Nematode and Nutsedge Resurgence in Double-cropped Cucumber after Methyl Bromide Chemical Alternatives and Solarization in Tomato

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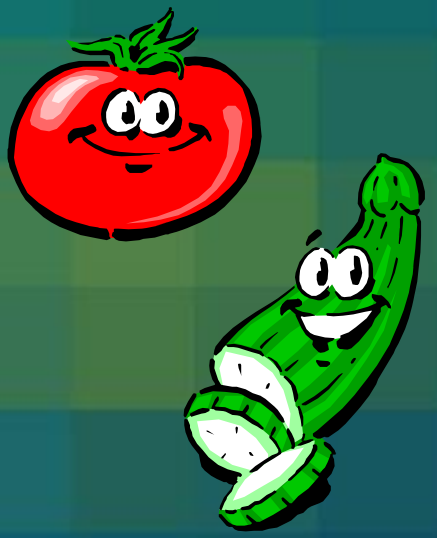
USDA



Why Nutsedge?

Cyperus rotundus & C. esculentus

- **Tomato yield loss: >30%.**
- **Hardest weed to control.**
- **Mulch penetration.**
- **Few labeled herbicides.**
- **No seasonal break.**

Why Nematodes?

- **Root-knot (*Meloidogyne* spp.); sting (*Belonolaimus* spp.).**
- **Stunt (*Tylenchorhynchus* spp.); ring (*Criconemoides* spp.).**
- **Reduced water and nutrient absorption.**

Methyl Bromide Alternatives

- **Chemical alternatives.**
  - ***1,3-dichloropropene + chloropicrin (1,3-D + Pic)***
  - ***Herbicides***
- **Non-chemical means.**
  - ***Solarization***

Double-Cropping

- **Growers usually produce tomato in the same field during one season per year.**
- **Next season the fields are either:**

  a) Disked and left fallow,

  b) Planted with a cover crop, or

  c) Rotation with another crop (double-cropping).

Sustainability of Double-Cropping

- Using the same beds and irrigation system, and residual fertilizer.
- Scarce work has addressed the benefit of MBr alternatives to a double-crop.
- The long-term fumigant effect on the following crop has not been demonstrated.

Questions to Answer

- Is there a long-term effect of fumigants on nematode and nutsedge populations?
- Is solarization an effective long-term MBr alternative?
- How do 1,3-D + Pic with herbicides perform against MBr?

Materials and Methods

- **Four consecutive fall and spring seasons.**
- **Gulf Coast Research and Education Center in Bradenton, Florida.**
  - ***EauGallie fine sand soil with 98% sand.***
  - ***<1% organic matter.***
  - ***pH = 7.1.***

Year-long Rotation

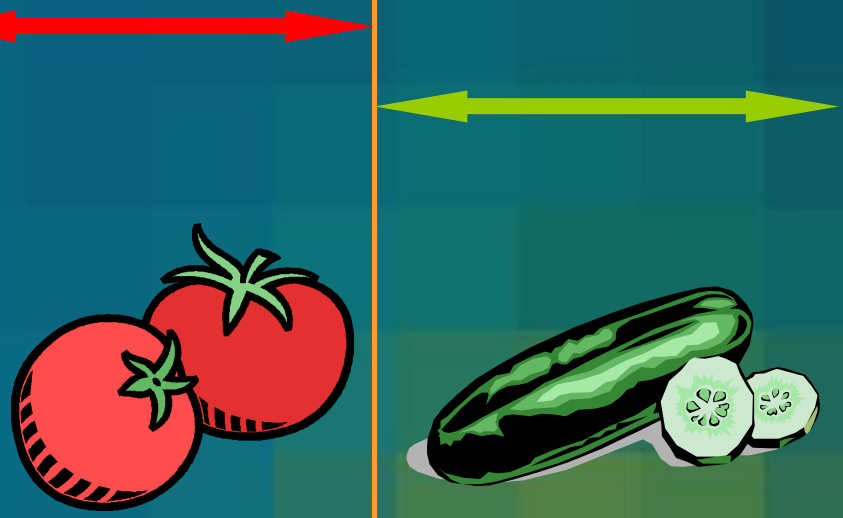
Summer *Fall* *Winter* *Spring*

1. Non-fumigated control.

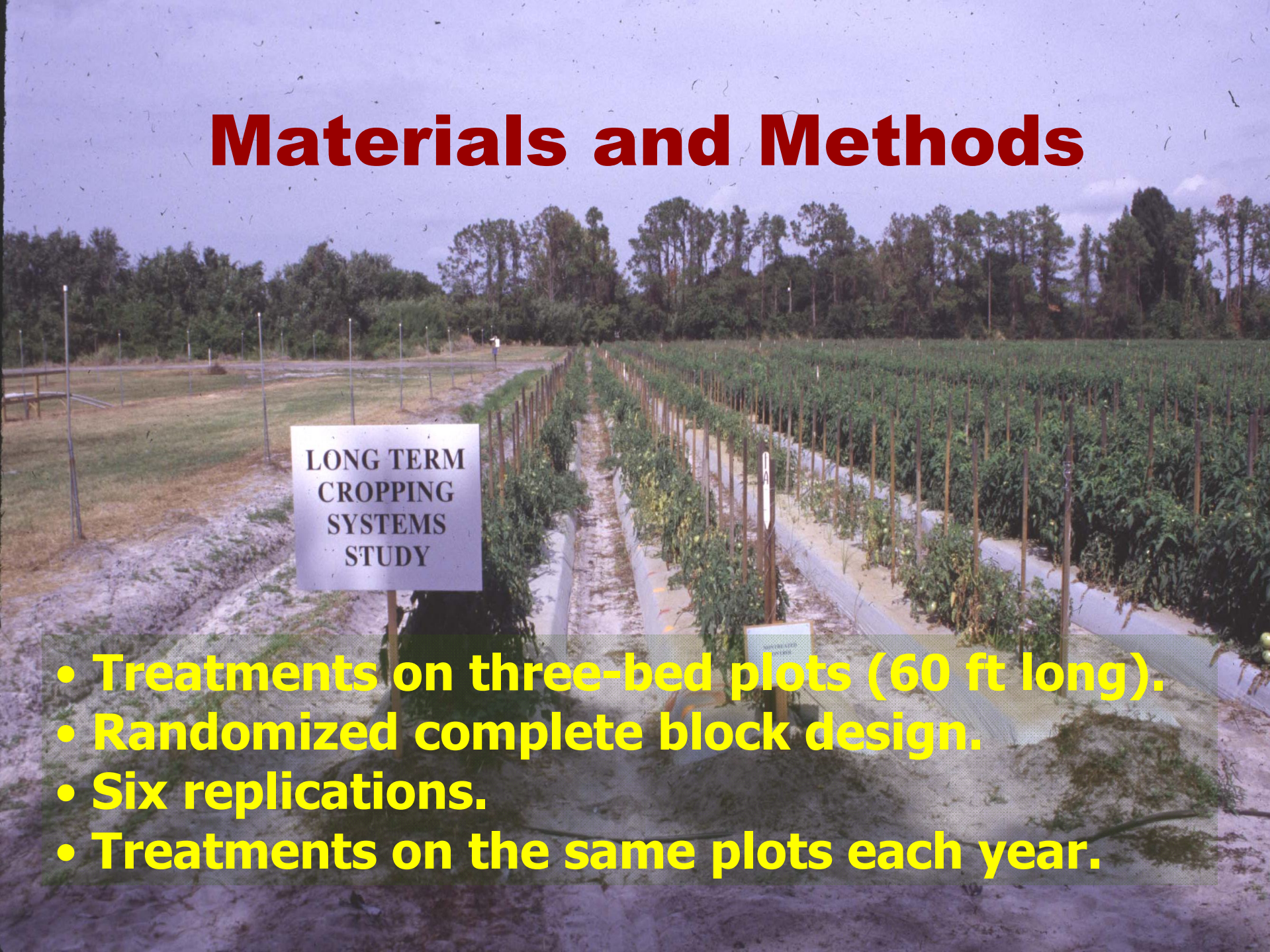
2. MBr + Pic 67:33 (350 lb/acre).

3. Pebulate + napropamide (4 & 2 lb/acre), followed by 1,3-D + Pic (40 gal/acre).

4. Napropamide (2 lb/acre), followed by solarization for 8 weeks.



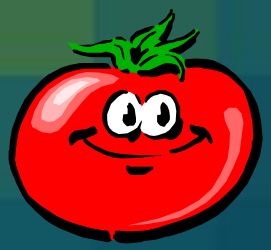
Materials and Methods



- Treatments on three-bed plots (60 ft long).
- Randomized complete block design.
- Six replications.
- Treatments on the same plots each year.

Materials and Methods

- **Beds covered with clear polyethylene film.**
- **Solarization ended by painting the film with white latex paint.**
- **MBr + Pic and 1,3-D + Pic:**
  - ***Injected ≥3 weeks before tomato transplanting.***
  - ***Three-knife rig at 10 inches deep.***



Materials and Methods

- 'Solimar' tomato.
- Subsurface and drip irrigation.
- At the end of each tomato season:
  - *Plots sprayed with paraquat twice.*
- 'Competitor' cucumbers direct-seeded.
- Drip lines used for water and fertilizer.

Materials and Methods

- **Cucumber plant vigor:**
  - *10, 7, and 9 WAP in 1999, 2000, and 2001.*
  - *100% = optimum vigor .*
- **Marketable yield.**
- **Nutsedge populations:**
  - *9, 10, 7, and 14 WAP.*
- **Nematode populations and galling:**
  - *Populations: Soil samples at 14 WAP.*
  - *Root-knot galling: 0-10 scale (0 = no galls).*

Materials and Methods

- **ANOVA (P=0.05).**
- **Nutsedge and nematode data:**
  - ***Transformed with $log_{10} + 1$.***
- **Cucumber plant vigor values:**
  - ***Square root arcsine transformation.***
- **Waller-Duncan multiple range test.**

Nutsedge Densities

Fumigants	Herbicides	----------plants/m^2----------			
		1999	2000	2001	2002
Non-treated	---	**33 a**	**282 a**	**87 a**	**37 a**
MBr + Pic	---	**7 b**	**24 b**	**3 c**	**27 a**
1,3-D + Pic	*Peb + napro*	**6 b**	**38 b**	**28 b**	**20 ab**
Solarization	*Napro*	**3 b**	**15 b**	**6 c**	**13 b**
Significance		*	*	*	*

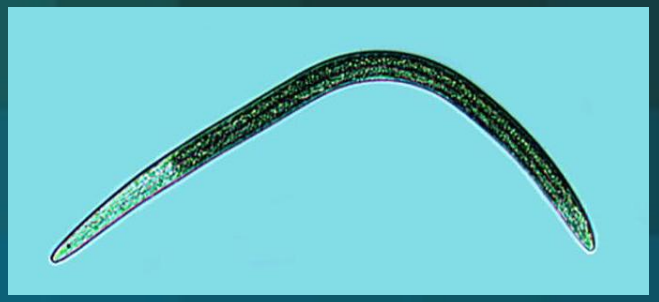
Root-knot Galling Index
(0 = no galls)

Fumigants	Herbicides	1999	2000	2002
Non-treated	---	**6.0 a**	**9.0 a**	**8.0**
MBr + Pic	---	**0.9 b**	**4.4 b**	**6.7**
1,3-D + Pic	*Peb + napro*	**3.8 ab**	**4.5 b**	**7.0**
Solarization	*Napro*	**6.2 a**	**5.6 b**	**6.6**
Significance		*	*	NS

Nematode Populations
2000

Fumigants	Herbicides	----------number/100 mL----------			
		Root-knot	Stunt	Ring	Sting
Non-treated	---	**332 a**	**35 a**	**11 a**	**10**
MBr + Pic	---	**156 b**	**7 b**	**0 b**	**0**
1,3-D + Pic	*Peb + napro*	**164 b**	**4 b**	**0 b**	**0**
Solarization	*Napro*	**339 a**	**7 b**	**0 b**	**0**
Significance		*	*	*	NS

Nematode Populations
2001



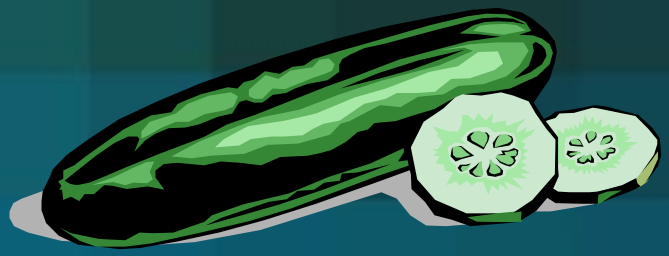
Fumigants	Herbicides	----------number/100 mL----------			
		Root-knot	Stunt	Ring	Sting
Non-treated	---	**40**	**32 a**	**117 a**	**56 a**
MBr + Pic	---	**59**	**1 b**	**0 b**	**1 c**
1,3-D + Pic	*Peb + napro*	**82**	**14 ab**	**0 b**	**3 bc**
Solarization	*Napro*	**156**	**11 ab**	**7 b**	**19 b**
Significance		NS	*	*	*

Nematode Populations
2002

Nematodes are shy, so no more pictures!!

Fumigants	Herbicides	----------number/100 mL----------			
		Root-knot	Stunt	Ring	Sting
Non-treated	---	**54**	**0**	**82**	**16 a**
MBr + Pic	---	**175**	**2**	**12**	**1 c**
1,3-D + Pic	*Peb + napro*	**78**	**1**	**1**	**0 c**
Solarization	*Napro*	**169**	**2**	**2**	**8 b**
Significance		NS	NS	NS	*

Cucumber Yield



Fumigants	Herbicides	----------t·ha^{-1}----------			
		1999	2000	2001	2002
Non-treated	---	**15.1 b**	**5.7 b**	**5.0 b**	**4.7 b**
MBr + Pic	---	**24.7 a**	**23.3 a**	**21.3 a**	**10.3 ab**
1,3-D + Pic	*Peb + napro*	**19.8 ab**	**22.2 a**	**17.0 a**	**11.7 ab**
Solarization	*Napro*	**12.7 b**	**21.6 a**	**9.6 b**	**15.5 a**
Significance		*	*	*	*

What did we learn?

- **Is there a long-term effect of fumigants on nematode and nutsedge populations?**
  - ***Yes, especially against some nematodes.***
- **Is solarization an effective long-term MBr alternative?**
  - ***No, it needs help.***

What did we learn?

- **How do 1,3-D + Pic with herbicides perform against MBr?**
  - ***Consistently similar to MBr all 4 years.***
- **Future research**
  - ***Combining solarization with other control means.***
  - ***Looking for a replacement for pebulate.***


Thank you!!!