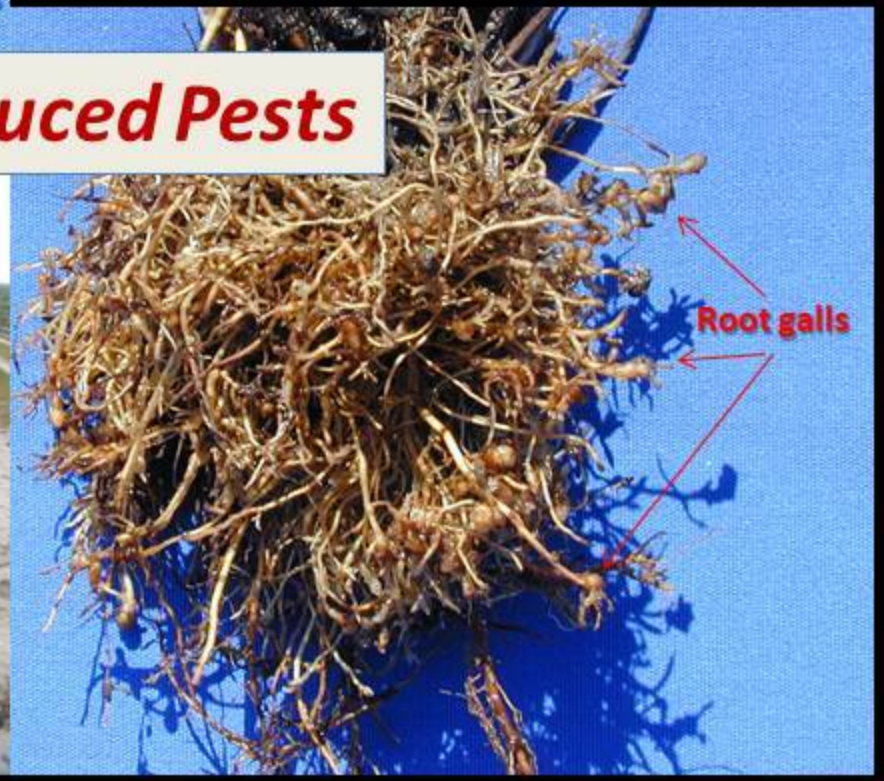
ROOT KNOT NEMATODE

(Meloidogyne hapla)
On Florida Strawberry

Field symptoms:
wilting, stunting,
plant mortality

Transplant Introduced Pests



Root Knot Nematode has come again ! and It came with the TRANSPLANTS and it came with a Vengence !

Canadian bare root source of Radiance

North Carolina bare root source of Radiance

70% end of season plant collapse

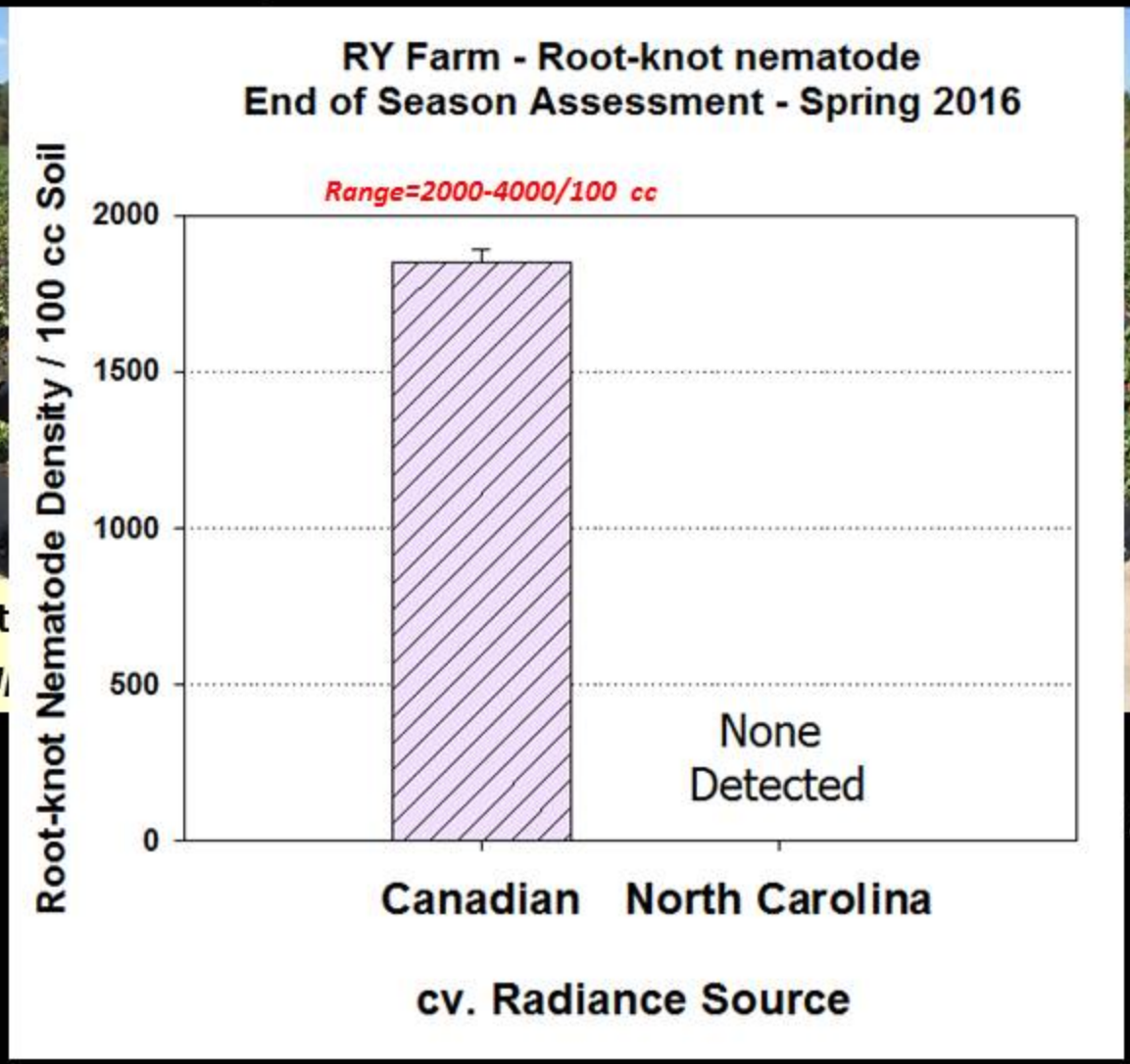
Range=2000-4000/100 cc

Root Knot Nematode has come again ! and It came with the TRANSPLANTS

Canadian bare root source of Radiance

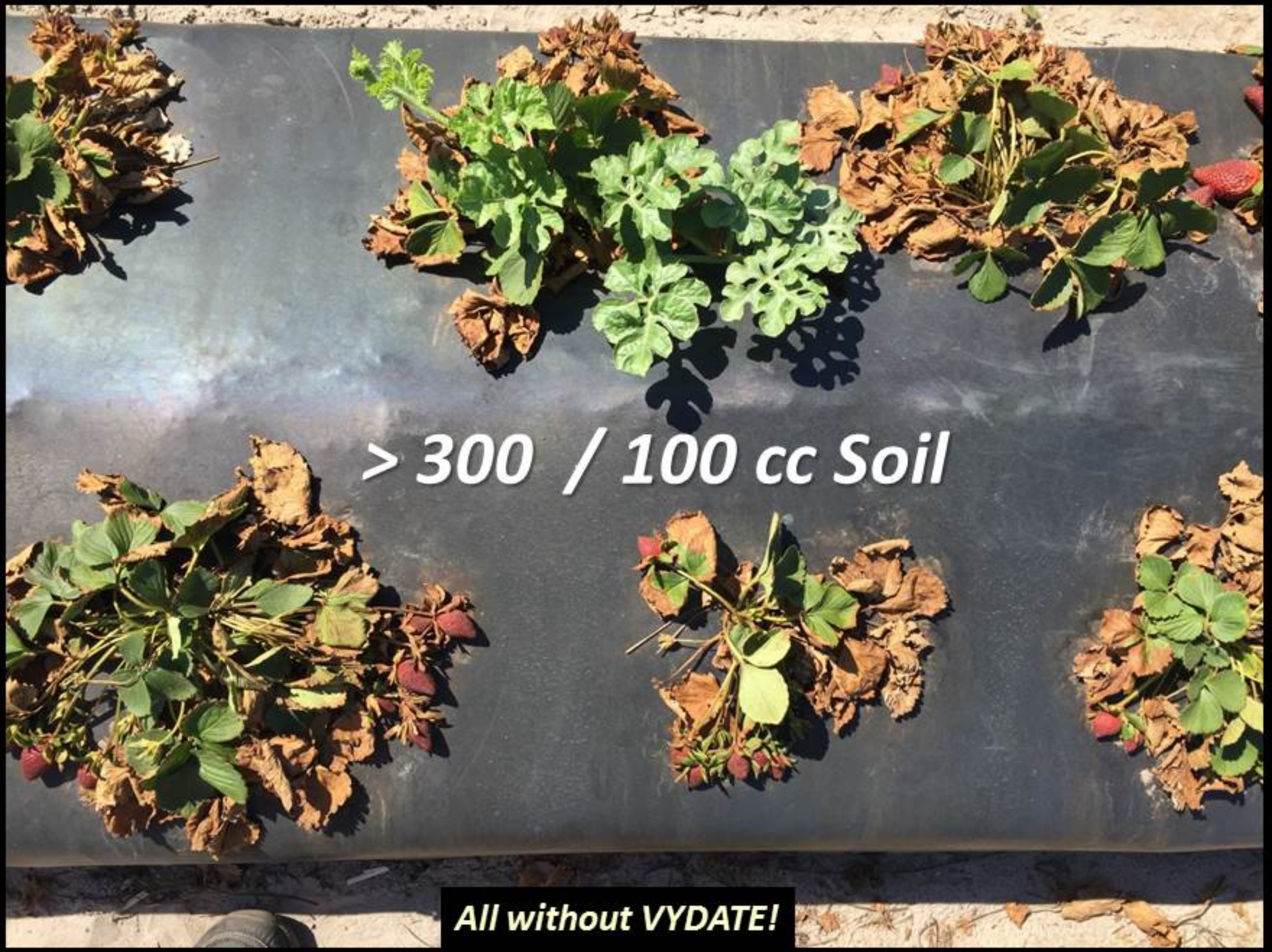
Root Knot Nemat
(*Meloidogyne ha*

North Carolina bare root source of Radiance



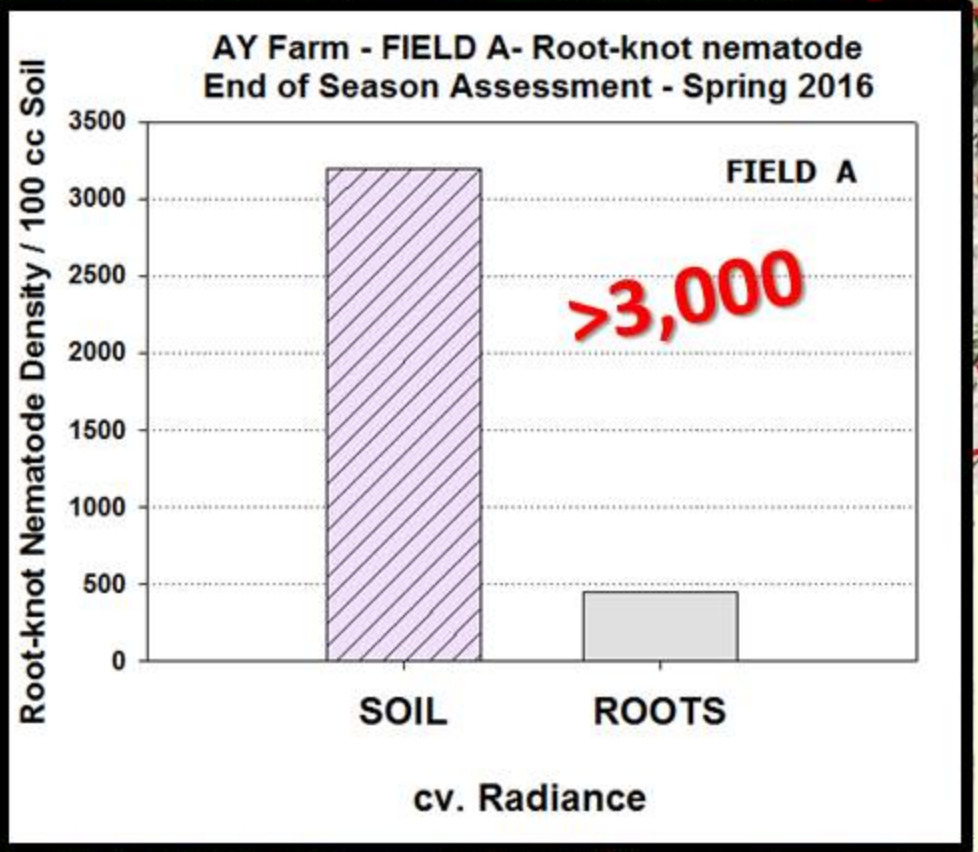
se

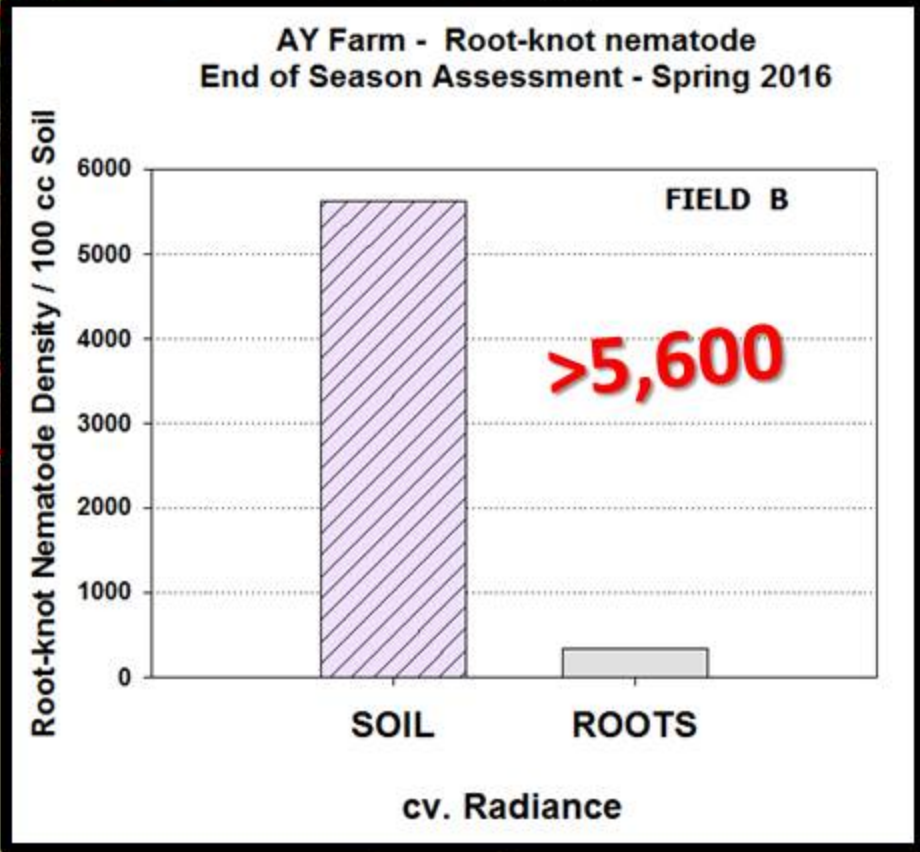
Second Crop of Watermelon will Suffer as well !



AY Farm
March 23, 2016
cv: Radiance
collapsing from
Extensive Infection
of Strawberry roots by
the Root knot nematode
Meloidogyne hapla

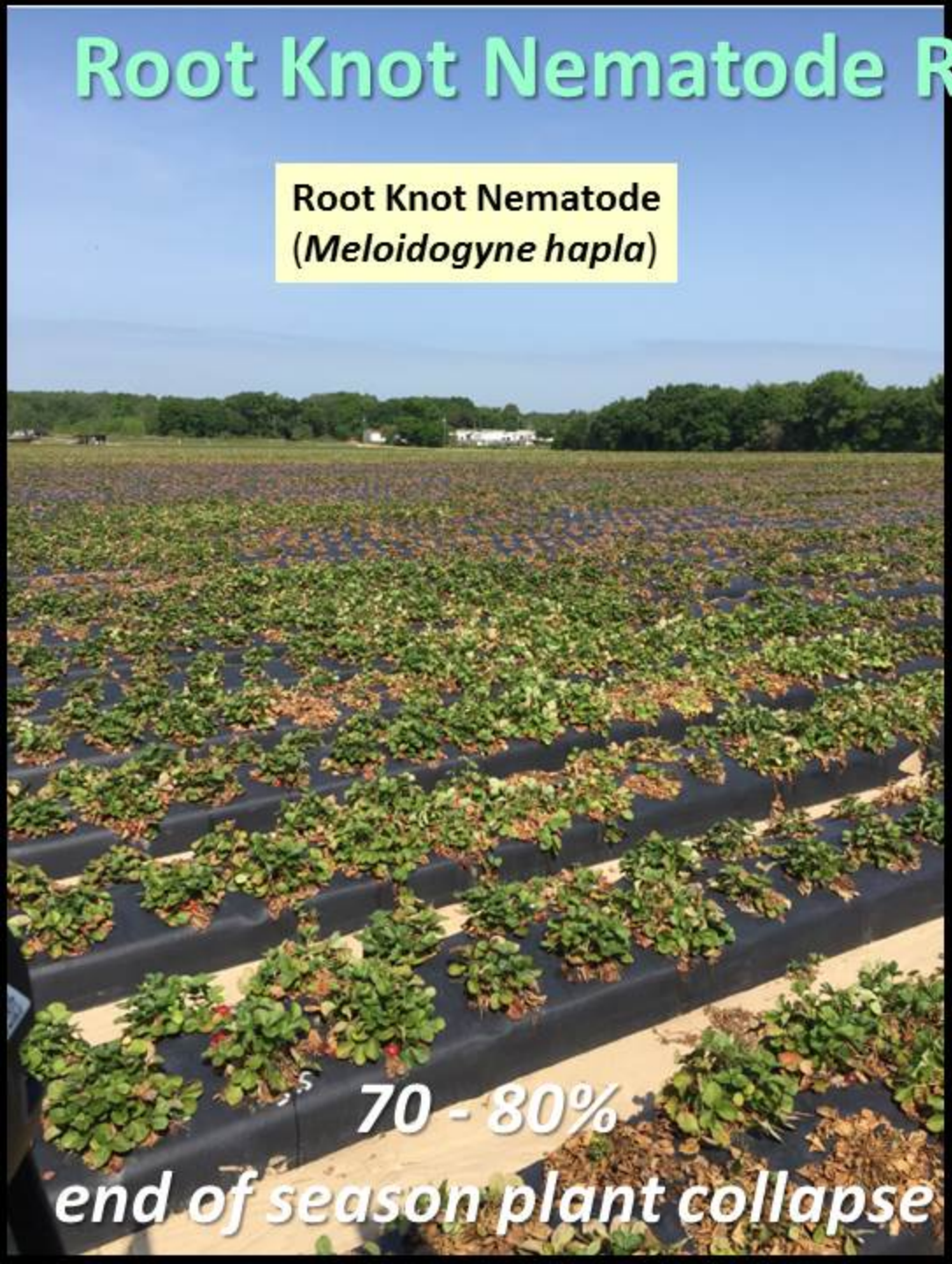
Wilting





Extensive Infection of Strawberry roots by the Root knot nematode *Meloidogyne hapla*

Root Knot Nematode Rearing Ugly Head!



Bare root Transplant Source

?

When or From Whom !

Does it Survive from One Crop to Next ?

YES !

- Sandy Soils
- Ineffective Rotations
- Limited Fumigant Availability

WHY IS THIS HAPPENING?

Health Canada Santé Canada

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Safety Measures for Soil Fumigant Products

Soil fumigants are a type of pesticide used to control soil pests or pathogens such as insects, nematodes, bacteria, fungi and weeds, which can disrupt plant growth and production. Once applied, a soil fumigant forms a gas and diffuses to fill cracks and pores in the soil. Soil fumigants are applied and incorporated into the soil; treated soil is sealed to prevent gases from escaping; and the soil is then aerated prior to planting.

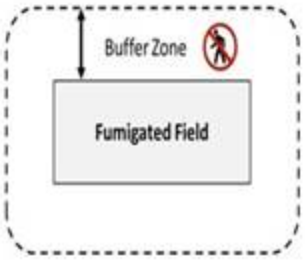
Health Canada requires strict safety measures for soil fumigant products containing chloropicrin, dazomet, metam sodium or metam potassium. These measures are to protect people who live, work or otherwise spend time near fields that are fumigated. Major requirements for soil fumigants include a Fumigation Management Plan, Buffer Zones and Emergency Measures.

Fumigation Management Plan

Applicators must develop a written fumigation management plan prior to the start of any application. The plan outlines in detail the key steps to help ensure a safe and effective fumigation, including: consideration of site conditions (soil, air, weather, etc.); establishing the appropriate buffer zones; and emergency response planning. A signed copy of the fumigation management plan must be maintained for a minimum of two years as a detailed record of the application.

Buffer Zones

A soil fumigant *Buffer Zone* is an untreated area surrounding a fumigated field where entry by anyone other than authorized personnel is prohibited. The Buffer Zone allows for the fumigant to dissipate before it can reach occupied areas. Residences, businesses, or other public areas which are occupied are not part of the Buffer Zone.



The minimum Buffer Zone distance is at least 8 metres from the fumigated field, but may be more depending on the application conditions. Entry into a Buffer Zone is not permitted for 48 hours after the application is complete.

2016 Fumigants Available

Chloropicrin
Vapam
Kpam

- *All Shank Applied*
- *Mulches not used to any great extent*
- *Custom Applied*

Health Canada Santé Canada

Canada

Health Canada

www.hc-sc.gc.ca

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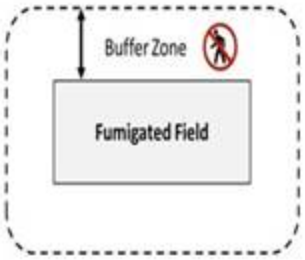

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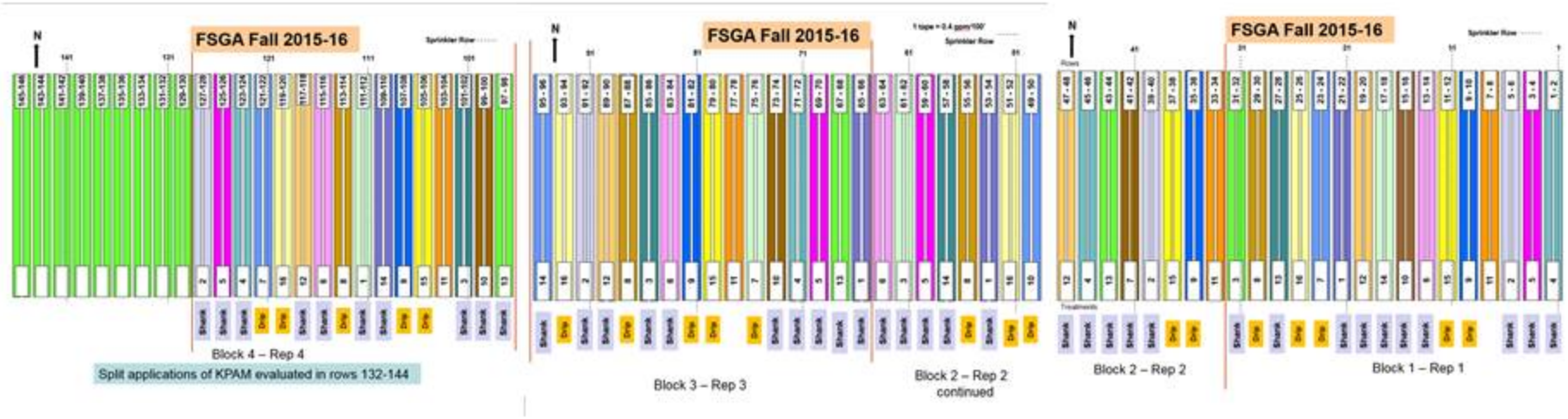
What Needs to be Done

AG Canada and Growers Needs to be Informed of the problem!

IPM Programs for Canadian Transplant Growers Needs to be Developed based on Survey & Presented !


FSGA FARM & Experimental Area
FALL 2015
Eye Altitude 615 ft
Vertical Management Zones:
New Considerations for
Sting Nematode Management
© 2014 Google
Google earth
Tour Guide
1992
Imagery Date: 1/17/2014 28°00'56.65" N 82°13'57.53" W elev 72 ft eye alt 618 ft

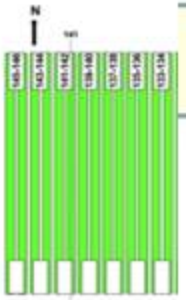

FSGA Fall 2015-16
Block 4 – Rep 4
Split applications of KPAM evaluated in rows 132-144
FSGA Fall 2015-16
Block 3 – Rep 3
Block 2 – Rep 2
continued
FSGA Fall 2015-16
Block 2 – Rep 2
FSGA Fall 2015-16
Block 1 – Rep 1

This Year ↓

Treatment List for FSGA 2015-16

1.	MBr + PIC 67/33 (350 lb/ta)	SHANK	+ TIF VaporSafe	1 tape	4 reps
2.	MBr + PIC 50/50 (320 lb/ta)	SHANK	+ TIF VaporSafe	1 tape	4 reps
3.	Telone C35 (30 gpta)	SHANK	+ LDPE	1 tape	4 reps
4.	Pic-Clor 60 (300 lb/ta)	SHANK	+ LDPE	1 tape	4 reps
5.	DMDS + PIC (40 gpta)	SHANK	+ TIF Vaporsafe	1 tape	4 reps
6.	DMDS + PIC (25 gpta)	SHANK	+ TIF Vaporsafe	1 tape	4 reps
7.	Dominus+PIC (400 lb/a)	DRIP	+ LDPE	1 tape	4 reps
8.	DMDS EC+PIC (40gpta)	DRIP	+ TIF Vaporsafe	1 tape	4 reps
9.	Kpam (62 gpta)	DRIP	+ LDPE	1 tape	4 reps
10.	Untreated + Deep Shank Telone II	SHANK	+ LDPE	1 tape	4 reps
11.	Untreated	--	+ LDPE	1 tape	4 reps
12.	Telone C35 +deep Shank Telone II (30gpta) + (12gpta)	SHANK SHANK	+ LDPE	1 tape	4 reps
13.	Telone C35 +deep Drip Telone EC (30gpta) + (12gpta)	SHANK DRIP	+ LDPE	1 tape	4 reps
14.	Telone C35 + deep Shank +deep Drip (30gpta)+(12gpta)+(12gpta)	SHANK DRIP	+ LDPE	1 tape	4 reps
15.	Dominus (25 gpta)	SHANK	+ LDPE	1 tape	4 reps
16.	Dominus+PIC 67/33 (325 lb/ta)	DRIP	+ LDPE	1 tape	4 reps

16 treatments x 4 reps x 2 row plots = 128 rows x 240 ft /row



The problem at FSGA this past season: Line plugging and No site gauges

Impact of Line Plugging

"In a Perfect World"

120

Rear Manifold

Delivery lines to soil shanks / knives

30 30 30 30

Bed 1 Bed 2

"In a Cheated World"

120

40 40 0 40

Bed 1 Bed 2

Dose / bed	**60**	**60**	**80**	**40**

2/3 Total Flow

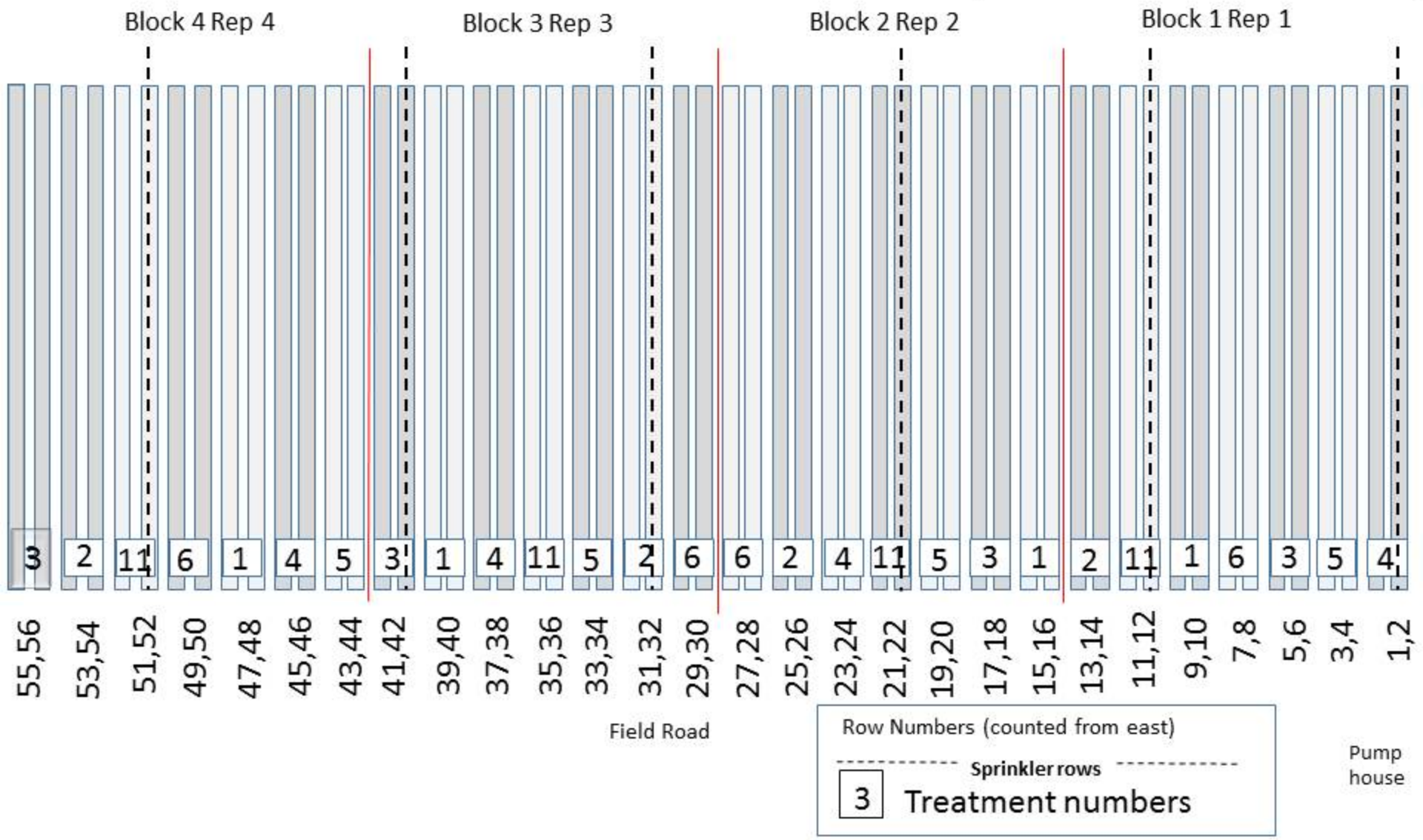
2x rate of Bed 2

Take Home Message

FSGA Redo of Shank Treatments 9-28-2015

Back North/West Field

Treatment	Row Assignments
1. MBR 67/33	9,10,15,16,39,40,47,48
2. MBR 50/50	13,14,25,26,31,32,53,54
3. C35	5,6,17,18,41,42,55,56
4. PC60	1,2,23,24,37,38,45,46
5. DMDS+PIC 40	3,4,19,20,33,34,43,44
6. DMDS+PIC 25	7,8,27,28,29,30,49,50
7. Check	11,12,21,22,35,36,51,52




FSGA 2015
Note weed emergence in rows with plugged shank
2 row Treatment Plots

FSGA

Shank Applied Fumigants

"Impacts from line plugging"

400 lb/ta 200 lb/ta

Pic Clor 60 (67/33) (300 lb/ta)

Vapor Pressure=

234 lb/ta 466 lb/ta

Methyl Bromide Chloropicrin 50/50+TIF (350 lb/ta)

Vapor Pressure=

23.3 gal/ta 46.6 gal/ta

Telone C35 (67/33) (35 gal/ta)

Vapor Pressure=

FSGA 2015

Impacts from a plugged delivery shank

400 lb/ta — 100 lb/ta

Pic Clor 60 (67/33) (300 lb/ta)

Vapor Pressure=

100 lb/ta — 100 lb/ta

Methyl Bromide Chloropicrin 50/50+TIF (350 lb/ta)

Vapor Pressure=

100 lb/ta — 100 lb/ta

Telone C35 (67/33) (35 gal/ta)

Vapor Pressure=

FSGA 2015

Impacts from a plugged delivery shank

400 lb/ta

100 lb/ta

62 gpta

62 gpta

DMDS + PIC (67/33) +TIF (25 gpta)

Untreated Control

KPAM (62 gpta) Drip Applied

FSGA - Rep 1

End of Season Collapse

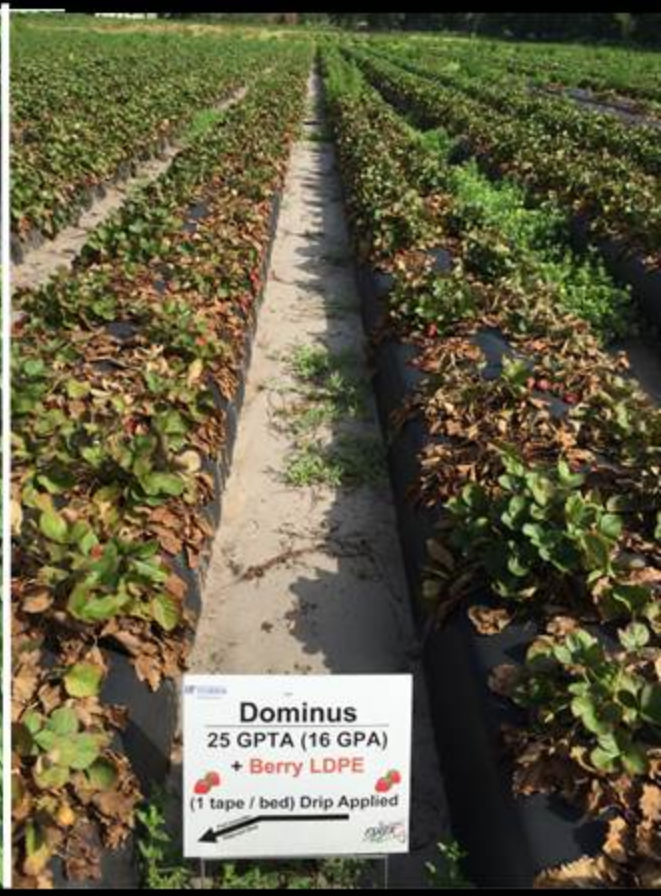
Dominus + PIC (67/33) (325 lb/ta) Drip Applied

Methyl Bromide Chloropicrin 67/33 (350 lb/ta)

Dominus (25 gpta) Drip Applied

FSGA - Rep 2

End of Season Collapse



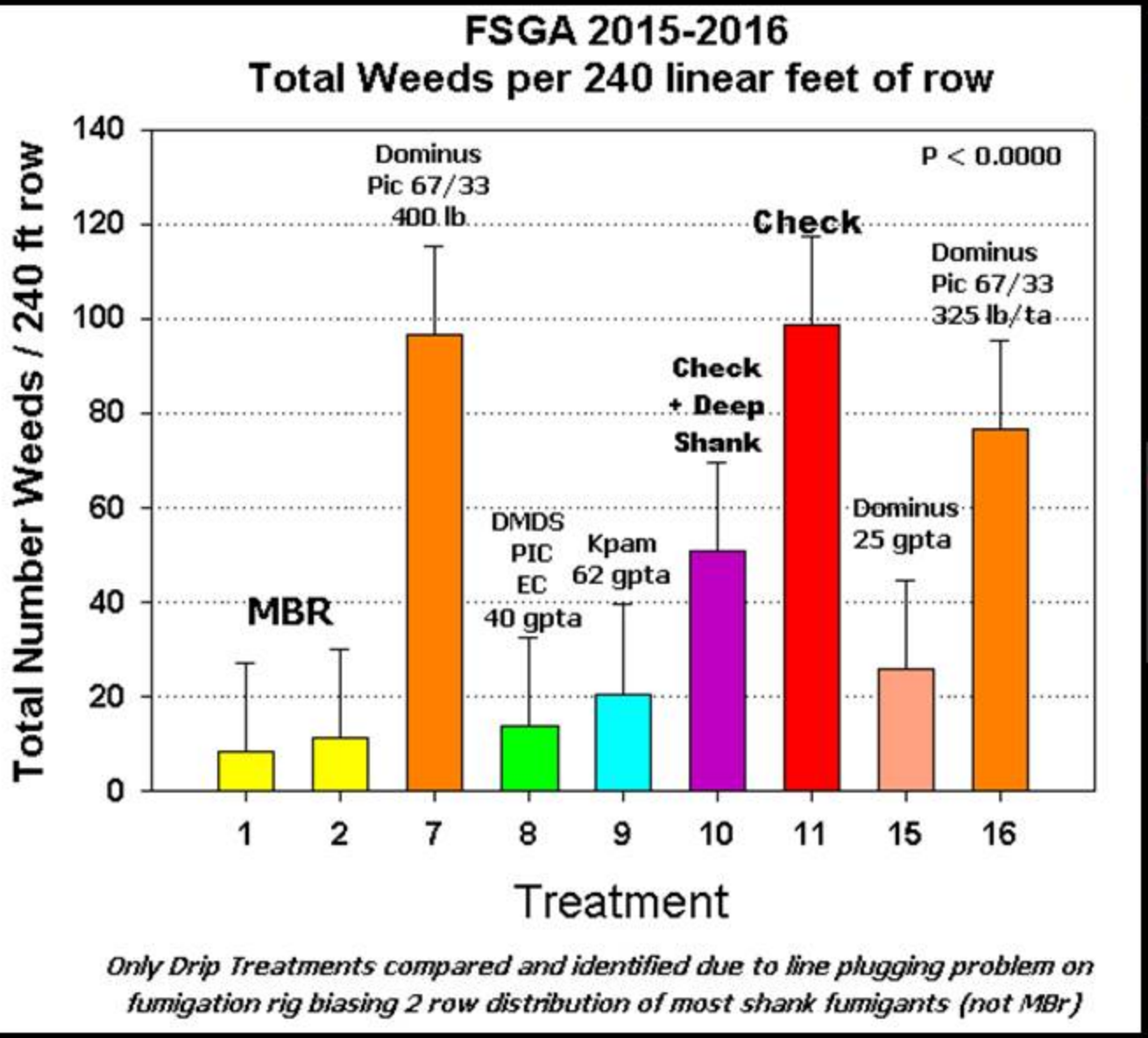
Dominus + PIC (67/33) (325 lb/ta)

Methyl Bromide Chloropicrin 50/50 (350 lb/ta)

Dominus (25 gpta) Drip Applied

FSGA 2015-16 - Total WEEDS

Drip Treatments



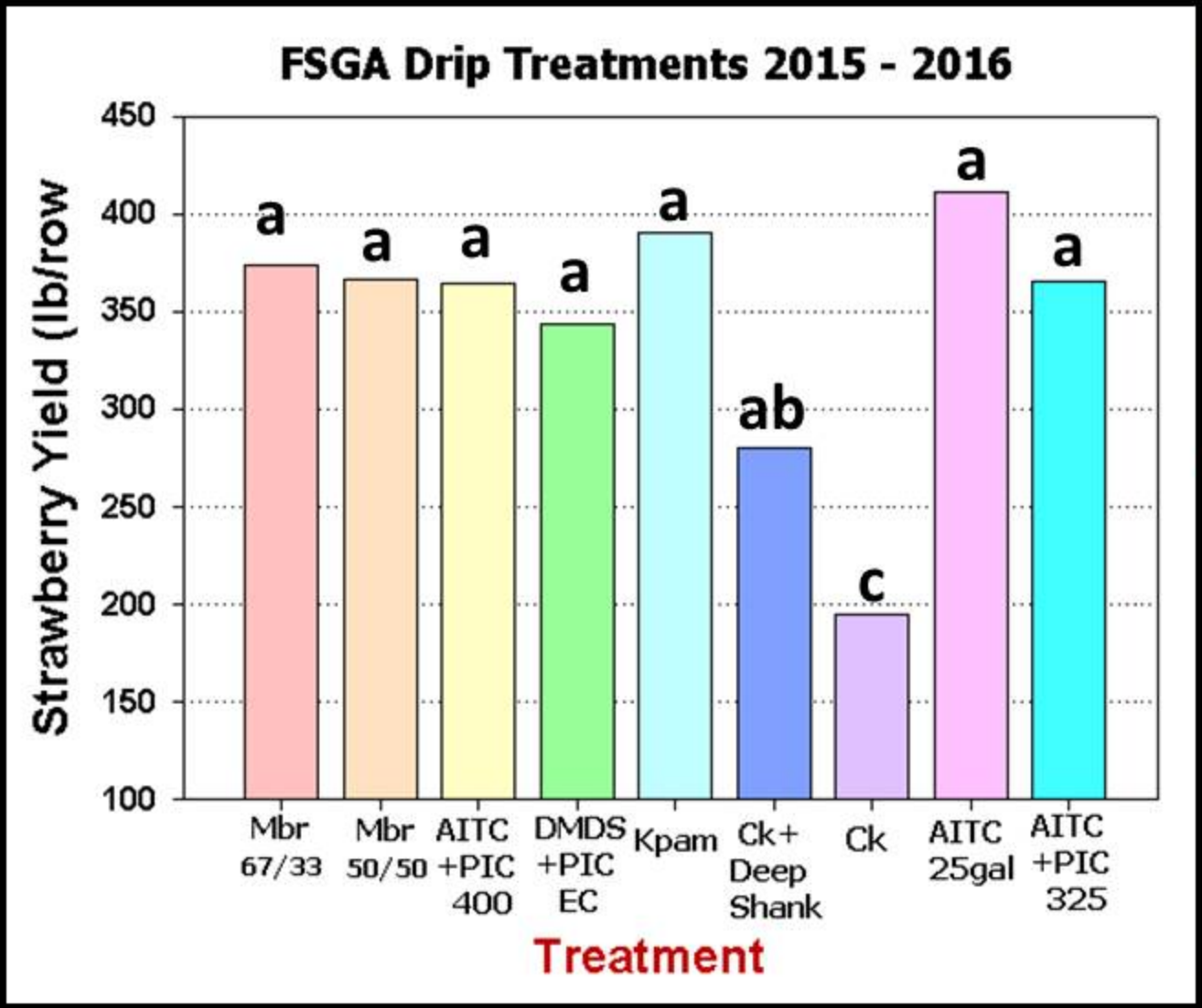
Only Drip Treatments compared and identified due to line plugging problem on fumigation rig biasing 2 row distribution of most shank fumigants (not MBr)

KEY POINTS

- **Check the Worst**
- **MBR the Best Followed by DMDS EC, KPam**
- **Deep Shank Telone reduced total weeds almost 50%**
- **Adding PIC to Dominus Compromises Weed Control**

FSGA 2015-16 - YIELD

Drip Treatments

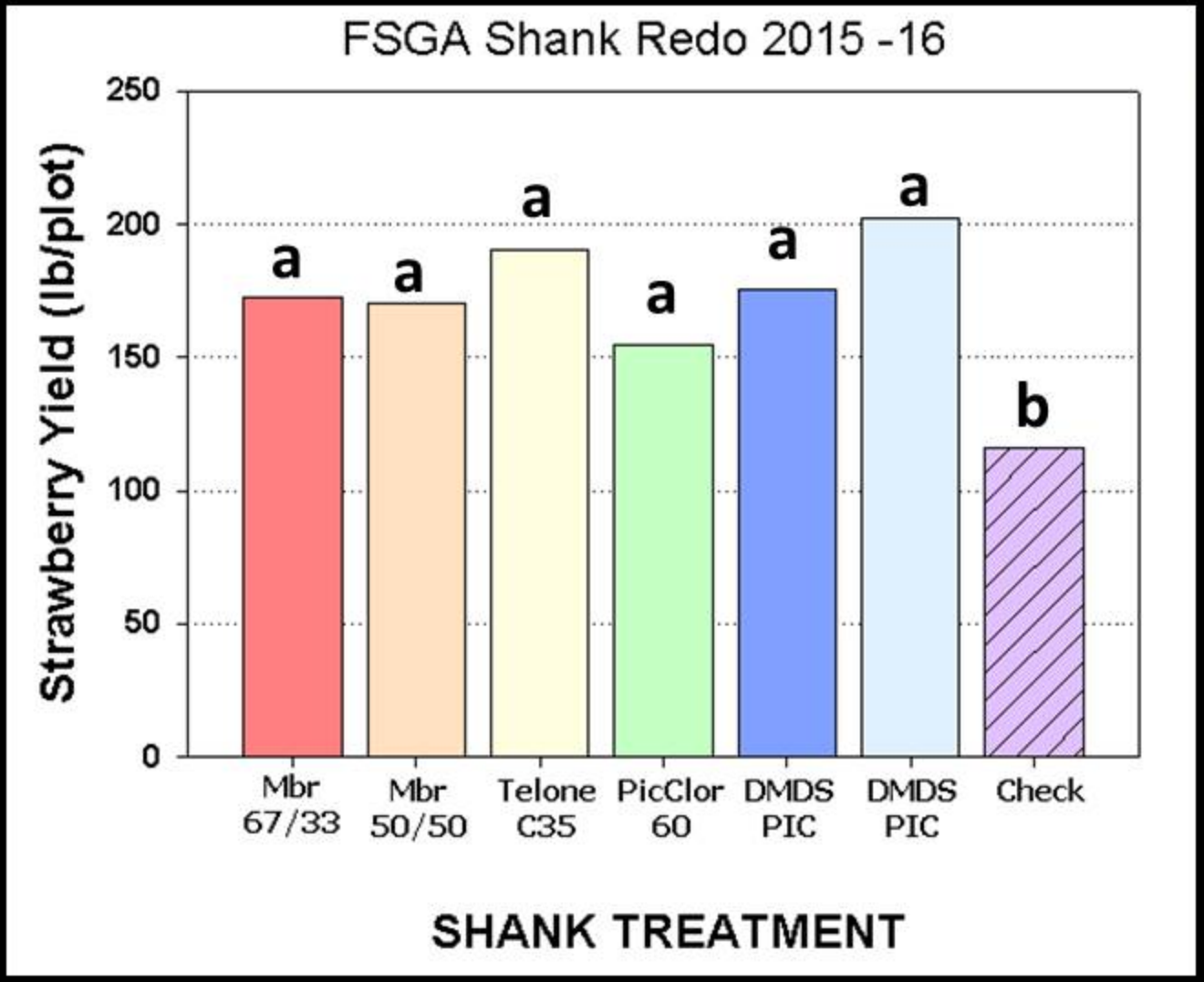


KEY POINTS

- Check the Worst
- Most Treatments Not Different
- Deep Shank Telone Increased Yield almost 45%
- Adding PIC to Dominus Did not Increase Yield

FSGA 2015-16 - YIELD

Shank Treatments



KEY POINTS

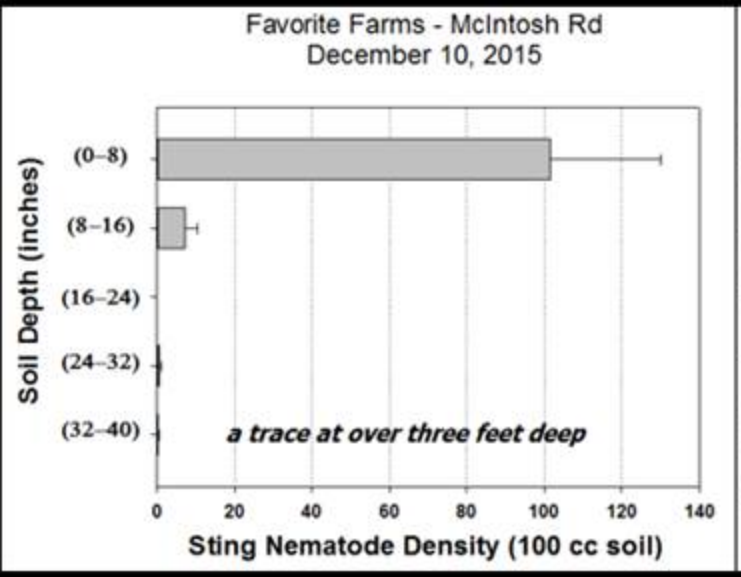
- Check the Worst
- Other Treatments Not Different
- A Late Planting And a Hot Season Did not Help Yield

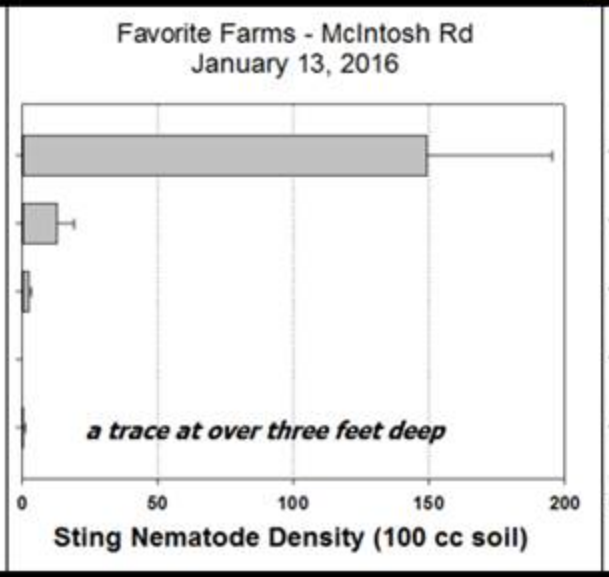
Maintain Equipment

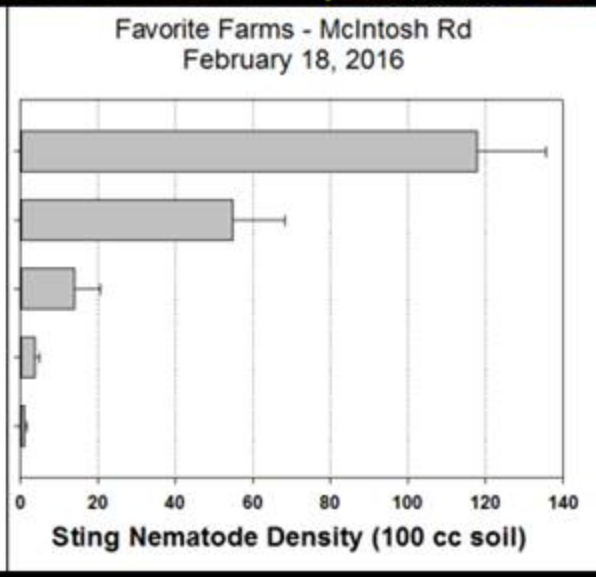
Flush the system after use
Inspect the system carefully
Change Filters regularly
Change and size the lines regularly
Clean up after running a bad product

Why do we need to consider Vertical Management Zones:

Where do Nematodes occur in the soil profile, and WHEN?



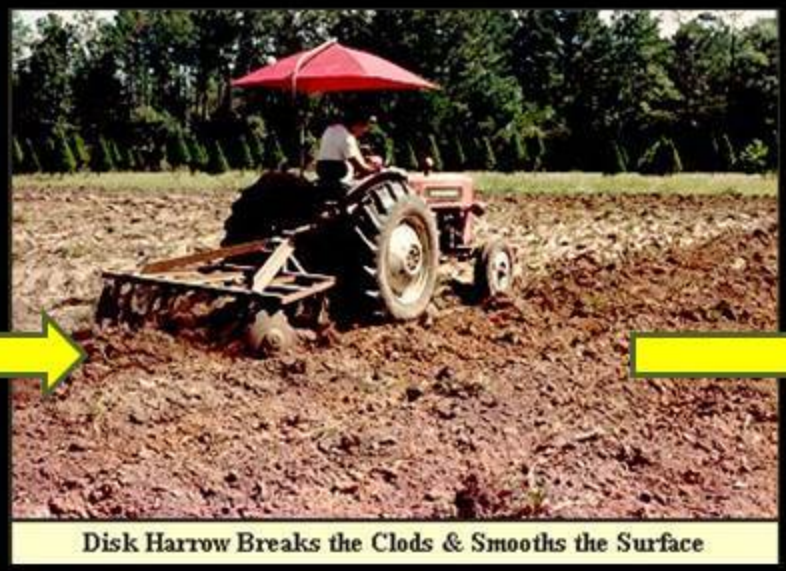




Sting Populations decline with soil depth !

Population increase with time at all depths !

Traffic Pan



- *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 !

What is Needed: NEW TECHNOLOGY for DEEP APPLICATION

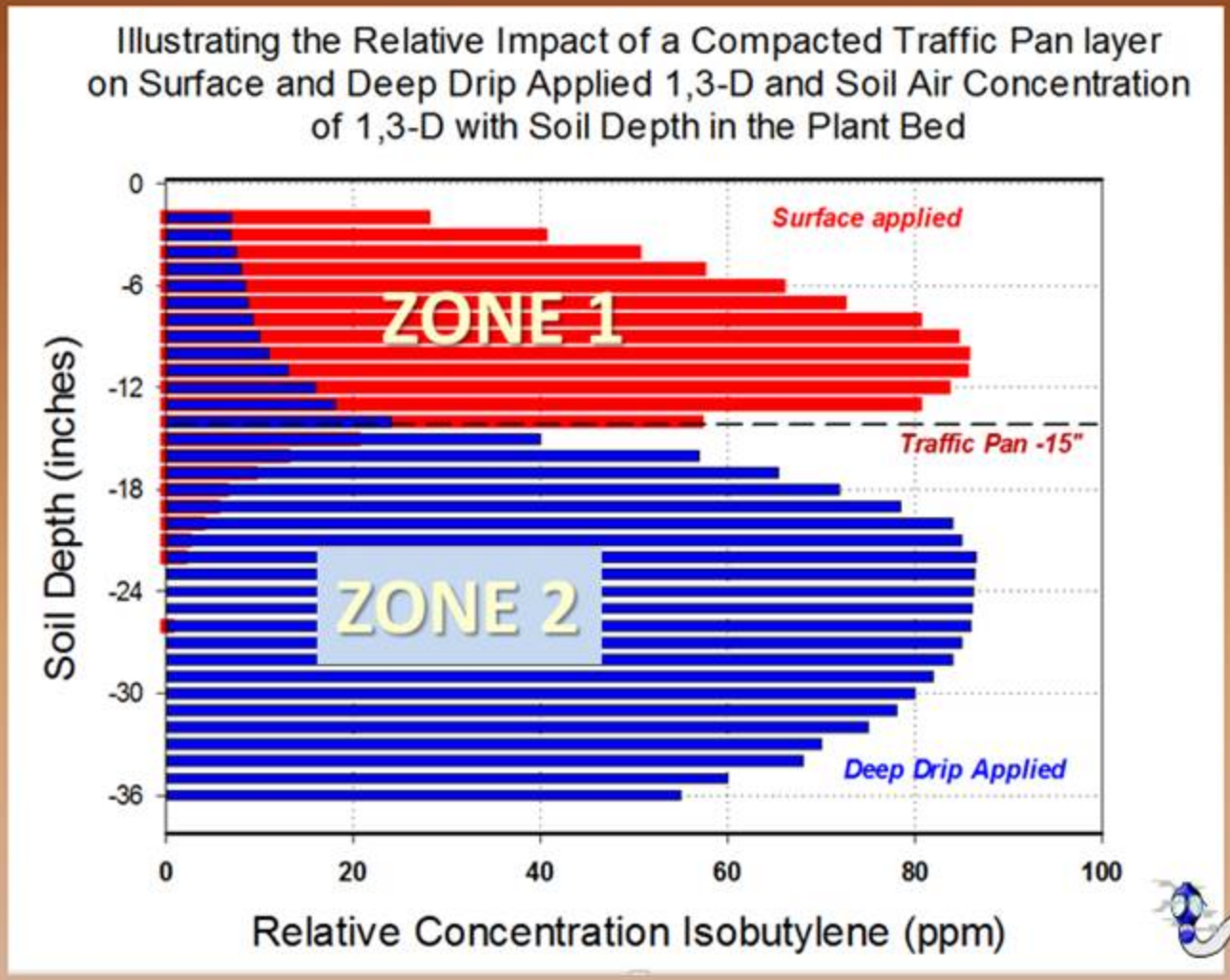
Auto Reset – Deep Drip

Auto Reset - Deep Shank w/ Wings

In this supplemental approach it is useful to consider resolving inconsistency by....

Restructuring Nematode Control

As a Composite of Vertical Management Zones



ZONE 1

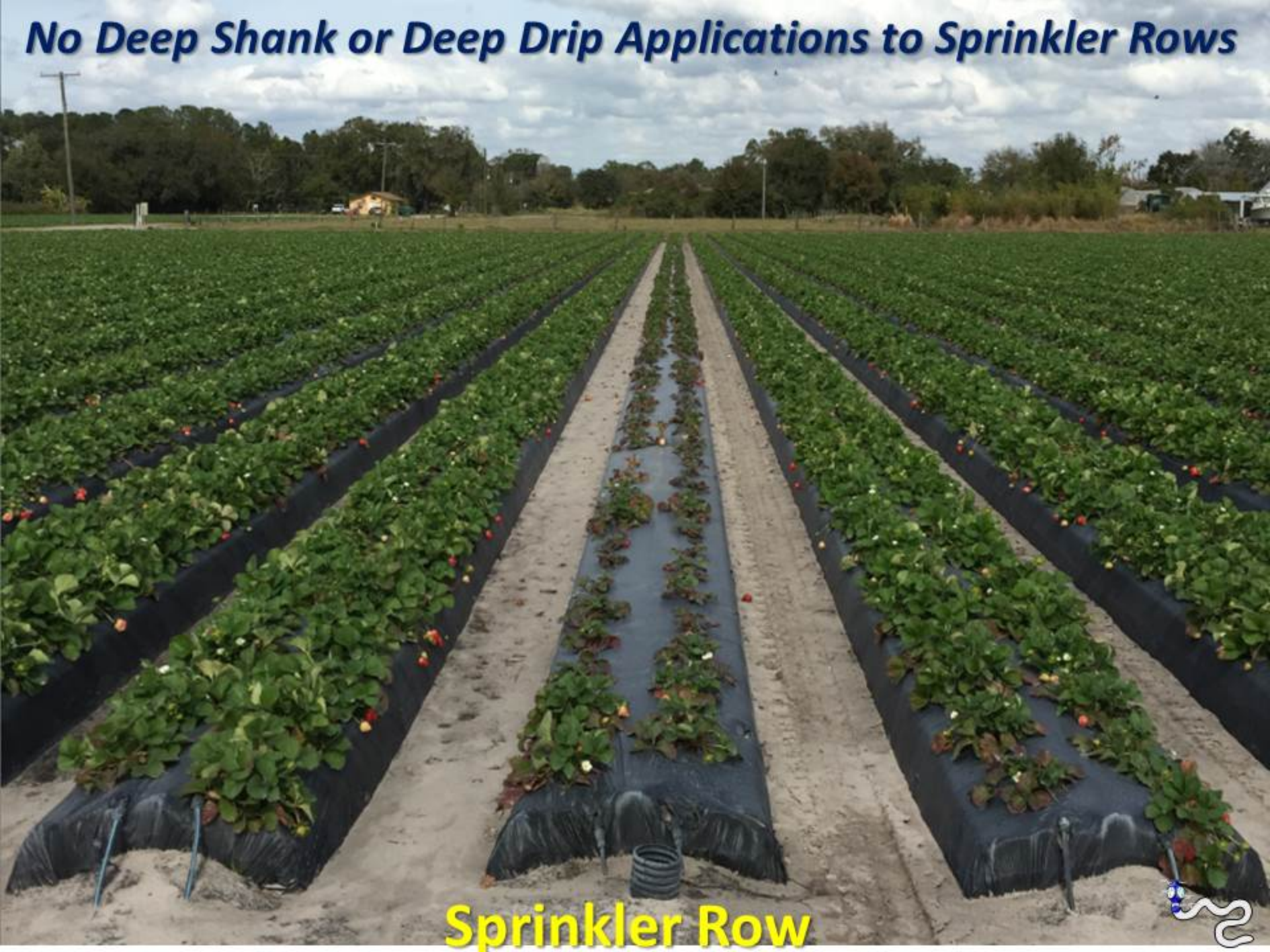
Surface Drip or Bed Shank

+

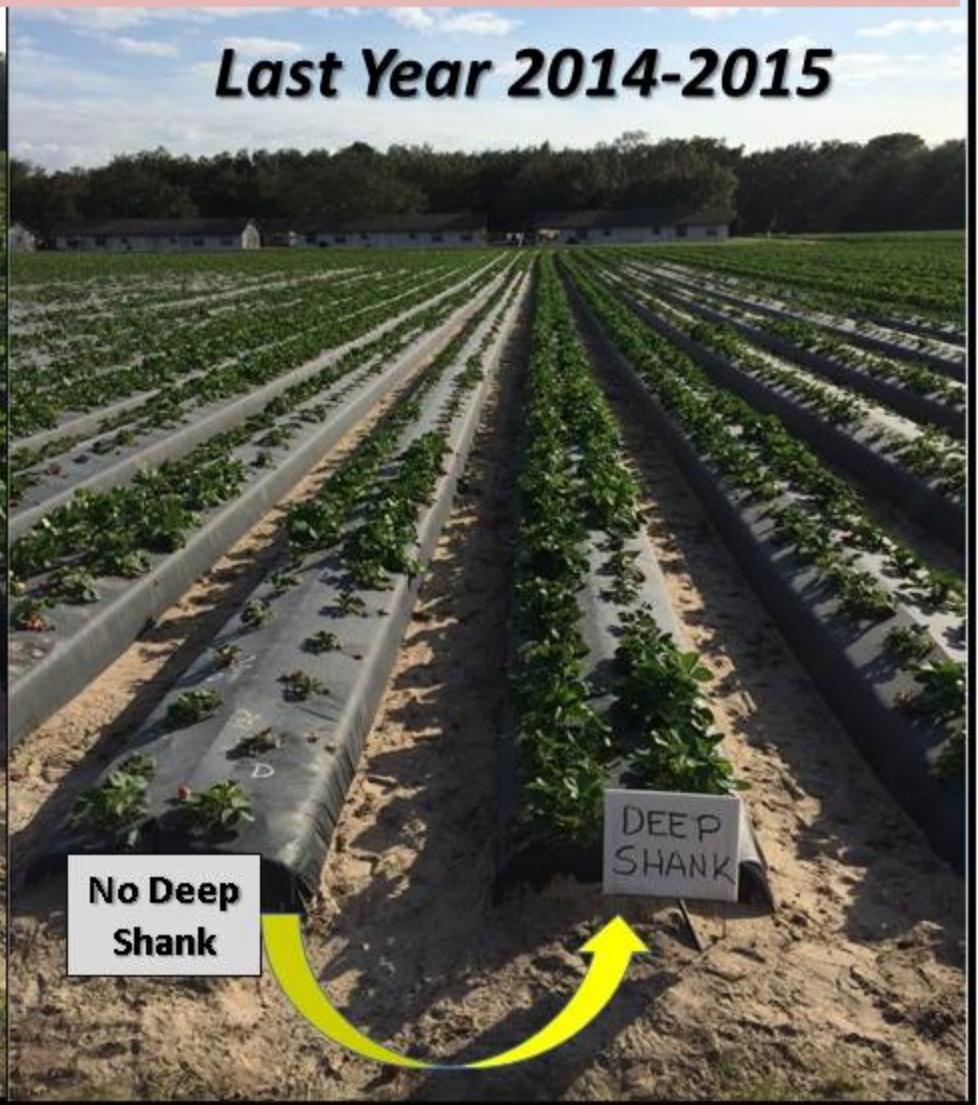
ZONE 2

Deep Drip or Deep Shank

No Deep Shank or Deep Drip Applications to Sprinkler Rows



What might be reasonable to expect in crop response viewing Sting Nematode Control as different Vertical Management Zones

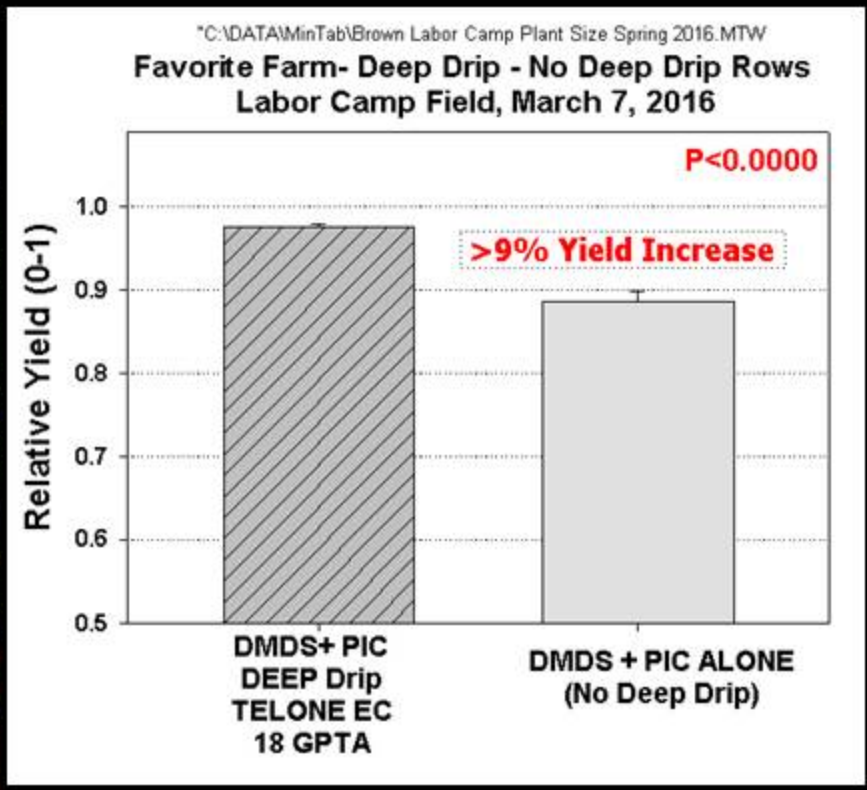


Preliminary Results in Strawberry Look Very Interesting ☺

Dover, FL Jan 2015

What might you expect from a deep placement fumigant?

Subsurface Deep Drip- Favorite Farms Spring 2016



9% Increase in Yield

Florida Strawberry Growers Association Research Farm (FSGA) - March 10, 2016

Do we need any treatments other than In-Bed and Deep Shank fumigants to manage Sting Nematode?

Untreated Control

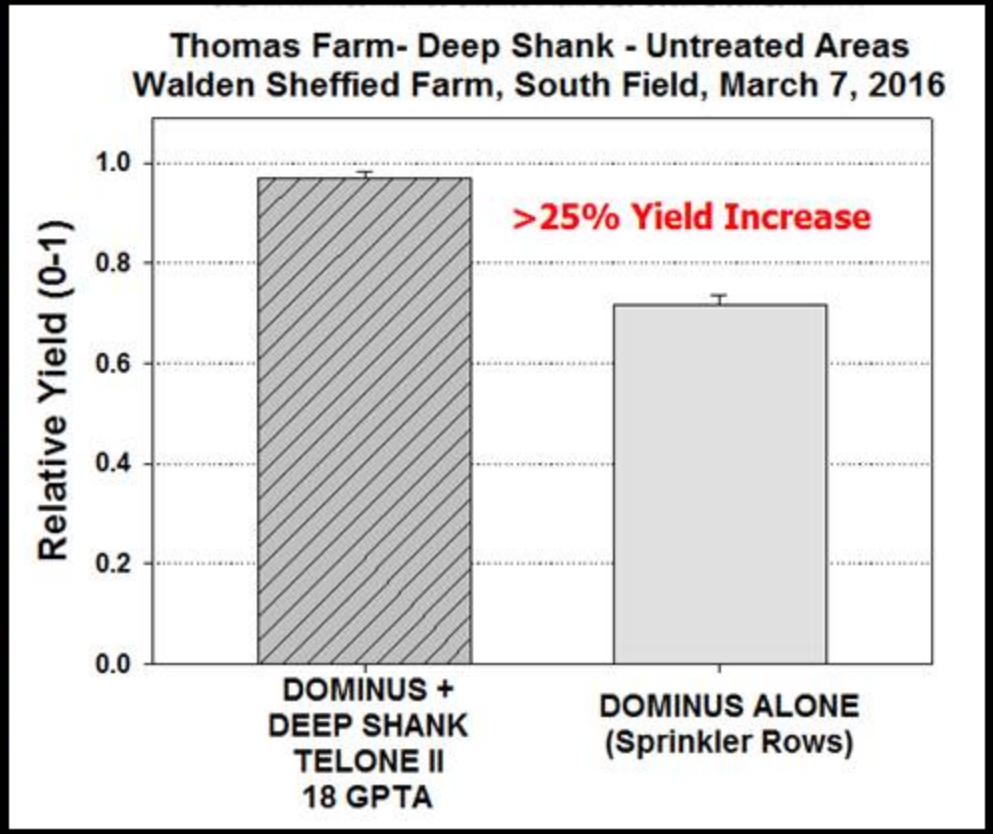
Only Deep Shank Telone (18gpta)

Yield increase 45%

In-Bed Telone C35 + Deep Shank Telone (18gpta)

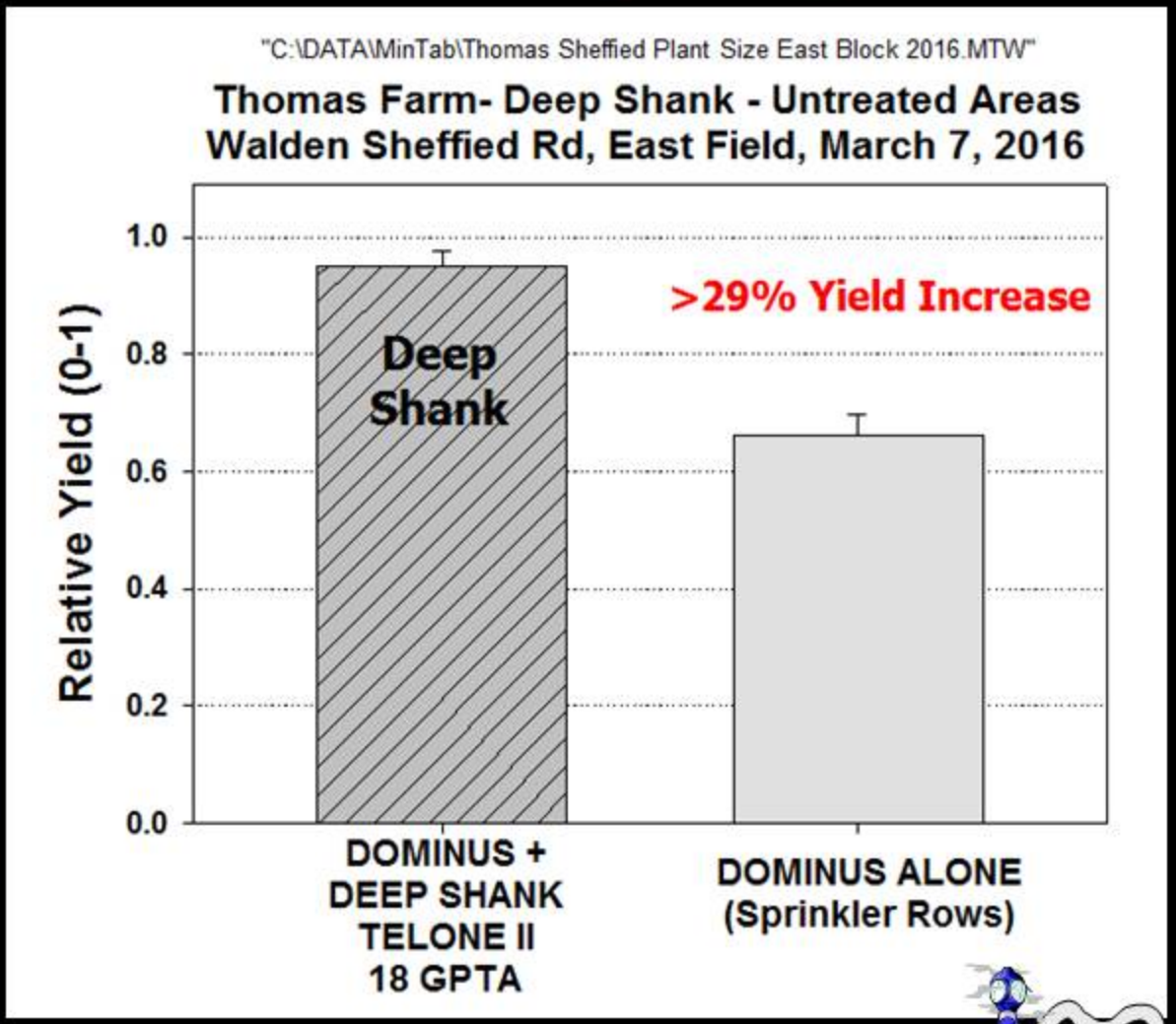
Florida Strawberry Growers Association Research Farm (FSGA) - March 10, 2016

Thomas South Field -Spring 2016



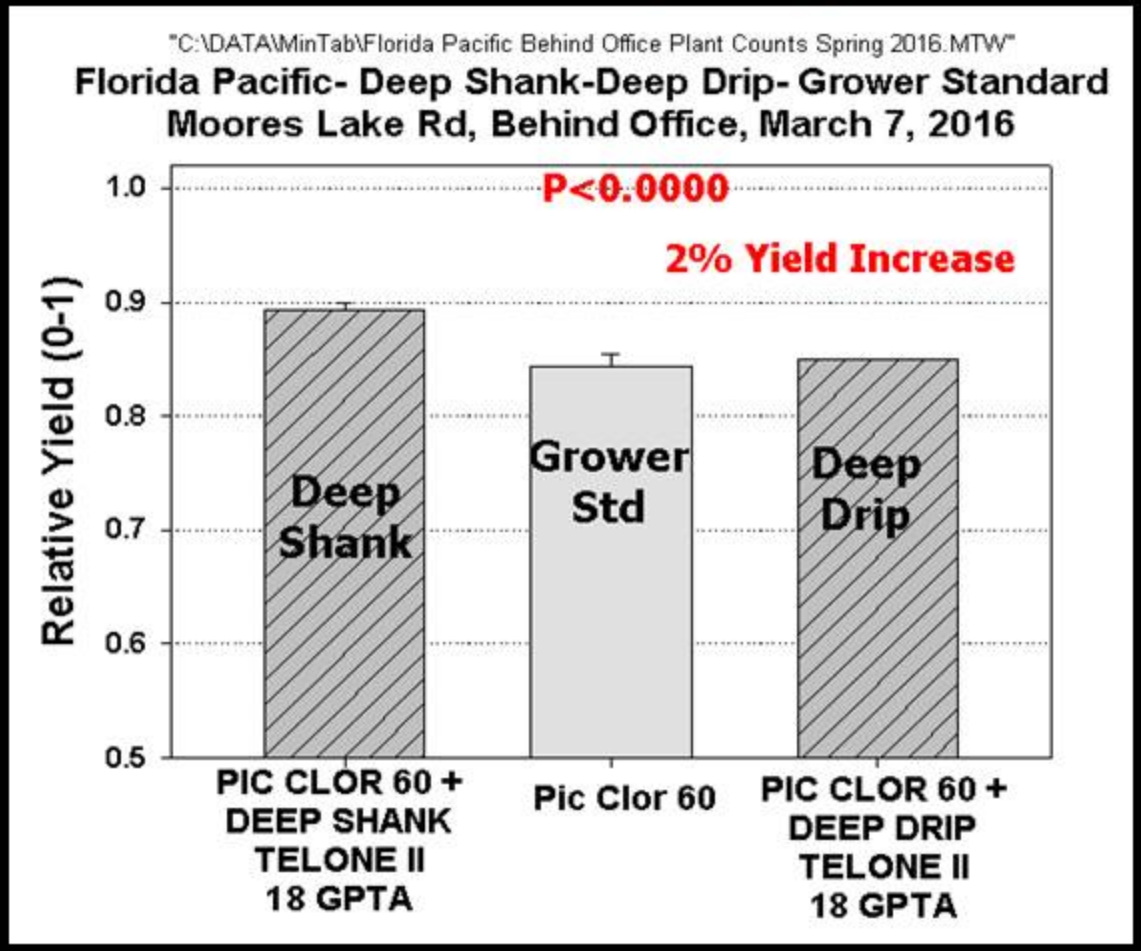
25% Increase in Yield

Deep Shank - Summer Broadcast
Thomas East Field WS - Spring 2016



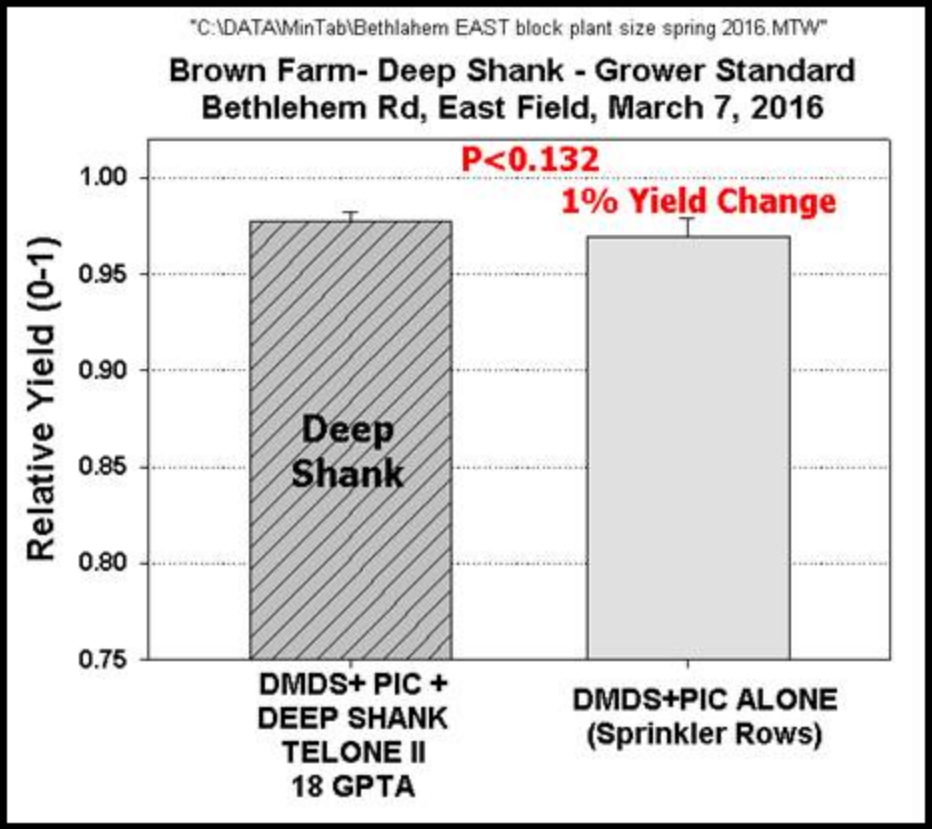
29% Increase in Yield

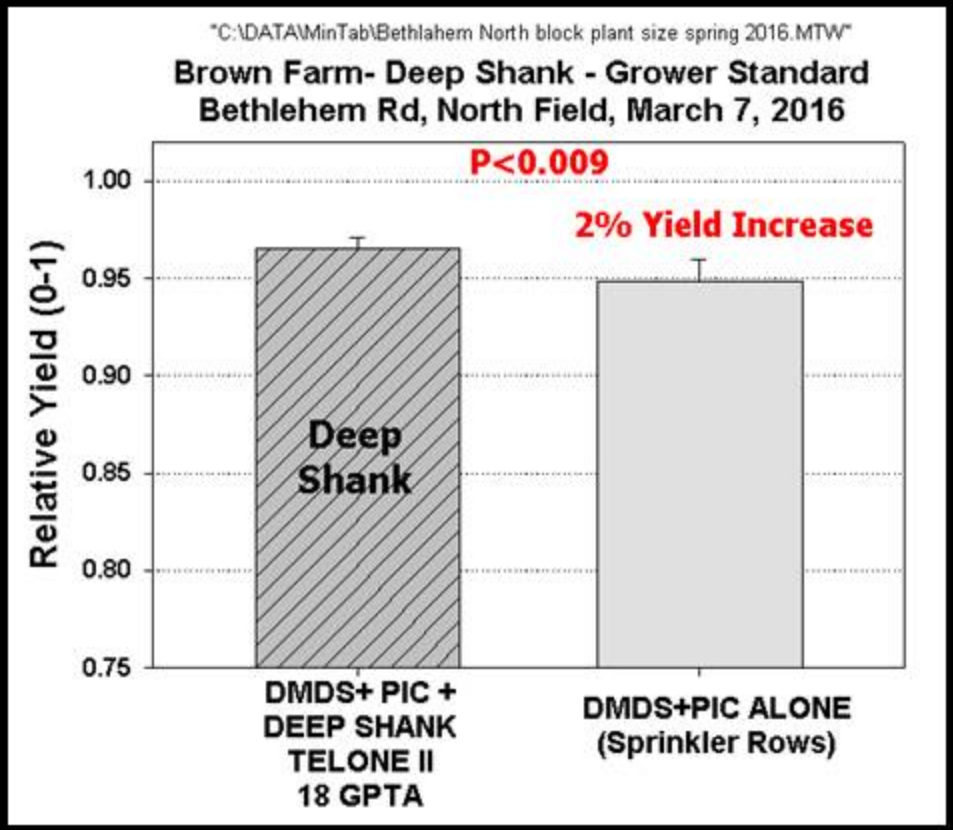
Deep Shank (In-Row) and Deep Drip
Florida Pacific Office Field - Spring 2016



2% Increase in Yield

Subsurface Deep Shank- (In-Row) Favorite Farms - Spring 2016



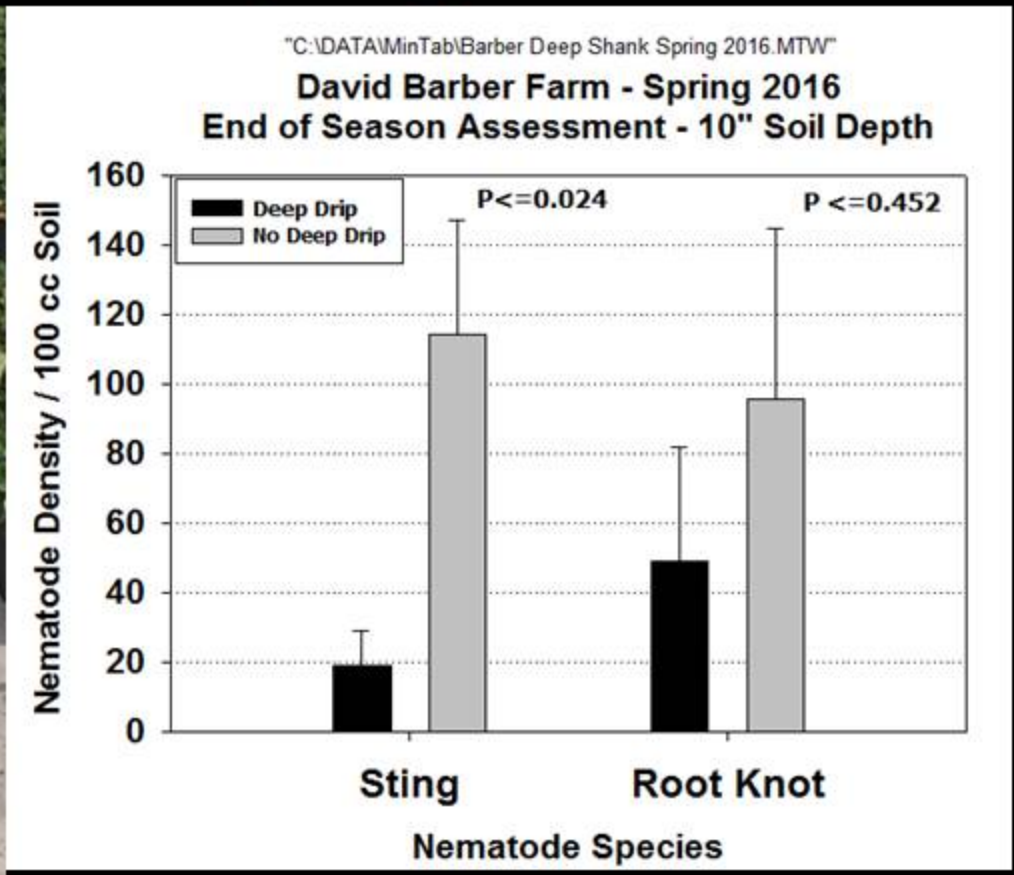


Nematode Pressures did not develop this year

Supplemental Deep Drip
David Barber Farm- Spring 2016

Dominus Alone

Dominus + Deep Drip
Telone II



Half as many nematodes at season's end With Deep Drip


Strategy is gaining traction !
Think about doing it yourself !

Where is the Research Going To ensure Deeper Coverage?

In-Row Resettable Shanks

No Shear pins to replace

Two Depths Fumigant Injection

Two Depths allow Flexibility

(Pic to Top & Telone to bottom)

Broadcast – Turn Plow

Turns Soil – Destroys Pan

Eliminates Shank Trace

Well in advance of Bedding


Deep, Multiport Shanks


Resettable Shanks


A Sophisticated Delivery System
to ensure spatial uniformity


An Integrated System: "State of the Art"
Tracking, Fumigating & Bedding Machine

Flat Land –Turn Bottom Plow Fumigant Applications

All Photos courtesy: Austin Hamilton, Southern Valley Farms

Destroy Traffic Pan and No residual Shank Trace to Deal With !

MAJESTENE™
BIONEMATICIDE

Active Ingredient:
Heat-killed *Burkholderia* spp. strain A396 cells and spent fermentation media 94.46%
Other Ingredients: 5.54%
Total: 100.00%

*Contains not less than 1,500 Beet Armyworm Killing Units (BAWKU)/mg. Note: The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

EPA Reg. No. 84059-14 **EPA Est. No. 84059-MI-001**

KEEP OUT OF REACH OF CHILDREN

CAUTION

Crop	Application Method	Product Use Rate per Application	Application Instructions
Strawberry	Soil Drench	4 – 8 quarts per acre	Apply in sufficient water to thoroughly soak the growing media and root zone. Apply **MAJESTENE™** prior to planting, at planting or shortly thereafter, at transplant or shortly thereafter, and in-season
	Chemigation	4 – 8 quarts per acre	Apply prior to, at, or shortly after planting or transplanting, and in season

Application Instructions for Drip Chemigation

1) Check to be sure that the system provides a uniform waterflow.
2) Irrigate crop with sufficient water to wet the root zone. Then, begin flow of the solution containing product solution from the chemical tank for a period to uniformly distribute the material. Discontinue flow of the **MAJESTENE™** mixture and let the system continue to run only as necessary to purge the line with fresh water. Let the **MAJESTENE™** solution remain in the root zone of the crop.

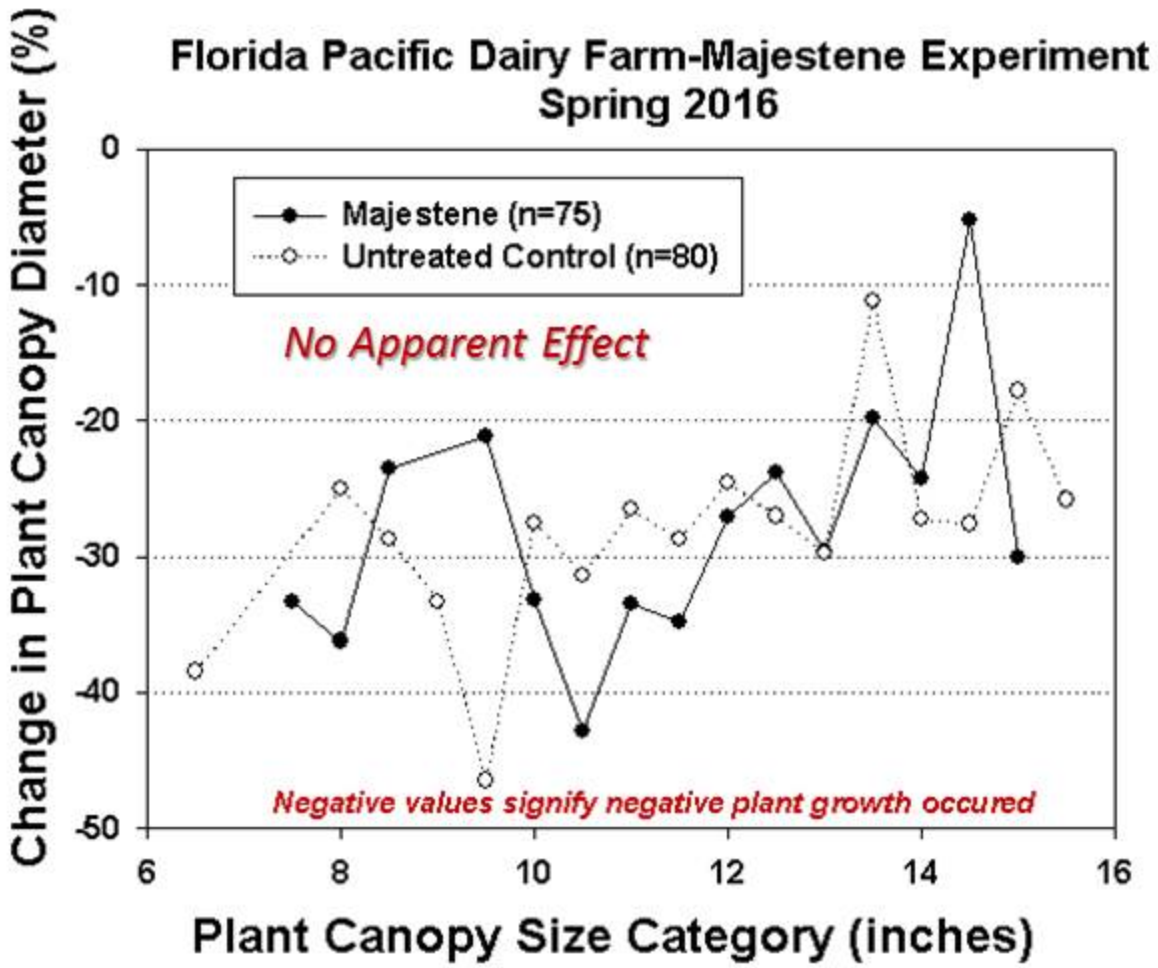
SHAKE WELL BEFORE USE

FOR USE ON THE FOLLOWING CROPS FOR CONTROL OF THE FOLLOWING NEMATODES: Root-knot (*Meloidogyne* spp.), lesion (*Pratylenchus* spp.), sting (*Belonolaimus* spp.), stunt (*Tylenchorhynchus* spp.), ring (*Bursaphelenchus* spp.) and reniform (*Rotylenchulus* spp.) nematodes

Determining Majestene treatment impacts

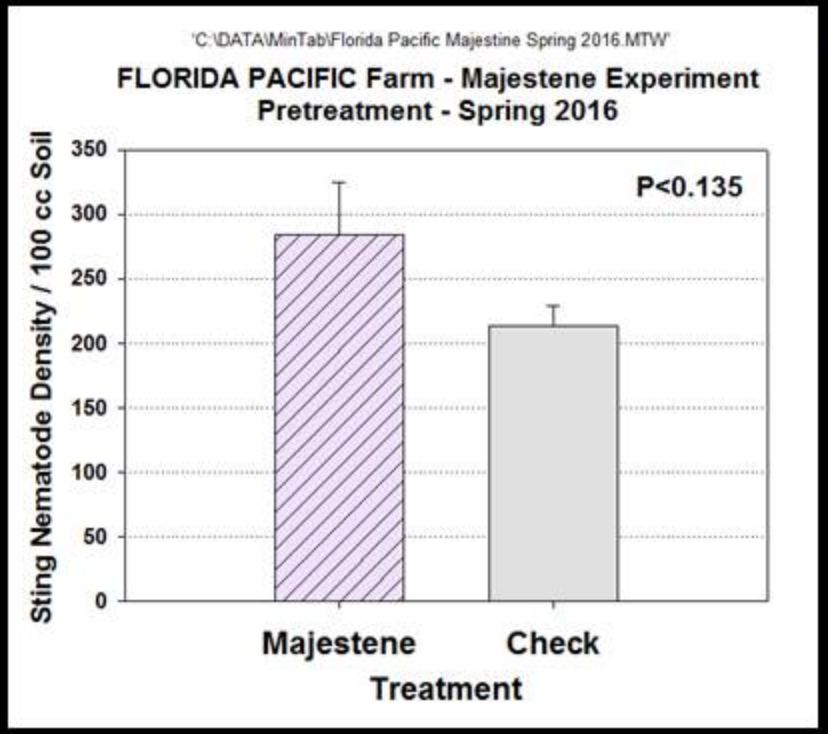
- Plant Canopy Diameter measured prior to treatment in Sting Nematode infested Field
- Averaged from two separate measurements
- Measurements reacquired 6 to 8 weeks after treatment
- Positive or negative changes in Canopy Diameter compiled from hundreds of plants

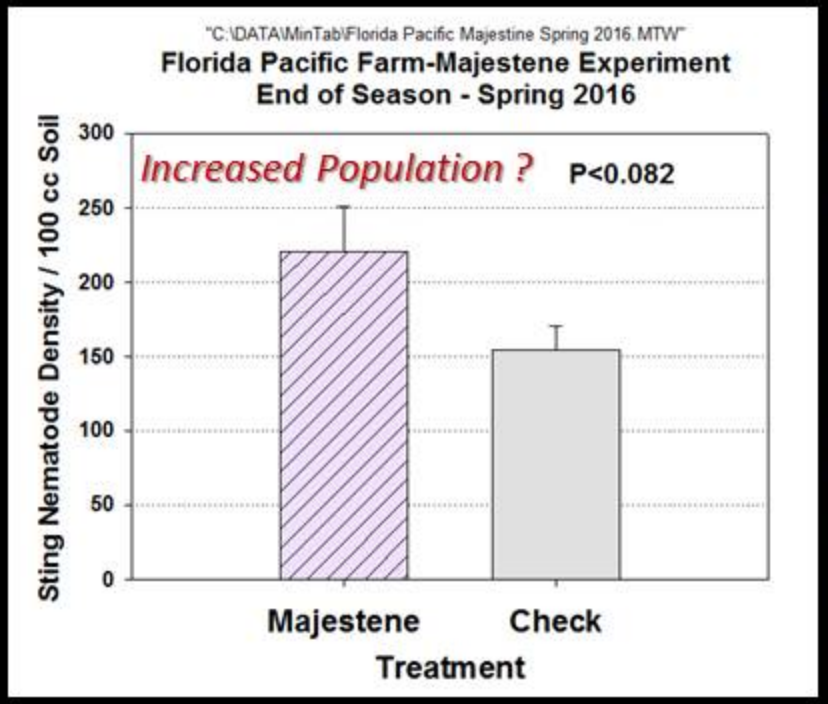
Florida Pacific –Dairy Farm
Moores Lake Rd



Collaborator: Alex Jimenez

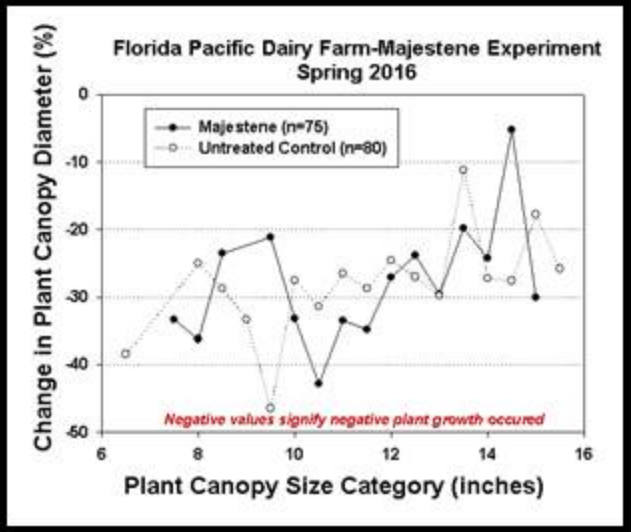
Florida Pacific Farms –Dairy Farm - Moores Lake Rd, Dover, FL



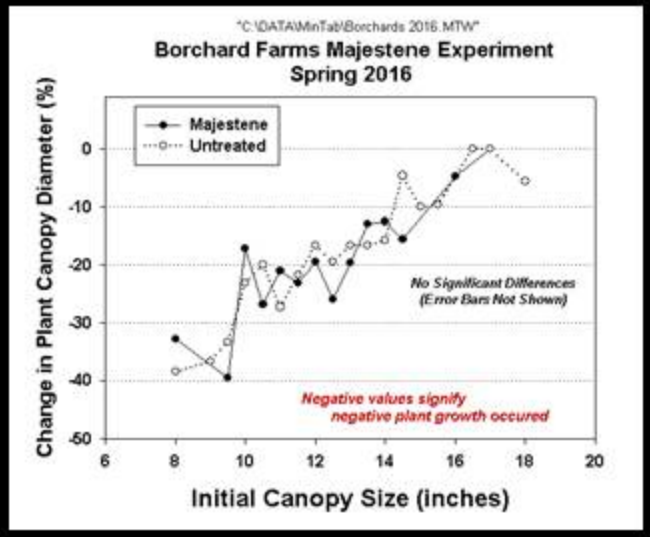


Any Canopy Growth Response to Majestene Treatment?

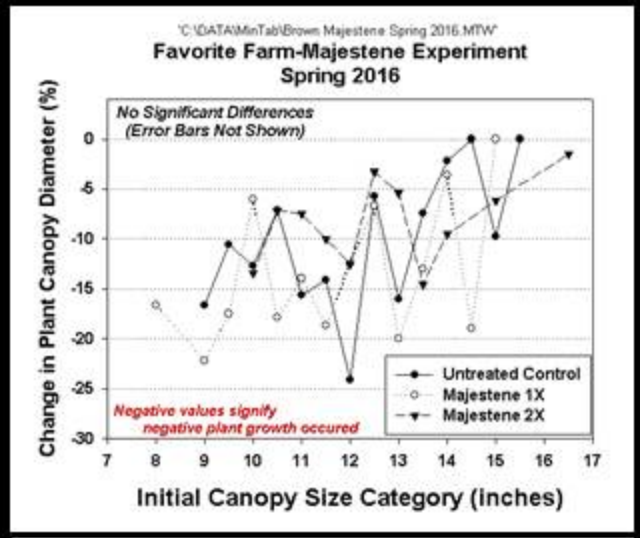
Site 1



Site 2



Site 3



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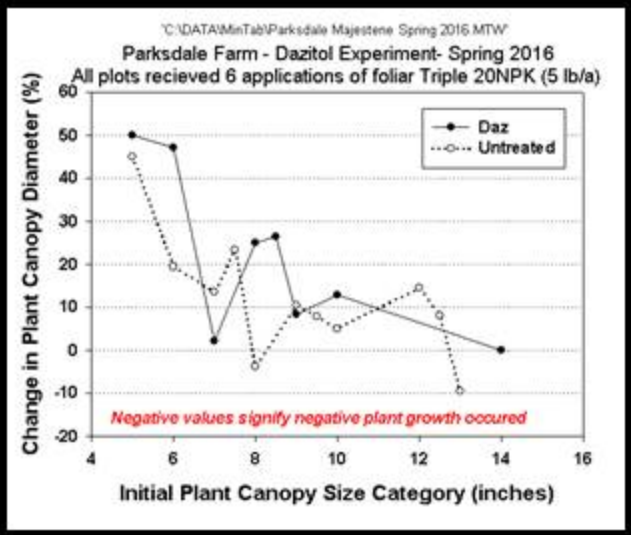
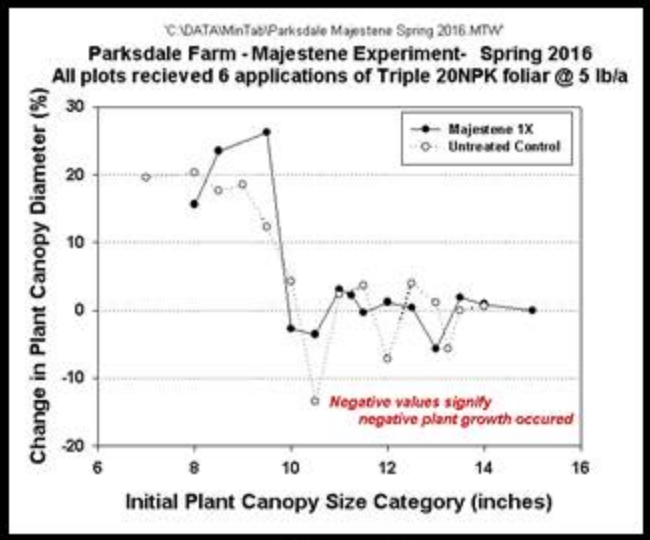


Site 5



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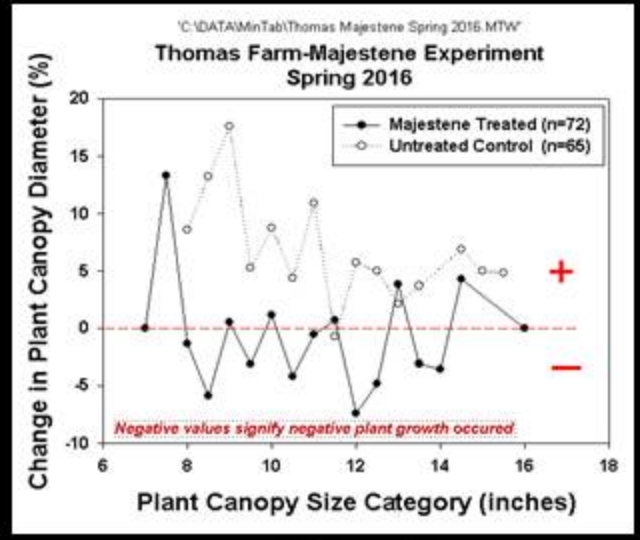
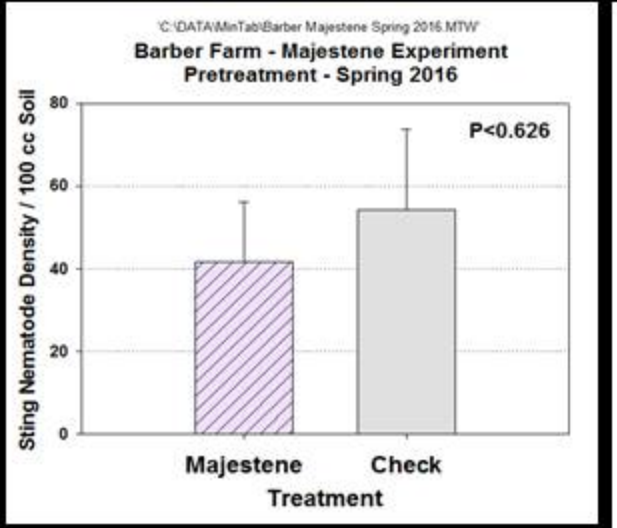


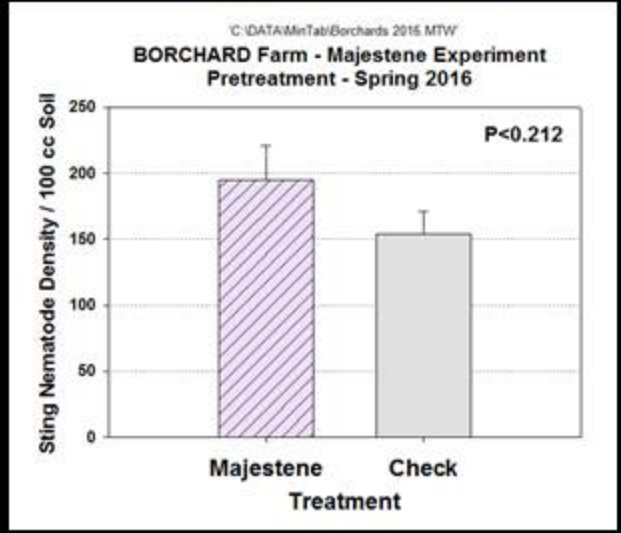
MAJESTENE

Suppression of Sting Nematode ?

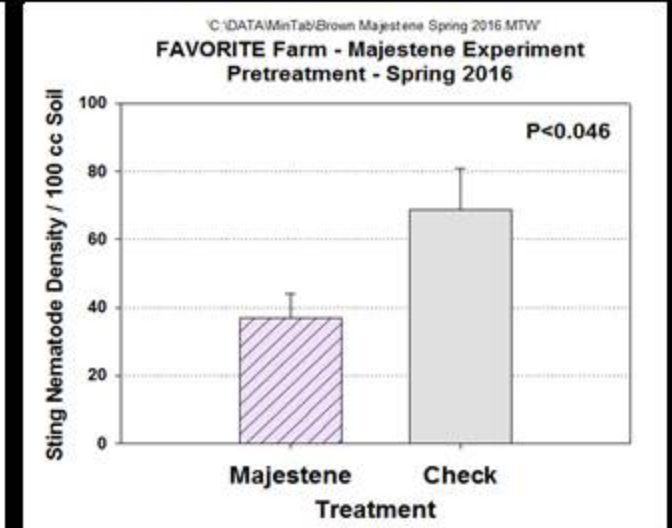
Site 1 Pretreatment

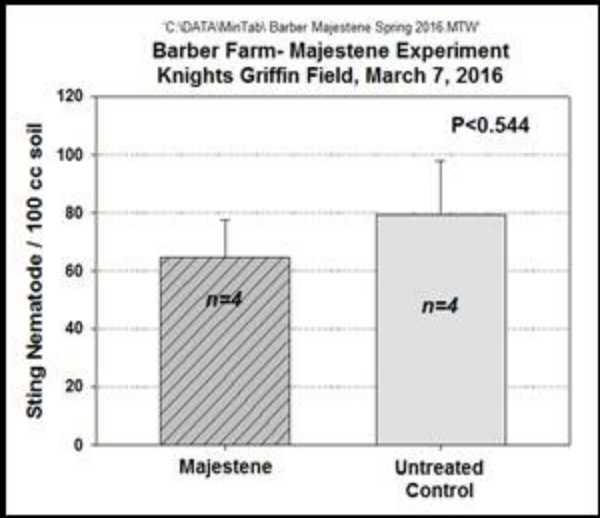


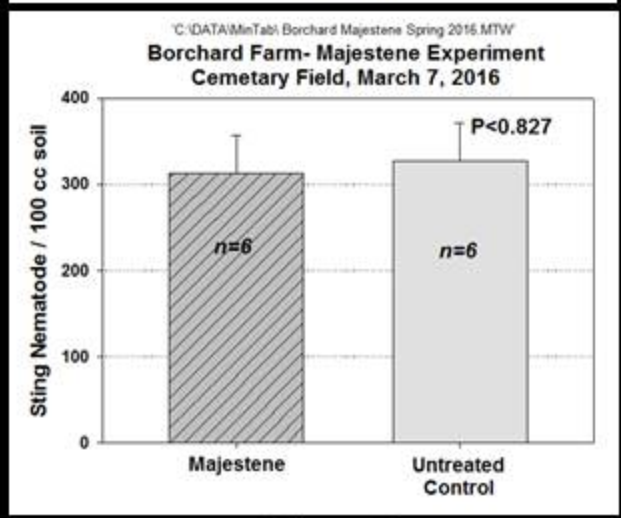
Site 2 Pretreatment

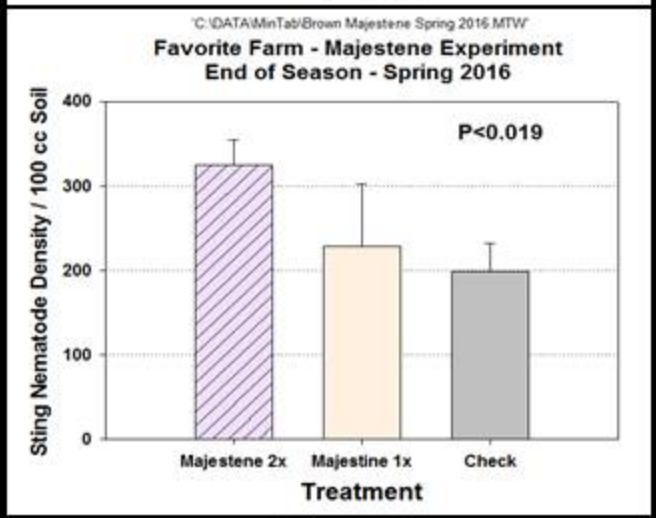


Site 3 Pretreatment









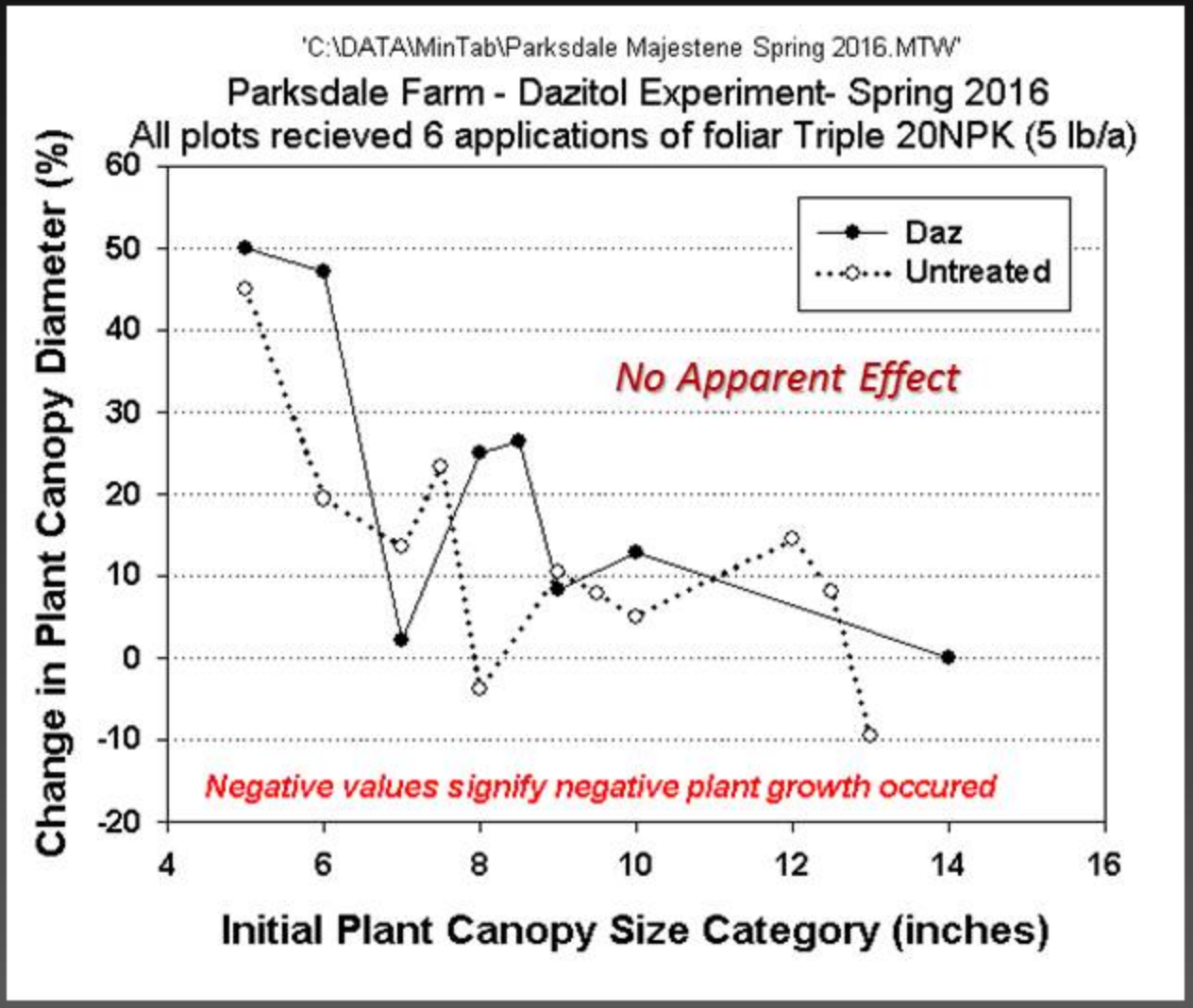
Site 1 8 wks Post-treatment

Site 2 8 wks Post-treatment

Site 3 8 wks Post-treatment

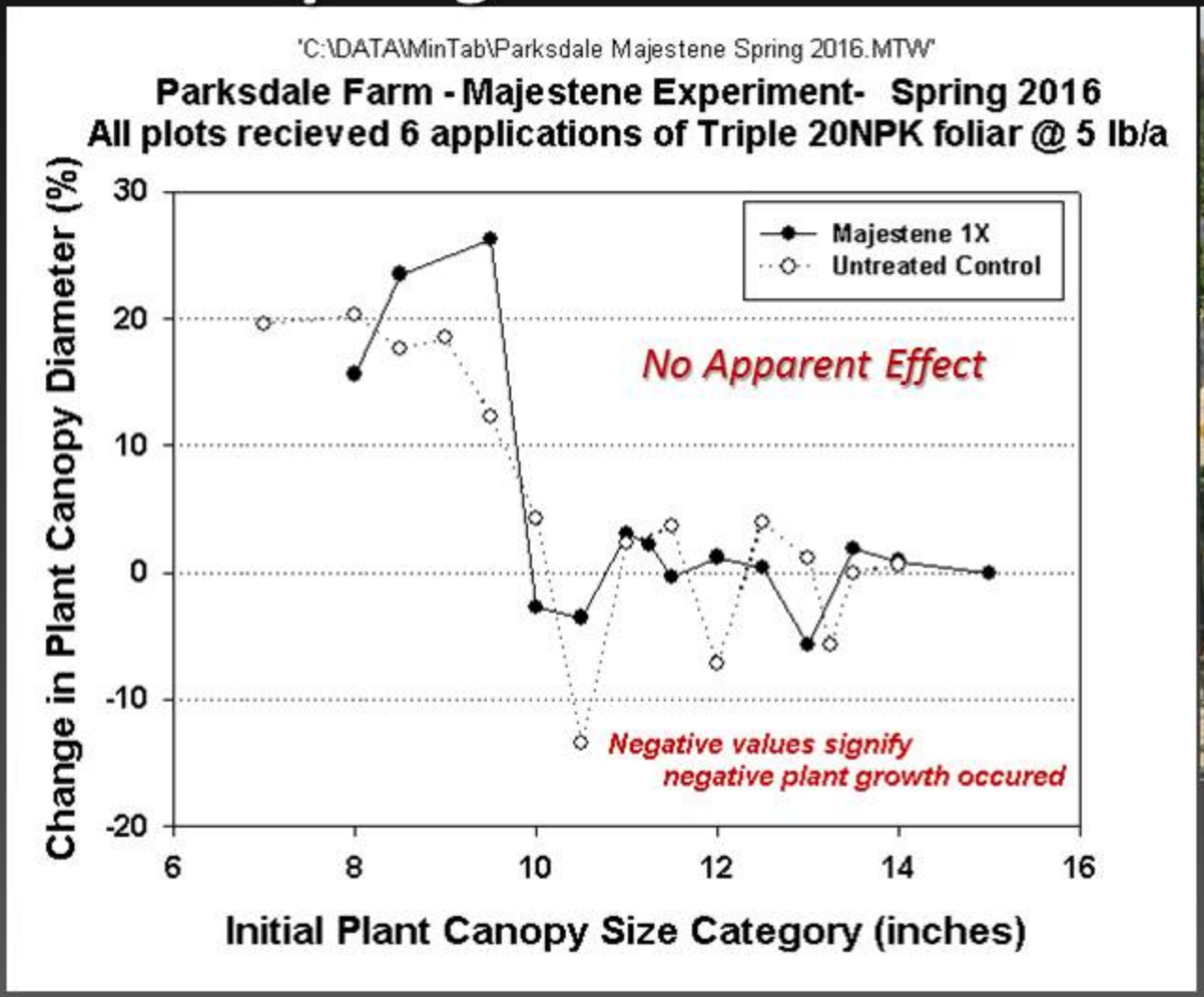
Parksdale Farm

Tanner Rd Field, Spring 2016



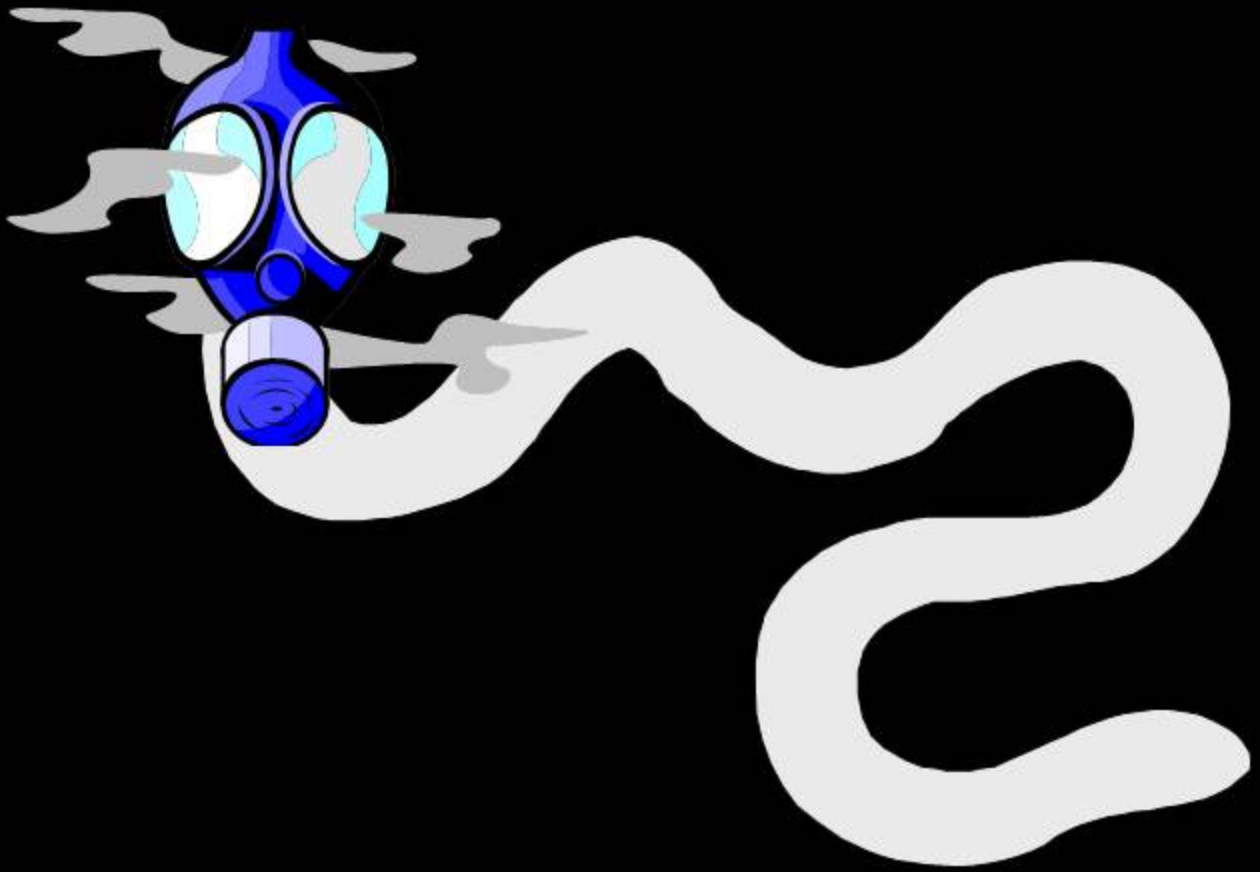
Collaborator:
Matt Parks

Parksdale Farm Tanner Rd Field Spring 2016



Collaborator: Matt Parks

Thank you ---- ANY QUESTIONS?



Triest Rig- Summer broadcast rig – 15 inch injection depth

June 2014

24'' Subsoiler Applications to Destroy the Traffic Pan and Kill Nematodes deep

Resolving Problems of Fumigant Inconsistency with Deep Tillage and Fumigant Application

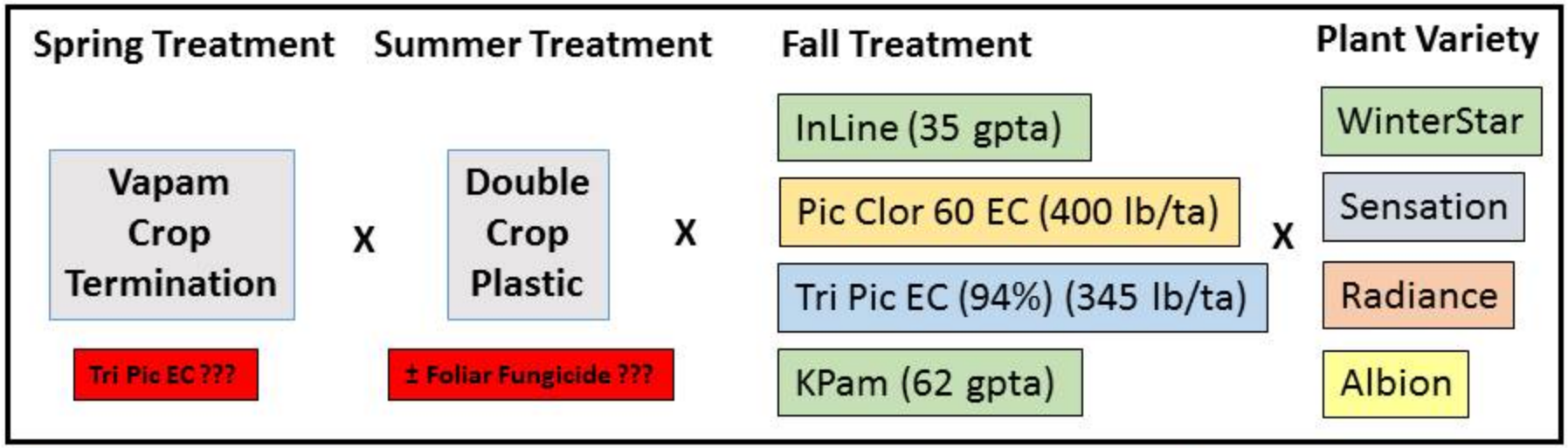
Potential Treatment Combinations to Manage Sting Nematode

	40gpa@$6.5/gal=$260/a	18gpa@$24/gal=$432/a Plus $265 Custom Application		June Bedding & Fumigation	12gpa@$24/gal=$288/a Plus Custom Application
1	Crop Termination			Sept Bedding & Fumigation	Deep Shank Deep Drip
2	Crop Termination	Broadcast Deep Shank		Sept Bedding & Fumigation	Deep Shank Deep Drip
3	Crop Termination	Broadcast Deep Shank	VIF Plastic Broadcast	Sept Bedding & Fumigation	Deep Shank Deep Drip
4	Crop Termination		June Bedding & Fumigation		Deep Shank Deep Drip
5	Crop Termination	Broadcast Deep Shank	June Bedding & Fumigation		
6		Broadcast Deep Shank	June Bedding & Fumigation		

1 vs 4 compares June vs Sept bedding and fumigation

2 vs 3 demonstrates whether VIF will resolve inconsistencies of broadcast deep shank

4 vs 5 demonstrates the superiority of broadcast deep Shank or Deep Shank at June Bedding & fumigation



Product	Density	Telone 1,3-D (62.5% of acre)	Chloropicrin (62.5% of acre)
InLine (35 gpta) (392 lb/ta)	11.2 lb/gal 6.81 lb/gal 1,3-D 3.73 lb/gal PIC	149.5 lb/a	81.6 lb/a
Pic Clor 60 EC (400 lb/ta) (33.9 gpta)	11.81 lb/gal 4.49 lb/gal 1,3-D 6.73 lb/gal PIC	95 lb/a	142.5 lb/a
Tri Pic EC (94%) (345 lb/ta) (25.6 gal/ta)	13.46 lb/gal 12.7 lb/gal PIC	0 lb/a	203 lb/a
Kpam (62 gal/ta)	5.8 lb MITC/gal	0	0

70-80 rows -2.5 acres
Plot size -4 rows