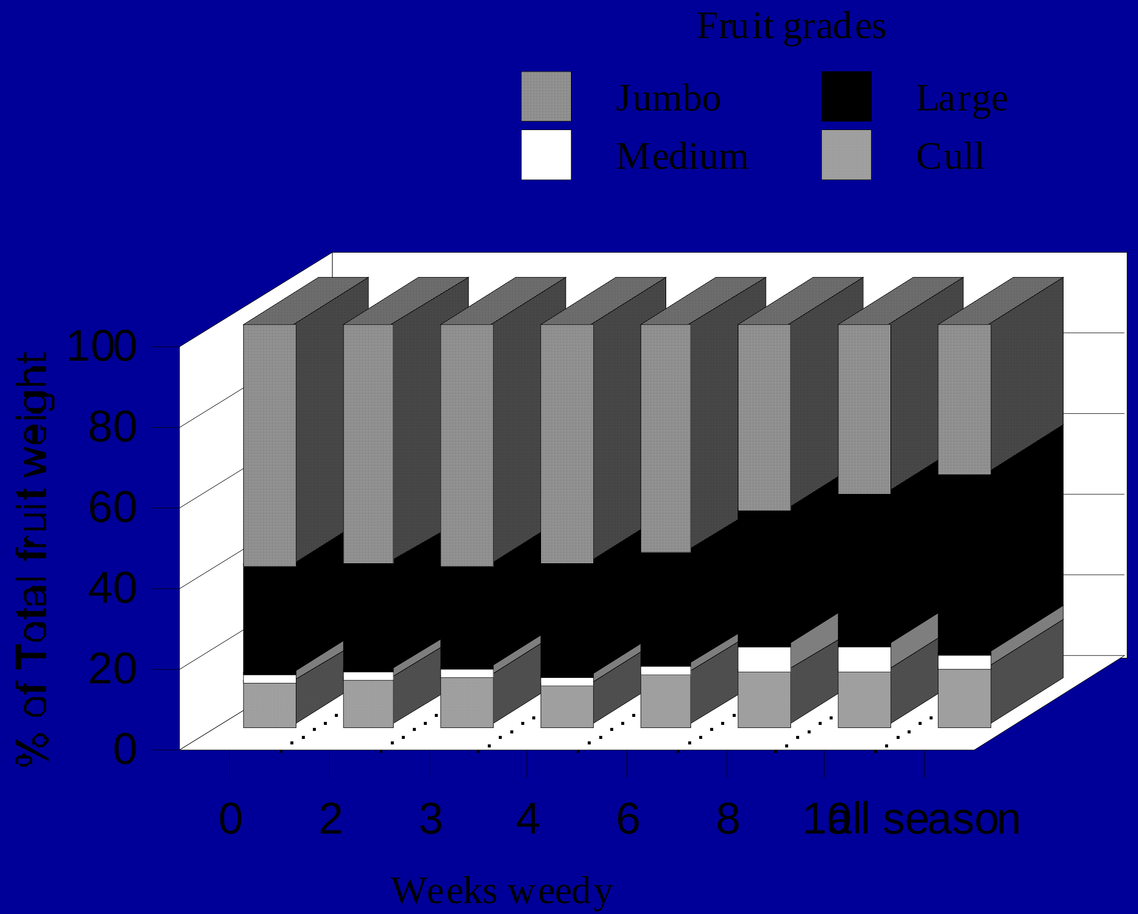
# Other Weeds

eastern black nightshade
groundcherry
hairy galinsoga
ivyleaf morningglory
jimsonweed
pitted morningglory
redroot pigweed
sicklepod
velvetleaf

# Effect of Amaranth Free Period on Tomato Fruit Grade



# Effect of Amaranth on Tomato Fruit Grade



# Nontreated Check

# Sencor

# High rate Sandea

# High rate Envoke

# Harmony GT
(not registered)

# Goal
# Dow AgroSciences

- Recently registered in NC, SC, VA, FL
- When laying drip tape and plastic minimize soil disturbance
- Application must occur at least 30 days prior to planting

# Goal
# Weeds

- Use rate is 1 to 2 pints/Acre
- Weeds controlled include Florida pusley, common purslane, Carolina geranium, cutleaf eveningprimrose, pigweed, ragweed, and nightshade and some annual grasses.

# Dual Magnum
# Syngenta

- Registered for PRE control of weeds in tomato
- Bareground – PPI or preplant to the soil surface before transplanting
- Post-directed to transplants after the first settling rain or irrigation

# Dual Magnum

- Bedded transplants
  - Apply to soil surface before laying plastic
  - Apply to row middles
- Use rate on coarse soils is 1 to 1.33 pints per acre

# Dual Magnum
# Weeds controlled

- Many annual grasses
- Pigweed species
- Nightshade species
- Groundcherry species

# Envoke

- Recently registered in FL and GA for control of nutsedge and grass in tomato
- A NC registration is expected soon
- Use rate is 0.1 to 0.2 oz/Acre post-directed to tomato grown on plastic

# Envoke

- Wait 2 weeks after transplanting before applying Envoke
- Apply prior to fruit set and at least 45 days prior to harvest
- Include a nonionic surfactant

# Treatments

- Methyl bromide
- Chloropicrin
- Chloropicrin + Dual PRE
- Chloropicrin + Goal PRE
- Telone C35

# Palmer Amaranth Counts

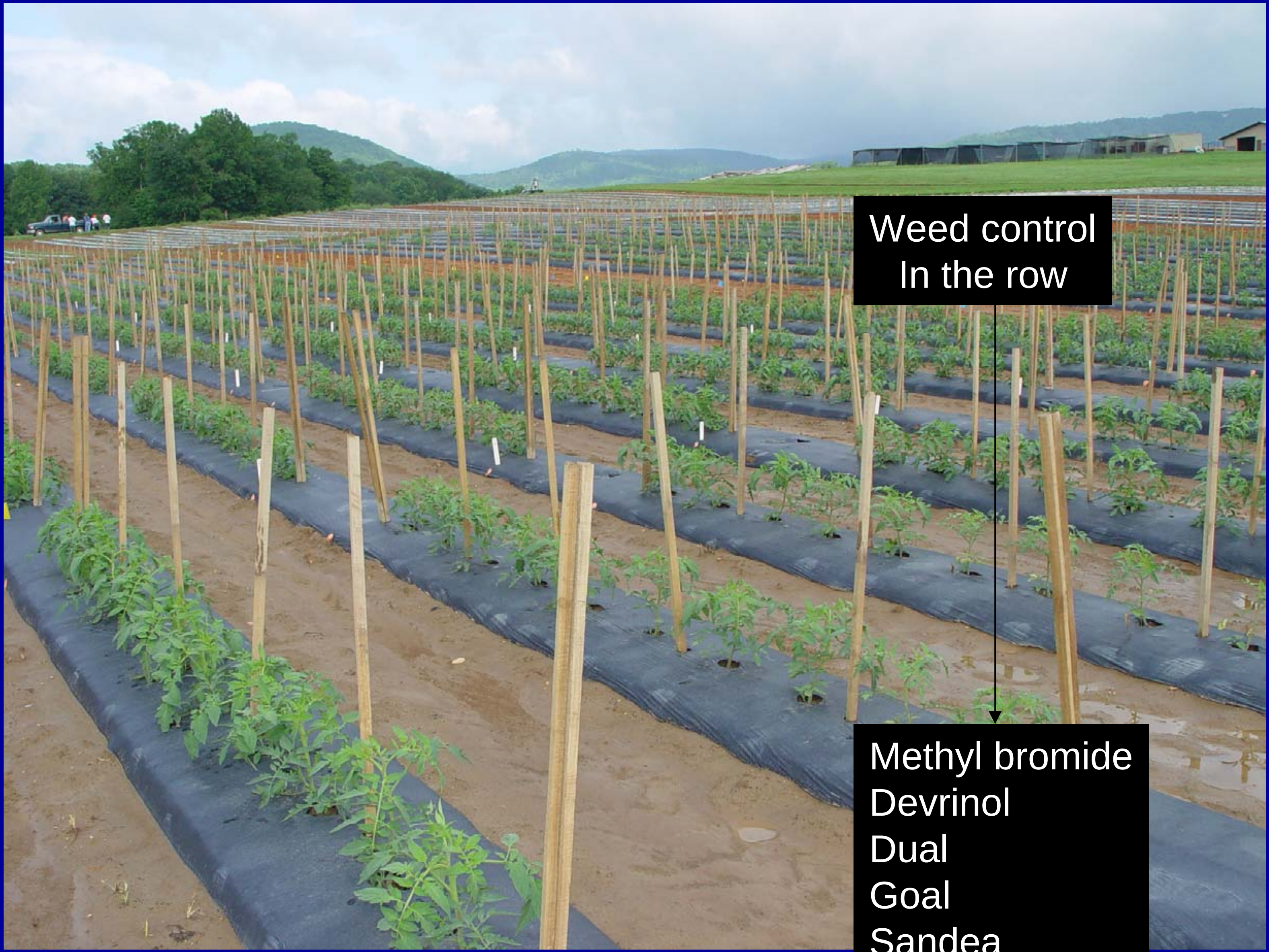
| | No herbicide | W/Dual | W/Goal |
|---|---|---|---|
| Nontreated | 21 | -- | -- |
| Methyl bromide | 0 | -- | -- |
| Chloropicrin | 25 | 0 | 5 |
| Telone C35 | 2 | -- | -- |

# Response of weeds to herbicides.

| Herbicides | Dual PD | Devrinol preplant | Sencor PD | Treflan preplant |
|---|---|---|---|---|
| Radish or mustard, wild | | | E | P |
| Redroot pigweed | E | F-G | E | E |
| Velvetleaf | N | N | E | P |
| Lambsquarters, common | F | G | E | G |
| Eastern black nightshade | E | N | P | P |
| Hairy galinsoga | E | G | E | P |
| Morningglory | N-P | P | F-G | P |
| Purslane | E | G | E | F-G |
| Yellow nutsedge | G-E | N | N-P | P |
| Annual grasses | E | E | N-P | E |

# Response of weeds to post-directed herbicides.

| Herbicides | Matrix | Paraquat | Sencor | Sandea |
|---|---|---|---|---|
| Radish or mustard, wild | E | F | P-F | E |
| Redroot pigweed | G | E | E | E |
| Velvetleaf | | E | E | E |
| Lambsquarters, common | F-G | G | E | P-F |
| Eastern black nightshade | P | E | F | P |
| Hairy galinsoga | G-E | E | E | E |
| Morningglory | F-G | G-E | F-G | F-G |
| Jimsonweed | | E | E | E |
| Yellow nutsedge | | F | N-P | E |
| Annual grasses | F-G | F-G | N-P | N |

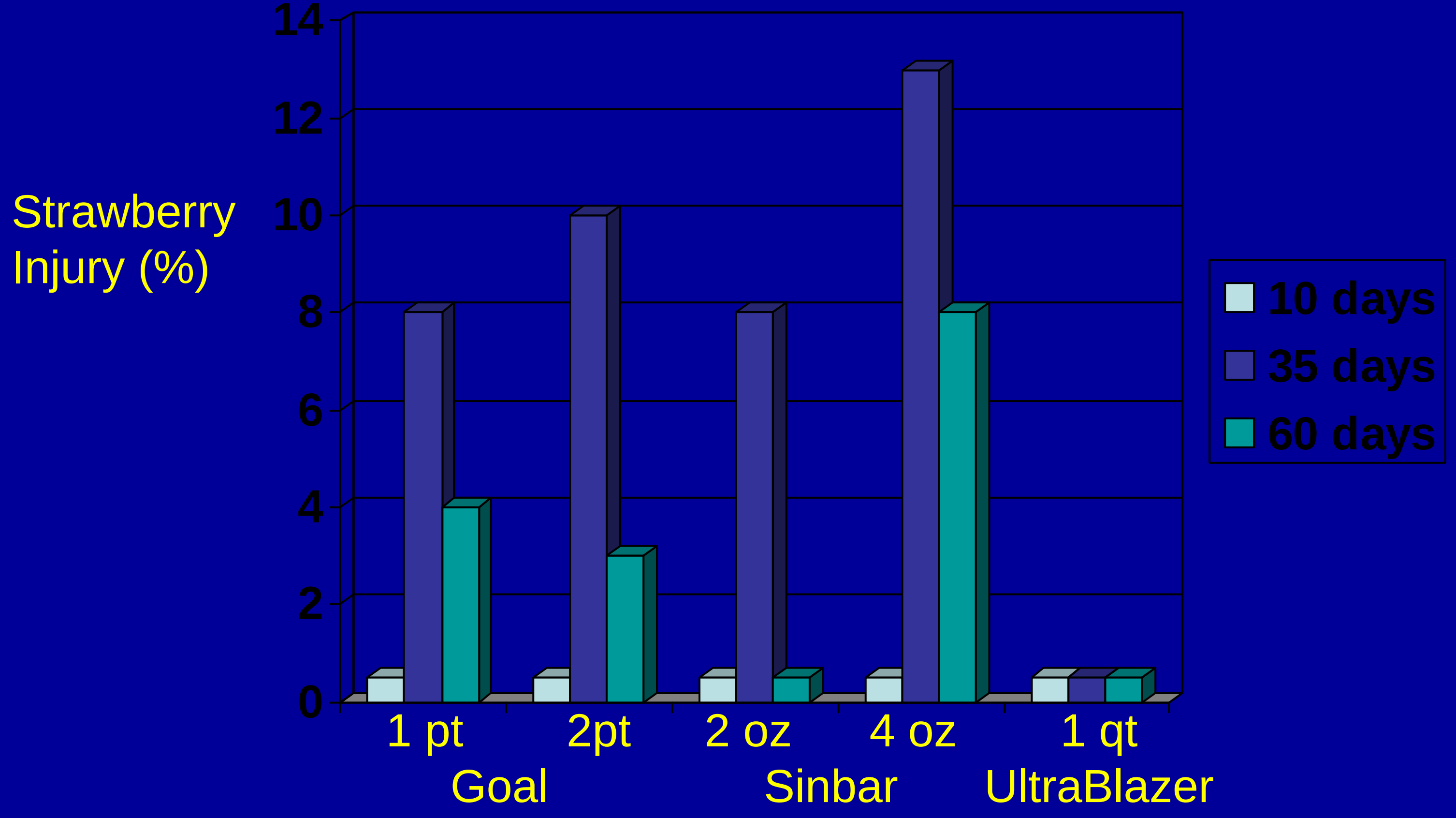

Weed control
In the row
Methyl bromide
Devrinol
Dual
Goal
Sandea
Poast, Select

# Cucumber or Cantaloupe

- Alanap POST: pre control of certain broadleaf weeds.
- Sandea POST: post control of nutsedge and many broadleaf weeds.


Preplant Study

# Strawberry Response to Preplant herbicides




Non Treated


Goal

# Goal

- Carolina geranium, cutleaf eveningprimrose, and some annual grasses.  Maybe will assist with resistance management in the row.

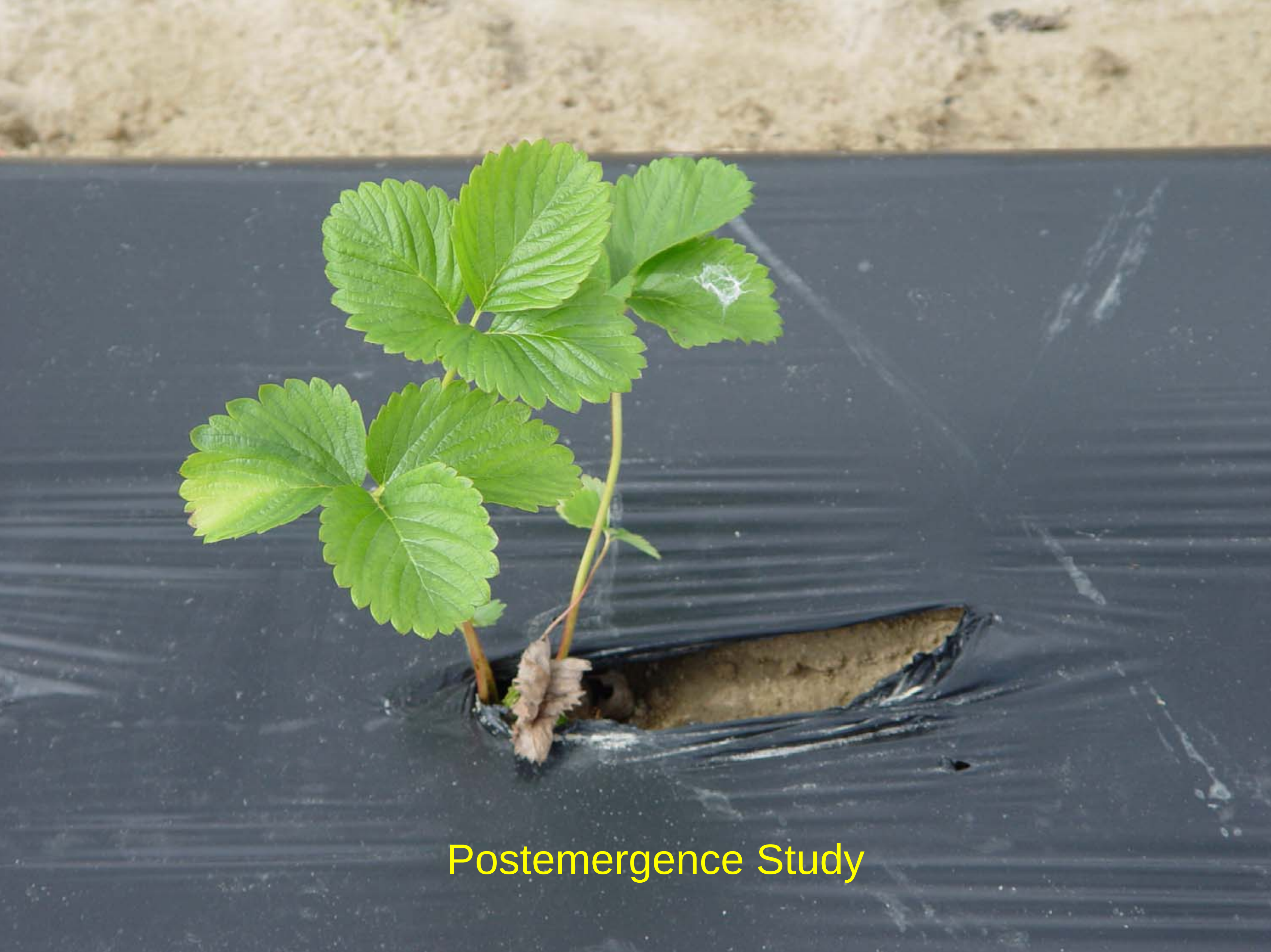

Sinbar


UltraBlazer

Nontreated


Ultra Blazer @ 2 pint/Acre


1 month after treatment

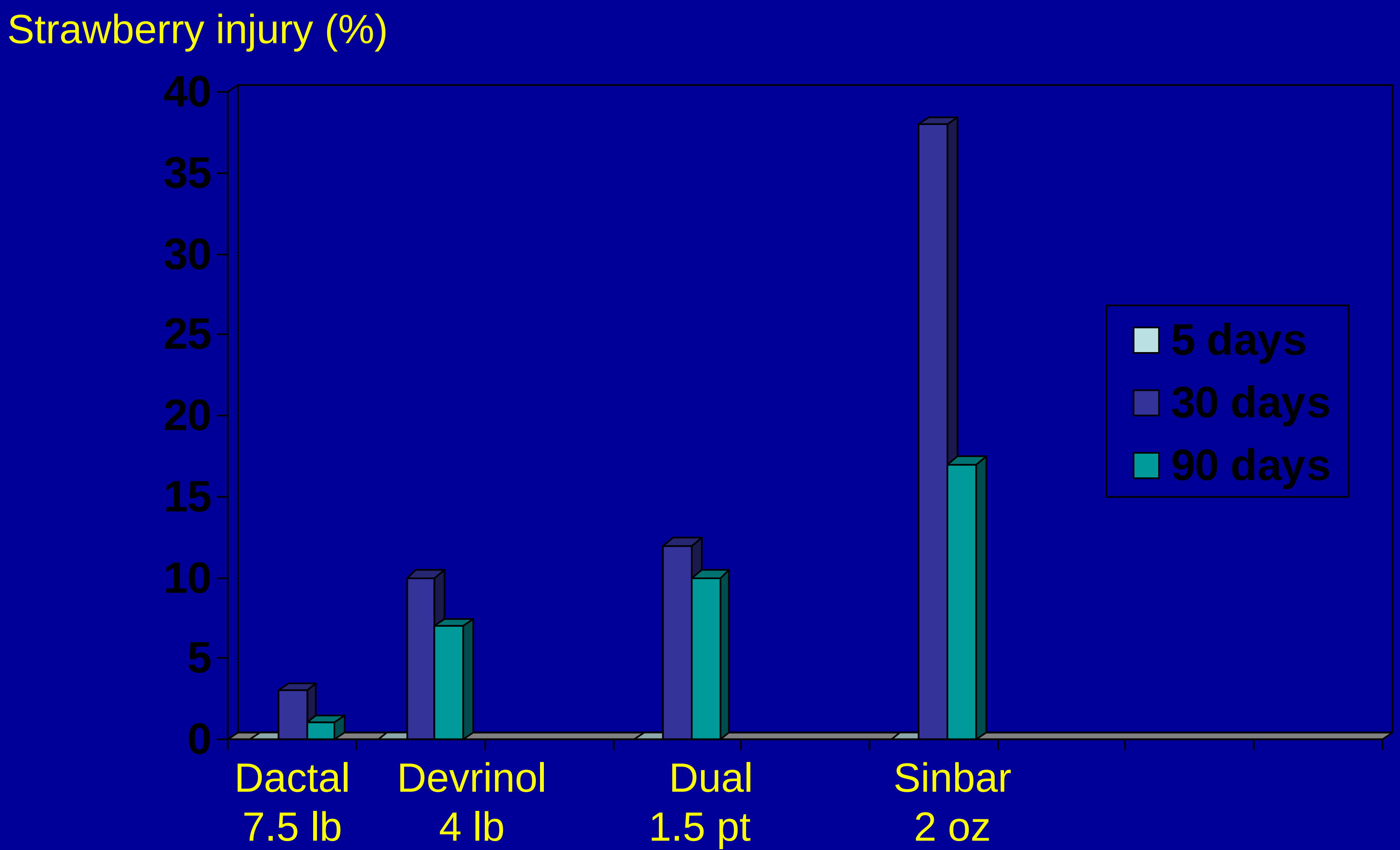


Postemergence Study

# Materials and Methods

- Chandler plug plants
- Planted on October 12, 2004
- Sprayed on October 14, 2004
- Location – Horticultural Crops Research Station, Clinton, NC
- Spray info - 20 GPA at 32 psi, even tip, 3 mph

# Strawberry Response to Herbicides




Non Treated


Dacthal


Devrinol


Dual


Sinbar

# Summary – in the row

- Dacthal, Devrinol and Dual banded over the crop and plastic for PRE control have potential to improve non nutsedge weeds with alternative fumigants.
- UltraBlazer, and Goal have potential for use under plastic for non nutsedge weeds.
- Goal has a label in NC, GA and FL with possible expansion in other states.

# Summary – in the row

- Stinger gives effective postemergence control:

  vetch, clover, prickly lettuce, annual sowthistle, cocklebur, galinsoga, common ragweed

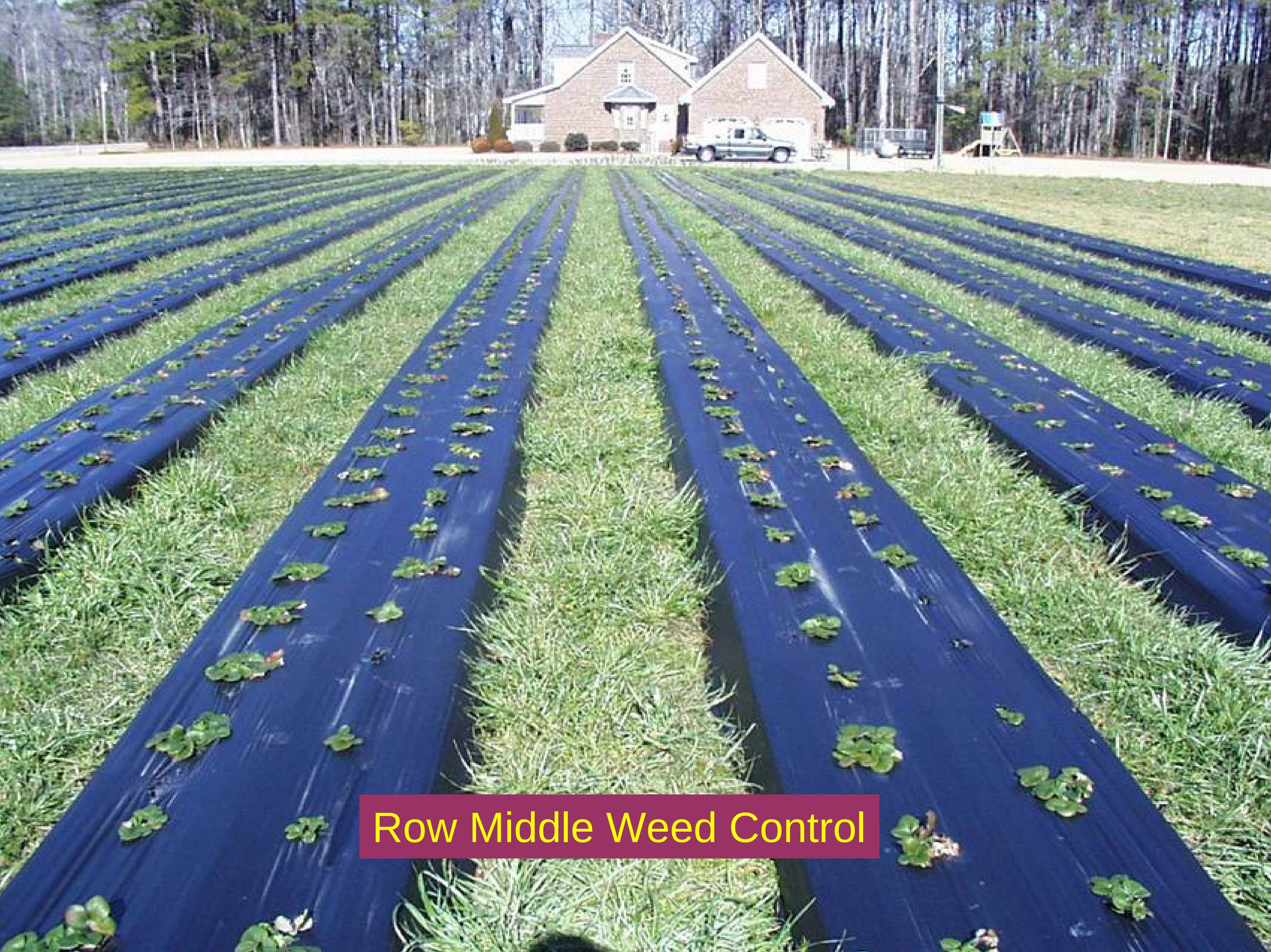
- Poast or Select gives effective postemergence control:

  annual and perennial grasses

Vetch

Stinger @ 2/3 pint

# Weed Control Between Rows


Row Middle Weed Control

# Several Options for Middles

Non chemical

- Ryegrass
- Winter grains (for example winter rye or wheat)

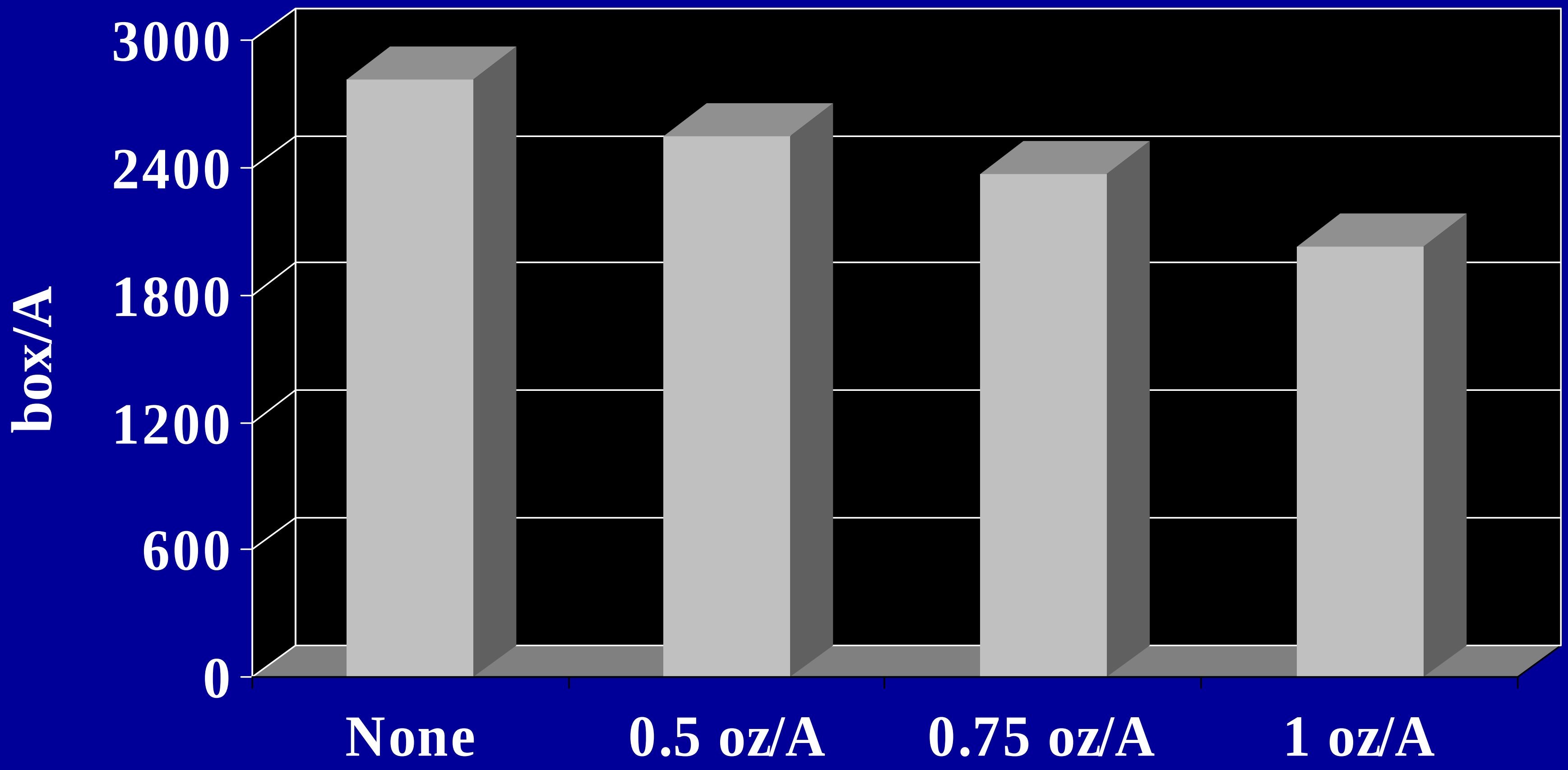
Chemical options

- Preemergence
  - Dacthal
  - Devrinol
- Postemergence
  - Gramoxone
  - Poast
  - Select
  - Stinger
  - Roundup WeatherMax
  - Aim

# Summary - middles

- Program
  - Cover crop
  - Preemergence with a postemergence herbicide

# Pepper Yields with Sandea Applied Under Plastic. Jumbo - Total Yield.




**Lewis Taylor Farms, Tifton, 2001.**

# Crops with limited Data

- Pepper – Goal is registered; weeds establish easily
- Squash
- Watermelon

*Sandea is too injurious to these crops.

# Methyl Bromide Alternatives: Virtually Impermeable Film

Powell Smith
Extension Entomologist
Clemson University, Edisto REC
Blackville, SC

# Methyl Bromide as a Fumigant

- MeBr was identified as an ozone depleter in 1985.
- Montreal Protocol of 1987 established use reduction plan.
  - Gradual phase-out to ease economic losses.
  - Developed countries to achieve 100% reduction by 2005 (Montreal protocol of 1997).

# Critical Uses and Exemptions

- Some uses have been defined as critical and use is allowed (at least until a satisfactory replacement is developed).
  - Mainly quarantine and preshipment fumigation uses.
- New protocol wording allowed ‘Critical Use Exemptions’.
  - If no viable alternatives existed, a ‘case’ could be submitted for use at a defined level to be continued.
  - Use rates for SE states estimated to allow MeBr use to continue on strawberries and selected vegetables.

# Critical Use Exemptions

- Allow research into alternatives while allowing growers to continue use.
  - New fumigation materials used in conjunction with MeBr - chloropicrin, herbicides, etc.
  - New fumigants - MeI, dazomet, MITC-materials.
  - Old fumigants with new partners - Telone products.
- Improve fumigation efficiency.
  - maintain efficacy but reduce rate.

# How Does Fumigation Work?

- It is a disinfestation (disinfection) process.
  - Cleansing of an inanimate surface of harmful microbes.
  - Reducing pathogens to below a critical threshold so disease won't develop (as soon).
    - Not 100% reduction - pathogen rebound.
    - Some beneficial microbes must remain.

# Important Parameters for Disinfestation

- Nature of the surface - unmanageable; soil is nonhomogenous; large surface area.
- Level of organic matter.
  - Humus - little management; varies with soil type.
  - Detritus - manageable; crop or weed residue.
  - Biota - little control; varies with soil type and use.
- Contact time - manageable??
- ‘Dose’ - rate of fumigant - manageable??

# Soil Microbes

- Soil is a complex environment with an extremely numerous and diverse biota.
  - 25,000 to 30,000 lbs per acre ft. of life.
    - 13,000 - 14,000 lb of fungi.
    - 12,000 lb of bacteria.
    - 1,800 lb of actinomycetes.
    - 200 lb of protozoa.
    - 50 lb of nematodes.
  - Algae, mites, & insects - variable but significant.
  - All organic - absorb/deplete fumigant dose.

# Contact Time

- Key element in any disinfestation process.
- Within 48 hrs. MeBr under PE mulch film has exerted lethal effect because concentration has declined to sub-lethal levels. (good cond.)
  - Effect = rate x time.
- Damage to plants after 7 day plant back period?
  - Bad fumigation conditions?
  - $NH_3$-toxicity - $(NH_2)CO + H_2O \rightarrow NH_3 + CO2; NH_4^+$.
  - Nitrifiers in soil - $NH_3 \rightarrow NO_3^-$; slow to reestablish.
- Increased contact time = more efficacy at reduced rates.

# Methyl Bromide Uses Globally

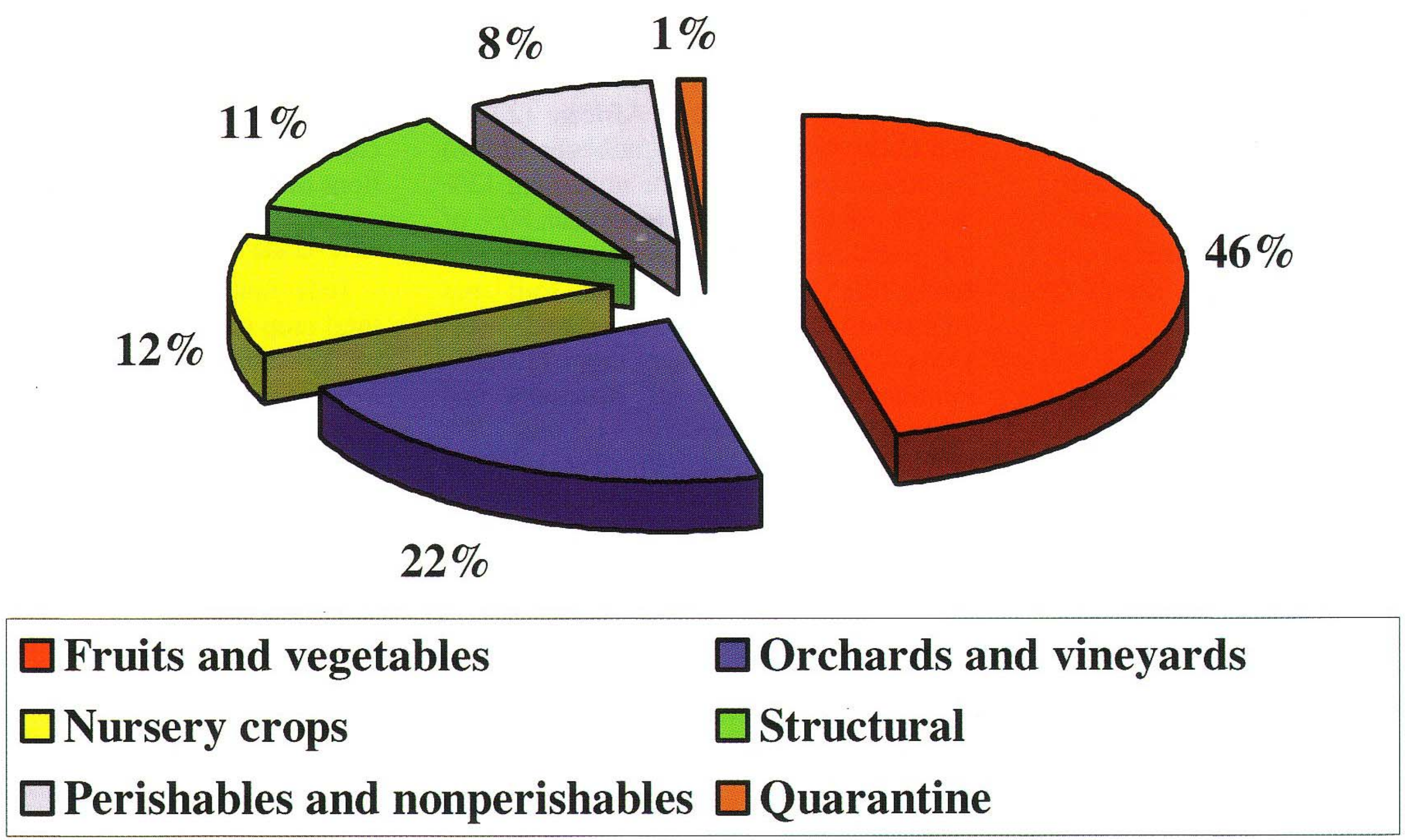



Fig. 2. Distribution of global methyl bromide use among different applications during 1992 (51,68).



Gullino et al Plant Disease 87(9)

# Methyl Bromide Users - Worldwide

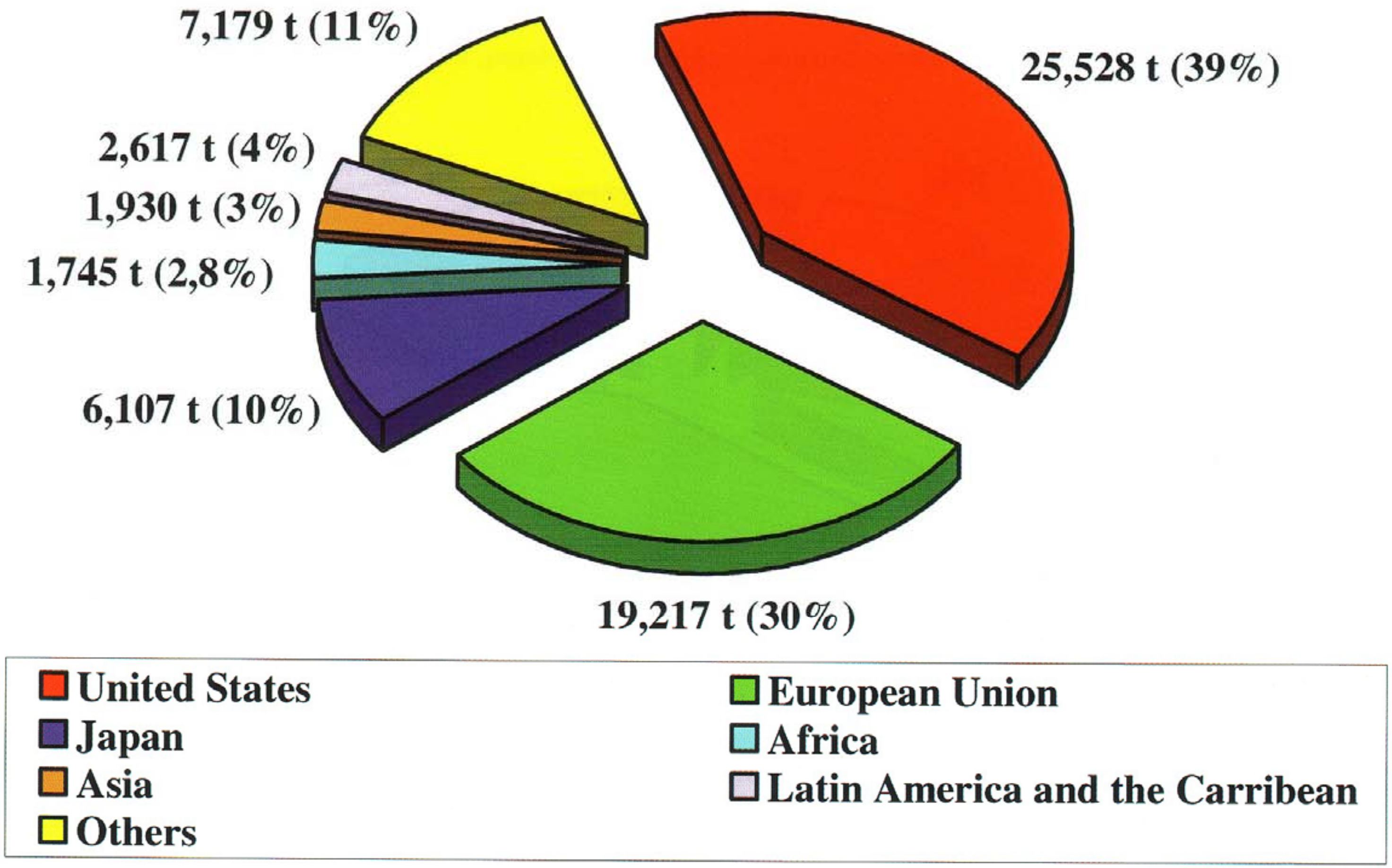



Fig. 1. World global methyl bromide use (metric tons) in 1991 (62).

# Italy - A Case Study

- Italy is EU's biggest user.
  - 7,600 MT in 1995.
  - Sicily is largest regional user - 4,000 MT-1995.
- After research showed rate reduction potential, Virtually Impermeable Film was mandated for MeBr fumigation in 2000.
- MeBr use in 2001 - 3,700 MT.
  - Sicily's use in 2001 = 2,000 MT.
  - No reduction in acreage.

# EU to United States

Conversion Factors: g/m$^2$/hour to oz/yd$^2$/hr

multiply number of grams by 0.0313

Today 1 euro = $1.31: E/m$^2$ to $/yd$^2$

multiply by euros by 1.17

# What is VIF?

- A composite product.
  - co-manufactured sheets of LDPE or HDPE and nylon or vinyl polymer.
  - Physical characteristics similar to PE.
    - Less stretchy; tends to be brittle.
    - reaction to temperatures is different.
- Me Br diffusion Characteristics.
  - PE - > 50 $g/m^2/hr$ (1.57 $oz/yd^2/hr$).
  - VIF - < 1 $g/m^2/hr$ (0.0313 $oz/yd^2/hr$).

# Costs

- In Italy
  - HD/LD PE film - $0.06/yd$^2$
  - VIF - $0.12/ yd$^2$
- Films applied with fumigant in Italy.
  - PE with full rate of MeBr = $0.70/ yd$^2$.
  - VIF with 1/2-rate of MeBr = $0.47/ yd$^2$.

# What’s Available in the US?

- European product
  - PE + nylon
  - PE + ethylene-vinyl alcohol polymer
- North American
  - Some metallized films have much lower MeBr diffusion rates than regular PE film.
  - Some grower and industry claims indicate that rates of MeBr under such films can be reduced by as much as 1/2.

# Research

- A growing body of research in the US indicates that use of VIF will allow rate reduction of MeBr without loss of efficacy.
- Current problems
  - Consistency of performance among films and batches.
  - Laying characteristics different from PE film.
    - Requires changes in fumigation process - slow down.
    - Poor soil to film contact in some cases.
    - Greater problems with wind after laying film.

# Edisto REC - 2005

- Replicated study to compare two VIF's and a metallized film to conventional PE film using reduced rates of MeBr.
  - no crop.
  - buried RKN and YNS at two depths.
  - measure MeBr under films at 2, 4, 24, 48, 72, and 96 hrs.
  - PE - 0, 0.5, and 1.0 rate of MeBr (200 lbs 67/33).
  - VIF's and Met Film - 0.5 and 0.75 rate.

# Methyl Bromide Critical Use Exemptions

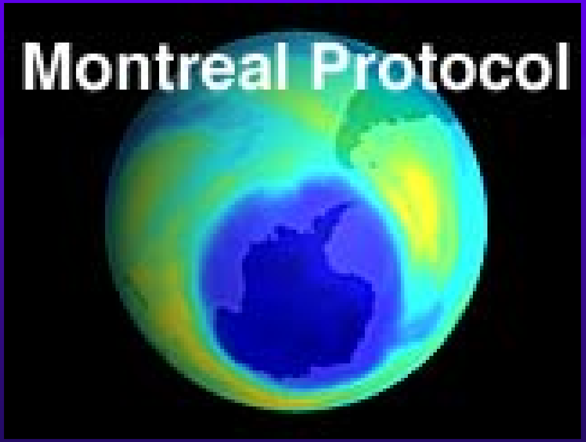
Stephen J. Toth, Jr.
Associate Director
Southern Region IPM Center
North Carolina State University

Southern IPM Center

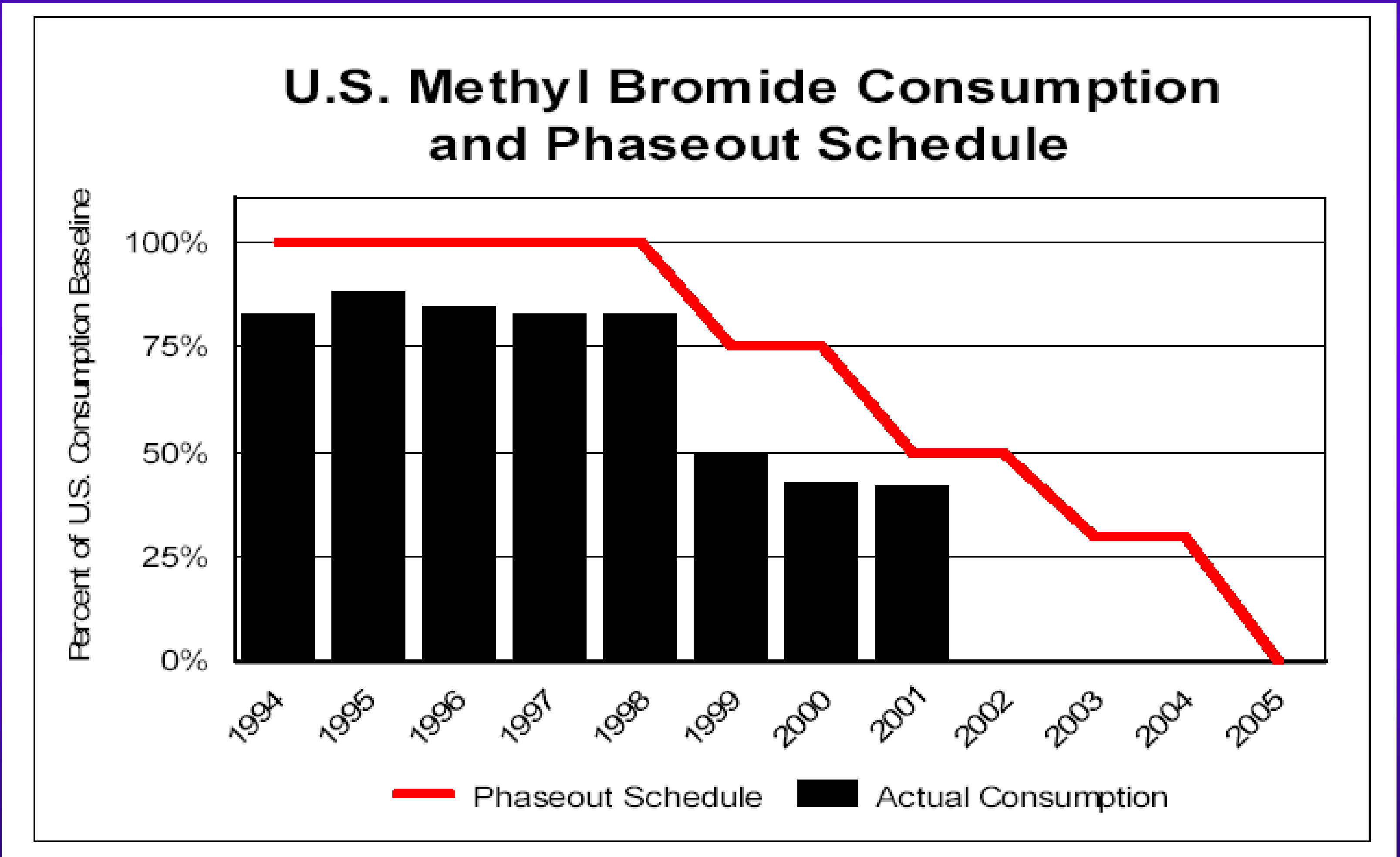
Photo from NCSU Communication Services

# Methyl Bromide Phase-Out

- Under the Federal Clean Air Act and an international treaty to protect the ozone layer (Montreal Protocol on Substances that Deplete the Ozone Layer), the production and import of methyl bromide will be phased out in the United States on January 1, 2005



# Methyl Bromide Phase-Out




Source: U.S. EPA

# Methyl Bromide Transition Program

- The USDA and Land-grant Universities have been supporting research for the discovery and implementation of practical pest management alternatives for commodities (i.e., fruit, vegetables, nurseries) affected by the phase-out of methyl bromide
- The USDA has spent over $146 million to date on research and outreach

USDA

# MeBr Critical Use Exemptions

- Parties to the Montreal Protocol recognized that methyl bromide users in some countries needed a temporary safety net to provide the time necessary to transition to alternatives
- The parties addressed the possibility that alternatives to methyl bromide may not be available for all uses by 2005

# MeBr Critical Use Exemptions

- Parties to the Montreal Protocol agreed to allow limited production and import of methyl bromide after January 1, 2005
- The Parties agreed to a specific timeline and data requirements for **"critical use exemptions"**


USDA/ARS

# MeBr Critical Use Exemptions

- In May 2002, EPA called for applications for critical use exemptions from U. S. users
- The information on application form used to determine if the specific use is **“critical”** because no **technically** or **economically feasible** alternative to methyl bromide is available
- A workshop was held August 7-8, 2002 in Raleigh, NC to develop applications for strawberries (field and nursery), tomatoes, peppers and cucurbits in the Southeastern U. S.; coordinated by North Carolina State University faculty

# MeBr Critical Use Exemptions

- EPA submitted a two-year exemption request for the U.S. to begin in 2005
- U.S. request for 2005 for 39% of the U.S. baseline consumption of methyl bromide
- Request for 16 crops/uses: food processing, commodity storage, forest seedlings, orchard seedlings, orchard replant, turf and sod, **tomatoes**, **peppers**, eggplant, **strawberry fruit**, **strawberry nurseries**, **cucurbits**, ornamentals, ginger, transplant trays used in greenhouse production systems, and sweetpotatoes

# MeBr Critical Use Exemptions

- U. S. nomination of critical methyl bromide uses for exemption in 2005 and 2006 submitted to the Ozone Secretariat of the United Nations
- In November 2003, Parties to the Montreal Protocol met to review recommendations; however, could not reach a decision
- In March 2004, Parties to the Montreal Protocol met again and granted limited critical use exemptions for 2005 to 11 developed countries (including the United States)

# MeBr Critical Use Exemptions

- The United States has been allocated 19.6 million pounds for 2005 (equivalent to 35% of the 1991 baseline)
- This 35% is composed of 30% new production and 5% existing stocks
- **This critical use exemption is for 1 year only!**
- Parties also authorized a small supplemental request for 2005, amounting to 2% of the 1991 baseline

# MeBr CUE for Cucurbits

- Pre-plant uses for Alabama, Arkansas, Georgia, North Carolina, South Carolina, Tennessee and Virginia growers with moderate to severe yellow or purple nutsedge infestation
- Includes cucumbers, melons and squash

NCSU Communication Services

# MeBr CUE for Peppers & Tomatoes

- Pre-plant uses for Alabama, Arkansas, Georgia, North Carolina, South Carolina, Tennessee and Virginia growers with one or more of the following limiting conditions: moderate to severe yellow or purple nutsedge infestation, and/or presence of an occupied structure within 76 meters of a grower's field the size of 100 acres or less

Bill Tarpenning

# MeBr CUE for Strawberry Fruit

- Pre-plant uses for Alabama, Arkansas, Georgia, North Carolina, South Carolina, Tennessee, Virginia, Ohio and New Jersey growers with one or more of the following limiting conditions: moderate to severe yellow or purple nutsedge infestation, and/or presence of an occupied structure within 76 meters of a grower’s field the size of 100 acres or less

Bob Nichols

# MeBr CUE for Strawberry Nurseries

- Pre-plant uses for North Carolina and Tennessee growers with the presence of an occupied structure within 76 meters of a grower's field the size of 100 acres or less.

Fred S. Witte

# MeBr CUE Allocation Process

- In August 2004, EPA proposed a process for allocating methyl bromide authorized under critical use exemptions
- EPA has received comments from interested parties and is currently formulating a decision for allocating methyl bromide
- An EPA ruling was released in the December 23, 2004 *Federal Register* which outlined the process for allocating methyl bromide under critical use exemptions

# MeBr Critical Use Exemptions for 2006

- Additional critical use exemptions were requested for 2006 in applications submitted in 2003
- U. S. requested 37% of the 1991 baseline for the 2006 calendar year (17 uses, including cucurbits, peppers, strawberries and tomatoes)
- The Parties authorized 27% and the remaining 10% will be considered at a one-day meeting in June 2005

# MeBr Critical Use Exemptions for 2007

- Additional critical use exemptions were requested for 2007 in applications submitted in 2004
- U. S. is requesting 29% of the 1991 baseline for the 2007 calendar year (15 uses, including cucurbits, peppers, strawberries, and peppers)
- The Methyl Bromide Technical Options Committee (MBTOC) will consider the request and make recommendations to the Parties; the Parties will meet in Nov. 2005 to consider the recommendations and authorize methyl bromide for critical needs in 2007

# MeBr Critical Use Exemptions for 2008

- Waiting on notice calling for methyl bromide critical use exemption applications for the 2008 calendar year
- Will evaluate the needs for methyl bromide critical use exemptions for 2008 and submit applications for crops with critical needs for methyl bromide in 2008  (Summer 2005?)
- Southeastern Consortium provides the infrastructure (i.e., contacts with scientists, industry, growers, etc.) to complete and submit critical use exemption applications

# Soil Fumigant Cluster Assessment

Stephen J. Toth, Jr.
Associate Director
Southern Region IPM Center
North Carolina State University

Photo by Bob Nichols

# Soil Fumigant Cluster Assessment

- EPA has begun work on a comparative human health risk assessment for several soil fumigants
- Soil fumigants are used in similar ways; thus, expected to result in similar human exposures
- Advantageous to review them concurrently to ensure that: 1) assessment approaches are consistent, and 2) risk management decisions consider risks and benefits of each chemical on an equal footing

# Soil Fumigant Cluster Assessment

Fumigants included in cluster assessment:

- Chloropicrin
- Dazomet
- Iodomethane *
- Metam sodium/potassium
- Methyl bromide
- Telone (1,3-dichloropropene) **

* New active ingredient not registered at this time
** Deemed eligible for reregistration in 1998

# Soil Fumigant Cluster Assessment

Upcoming Schedule and Milestones:

- April/May 2005: 60-day public comment period on preliminary risk assessments
- June/July 2005: Agency consideration of public comments on preliminary risk assessments; completion of preliminary benefits assessments and risk management options (with input from stakeholders)

# Soil Fumigant Cluster Assessment

Schedules and Milestones:

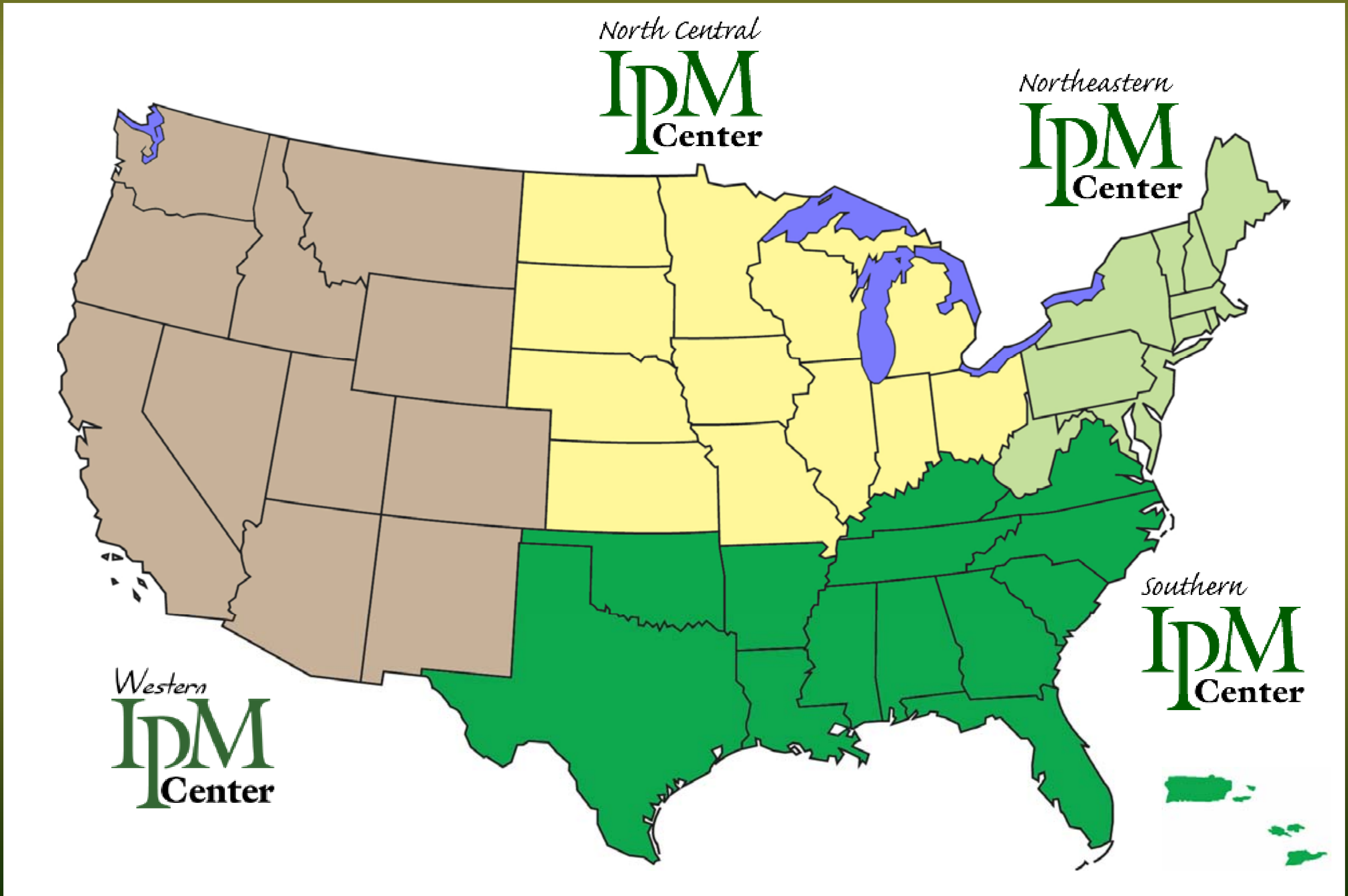
- August/September 2005: 60-day public comment period on revised risk assessments, preliminary benefit assessments, and preliminary risk management options
- October/December 2005: EPA consideration of public comments on revised risk assessments and preliminary benefits assessment and risk management options; development of risk management decision in consultation with all stakeholders

# Soil Fumigant Cluster Assessment

Important Points:

- A very ambitious schedule for completion of the soil fumigant cluster assessment
- Short time frames for stakeholders to respond to preliminary/revised assessment decisions by EPA
- The need for information on soil fumigant usage will be considerable *(see handout)*

# USDA Regional IPM Centers
## Participating States and Territories



# Methyl Bromide Critical Use Exemptions: *Process, Decisions, and Implementation*

Methyl Bromide Alternatives Agents Training

February 24, 2005

North Carolina State University

Raleigh, North Carolina

# FFVA

- Voluntary Agricultural Trade Association
- Represent Producers of Vegetables, Fresh and Processed Citrus, Tropical Fruit, Sugar Cane, and Sod.
- Actively Involved with Issues Surrounding Methyl Bromide Since 1991.

# Methyl Bromide Phaseout – Clean Air Act

- Petition 1991 by NRDC, EDF, and WWF to list Mebr and other compounds as ozone depleters.
- Rule Adopted Dec 10, 1993 regulating Mebr as a Category I Ozone Depleter with an ODP of greater than 0.2.
- Rule set a freeze at the 1991 baseline and set the schedule for phaseout on Jan 1, 2001

# Methyl Bromide Phaseout – Montreal Protocol

- Methyl Bromide Added to Controlled Substance List – 1992, Copenhagen Amendments.
- Meeting of the Parties (MOP) in 1995 set 2010 Phaseout for Industrialized Nations with a Provision for “Critical Use Exemptions”
- MOP 1997– Modified Phaseout Schedule for Industrialized Nations to 2005 with Interim Reductions in 1999, 2001 and 2003.

# Critical Use Exemption

- Montreal Protocol, Article 2H (5) -- Provides that the 2005 phaseout shall not apply “to the extent the Parties decides to permit the level of production or consumption that is necessary to satisfy uses agreed by them to be critical uses”.

# Critical Use Exemption

- Clean Air Act (as amended in 1997) -- “ to the extent consistent with the Montreal Protocol,” the Administrator may exempt methyl bromide for critical uses.

# Critical Use Exemption -- Criteria

Criteria for determining critical use exemptions were made as decisions by the Parties to the Montreal Protocol, Decision IX/6 at the $9^{th}$ MOP (November 1997) and Decisions Ex.1/3 and Ex.1/4 at the first Extraordinary Meeting of the Parties (March 1994)

# Montreal Protocol Decision: MOP IX/6

Review Based on:

- There are no technically and economically feasible alternatives or substitutes available to the use that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination; and,

1. All technically and feasible steps have been taken to minimize the use and emissions of Mebr,
2. Mebr is not available in sufficient quantity from existing stocks of banked or recycled Mebr, and
3. An appropriate effort is in place to evaluate, commercialize and secure national regulatory approval of alternatives and substitutes.

# Montreal Protocol Decision: Ex. 1/3

- Set the Allowable Amounts for Production or Consumption in 2005
  - Annex II A – List of Approved Critical Uses for Each Party
  - Annex II B – Level of Production and Consumption for Parties with Critical Use Exemptions

# Montreal Protocol Decision: Ex. 1/4

- Provided for additional Mebr beyond that approved for production or consumption (difference drawn from existing stocks).
- Limited use for approved critical uses to the total amount approved in aggregate for critical uses by each party.
- Required the Parties to endeavor to allocate Mebr for crops as designated in Annex II A for critical uses.
- Required report to the Parties of the method used to ensure conditions of granting the CUE are followed.

# Critical Use Exemption -- Application Process

- No Specific Guidance
- Each Party Devised Their Individual Process
- US Lead Agency – EPA, Office of Air and Radiation
- Cooperated with EPA OPP

# U. S. Application Process

- EPA Information Request – Requires OMB Approval
- Several Meetings with Stakeholders in 2000 & 2001
- Request for Exemption Application Noticed in FR 67:91, pp 31796-31801 (May 10, 2002) with September Application Deadline

# First Round of U. S. Applications: 2002

- Total of 54 Applications
- Much Variability in Information Provided
- Florida Petitions
  - Tomato
  - Strawberry
  - Solanaceous Crops Other than Tomato (Pepper & Eggplant)

# Application Review Timeline – First Round

- Sept 10, 2002 -- Completed Application submitted to EPA,OAR
- Sept – Dec, 2002 -- Internal U. S. Review
- Feb 2003 – US Nomination to UNEP
- April 2003 – MBTOC Review
- June 2003 – UNEP review of MBTOC/TEAP Recommendation
- November 2003 – Consideration of Recommendations by the meeting of the Parties
- February 2004 – Additional review and recommendations from MBTOC
- March 2004 – First Extraordinary Meeting of the Parties

# U.S. Nomination 2005 – First Round (2003)

- Requested Exemption for 2005 and 2006
- Requested Lump Sum Exemption for 9,921 tonnes (3,783 ODP tonnes)
- Covered 16 Industry Sectors, Including:

  | | |
  |---|---|
  | Commodity Storage | Orchard Replant |
  | Cucurbits | Ornamental Nursery |
  | Eggplant | Pepper |
  | Food Processing | Strawberry |
  | Forest Tree Seedling Nursery | Strawberry Nursery |
  | Ginger | Sweet Potato |
  | Nursery Seedbed Trays | Tomato |
  | Orchard Nursery | Turfgrass |

- Represented 38% of 1991 Baseline

# Second Round of U. S. Applications: 2003

- Included New Applications for 2005 CUE
- New Formats – Additional Information
- FFVA Petition – consolidated into a single petition across the same commodities

# Application Review Timeline – Second Round

- August 8, 2003 – Completed Application submitted to EPA, OAR
- Sept – Dec, 2003 – Internal U. S. Review
- Feb 2004 – US Nomination to UNEP
- April 2004 – MBTOC Review
- July 2004 – UNEP review of MBTOC/TEAP Recommendations
- November 2004 – Consideration of Recommendations by the Meeting of the Parties (Approval of 2005 Supplemental Request)
- April 2005 – Additional review and recommendations from MBTOC on Sectors to be considered at Second Extraordinary Meeting of the Parties
- June 2005 – Second Extraordinary Meeting of the Parties

# U. S. Nomination -- Second Round Nomination (2004)

- Requested Exemption for 2006 and Supplemental Information on 2005 CUE Needs
- 2005 Supplemental Request – 610.665 tonnes
- Commodities:

Dry Commodities – Structures
Dry Commodities – Processed Food
Dried Fruits and Nuts
Eggplant
Ornamentals
Peppers
Tomato
Smokehouse Ham
Strawberry – Field

# Montreal Protocol Review

- No Concrete Guidelines for Review Process
- In-house Closed Review Process
- Administered by UNEP through MBTOC and TEAP
- Pressure Created by Impossible Timelines
- Review Recommendations Considered for Final Approval (Consensus) at Meetings of the Parties

# 2005 Critical Use Exemptions
# UNEP Review and Decision Meetings

| | | | |
|---|---|---|---|
| 3/03 | MBTOC | South Africa | Closed |
| 5/03 | MBTOC/TEAP | Great Britain | Closed |
| 7/03 | OEWG | Canada | Open |
| 9/03 | MBTOC | United States | Closed |
| 11/03 | MOP | Kenya | Open |
| 12/03 | | Argentina | Closed |
| 1/04 | MBTOC | United States | Closed |
| 3/04 | Ex MOP | Canada | Open |
| 4/04 | MBTOC | Thailand | Closed |
| 5/04 | MBTOC/TEAP | Portugal | Closed |
| 7/04 | OEWG | Switzerland | Open |
| 11/04 | MOP | Czech Republic | Open |

# Key Decisions

- Decision Ex.1/3:  Sets initial Quantity for 2005 US CUE, Total CUE 35% of 1991 Baseline
  - 30 % 1991 Baseline, Approved for Production and Consumption
  - 5% 1991 Baseline, Approved for CUE use from Available Stocks
- Decision XVI/2:  Sets Supplemental Amounts for 2005 CUE, Additional 2 %.

# U. S. Clean Air Act, Allocation Process

- International Decisions Required Prior to Adoption of Final Rule

- Two Parts:

1. Process Framework for Administration
2. Quantities to be Exempted have to be identified

# Rule Making Process

- Very Complex
- Constrained by International Scheduling
- Additional Pressure Created by Political Situation

# Federal Register Notice – Proposed Rule Making, August 25, 2004

- Very Prescriptive
- Huge Fines
- Complex Self-certification Process
- No Definite Identification of “Approved Critical User”
- Penalized CUE Petitioners in Regard to use of Existing Stocks

# Federal Register Notice – Final Rule, December 23, 2004

- Became Effective January 1, 2005
- Sets 2005 CUE Control Period, Jan 1 – Dec 31, 2005
- Provides Criteria for Identification of "Approved Critical User"
- Identifies Quantities and Distribution of Critical Use Allowances
- Identifies Entities with Critical Stocks Allowance
- Provides for Record Keeping and Reporting to Meet the Requirements of the Montreal Protocol and the Clean Air Act.

# Implementation

- Growers Have Responsibility to Certify Prior Purchase of Mebr or Contract for Application Services for Mebr, that they are an “Approved Critical User”.
- Criteria for Meeting Conditions is “reasonable expectation” that Conditions will exist without use of Mebr”
- Conditions of Use for Specific Industry Sectors are Defined in Appendix L to Subpart A of 40 CFR, Part 82.
- Creates a Record Keeping Burden on Distributors, Dealer, and Custom Applicators.

# Issues

- Pre-purchased Materials or Services
- Tracking of Critical Use Allocations Through the Control Period
- Lag Time at the End of the Control Period
- Existing Stocks

# NRDC Rule Challenge

- Requested Administrative Stay of Rule on Dec 23, 2004
- At the Same Time Filed a Request for Judicial Review with the U. S. Court of Appeals for the District of Columbia.
- Filed an Emergency Motion for Stay Pending Review and Expedited Consideration on Jan 24, 2005.

# NRDC Rule Challenge

- Allegations:
  - EPA Unlawfully Allows Existing Stocks to be Used for Non-critical Uses.
  - EPA Is Unlawfully Allowing Production or Importation of New Methyl Bromide in 2005.
- Requested Actions:
  - Stay the Rule to the Extent it Allows Existing Stocks to be Used for Non-critical Uses.
  - Stay any Production of Methyl Bromide Pending Review of the Rule.

# What Does the Future Hold?

- More Uncertainty
- Hearing Scheduled by the House Ag Committee on Critical Use Exemption Process, March 10, 2005
- Contentious Debate over the 2006 and 2007 CUE at the International Level.
- More Work for Everybody

# Methyl Bromide Transition Competitive Grants Program

Dennis D. Kopp

USDA/CSREES

Raleigh, NC

February 25, 2005

# Sequences

- 1994 Montreal Protocol – Phase out of MB by January 2005
- 1994-2001 - Problem and MB ban denial. Hope for a “political” solution and research focused on “saving” MB
- 2000 - Methyl Bromide Transition Program
- Future research needs to evolve focus on relevant, applicable and sustainable alternatives

# USDA Programs supporting MB Research & Extension Work

- Agricultural Research Service Field Stations across the country
- Competitive funds:
  - Methyl Bromide Transitions – Integrated Res.
  - IR-4 Methyl Bromide Research grants
  - Organic Transitions Programs
  - SARE Farmer Grants
  - EQUIP grants

# USDA Methyl Bromide Transitions Competitive Grant Res. Program

- Initiated in 2000 as one of 5 new “Integrated Pest Management Research” Programs
- The intent is to enable the United States to comply with the Montreal Protocol.
- Funding is allocated through a Competitive research grant program called Methyl Bromide Transitions

# Goals of MBT Program

- Discover, develop, and demonstrate Methyl Bromide alternatives
- Develop integrated research, education, and/or extension programming
- Develop tools and data to aid rapid, well-informed regulatory decisions
- Develop economic assessments for impact data for use in Critical Use Exemptions and the costs/benefits of transitions

# MBT Competitive Funding Supports ~~~

- Short- to intermediate-term Projects
- Approaches should lead to more sustainable systems
- Research supporting CUE data gaps
- Relevant programs and activities in:
  - research, education, and extension
  - field trials and/or demonstration projects of MB alternatives

# USDA Methyl Bromide Transitions Competitive Grant Res. Program

- Since 2000, USDA/CSREES has funded a total of 32 research projects
- Funding level at nearly 3 million dollars a year (= ca. $14 M since 2000)
- MBT has cultivated new working partnership between the USDA, agricultural colleges and universities, commodity groups, the regulatory community and farmers.

# FY 2004 MBT Grant Awards

- In FY 2004 MBT program funded the 8 top-ranked projects of the 28 submitted proposals
- These 8 projects provided research resources for 26 additional scientists and extension educators at 15 research facilities in 9 states
- These 8 projects contributed to the training of the next generation of agricultural scientist involving:
  - 30+ agricultural technicians
  - 25+ graduate students

  ~~ working to solve complex real-world problems

# Impacts and Outcomes
## The MBT Program has ~~~~

- Contributed to an appreciable reductions in MB usage
- Reduced MB usage = reduced risk to the ozone layer
- Demonstrated innovative and viable alternatives in certain MB dependent production systems
- Protected American farmer’s income by maintaining international competitiveness
- Contributed positively to the U.S. balance of trade
- Helped maintain low consumer supermarket prices on fresh fruits and vegetables

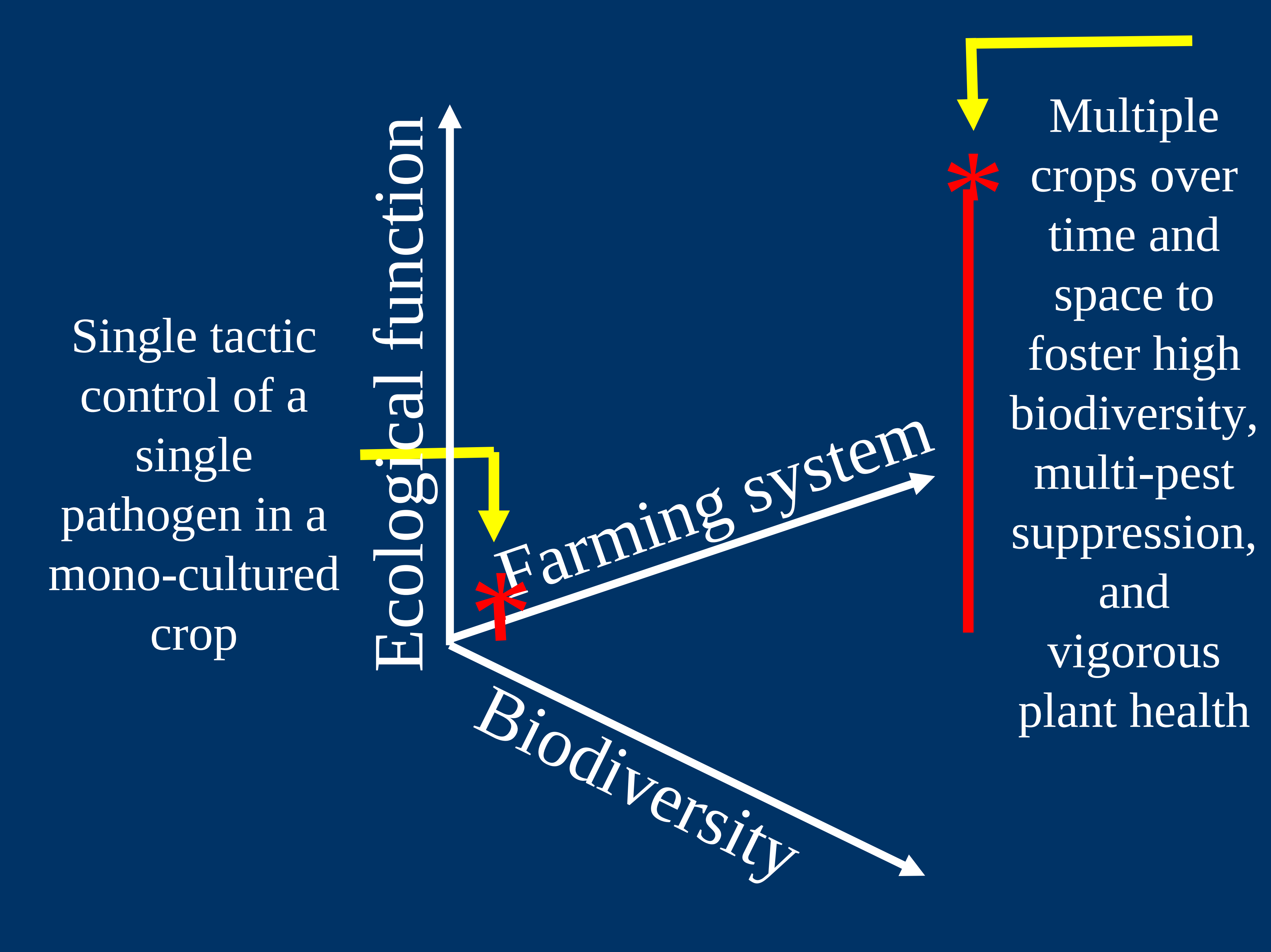
# Impacts and Outcomes

## The MBT Program has ~~~~

- Contributed to the L-G University Mission by meaningfully engaging the talents of research scientists and extension educators on relevant applied agricultural issue.
- Contributed to the education and graduate training of the next generation of agricultural scientist and technicians through solving real-world problems

# Where to Next?

- Soil pest were a production problem before MB was used as a pesticide
- MB usage will end in the near future
- We need to realignment shrinking research resources to problem areas
- Changing focus from pesticide to pest
- How about: **"Soil Pest Management in Specialty Crop Production" ????**


Multiple crops over time and space to foster high biodiversity, multi-pest suppression, and vigorous plant health
Single tactic control of a single pathogen in a mono-cultured crop
Ecological function
Farming system
Biodiversity

# 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

# Treatments

Compost

Methyl Bromide

Telone C35

Unfumigated Control

- **Plots (4 beds 40 ft long)**
- **Data collection inner 20 ft of inner 2 beds**
- **Latin Sq. design**
- **Same location for 3 consecutive years (i.e. no crop rotation)**
- **Fall plant. Harvest=April - June**

# Controlled Microbial Compost

- **Management intensive system**
- **Compost pile monitored and adjusted daily for temperature, moisture and $CO_2$ content**

**Recipe:** **30 % Dairy manure**
**30% Waste Hay**
**30% Waste Silage**
**5% Finished compost**
**5% Clay soil**

Legume-Grass Cover Crop

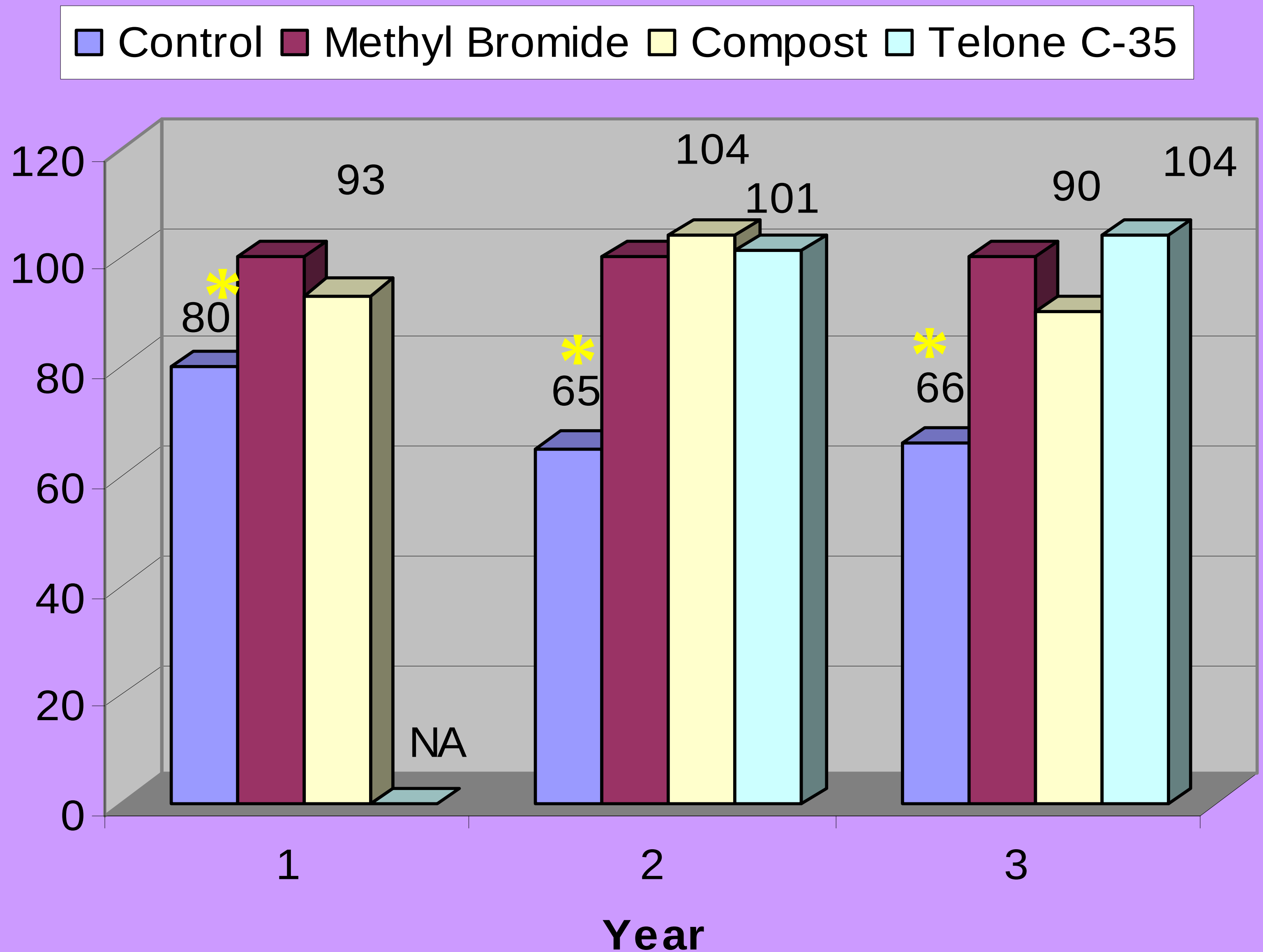
**Year 1:** 30 $yd^3$/acre
**Year 2:** 20 $yd^3$/acre
**Year 3+:** 15-20 $yd^3$/acre

## Rotary Spader

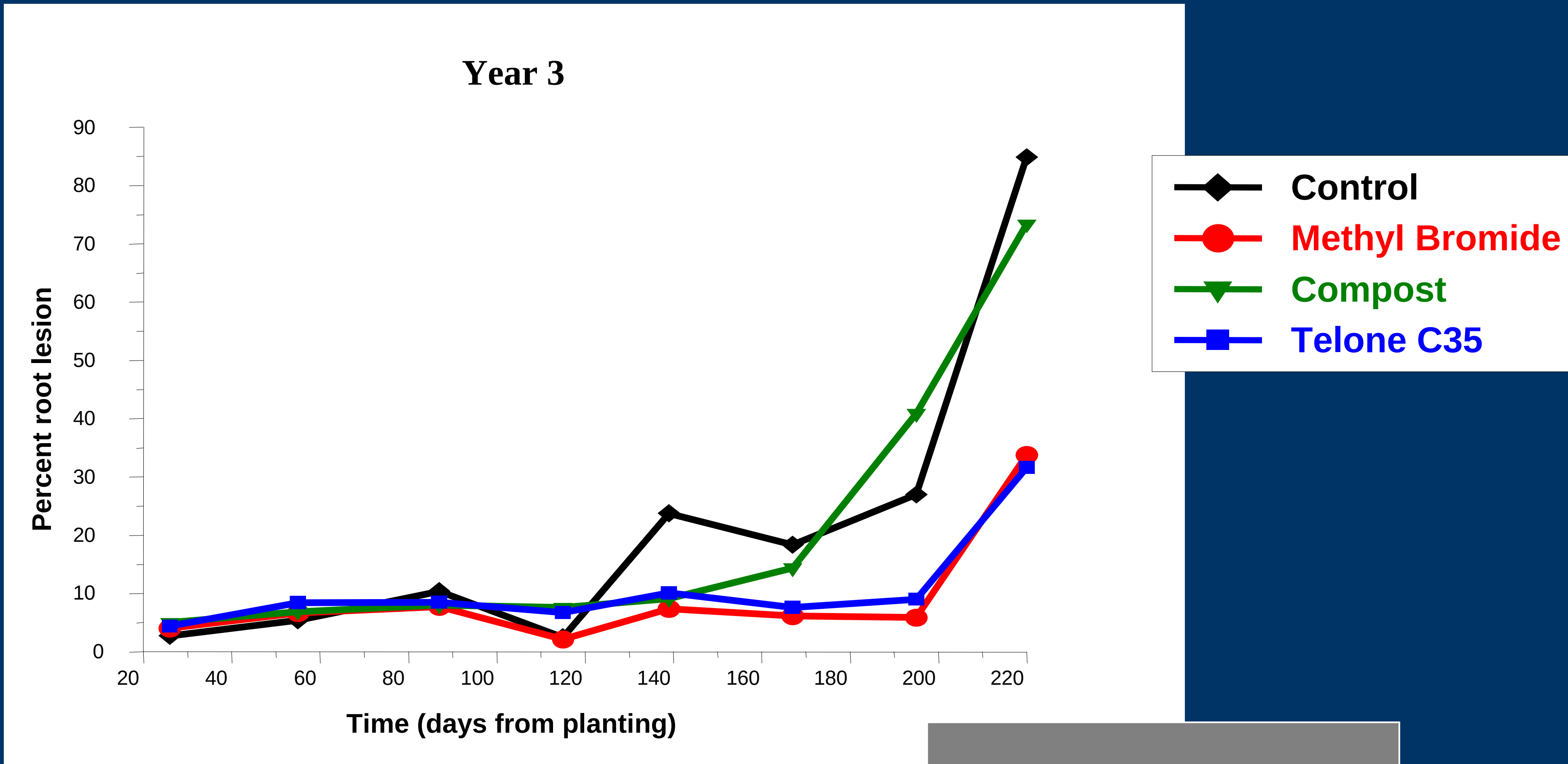
## Raising of the Beds

## Crop Establishment

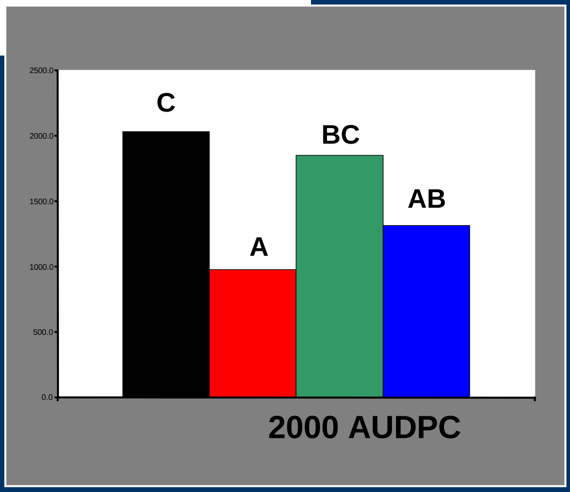
# Marketable Yield




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



Year 3
Percent root lesion
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
Time (days from planting)
Control
Methyl Bromide
Compost
Telone C35

2500.0
2000.0
1500.0
1000.0
500.0
0.0
C
A
BC
AB
2000 AUDPC

# Microbial ecology

Objective:

- To characterize the population dynamics of pathogens and biocontrol agents in roots and soil from both the transplant and field production systems.

- To research biological methods and processes to enhance disease management.

# Pathogens to Control

- *Isolated and characterized over 1200 fungi*

  *(G. Abad; F.Louws; L. Ferguson; G. Fernandez)*

  - *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*
- *Described new Phytophthora species*

# Why do growers fumigate?

Healthy

Black Root Rot Complex


Leonor Leandro et al. POSTER 331B

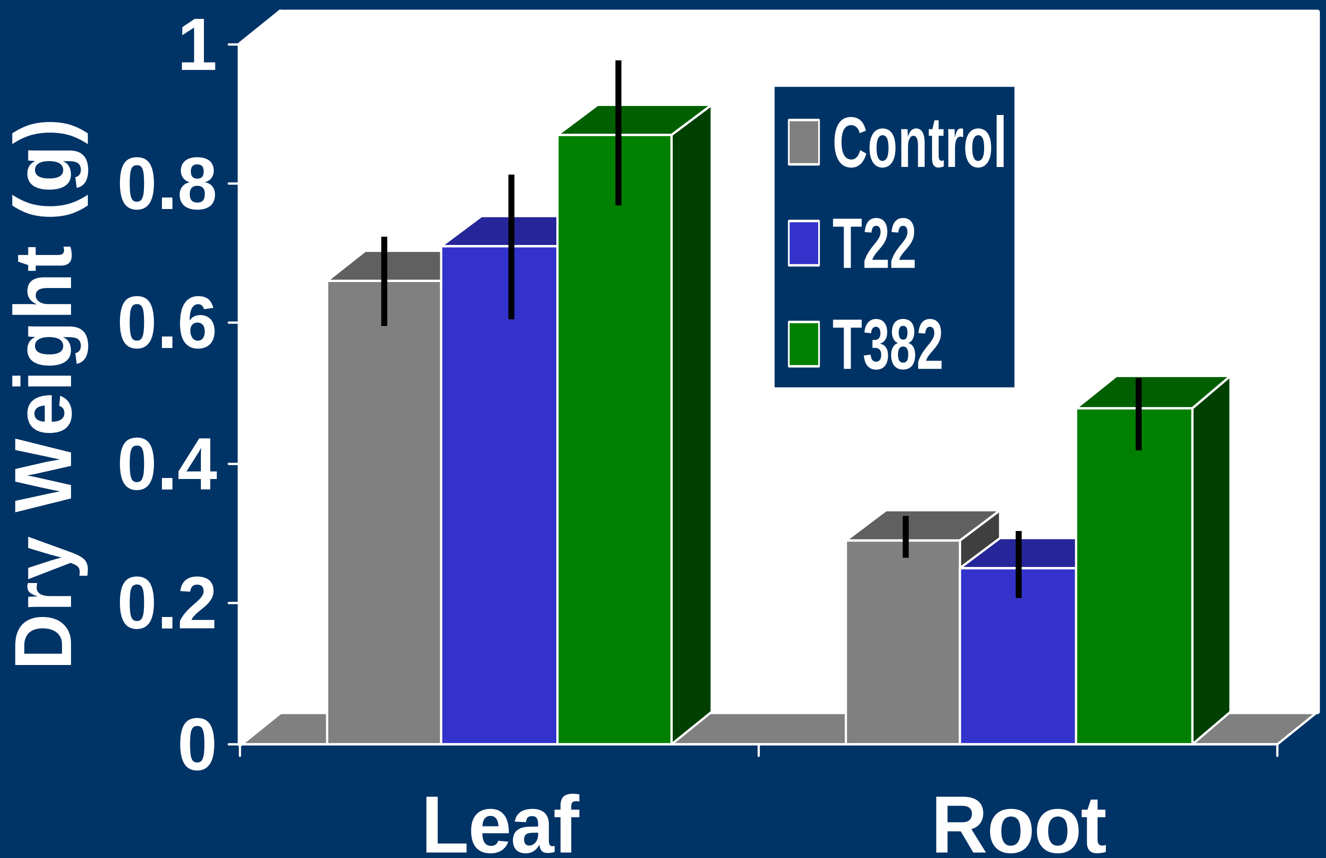
# Can we get specific suppression

Fungal isolation frequency (%) from roots of 4-week-old plug transplants for each treatment.

| Fungal genus/ species | Diseased Roots | | | Healthy Roots | | |
|---|---|---|---|---|---|---|
| | Control (n=19) | T22 (n=10) | T382 (n=18) | Control (n=46) | T22 (n=22) | T382 (n=22) |
| *Trichoderma* | **36.8** | **70.0** | **27.8** | **41.3** | **81.8** | **59.1** |
| *P. irregulare* | **21.6** | **0.0** | **11.1** | **15.2** | **0.0** | **4.5** |
| *Phytoph. cactorum* | **36.8** | **30.0** | **0.0** | **13.0** | **4.5** | **0.0** |

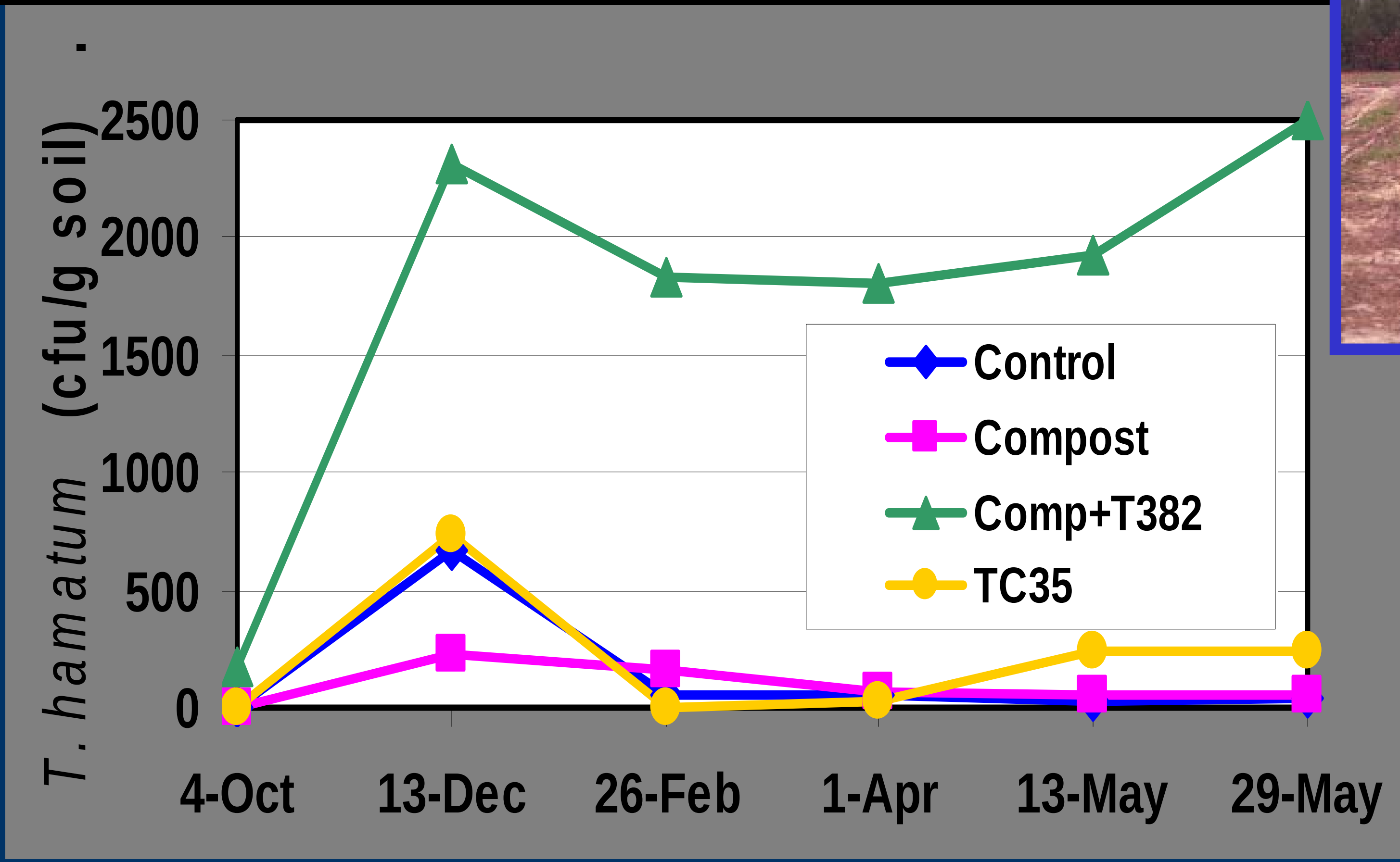
**T22 = *Trichoderma harzianum* ; T382= *T. hamatum***

Effects of *Trichoderma* biocontrols on root health and growth of 4-week-old plug transplants.




**Preliminary Data**

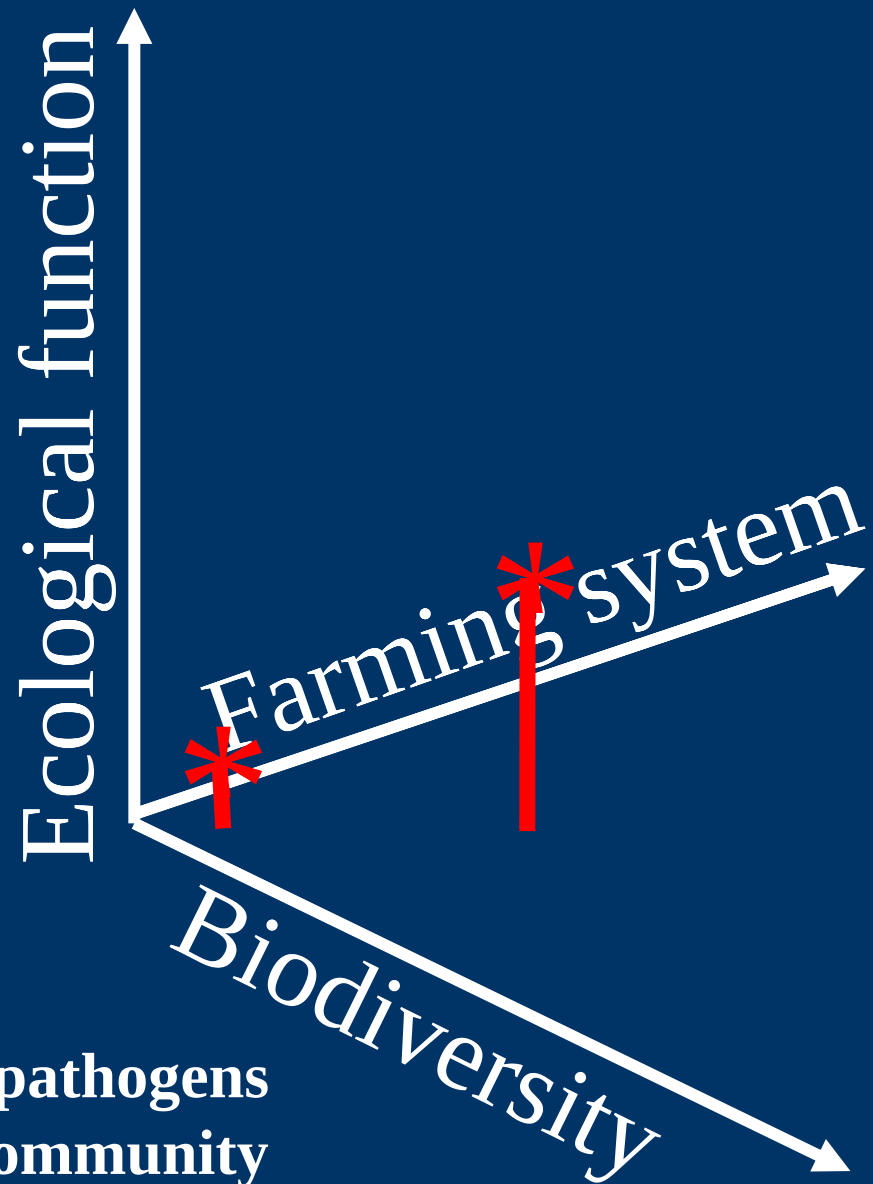
# Can we bias the soil community to favor T382 populations?




Population of *T. hamatum* in field soil. Compost was inoculated with T382 and incorporated into field soil after two weeks.

## RESEARCH COMPONENTS

- Disease suppression
- Plant growth promotion
- Good Yields

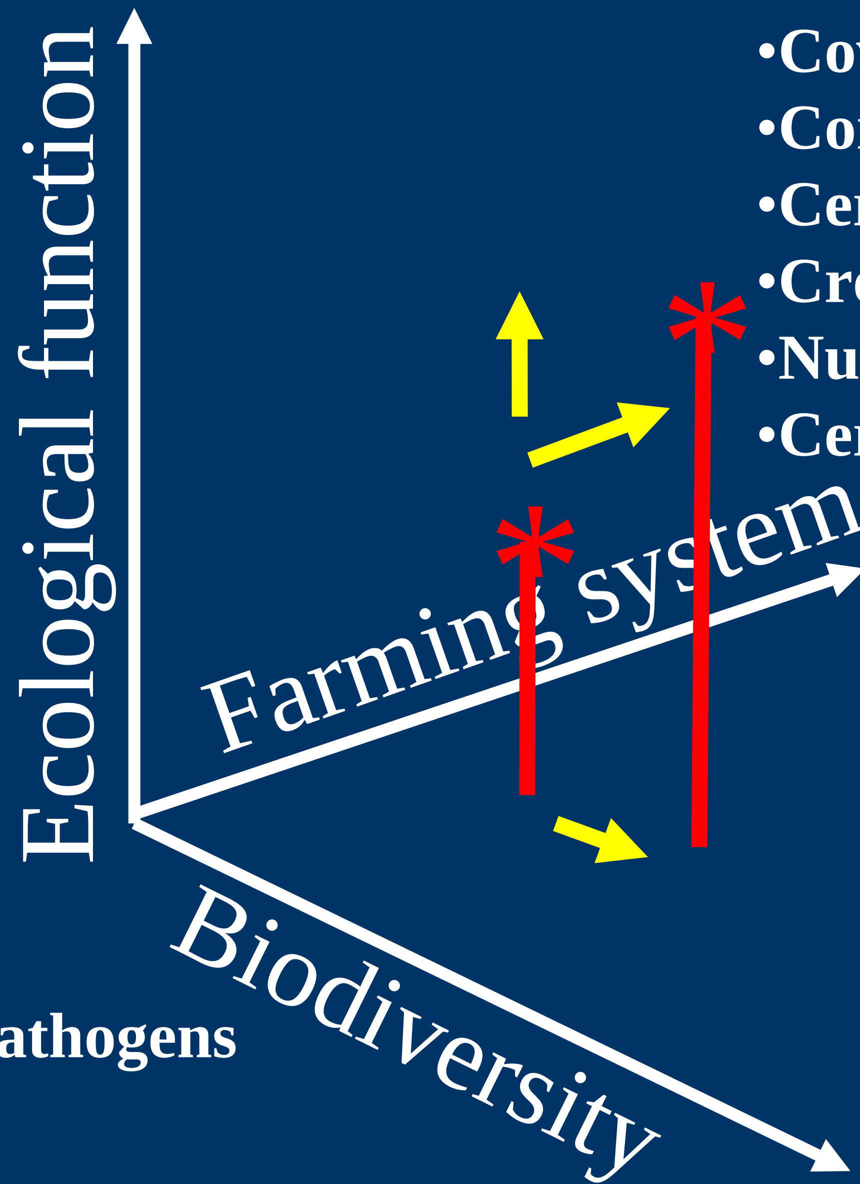



•Cover crops
•Compost

•Biologicals
•Knowledge of pathogens
•(Biased) Soil community

# EXTENSION & IMPLEMENTATION COMPONENTS

- Disease suppression
- Plant growth promotion
- Good Yields
- Weed suppression
- Nutrient cycling/CEC




•Cover crops
•Compost
•Certified plants
•Crop rotation
•Nutrient mgmt
•Certified organic

•Biologicals
•Knowledge of pathogens
•Soil community
•Crop diversity