This is what the field looked like after 3 sequential fumigations:

- Spring Crop Destruct Drip Fumigation Treatment (75 gpta Vapam)
- Summer Fallow Followed by Subsoil Fumigation (15-18 gpa Telone II) to destroy traffic pan (soil compaction zone) enhance downward diffusion
- Fall Drip Fumigation 2 tapes / bed (Pic Clor 60 EC-300 lb/a)

*It picked about a third (33% of 27,000 lb/a) of what it should have picked!*

10:40 am: New Insights Regarding the Spatial Distribution of Nematodes and Soil Applied Fumigants and the Needs for New Strategies Considering Vertical Management Zones for Nematode Control

J.W. Noling, Gary Vallad, Nathan Boyd  Tomato Institute, September 9, 2015

Thank you: Dow Agrosciences, TriEst, Fl. Ag Research, Favorite Farms, Driscoll, FSGA, And so many others......
What is Going On?
IS IT ANY WONDER
WE STILL HEAR TALK
ABOUT METHYL BROMIDE
& REVIVING CRITICAL USE?

This is what one of the fields looked like after 3 separate fumigations:
• Spring Crop Destruct Drip Fumigation Treatment (75 gpa Vapam)
• Summer Fallow Followed by Subsoil Fumigation (15-18 gpa Telone II)
• Fall Drip Fumigation 2 tapes / bed (Pic Clor 60 EC- 300 lb/a)

It picked about a third (33% of 27,000 lb/a) of what it should have picked!

Addressing Causes of inconsistency
All fields, unless subsoiled, have a compacted zone (traffic pan) just below the depth of the deepest tillage implement used in the field.

Traffic pan occurs just below the base of the raised, plastic mulch covered bed.

Unavoidably cause changes in soil hydraulic conductivity, diffusion of fumigant gases, and thus fumigant efficacy and field distribution of nematodes and crop damage.

Dealing with a Traffic Pan is a new issue in Post Methyl Bromide era Florida!
Introducing our new deep soil exploration tool 😊

**The Probinator**

- Seasonal depth distribution of Sting-Root knot nematode
- Fumigant treatment impact & inconsistency (measure soil air [conc])
- Identify origins of bed recolonizing populations of Sting Nematode

*Arkema*
*Dow AgroSciences*
Where do Nematodes occur in the soil profile?

Unless an impermeable clay or spodic horizon occurs:

Nematodes observed:
- To maximum depth of probe (36-48”)
- Well below depth of root penetration
- Well below depth of typical sampling

• Question is: Are Root-knot capable of upward migration!
Seasonal Migration of *Meloidogyne chitwoodi* and its Role in Potato Production

Mojtahedi et al., 1991

9 days after placement at the “bottoms” of tubes, *Meloidogyne chitwoodi* had moved 22 inches (2.5”/day)

Inoculum placed at 90, 120, and 150 cm caused significant potato root infection losses in potato tuber quality in the field.
Crop Termination Drip Fumigation Treatment Results...

Measuring where Fumigants go, and Don’t go!

Fig. 1. Concentration Isobutylene in soil strata above and below a 14 inch traffic pan. Soil air measurement obtained thru center of a 12½” raised, mulch covered bed 3 days post application Telone EC (12 gpa). Data points are means & S.E. 8 reps MB farm, Dover, FL

Illustrated example of fumigant gas concentrations above and below a strawberry traffic pan shortly after soil injection to a depth of 10-12”

Did a great job in the raised bed, BUT...
The traffic pan formed a very effective impermeable layer
THE Probinator allows us to ask: How good of a job are we doing with DRIP Fumigants after months of clean fallow?

Telone II (18 gpa) Pretreatment Samples
Depth Distribution of Root-knot nematode
Deep core Probinator samples
June 26, 2014 Barberville, FL

Soil Depth (12" increments)

0-12"

13-24"

25-36"

None Detected 1-12" soil depth

Density Root-knot nematode (100 cc/soil)

0 100 200 300 400 500 600 700 800 900
Measuring where Fumigants go, & Don’t go even when deep injected!

- Traffic pan destroyed
- Even with deep placement, Telone diffusion process was mostly upward, not to depths where nematodes reside

Figure 3. Fumigant Gas Concentration within the Shank Trace and midway between ripper shanks to a soil depth of 36 inches. Fumigant was broadcast applied to a 15 inch soil depth. Datapoints are means and standard errors of 4 replicate observations. Barberville, FL. Telone II (18 gpa) - 1 DAA - July 12, 2014
Closing the Shank Trace........It ain’t easy

Is it any wonder fumigant movement is upward and out, following the Path of Least Resistance!
What has the Probinator told us?

Impact of the Soil Compaction Layer – Traffic Pan on Fumigant Movement & Nematode Control

- Soil surface
- Travel
- Fumigant Knife & plume
- "In or above compacted zone"

6-10”

Even Deep Placement below Traffic Pan did not Meaningfully Improve Fumigant Penetration into Subsoil

- Soil surface
- Travel
- Fumigant Shank & plume
- "In, above or below compacted zone"

6-10”

the Traffic Pan effectively blocks downward diffusion

the Shank Trace effectively promotes upward movement
What is Needed: NEW TECHNOLOGY for DEEP APPLICATION

Many Thanks Jerry Nance Dow AgroSciences

Auto Reset – Deep Drip

Auto Reset - Deep Shank w/ Wings
DEEP PREBED APPLICATIONS

Place the Telone below the traffic pan where nematodes reside, and shortly before where the raised bed will be placed.

Prebed Deep Shank Injection Telone II (15-18 gpa)
We measured Telone Gases in Soil

We sampled air concentrations of Telone II at multiple depths and locations using a MiniRae VOC with different soil probes.

Objective:
To determine whether disturbing the Traffic pan results in a redistribution of a soil fumigant vertically through the soil profile.
SOIL AIR MONITORING: What Has it Told Us?
Gases don’t occur below the pan unless we put them there!

High Concentrations Observed well below Traffic Pan

Lateral Movement of the Fumigant extends Into Row Middles
What a Difference Fumigant Placement and Sequential Treatment Makes towards **Diffusion & Equilibration**!

**Apply Deep Shank**  **fb**  **Apply Grower Standard**  **fb**  **Install Mulch**

- Prebed Deep Shank Injection (Telone II (15-18 gpa))
- LDPE
- VaporSafe TIF
- Plastic Mulch Installed
Subsurfacing Drip Fumigation for Nematode Control
5 Deep Drip Field Trials of Telone EC (12-15 gpa) - Where did it go?

Soil Air Concentrations with depth – 5 different fields – June 2015

Deep Drip Application (15 gpta)(3.5 hr injection)
Favorite Farms - North Hilltop Field - Dover, FL June 12, 2015

Soil Depth (inches from bed top)

Clay lens beginning at 24 inch soil depth

Deep Drip Application (15 gpta)(3.5 hr injection)
Favorite Farms - South Hilltop Field - Dover, FL June 12, 2015

Soil Depth (inches from bed top)

Clay lens beginning at 24 inch soil depth

Deep Drip Application (15 gpta)(3.5 hr injection)
Favorite Farms - Labor Camp - Dover, FL June 12, 2015

Soil Depth (inches from bed top)

Deep Drip Application (15 gpta)(3.5 hr injection)
Favorite Farms - South Field - Bethlehem Rd - Dover, FL June 16, 2015

Soil Depth (inches from bed top)

Deep Drip Application (15 gpta)(3.5 hr injection)
Favorite Farms - North Field - Bethlehem Rd - Dover, FL June 16, 2015

Soil Depth (inches from bed top)
Nematode Management Considerations:

Benefits of Subsoil applied fumigants expressed 2 years after treatment!

Red bands define stunted plants where no Subsoil treatment was applied.
What might be reasonable to expect in crop response viewing Sting Nematode Control as different Vertical Management Zones

Preliminary Results in Strawberry Look Very Interesting 😊
The Probinator has allowed us to question the need for:

**Restructuring Nematode Control**

**As a Composite of Vertical Management Zones**

Illustrating the Relative Impact of a Compacted Traffic Pan layer on Surface and Deep Drip Applied 1,3-D and Soil Air Concentration of 1,3-D with Soil Depth in the Plant Bed.

ZONE 1
Surface Drip or Bed Shank

ZONE 2
Deep Drip or Deep Shank
Question is:

Will it work in South Florida Flatwood soils under rainy conditions, high water table and seepage irrigation?
SEEP IRRIGATION

Having to adjust the water table to within 12” to 18” of the soil surface to make a bed precludes the ability to deep shank or drip apply a fumigant of any kind on new plastic below the traffic pan!

Preferred soil moisture for preparing beds
Using Seep Irrigation = 10% to 15%
“100 to 200% of water holding capacity”
Field, or significant portion thereof, remaining saturated under condition of frequent rainfall

The Environment Strongly Influences Sustainability of Fumigant practices!

- Plant back
- Degraded performance
Could Rainfall and Water Table pose a scheduling problem?

Rainfall

A clearly defined wet season

Water Table

http://climatecenter.fsu.edu/products-services/data
When to coordinate Deep Fumigant Treatments based on Rainfall and Groundwater?

For Deep Placement the Window of Opportunity January to June
Deep Drip Timeline For Double Crop Flatwood Sites

July - January
Install the DEEP DRIP TAPE now under new plastic even though HIGH Rainfall and Water Table prohibit deep fumigant application of any kind!

February - May
Apply the deep drip, crop termination (under bed) treatment at the end of the spring crop at a time of low rainfall and water table.
Summary

The Reality of the Current Situation

- Nematodes reside at all depths of soil column
- Traffic Pan very effective impermeable layer
- Current Equipment designed for Methyl bromide
- Shortcomings of alternatives = Vapor Pressure + Interaction with soil moisture and environment

Question becomes one of how best to resolve:

- Deep placement one of many approaches
- The different approaches defines our future focus
Thank you