North American Greenhouse Overview from emerging GH Structure(s), crops to pesticide registration process and products.

[Part 2]

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New GATES construction in Texas – Semi-closed











Greenhouse Grown

Photosynthesis 101 Plants uses solar energy to combine water and carbon dioxide to form sugars

- More sunshine, more sugars
- Temperature dependent
 - Too cold and sugars are stored as starch
 - Too hot and the sugars are consumed in respiration
 - Must balance distribution of sugars within the plant
- Stomata must be open to absorb CO2

Good for the Earth®

greenhouse grown



Sunshine and/or lighting ?



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Greenhouse Grown

Light Energy

Sunshine and/or lighting ?



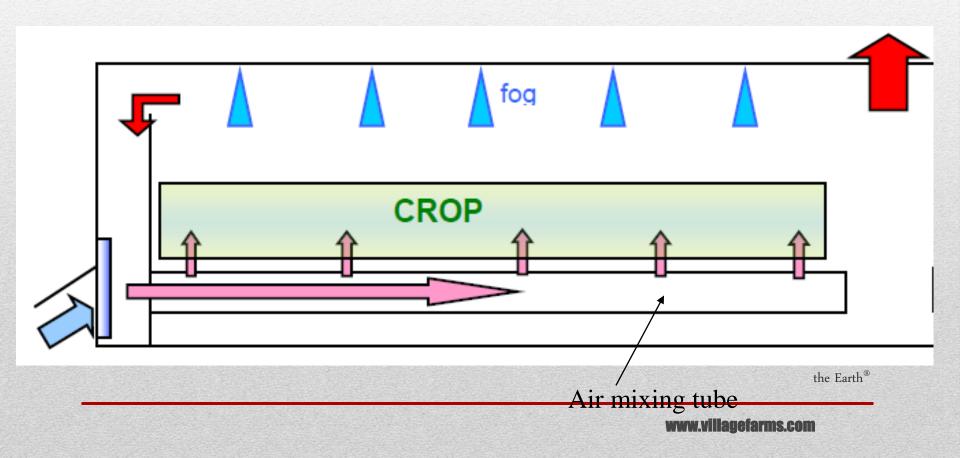


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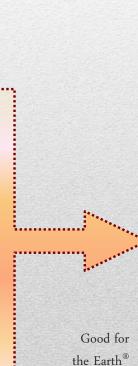
Air moving systems in new generation greenhouses



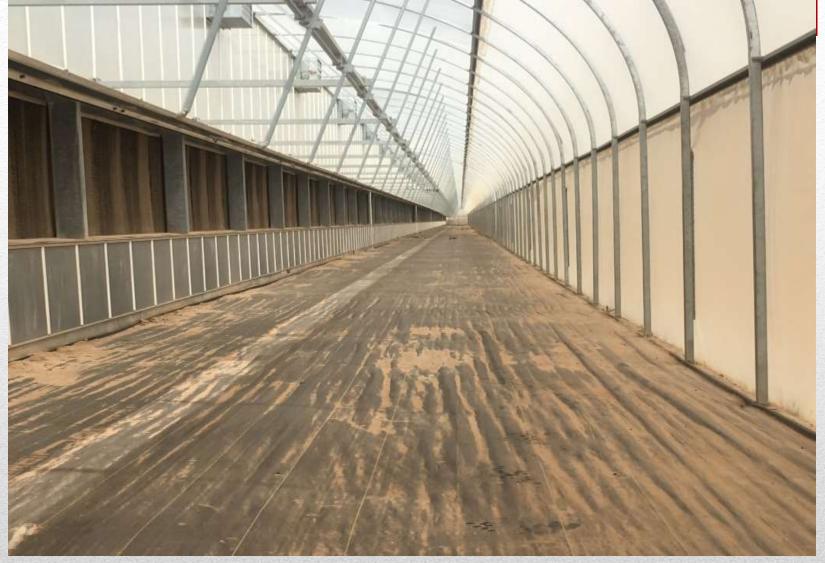
Why do we move air in this way?

Photosynthesis is temperature dependent Stomata must be open to absorb CO2

- Precise control of temperature and humidity
- Smaller temperature and humidity gradients
- Recirculation is conserving humidity and CO₂ -> Higher CO₂ levels are possible
- By keeping the stomata open -> higher CO₂ assimilation rates for longer periods
- Higher radiation and CO₂ use efficiency



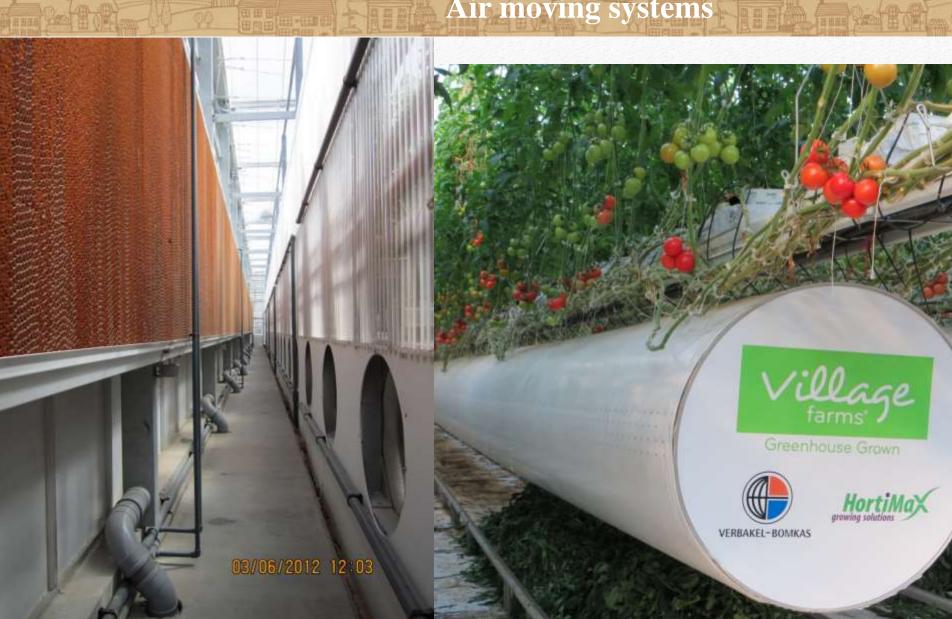




Inside screened area







Greenhouse Grown

Air moving systems



Pesticide Registrations and why Minor Use

- Corn: 96.4 M Acres
 - 40M Ha.
- Soybeans 76.1 M Acres
 - 31M Ha
- Wheat 56 M Acres
 - 23M Ha
- Cotton 12.6 M Acres
 - 5M Ha
- Peanut: 1.42 M Acres
 - 0.6M Ha
- Fresh Market Tomato
 - Field: ~113,000 Acres (4600 Ha)
 - Greenhouse 1500 Acres (607 Ha)

Minor Use under 300,000 acres (121,000 HA)



Beyond Core US Crop Markets USDA 2013 Statistic



- Take up the challenge of defending and supporting Specialty and minor crops.
- Offer incentives to Basics Pesticide Manufacturers (BPM) for Minor/Specialty Crop registrations.
- Permits minor crops to have a someone to approach Basic Producers (BPs).
- Have helped support many smaller BPs, especially with Biological registrations.

IR-4 and PMC Programs

- 1990: Nothing specifically registered for Greenhouse vegetable in USA.
- Canada had multiple products labeled
- End of Organophosphates, and carbamates
- EPA Registration Program Reorganizing
- New industry needing help
 - Turned to IR-4
 - USEPA (Certification and Worker Protection Branch)
 - Richard Pont USEPA
- "Based on information provided to me by Jack Neylan, Anne Lindsay and Jim Jones (Deputy Director of OPP), I confirmed that it is now "EPA's" position (and by that I mean management at OPP, OECA and OGC have apparently agreed on this) that unless use in a greenhouse is expressly prohibited on the label, then it would not be considered use inconsistent with the label to use a product in a greenhouse as long as the crop site was listed on the label.+

US Regulatory Challenges for an emerging industry



USEPA-Richard Pont

Certification and Worker Protection Branch

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- Our US and Canadian industry would not exist today in it current form without the IR-4 and PMC programs.
- Even with the USEPA's letter permitting use of field labels in US, the labels were developed for field and were difficult to use in greenhouses.

Survival

Largescale GH challenges

- Pre-Harvest Interval(PHI) Field: (7,14,21,28,32 day)
 - Needed 0-3 day PHI for GH tomato,
 - 0-1 for Cucumber.
- Many Basic Pesticide Manufacturers
 - Concerned over greenhouse use.
 - Generally, over protecting from resistance development
- Monocrop
- 121 mile rule (40 acre 16 Ha)
 - Chemigation
 - Fogging
 - Dusting
 - Foliar

121 mile Rule (1400 Km)

• Bombus spp.



• Encarsia formosa –WF,

•

• Eretmocerus spp. – WF,

•

• Amblyseius swirskii- Cucumber – Thrips, WF



BENIFICIALS

Tomato Disease:

- PepMV: Ch2 and US1 Strains
 - Seed borne
 - DCM PMV-01 (Belgium)
 - Valto V-10 (Dutch)
 - Not yet labeled in NA. Used in Europe under emergency registrations
- Rhizobium radiobacter/ Agrobacterium rhizogenes (Crazy Root)
 - Seed borne
 - Alters plant energy sink
 - Circulates in water (24-48 hours, low levels for 3 weeks
- Pythium
- Botrytis
- PM
- Fusarium/ Phytophthora
- TYLCV
- Clavibacter (on decline in most NA areas)
 - Seed borne
 - GSPP Good Seed and Plant Practices
 - Except Michigan (Leamington) -Cmm
 - Areas in Mexico and Central America



Pest Challenges in NA

Tomato Insect

- Psyllids (Bactericera cockerlli)
 - 0 tolerance
 - Symptoms similar to Bushy Stunt Virus
 - Candidatus Liberibacter solancearum
 - Zebra stripe in potatoes
- Whitefly
 - Arbovirus transmission
- Leps (Worms)
 - Periodic problem
- Miridae (Plant Bug)
 - Engy Bug:
 - Engytatus modestus
- Aphids
- TSSM











Pest Challenges in NA

Cucumber Disease

- CGMMV (Cucumber Green Mottle Mosaic Virus)
- PM
- Botrytis
- Gummy Stem Blight







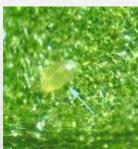




Cucumber Insect

- TSSM
- Broad mite
- Thrips
- Leps (worms)





Female broad mite photographed at externe magnification.



Pest Challenges in NA

Seed Testing Program for Village Farms

- Started in 2007
 - 2000 Tomato Seeds
 - 500 Cucumber Seeds
- Initially due to Cmm and PepMV on Tomatoes
- 8 positives since start (Cmm and PepMV)
- Expanded
 - pathogens and included Cucumbers

Seed Testing Prior to Propagation Program

Pathogen	Symbol
Clavibacter (Bacterial Canker)	Cmm
Pepino Mosaic virus	PepMV
Potato Spindle Tuber Viroid	PSTVd
Columnea Latent Viroid	CLVd
Ralstonia solanacearum	bacterial wilt or southern wilt of tomato
Agrobacterium rhizogenes	Crazy root

Seed Testing Prior to Propagation

Cucumber Seed Testing Program - 500 seeds

Pathogen	Symbol
Cucumber mosaic virus	CMV
Cucumber green mottle masaic virus	CGMMV
Melon necrotic spot virus	MNSV
Tobacco mosaic virus	TMV
Tomato mosaic virus	ToMV
Zucchini yellow mosaic virus	ZYMU
Squash Mosaic Virus	SqMV
Agrobacterium rhizogenes	Crazy Root
Acidovorax avenae subsp. citrulli	BFB (Seedling PCR)

Seed Testing Prior to Propagation



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Questions?

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	Chemi	ical																	C	OI	IT	R)L	S											
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Ambush 25W	Permethrin	6	0	12												\Box	_						_	_	_								
ASCEND PGR	Cytokinin, Gibberellio Aoid. Indole Butyrio Aoid	0	0	4	PGR																												
Ascend WSG PGR	Cytokinin, Gibberellio Aold. Indole Butyrio Aold	0	0	4	PGR																												
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BotaniGard	Breauveria bassiana	0	0	4																													
Botran 75W	Dioloran	4	10	12																												\Box	
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Closer SC	sulfoxation	4	1	12																													
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Decree 50WDG	Fenhexamid	3	1	4		Ш						Ш	\perp																				\sqcup		
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Met 52 EC Drench	Metarhizium anicopilae Strain F62*	0	0	4	Biological	al																													
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(foliar)	Copper Sulfate Pentahydrate	0	0	48					_	Ш	_	\sqcup	_	_		_	_							_											
Orondis Ultra A	Oxathiapiprolin	4	0	4	U15	H			+	\vdash	+	++	+	+		+	+		-					_									\vdash	-+	-
Orondis Ultra B	Mandipropamid	4	1	4	40				_	H	+	$\frac{1}{1}$	+						_					_									\vdash	-	
Orondis Opti A OSO 5%SC	Oxathiapiprolin	4	0	4	U15	Н			+	H	+	+	+	+																			\vdash	\longrightarrow	
Fungicide Oxidate	Polyoxin D zino sait Hydrogen Dioxide	0	0	4	19 23				+	\Box	+																						$\vdash \vdash$	\dashv	
Pageant Intrinsic	Pyraolostrobin bosoalid	3	0	12	7 & 11																														
Permethrin 3.2 EC AG	Permethrin	6	0	12																															
PFR-97 20% WDG	Isaria fumosorosea	0	0	4	Biological	al																													
Ph-D WDG	Polyoxin D zino sait	0	0	4	19																														

								_																											
	Chemi	ical																200	C	NC	IT	RC)L	S											
		w				- 60	-			- 12		Inse	ects		(5)		100										Dis	ease							
Trade Name	Comon Name	. In lited Agos per mason if any High Rate)	PHI	REI	Class or Group	Psyllids ware / Plant	Bugs)	Whiffles	Leps. (worms)	Leafminer	Broad Mitte	Russett Mites	Pepper Weevil	Engy	Brown Marmorated Stink Bug	Nematodes	Colorado Potato Beetle	Fungus gnat, Fles	Botrytis	Crazy Root	Me	DIM	Cmm	Pythium	Alternaria Early Blight	Late Blight Phytopthora	Fusaroium	Leaf Mold - Fulvia fulva	Anthracnose	Pepino MV	Septoria	Leaf Mold (Fulvia fulva) Cladosporium	Gray Leaf Spot (Stemphylium	Bacterial Speck	Bacterial Spot
Portal XLO	Fenpyroximate	2	1		21A	L																													
Preferal (Foliar)	Icaria fumocorosea	0	0	4	Blological																														
Presidio Drip Supplemental	fluopioolide	0	2		0																														
Presidio Supplemental	fluopicolide	0	2		43																														
Prev-Am	Sodium Tetraborohydrate Decahydrate	0	0																																
Previour Flex Drip	propamocarb hydrochloride	4	0						Ш		П		П																						
Previour Flex Foliar	propamocarb hydrochloride	2	1										Н	_																			\sqcup		
Pylon	ohlorfenapyr	3	0	12	13				П																										
Pyreth-It Non- tankmixed	Pyrethrins + PBO	0	0	12	Biological																														
Pyreth-It Tankmixed	Pyrethrins + PBO	0	0	12	Biological								Н						_														\vdash		
Phyton 27AG (Drlp)	Copper SulfatePentahydrate	139	0	24																															
Phyton 27AG (Follar)	Copper SulfatePentahydrate	52	0	24																													\sqcup		
Portal XLO	Fenpyroximate	2	1	12	21A																														
Prestop biofungicide Power (WP) FOLIAR	Gilooladium oatenulatum	0	0	0	Biological																														
Prestop biofungicide Power (WP) DRIP	Glicoladium catenulatum	#####	0	0	Biological																														
Proaxix	Gamma-oyhalothrin	12	5	24																															AND INVANCE
Pro-San LC	GRAS Materials	0	0	0																															
Quadris Flowable	azoxyctrobin methyl	2	0		11																														
Quadris Top	Azostrobin & Difenoconazole	6	0	12	11 & 3		000000			W/2019	Darker of			1000		THE LANE		Was a second	Service 1			1637	50100				10000								

	Chemic	al																	C	NC	T	₹0	L	3											
		24		Ī								Ins	ects	3													Dis	ease							
Trade Name	Comon Name	.In lied Apps per moson if any High Rate)	HI	REI	Class or Group	Psyllids	Lygus (Flam Bugs)	Whitflies	Leps. (worms)	Aphids Leafminer	Broad Mitte	TSSM Mites	Pepper Weevil	Engy	Brown Marmorated Stink Bug	Nematodes	Colorado Potato Beetle	Fungus gnat, Files	Botrytis	Crazy Root	PM	DM	Cmm	Pythium	Alternaria Early Blight	_ate Blight Phytopthora	Fusaroium	Leaf Mold - Fulvia fulva	Anthracnose	Pepino MV	Septoria	Leaf Mold (Fulvia fulva) Cladosporium	Sray Leaf Spot Stemphylium	Bacterial Speck	Bacterial Spot
Quintec Product bulletin	quinoxyfen	0	0	12	13																														10.24
Radient SC Raily 40WSP	spinetoram Myolobutanii	3	1	4 24																	Best														TO STATE STATE
ixally 40170F	myolobutanii			24		Н			+		+		+			+					Dest														3
Ranman	Cyazofamid	6	0		21					\vdash	+		+			+	1	\vdash											\vdash				$\vdash \vdash$	-	
Reaper 0.15EC	abameotin Potassium salt of fatty aoids	0	7	12	None								┢			+		\vdash											\vdash				\vdash	\rightarrow	
Revus	Mandipropamid	4	1	12	40																														- North
Revus Supplemental	Mandipropamid	4	1	4	40																														
Revus Top	Mandipropamid & Diffenceonazole	4	1		40	Ш			\perp	\perp	\perp		\perp																						8
Rhyme fungicide Ridomii Gold	Flutriafol Mefenoxam & Copper	4	0	12	3	Ш																													
Copper Ridomii Gold	Hydroxide	3	14		4. M1	H		+	+	\vdash	+	\perp	+			+-		\vdash	_														\vdash	\rightarrow	
MZ WG Ridomii Gold SL	Mefenoxam + manoczeb	4	5	48		Н		+	+	\vdash	+		+			+		\vdash	_														\vdash	-	
Drench Ridomii Gold SL Follar	Mefenoxam	3	7		4	\Box		+	+	\vdash	+		+																						
Rimon 0.83 EC	novauron	3	1		Mikble1!						+		$^{+}$																						
RootShield PLUS WP	Triohoderma harzianum + Triohoderma virens	0	0	4	9																														
SaniDate 5.0 Post Harvest	Hydrogen Peroxide & PAA																	Ш																	
Safari 20SG (drench)	Dinotefuran	2	1	12	4A																														
Safari 20SG (foliar)	Dinotefuran	5	1	12	4A													Ш															\sqcup		
Safari (Propigarion)	Dinofefuran	1	1	12	4A													Ш																	
Sequola	sulfoxaflor	4	1	12	4C																														
Scala SC	pyrimethanii	5	1	12	9	Ш																													
Scholar SC	Fludioxonii	1	0	0	12	Ш																													
Scorpion (Drip)	Dinotefuron	1	21		4A																	The state of the s													2000000

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	Chem	nical			-17 17														C		П	₹0	L	5											
		, and				0.00		100	v.5. n/	A - 172	# V2	Ins	ect	s		0	Ann P	. 0	3	No 4.			V 47	- 0			Dis	ease	1 V	Ĭ	2 9				
		son if an							s)			4	18				tato	49							ırly				100			_ =	n ot	eck	-
		Ser 380			9	lant		Whitflies	orm	100	itte	Miles	Nee		Brown Marmorated Stink Bug	ses	colorado Potato Seetle	ungus gnat. Tes		Root					Vitemaria Early Blight	ate Blight Phytopthora	E	eaf Mold - uivia fulva	nthracnose	3		eaf Mold Fulvia fulva) Sladosporium	af Si	acterial Speck	acterial Spot
		Apps (ath)			lass or Gro	yllids Alexander	S	ffles	3	ill de	W pa	N N	ber	ngy	WII	ato	rad(Sing	otrytis	y R			i i	ythium	man	Blig	aroi	Mo	racı	Pepino MV	eptoria	Mo Via f	m te	eria	leria
Trade Nam	Comon Name	In Red Apps Sigh Rate)	포	E E	88	lys'	2 5	While Fried	de l	ea le	308	SS	da	Bu	Prov Mari	Ten	See See	in sel	i de	Crazy	No.	N	Smm	\$	Nte.	ate Phyl	sn.	uk	ŧ	de	deg	Ful Mac	Ste	Sac	Bac
Scorpion (Foliar)	Dinotefuron	1	1		4A						\vdash	+						-	_				_										\vdash		
		4		40	4C																														à
Sequola	sulfoxafior	4	1	12	40						\forall	+	+																				\vdash	\dashv	-
SIvanto 200 SL																																			
(DRENCH)	Flupyradifurone	1	45	4							Ш	_																					\vdash		8
SIvanto 200 SL (FOLIAR)	Flupyradifurone	2	1	4	4D				Ш		Ш		Ц																				\square		
Sniper	Bifenthrin G8-omega/kappa-Hxtx-	4	1					٩.			Н		+					-	\vdash			\vdash	_										\vdash	\longrightarrow	- 8
Spear T	Hv1a	0	0	4	Biological		-					+	+					-	\vdash														\vdash	\longrightarrow	- 8
Spintor	spinosad	4	1			+	\dashv				\vdash	+	+	\vdash				\vdash	\vdash			\vdash	\dashv	\dashv									\vdash	\rightarrow	-
Stimplex Crop Biostimulent	Cytokinin	0	0	4	PGR																														
PGR	Cytokinin	U	0	4	PGR	+	\dashv	+	\forall		\forall	+	+	\Box																				\rightarrow	
Stimulate Yield	Cyfokinin, Gibberellio Aold, IAA																																		
Enhancer PGR	Aold, IAA	0			PGR	+	\dashv	+	++		\vdash	+	+					-					\dashv	-									\vdash	\longrightarrow	
StorOx	Hydrogen Dioxide	0	0	0	Post Harvest																														
																																			2
Success	spinosad	4	1																																5
SullOll-X	Petroleum OII	0	0																															\neg	2011/2
Supr-spred	Non-ionio	0	0																																2022
Surf-Ac 820	Non-ionio	0	0			\vdash	\dashv	+	++	+	\vdash	+	+	\vdash				\vdash				\vdash	\dashv	\dashv									\vdash	\dashv	N. Carlot
Switch 62.5WG	oyprodinii & fludioxonii	4	0			\vdash	\dashv	+	++	+	\forall	+	+	\vdash				\vdash															\vdash	\dashv	100
Taegro 2	Baoillus subtilus	0	0	4	Biological				++	+	\forall	+	+	\vdash				\vdash					\dashv										\vdash	\dashv	
Talus IGR	buprofezin Cymoxanii +	2	1						\sqcup	_	\Box	\perp	\perp					Ш															\sqcup		
Tanos	Famoxadone	9	8							-	\Box		+					\vdash	_														\vdash	\longrightarrow	Š
Temprano 1.9%		3	7							-	+		+	\vdash				\vdash	_														$\vdash \vdash$	\rightarrow	5012
Terramaster 4EC	Etridiazole	3	3	12	14	$\sqcup \! \! \perp$			$\perp \perp$		\sqcup	\perp	\perp	\sqcup		$oxed{oxed}$				\sqcup		\sqcup					$\sqcup \sqcup$		$\sqcup \sqcup$		$\sqcup \sqcup$		\longrightarrow		95

	Chemi	cal											7000						C	NC	Т	RC)L	S											
												Inse	ects	()													Dis	ease			00 - 20				
Trade Name	Comon Name	Limited Apps per associal any N-High Rate)	IH. 1	12 KEI	Class or Group	Psyllids	Bugs)	Whiffles	Leps. (worms)	Leafminer	Broad Mitte	Russett Mites	Pepper Weevil	Engy	Marmorated Stink Bug	Nematodes	Colorado Potato Beetle	Fungus gnat, Flies	Botrytis	Grazy Root	PM	MG	Cmm	Pythium	Attemaria Early Blight	Late Blight Phytopthora	Fusaroium	Leaf Mold - Fulvia fulva	Anthracnose	Pepino MV	Septoria	Leaf Mold (Fulvia fulva) Cladosporium	Gray Leaf Spot (Stemphylium	Bacterial Speck	Bacterial Spot
TetraSan 5WDG	Lioxazoio	2	<u> </u>	12		H			$\forall t$	+			H																						\exists
Supplemental	Etoxazole	2	1	12	\vdash	H	-	+	₩	+	\vdash		\vdash	_																				\dashv	-1
Triathion BA	Baoillus amyloliquefaciens	0	0	4	Biological				Ш	\perp			Ш																						
Trigard	oyromazine	6	0	12	17																														
									П		╽		\sqcap																						\neg
Tristar 8.5 SL Tristar 30SG	Acetamiprid	1	1	12	4A						\vdash	+	\vdash						Н										\vdash					\dashv	
Supplemental Timectin 0.15EC	aoetamiprid abameotin	3	7	12	4A				H										\vdash										\vdash					$\overline{}$	\dashv
Tombstone Insecticide	Cyfluthrin	6	0										\Box																						\neg
Uptake	DDAC	0	0																																
MgSO4 Follar	Mg8O4	_	Ů					\perp		\pm		+																	\Box					\equiv	\exists
MgSO4 Paste	Mg804 Cytokinin	0	0	4	PGR																														
Venom 208G Foliar	Dinotefuran	1	1			Ш							\coprod																Ш						
Venom 208G Drlp	Dinotefuran	2	21										\Box																Ш						
Zoro	abameotin	3	7										$\vdash \vdash$	+					_			\vdash							$\vdash \vdash$					\dashv	-
Vydate L	oxamyl	8	3			Ш							\sqcup										_						\sqcup						
Veranda O	Polyoxin D zino sait	5	0		19																		_						\sqcup					\longrightarrow	
Vollam Xpress Warrier II with	Lambda-oyhalothrin	3	5	24							\vdash								_			_	_						\sqcup					\dashv	_
Zeon Technology	Lambda-oyhalothrin	12	5	24	3																														
Zonix Biofungicide	Rhamnolipid Biosurfactant	0	0	4	Biological																														
						H	\dashv	\mp	\prod	+	H	+	\Box	\perp															\vdash					\dashv	-
State of the last						-	V1000								All and relian	-	The same is			11000	_				THE CASE						-		ENVIOLE STATE		



mebledsoe@villagefarms.com

407-493-3933 US Cell

Questions?

Tomato Disease:

- **PepMV**: Ch2 and US1 Strains
 - DCM PMV-01 (Belgium)
 - Valto V-10 (Dutch)
 - Not yet labeled in NA. Used in Europe under emergency registrations
- Agrobacterium rhizogenes (Crazy Root)
- Pythium
 - Rootshield
 - Previour Flex
- Botrytis
 - Cease + Milstop
 - Switch
 - Pageant
 - Decree
 - Scala
- PM
 - Cease + Milstop
 - Switch
 - Pageant
- Fusarium/ Phytophthora
- TYLCV
- Clavibacter (on decline in most NA areas) Except Michigan (Leamington)
 - GSPP Good Seed and Plant Practices
 - Except Michigan (Leamington) -Cmm
 - · Areas in Mexico and Central America



