

Leading Methyl Bromide Alternatives for Tomato Production in Florida, USA

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Mulched Florida Vegetables

Crop	Area (Ha)	Value (US\$M)
Tomato	9,500	508
Bell Pepper	6,000	219
Strawberry	2,500	153
Watermelon	9,000	62
Cucumber	3,000	59
Squash	4,500	41

Source: USDA, 2003

We only have a LITTLE weed pressure...



...and just a FEW nematodes and soilborne diseases!



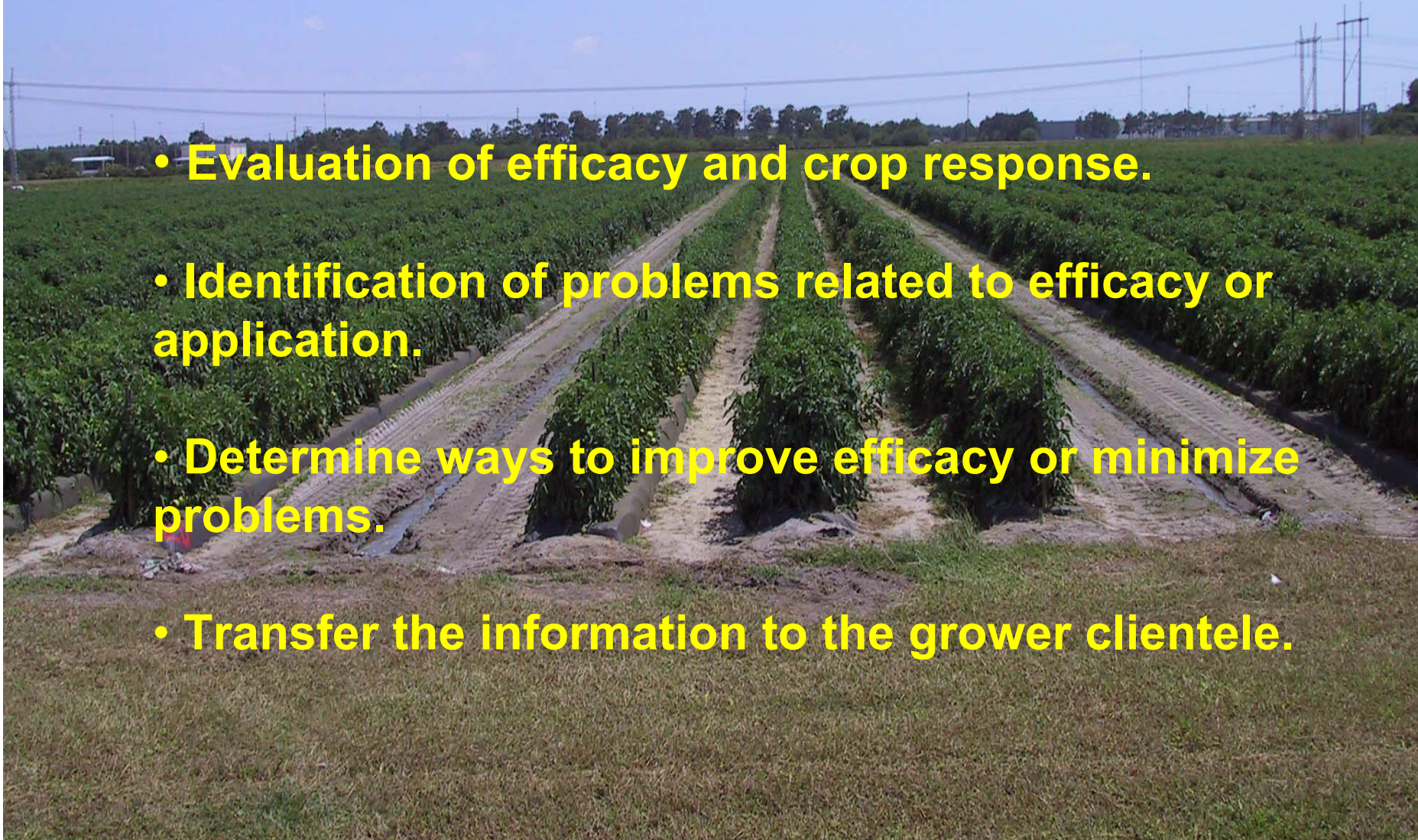
The Grower-Scientist Relationship

- Most growers have confidence in the research process.
- Growers feel like the “risk-takers” and feel scientists have no real financial stake in the results.
- Most scientists do all their research in small plots, and growers feel that it is different in the “real world”.



Approach for MBr Research and Extension

- Evaluation of efficacy and crop response.
- Identification of problems related to efficacy or application.
- Determine ways to improve efficacy or minimize problems.
- Transfer the information to the grower clientele.



Weed Control



- Purple and yellow nutsedge (*Cyperus rotundus* & *C. esculentus*).
- Main concern for any MBr alternative.

Weed Control

- **Early on, none of the alternatives provided consistent control.**
- **Broadening our search and integrating a limited selection of herbicides with fumigant alternatives.**
- **It was determined:**
 - **A broadcast incorporated application of pebulate,**
 - **Followed by 1,3-dichloropropene + chloropicrin (1,3-D + Pic).**



← **Control**

**1,3-D + Pic plus
pebulate** →



Weed Control

- **Demonstration-research trials were generally good.**
- **Inconsistencies occurred due to mistakes in the application and incorporation of pebulate.**
- **Unfortunately, pebulate is not longer registered in the USA, resulting in a renewed search.**



Paper Mulch Films

- Very effective at reducing nutsedge emergence through the film.
- Quickly rotted and wind would blow large sections off the field.



Virtually Impermeable Films (VIF)

- A means for reducing MB rates and emissions.
- Early VIF products had very poor handling characteristics and would rip easily.
- There were differences in fumigant retention as well as amount of UV inhibitor and field life.



Virtually Impermeable Films (VIF)

- After small plot trials, large grower demonstrations were conducted.
- In commercial plots, mulch films must be installed quickly to meet production schedules.
- Minor handling flaws become major ones in these situations.



Virtually Impermeable Films (VIF)

- There are differences in handling and MBr retention among and within manufacturers.
- As a result, growers are reluctant to adopt VIF.
- There are benefits that are encouraging:
 - Emission reductions and cost savings.



Virtually Impermeable Films (VIF)

- **UF research: MBr rates can be reduced by 25% of the standard rate when combined with a “good” VIF.**
- **Grower scale trials have repeatedly demonstrated the success of a 50% reduction in rate with VIF.**
- **The combinations of VIF + methyl iodide (MI), and VIF + 1,3-D + Pic have been interesting.**
 - **Greatly improved weed control with no decrease in yield.**
 - **Spring 2004: Acceptable nutsedge control.**

Virtually Impermeable Films (VIF)

- **VIF can reduce the MI rate required for a given level of pest control.**
- **This would make MI much more cost competitive, increasing its chances for adoption by growers.**
- **In order for VIF to be adopted by USA growers, films must be improved so they can be laid at 6 to 8 km/h without tearing.**

Virtually Impermeable Films (VIF)

- **The film should have sufficient UV inhibitor to last in the field.**
- **Manufacturers must maintain very strict quality control procedures to assure acceptance in the USA.**
- **Part of the success of VIF in Europe is the greater film thickness compared to the ones sold in the USA.**
- **This provides greater strength and reduces rips and tears which will not be tolerated in the USA market.**

Soil Solarization

- Good control of nutsedge in some early work with infrared retentive film.
- To be successful, solarization must be done for at least 8 weeks.
- There is seldom >8 weeks between tomato crops in Florida.
- Thus, there is little time for solarization and the time available is not the best time.



Metam Sodium (MNa)

- **Early work: Using existing fumigant rigs, which utilized chisels spaced 30 cm apart for MBr application. Results were poor.**
- **Late work: Many different application methods:**
 - Applying with more chisels,
 - Spraying MNa ahead of disk hillers,
 - Incorporation with rototiller, disk, or spring tooth harrow,
 - Spraying on the bed surface prior to laying the mulch film,
 - Subsurface delivery, and
 - Delivery through the drip irrigation system.
- **The failure rate was greater than 3 out of 4 initially.**

Metam Sodium (MNa)

- **Today, we achieve much greater consistency:**
 - Applying MNa as a spray just ahead of a rototiller then forming and covering the beds, or
 - Applying through multiple drip irrigation tubes.
- **To be effective:**
 - The soil must be moist and warm at the time of application,
 - MNa must be delivered uniformly to the soil,
 - The target pest must be actively respiring,
 - MNa must be present in the proper concentration for the correct time duration.

Metam Sodium (MNa)

- **2003-04 research:**

- The correct time duration for a given concentration is still unknown.
- We know that MNa does not move beyond the wetting front (top 20 cm in Florida sandy soils).
- The number of irrigation tubes: Based on the bed width, practicality and economics.



Metam Potassium



Control



6000 ppm

Chloropicrin (Pic)

- It can stimulate the nutsedge emergence if applied at the proper rate.
- This stimulation can be used in combination with delayed application of MNa to provide greatly improved nutsedge control.
- This approach can be used with either Pic alone or in combination with 1,3-D.



Chloropicrin (Pic)

- However, the requirement for multiple micro-irrigation tubes determines how practical this will be.
- Most growers prefer a 1 m-wide beds for a number of reasons.
- Adoption of this technique will require changes in bed width and in the bedding equipment.



1,3-D + Pic

- Research was conducted on broadcast applications of 1,3-D + Pic.
- Reduce risk of personnel exposure.
- Early results were poor.
- Emphasis was placed on identifying the best equipment.



Mirusso - Yetter Avenger coulters

1,3-D + Pic

- The emulsifiable concentrate formulation also have improved results.
- It moves beyond the wetting front, so irrigation tubing can be spaced further apart than with MNa.
- It still requires more than one tube for a bed:
 - Increased costs,
 - Difficulty of alignment,
 - Risks of damaging lines,
 - Depends on soil moisture.



Methyl Iodide (MI)

- **It can be applied with existing application equipment and is a true broad spectrum fumigant.**
- **It has shown promise against soilborne fungi, nematodes and weeds, including the nutsedges.**
- **More research is needed to better define rates.**
- **MI is projected to be rather expensive:**
 - **Research with low rates,**
 - **Combinations with Pic.**

Methyl Iodide (MI)

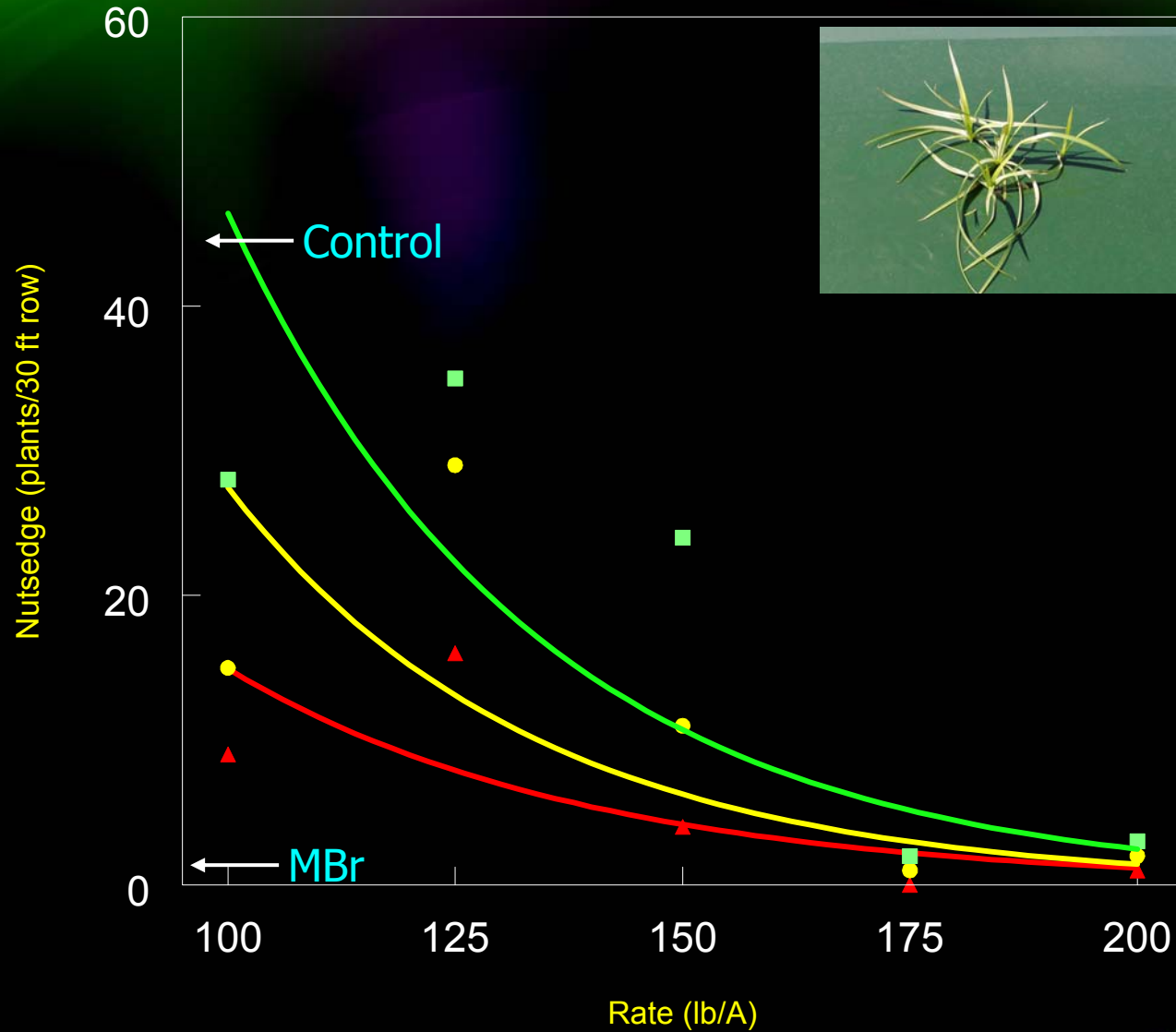
- **This resulted in mixed efficacy reports and mixed opinions as to MI effectiveness.**
- **The USA-EPA has been slow to register it.**
- **This delay has not inspired confidence in its potential.**



Which MI:Pic rate performs better against nutsedge?

MI + Pic 98:2

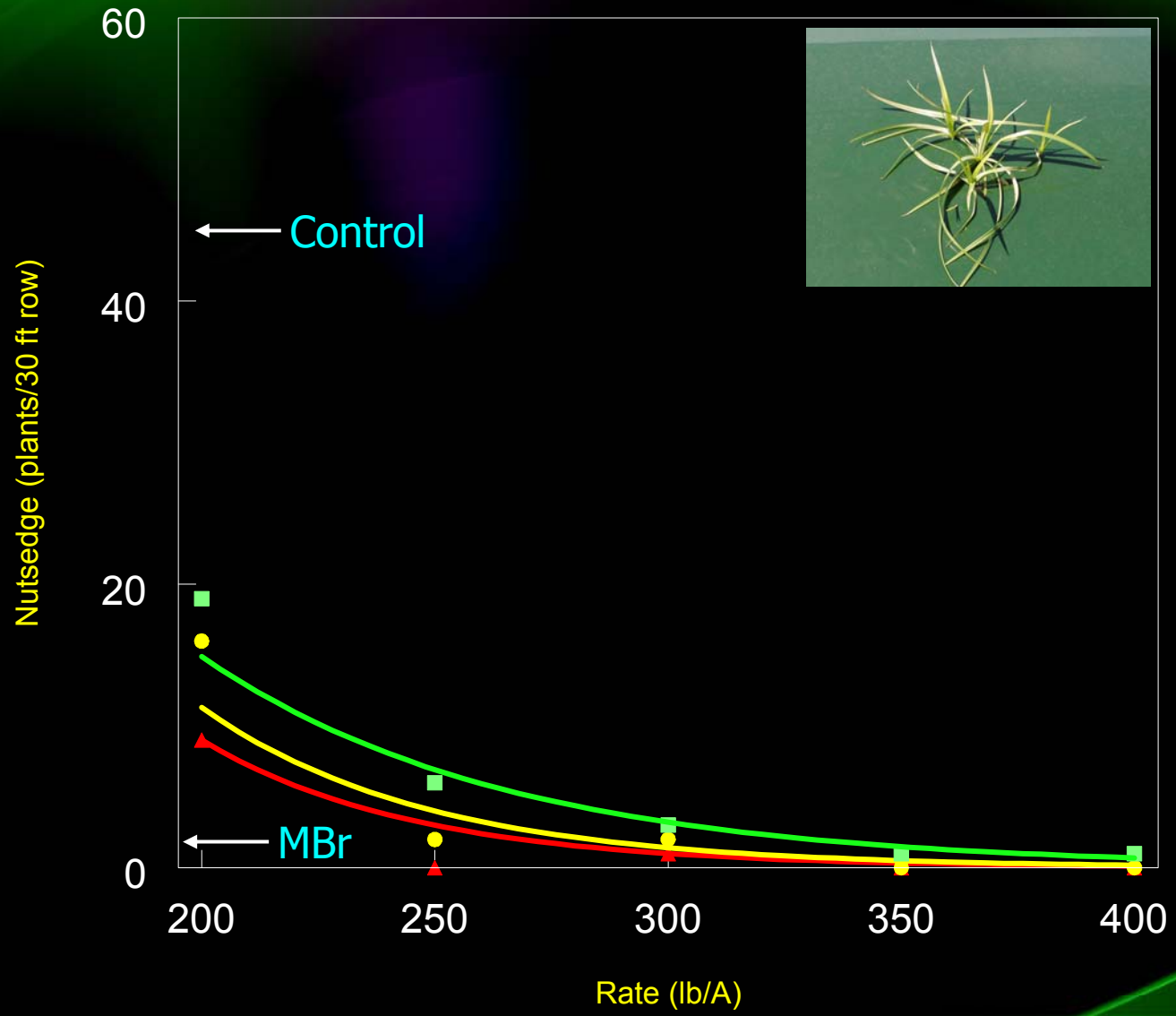
▲ 3 WAT ● 6 WAT ■ 10 WAT



Which MI:Pic rate performs better against nutsedge?

MI + Pic 50:50

▲ 3 WAT ● 6 WAT ■ 10 WAT



Sodium Azide

- As with MNa, it is affected by the lateral distribution of water in the soil.
- Rates are still being investigated and concentration appears to be more important than rate (400-600 ppm?).
- Results with tomato have been very promising when applied correctly at the proper concentration.



Dimethyl Disulfide (DMDS)

- Preliminary results have been somewhat mixed but overall are positive.
- DMDS appears to be compatible with application via drip irrigation and chisel or knife injection.
- Rates need to be better defined as well as pest control spectrum and crop response (>400 kg/ha??).



Propozone

- Preliminary results have been positive.
- Propozone must be applied with a 3-chisel rig to ensure coverage.
- Rates need to be better defined as well as pest control spectrum and crop response (≈ 750 L/ha).



Challenges Ahead

- All these products have been non-injurious to tomato when properly applied.
- Teaching growers the finer points of rates and application can be challenging.
- Few tomato growers have experience with herbicide application to the soil.
- Most of their experience is based upon shielded spray applications of nonselective herbicides.

Challenges Ahead

- **The USA tomato industry is most likely to replace MB with 1,3-D + Pic with mixtures of herbicides.**
- **Some growers will use MNa in combination with 1,3-D + Pic.**
- **The future is difficult to predict because it involves regulatory considerations as well as efficacy and economics.**
- **There is great potential for VIF, if manufacturers provide what growers want.**

Challenges Ahead

- Funding has greatly diminished and interest is waning as the process is protracted.
- Not every grower will survive because change comes hard to some.
- Those who engage in the search for alternatives and want to learn will survive.
- In this process, we are not only scientists but also agents of change.





Thank you!!!

