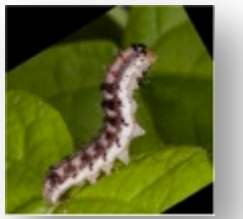
Insecticide Resistance Action Committee

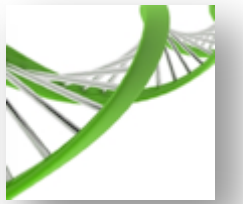
IRAC Tuta absoluta IRM Task Team

Introduction & Planning Session

50th IRAC International Meeting,

Dublin April 5, 2016

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IRAC Tuta Task Team

- **Russell Slater: Introduction & Purpose of Task Teams**
- **Andrea Bassi: Tuta absoluta in Europe**
  - History, Distribution, Pest Status
  - Current IRM BMP's
    - Challenges
  - Suggestions from Experience
  - Training Resources
- **John Andaloro: Plan Summary**
  - Task team Objectives and Expectations
  - Countries Interested?
  - Structures of Teams
  - Proposed Schedule and Timeline

IRAC Tuta Task Team - Objectives

Overall Objective of the Tuta Task Team: Provide cross-industry advice for best practice Tuta insect control in selected Europe, Middle East, and African countries by designing a regional Tuta pest control program that will be adapted, communicated and implemented locally to growers, influencers and the product supply chain.

IRAC Tuta Task Team – Leaders/Coordinators: Individuals who will drive the Tuta Training process and creation of the Regional BMP's, Train The Trainers, Locally Adapt BMP's

Global:	**Core Team (Selected Executive Companies)**
Objective:	Conduct regional Tuta IRM training session
	Complete Tuta IRM BMP training package
	Achieve Industry Alignment
	Follow-through auditing of progress and issues
Regional:	**Company Reps (2-3 company members)**
Objective:	Assist with regional training program
	Liaison with country training teams
	Expert advisors to country trainers
Country:	**Company Rep/country + Key Officials/Influencers**
Objective:	Coordinate/liaise with Industry expert influencers
	Train-Communicate-Implement Tuta IRM BMP's
	Expert advisors

Andrea’s Slides

Introduction into problem of *Tuta absoluta* in Europe

A. Bassi, IRAC Annual, Dublin, Apr. 4-9 2016

2008 - a quick learning process

Timely, abundant, good-quality technical info

IPM : an obligate Pest Management paradigma

Insect exclusion

Old greenhouse:
a much bigger issue

New greenhouse:
a manageable issue

The Tomato Leafminer - *Tuta abso*

- IRM (Insecticide Resistance Management) is functional to IPM
- Insecticidal MoA alternation is essential to maintain insect susceptibility

Insecticidal MoA available for *T. absoluta* control

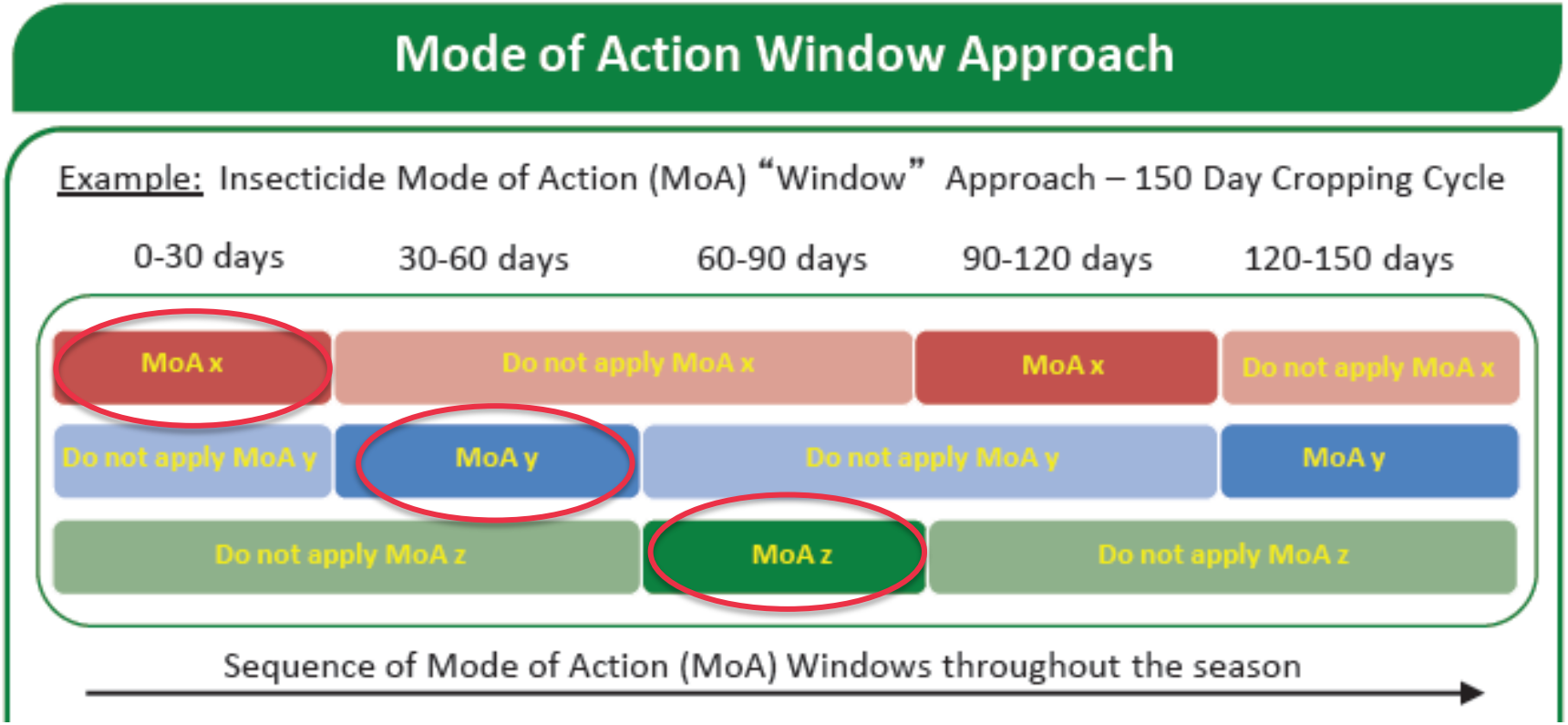
Insecticide MoA Groups for the Control of *Tuta absoluta*

Group	Mode of Action	Chemical Class	Common Names (e.g.)
1B	Acetylcholinesterase (AChE) inhibitors	Organophosphates	Chlorpyrifos, Methamidophos
3A	Sodium channel modulators	Pyrethroids	Bifenthrin, Cyfluthrin, *beta*-Cyfluthrin, *gamma*-Cyhalothrin, *lambda*-Cyhalothrin, Cypermethrin, *alpha*-Cypermethrin, *beta*-Cypermethrin, *zeta*-Cypermethrin, Delthamethrin, Esfenvalerate, Etofenprox, *tau*-Fluvalinate, Fenpropathrin, Permethrin
5	Nicotinic acetylcholine receptor (nAChR) allosteric modulators	Spinosyns	Spinetoram, Spinosad
6	Chloride channel activators	Avermectins, Milbemycins	Abamectin, Emamectin benzoate
11	Microbial disruptors of insect midgut membranes and derived toxins		*Bacillus thuringiensis aizaw*
13	Uncouplers of oxidative phosphorylation via disruption of the proton gradient	Pyrroles	Chlorfenapyr
14	Nicotinic acetylcholine receptor (nAChR) channel blockers	Nereistoxin analogues	Cartap
15	Inhibitors of chitin biosynthesis, type 0	Benzoylureas	Diflubenzuron, Flufenoxuron, Lu Noviflumuron, Teflubenzuron, Tri
18	Ecdysone receptor agonists	Diacylhydrazines	Chromafenozide, Methoxyfenozide
22A	Voltage-dependent sodium channel blockers	Oxadiazine	Indoxacarb
22B	Voltage-dependent sodium channel blockers	Semi-carbazone	Metaflumizone
28	Ryanodine receptor modulators	Diamides	Chlorantraniliprole, Flubendiamide
UN	Compounds of unknown or uncertain MoA	Tetranortriterpenoid	Azadirachtin

Notes on the MoA Groups for the control of *Tuta absoluta* are on the next page

IRAC simple IRM strategy: MoA alternation

- **do not overuse individual MoA**



Diamide insecticides – Chlorantraniliprole*

- The 1st diamide insecticide extensively registered in tomato.
- IRAC Mode of Action (MoA) «Group 28**».
- Discovered in June 2001.
- Commercialized in the EU since 2008/10.

* Rynaxypyr™

** Ryanodine-receptor modulators

The Tomato Leafminer - *Tuta absoluta*

Recommendations for Sustainable and Effective Resistance Management

- **First, determine the baseline sensitivity of *T. absoluta* to new & existing MoA.**

IRAC

Insecticide Resistance Management

T. absoluta baseline to Chlorantraniliprole

- DuPont coordinated a collaborative study in the Mediterranean area, for validating of the novel bioassay method for *T. absoluta* proposed by IRAC (IRAC Method 022).

- In order to determine the product baseline susceptibility of 23 field collected populations from Spain, Italy and Greece (Roditakis *et al.*, 2012).

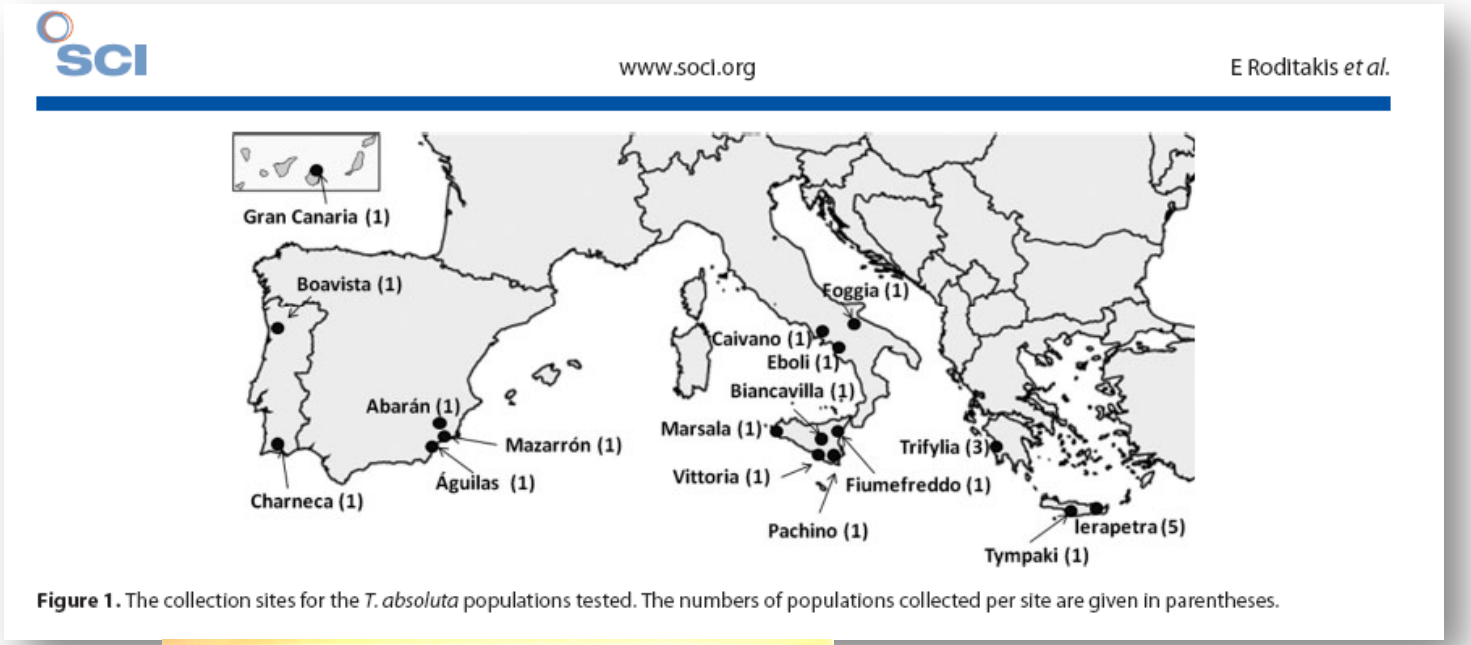
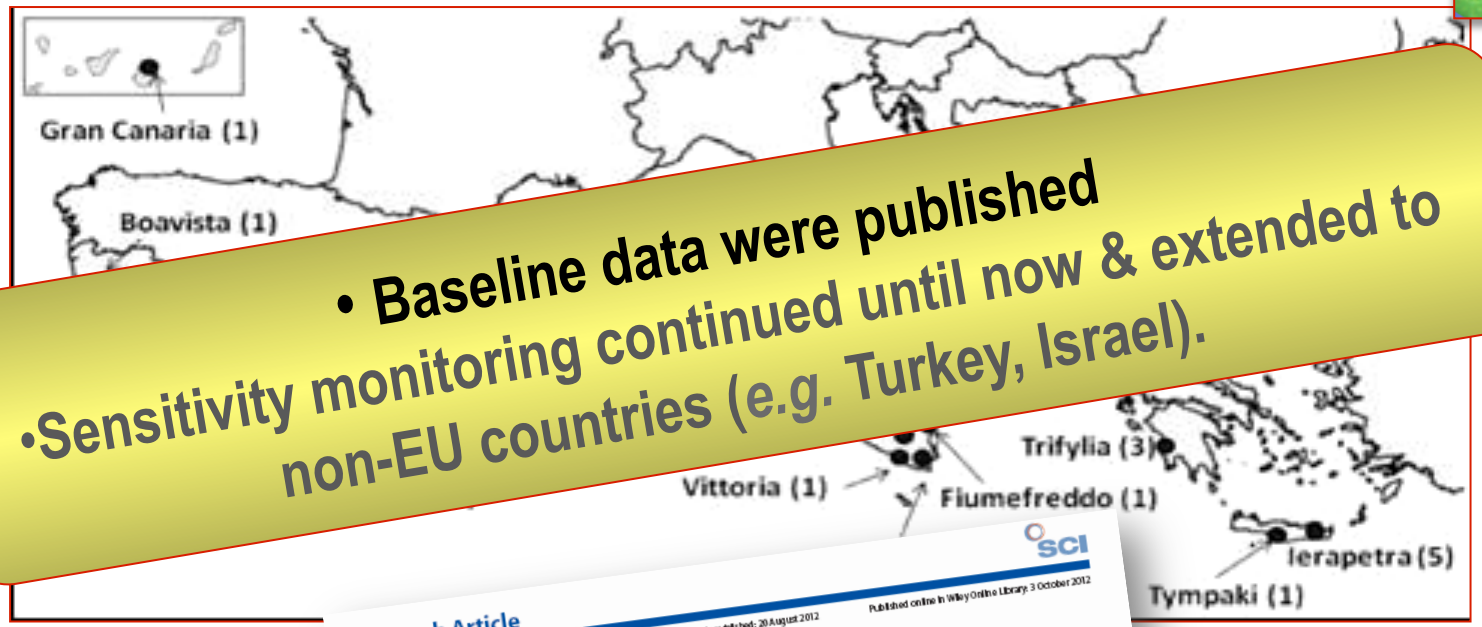


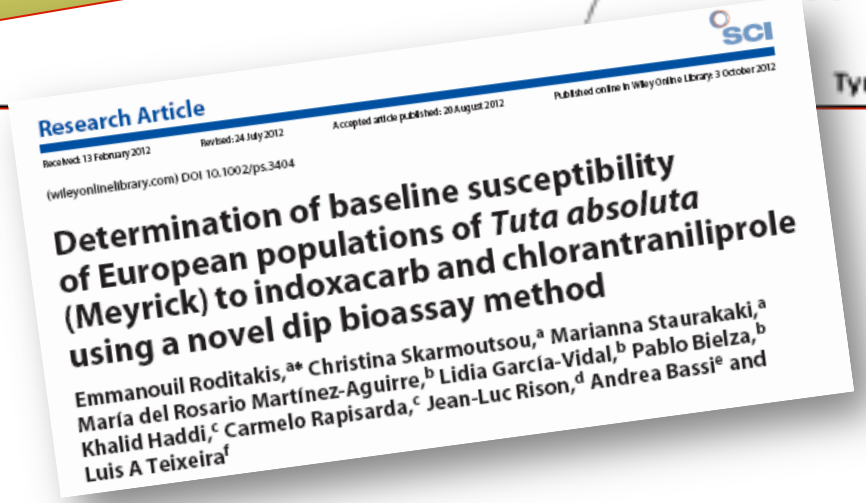
Figure 1. The collection sites for the *T. absoluta* populations tested. The numbers of populations collected per site are given in parentheses.

Leaf-dip bioassay
IRAC Method No. 022

Sensitivity bioassays results (IRAC method 022)



- **Baseline data were published**
- **Sensitivity monitoring continued until now & extended to non-EU countries (e.g. Turkey, Israel).**



Research Article

Received: 13 February 2012 Revised: 24 July 2012 Accepted article published: 20 August 2012 Published online in Wiley Online Library: 3 October 2012

(wileyonlinelibrary.com) DOI 10.1002/ps.3404

Determination of baseline susceptibility of European populations of *Tuta absoluta* (Meyrick) to indoxacarb and chlorantraniliprole using a novel dip bioassay method

Emmanouil Roditakis,[a]* Christina Skarmoutsou,[a] Marianna Staurakaki,[a] María del Rosario Martínez-Aguirre,[b] Lidia García-Vidal,[b] Pablo Bielza,[b] Khalid Haddi,[c] Carmelo Rapisarda,[c] Jean-Luc Rison,[d] Andrea Bassi[e] and Luis A Teixeira[f]

E. Roditakis *et al.*, Pest Manag Sci 5 Aug. 2013

2014 Results – Sensitivy monitoring in Sicily (Italy)

- In May 2014, four ***Tuta absoluta*** **populations were sampled** by DuPont **in Sicily (IT)** following up to an alert of poor performance with Chlorantraniliprole.

- The populations were assayed at NAGREF lab. (Crete, GR) according to the IRAC method 022 (sensitivity bioassay of *T. absoluta)*.

Farmers interviews

Farmers interviews witnessed systematic off-label use of Chlorantraniliprole.

Data trattamento	Prodotto
3/17/2014	**Chlorantraniliprole**
	Acidi umici
3/28/2014	**Chlorantraniliprole**
	Acidi umici
4/8/2014	**Chlorantraniliprole**
	Acidi umici
4/15/2014	**Chlorantraniliprole**
	Codacide
4/24/2014	**Chlorantraniliprole**
	Acidi umici
5/5/2014	**Chlorantraniliprole**
	Codacide
	Impero
5/15/2014	Success
	Codacide
5/22/2014	**Chlorantraniliprole**
	Acidi umici
5/24/2014	Steward
	Codacide
	Impero

e.g. 7 chlorantraniliprole-based products applied (either by drip or foliar) over 65 days (max. label use: 2 applns/crop/year).

Result evaluation (I)

- 2014 bioassay results indicated significant **resistance ratios (RR) to both Chlorantraniliprole & Flubendiamide** for all the four populations.

- Relative to the Cretan sensitive reference (SR) strain, resistance ratios are **ranging from 265- to 2414-fold** (range inclusive of both aa.ss. tested).

Result evaluation (II)

Baseline sensitivity (2009-2011) vis-à-vis targeted sensitivity bioassays (2014) of *T. absoluta* populations sampled in South-East Sicily. Estimated LC_{50} based on log-dose probit-mortality data with chlorantraniliprole and flubendiamide*. In all 2014 assays, the NAGREF lab strain is the susceptible reference strain used.

Baseline (Sicily 2009-2011)					Field populations (Sicily 2014)								
Chlorantraniliprole					Chlorantraniliprole					Flubendiamide			
Population	**Reps.**	**N**	**LC_{50}**	**CL 95%**	**Population**	**N**	**LC_{50}**	**CL 95%**	**RR**	**N**	**LC_{50}**	**CL 95%**	**RR**
Pachino	2	384	0.58	0.21-1.21	NAGREF lab ref.	187	0.18	0.13-0.30	1	186	0.79	0.31-1.50	1
Vittoria F_1	1	192	0.74	0.29-1.34	Pachino 1	189	47.6	31-77	265	127	993	384-1649	1257
Vittoria F_2	1	224	0.78	0.44-1.28	Pachino 2	126	63.7	42-128	354	128	1376	792-2772	1742
Marsala	2	384	0.93	0.48-1.58	Acate (t2)	192	435	165-1193	2414	/	/	/	/
Fiumefreddo	2	384	1.34	0.49-2.86	Gela	191	225	135-343	1250	190	1019	500-2131	1289

**Roditakis et al. (2015) - First report of Tuta absoluta resistance to diamide insecticides. J Pest Sci: DOI 10.1007/s10340-015-0643-5.*

Recap

- ✓ *T. absoluta* arrived in Italy: 2008-2009
- ✓ Chlorantraniliprole registered : 2009-2010
- ✓ <u>First resistance cases in Sicily: 2014</u>

- ✓ Cross-resistance also concerns another insecticide sharing the same MoA 28 (Flubendiamide).
- ✓ Unpublished molecular and inheritance studies suggest target-site mutation as the likely resistance mechanism.

Additional findings

- ✓ The populations in question were kept under rearing for **subsequent studies** (*e.g.* cross-resistance to other MoA, fitness cost, mechanism of resistance).
- ✓ There appear to be **no fitness cost associated** with the resistance factor.
- ✓ **No clear indications for cross-resistance** were found to other insecticides/MoA groups such as MoA 5 (*e.g.* spinosad), MoA 6 (*e.g.* emamectine benzoate), or MoA 22A (indoxacarb).
- ✓ As for the resistance mechanism, initial molecular studies have **detected the target-site mutation G4946E** (a glycine to glutamic acid substitution) in one of the resistant *T. absoluta* populations.

These day's objective

- **Team-up to reinstate correct diamide use (respect of label), MoA alternation, *Tuta absoluta* control "only within IPM".**

- Break the buildup of resistance alleles within the *T. absoluta* population across the Mediterranean region.

Tomato in the Mediterranean basin & *T. absoluta*

latest to arrive, from Israel

In blue sample 1 collected in Kmehin => no resistance

In red sample 2 collected in 3 villages => resistant

The sites regarding the second shipment of *Tuta Absoluta* larvae were:				
1.	Tamra-in the western Galilee of Israel – 32°, 51', 14" north, 35°, 11', 28" east.			
2.	Ibblin-in the western Galilee of Israel-32°, 49', 45" north, 35°, 11', 10" east.			
3.	Tubas-in the Palestinian Authority, in the eastern Samaria-32°, 19', 00" north, 35°, 22", 08" east.			

2015-16 findings (DP-own activity)

- Confirmation of widespread diamide-resistant *T. absoluta* in Sicily.
  - 2 highly resistant *T. absoluta* population from Crete.
- 1 highly resistant *T. absoluta* sample (a pooled sample) from Israel.
- No highly resistant *T. absoluta* population from Spain (1 in the grey area).
  - Some T. *population are* under scrutiny in Turkey.

"Why farmers do not implement resistance mgmt?"

some factors that play against IRM (examples)

- **Food chain**: external push to minimize the number of CPC residues.

- **Economic**: the smaller farmers cannot afford changing the GH structure and buying multiple insecticides for the same target.

- **Relational**: small farmers refer to dealers. Dealers margin is often higher for non-CPC (*e.g.* biostimulants, natural substances, biologicals) claiming positive side-effects on pests & diseases. The insecticide transaction becomes secondary, but the insecticide must work for all (bests are abused).

Path forward

- Monitoring of spraying behaviors to **avoid abuse of "the best product"** of the moment.
- Reiterate a consistent message on MoA alternation.
- **Design & validate simple MoA alternation programmes** and demonstrate to the whole value-chain.
- **Share a general** sampling & **monitoring program** of *T. absoluta* sensitivity **to multiple MoA** assayed at a few critical concentrations.

Chlorantraniliprole (season long appl.)

Untreated Check

Indoxacarb + Codacide (season long appl.)

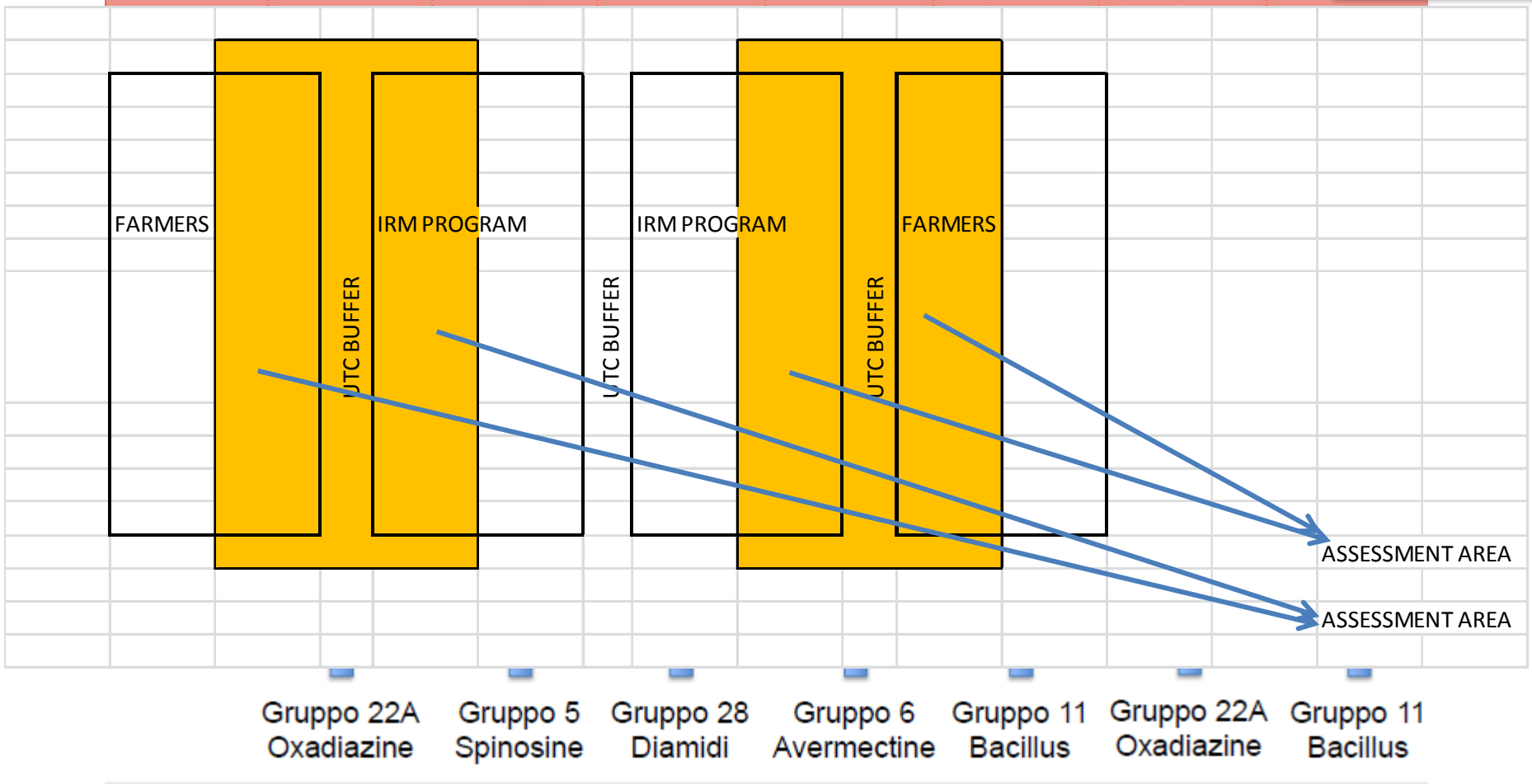
Match 50EC (season long appl.)

two themes of 2015 flied activity

1. Comparative performance of diamide vs. other insecticidal MoA for *T. absoluta* control under severe infestation / Greenhouse TOMATO (Small plots).

2. Validation of IRM strategy for *T. absoluta* control (Large Plots)

IRM Platforms – MoA alternation programmes



Comparative performance of diamide vs. other insecticidal MoA for *Tuta absoluta* control under severe infestation / Greenhouse TOMATO

OPT.TRT#	OPTIONAL TREATMENT DESCRIPTION
1	Indoxacarb+ Codacide 12,5+250 ml FP/hl
2	Spinosad 25 ml FP/hl
3	Rynaxypyr + Codacide 12 + 250 ml FP/hl
4	Emamectina b.+ Break T.1500+200 mlFP/ha
5	Bacillus T. 2 kg FP/ha
6	Methomil 125 ml FP/hl
7	Ryn.+Met+Cod. 12+125+250 mlFP/hl
8	Cyazypyr + Codacide 75+250 ml FP/hl
9	Match 60 ml FP/hl
10	Ind+Spin+Ryn 12,5+25+ 12 ml FP/hl
999	Untreated

Protocol EMA-15-401

Country	n. trials
Greece	2
Italy	2
Spain	2

Validation of IRM strategy for Tuta absoluta control and Comparative performance of diamide vs other insecticidal MoA under severe infestation / Greenhouse – LPTs Protocol EMA-15-400

OPT. TRT#	PART	TREATMENT COMPONENT	FORM TYPE	CONC UNIT	LOT #	RATE	UNIT	TIMING	TIM#
1								T1 AT THE BEGINNIGN OF FEBRUARY	
	A	STEWARD (WG 30 PC)	WG	30.00 %		3.750000	GAL	2015	01
								T1 AT THE BEGINNIGN OF FEBRUARY	
	B	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250000	PMV	2015	01
	C	STEWARD (WG 30 PC)	WG	300.00 GKG		3.750000	GAL	T2 07-10 DD SPRAY INTERVAL	02
	D	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250000	PMV	T2 07-10 DD SPRAY INTERVAL	02
	E	LASER (SC 480.00 G/L)	SC	480.00 GL		12.000000	GAL	T3 07-10 DD SPRAY INTERVAL	03
	F	LASER (SC 480.00 G/L)	SC	480.00 GL		12.000000	GAL	T4 07-10 DD SPRAY INTERVAL	04
	G	ALTACOR (WG 35 PC)	WG	35.00 %		4.200000	GAL	T5 07-10 DD SPRAY INTERVAL	05
	H	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250000	PMV	T5 07-10 DD SPRAY INTERVAL	05
	I	ALTACOR (WG 35 PC)	WG	35.00 %		4.200000	GAL	T6 07-10 DD SPRAY INTERVAL	06
	J	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250000	PMV	T6 07-10 DD SPRAY INTERVAL	06
	K	AFFIRM (SG 0.95 PC)	SG	0.95 %		1.425000	GAL	T7 07-10 DD SPRAY INTERVAL	07
	L	BREAKTHRU S240 (EC 765.00 G/L)	EC	240.00 GL		200.000000	GAH	T7 07-10 DD SPRAY INTERVAL	07
	M	AFFIRM (SG 0.95 PC)	SG	0.95 %		1.425000	GAL	T8 07-10 DD SPRAY INTERVAL	08
	N	BREAKTHRU S240 (EC 765.00 G/L)	EC	240.00 GL		200.000000	GAH	T8 07-10 DD SPRAY INTERVAL	08
	O	DELFIN (B. THURINGENSIS 6,4 PC)	WG	6.40 %		128.000000	GAH	T9 07-10 DD SPRAY INTERVAL	09
	P	DELFIN (B. THURINGENSIS 6,4 PC)	WG	6.40 %		128.000000	GAH	T10 07-10 DD SPRAY INTERVAL	10
	Q	STEWARD (WG 30 PC)	WG	300.00 GKG		3.750000	GAL	T11 07-10 DD SPRAY INTERVAL	11
	R	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250000	PMV	T11 07-10 DD SPRAY INTERVAL	11
	S	STEWARD (WG 30 PC)	WG	300.00 GKG		3.750000	GAL	T12 07-10 DD SPRAY INTERVAL	12
	T	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250000	PMV	T12 07-10 DD SPRAY INTERVAL	12
								T13A APPLY ONLY IF NEEDED FOR	
	U	DELFIN (B. THURINGENSIS 6,4 PC)	WG	6.40 %		128.000000	GAH	END SEASON(FOR MEDIUM INFEST.)	13
								T13B APPLY ONLY IF NEEDED FOR	
	V	LASER (SC 480.00 G/L)	SC	480.00 GL		12.000000	GAL	END SEASON(FOR STRONG INFEST.)	14
800	A	FARMER STANDARD				0.000000	GAL	FARMER STANDARD	15
900	A	UNTREATED CHECK	NA	0.00 GL		0.000000	NA	UNTREATED TIMING (FP)	00

Protocol EMA-15-400

Country	n. trials
Greece	2
Italy	2
Spain	2

ESP-15-400 / ESG-15-605

TRIAL #:	ES 605/15/01 ESI 03	ALTERNATE ID#:	ESG-15-605
PROTOCOL #:	ES 605/15/01	ALTERNATE ID#:	EMA-15-400
CREATED BY:	ES RUBIOA		
CREATED:	02/19/2015	REVISED:	07/24/2015
COMPLETED:	NOT COMPLETED		
TITLE:	Validation of IRM strategy for Tuta control / Greenhouse TOMATO (Tuta absoluta)		
COORDINATOR:	IT AB Andrea Bassi		
TRIAL TYPE:	INSECTICIDE OR INSECT GROWTH REGULATOR		
RESEARCHER:	VICENTE QUINTO		
CONFIDENCE:	TO BE SELECTED		
REPORTED BY:	ES Contractor Daye And Adolfo Rubio		
COOPERATOR:	DAYE Desarrollo Agrícola		
DATA SOURCE:	IN-HOUSE		
LOCATION:	Tomato 2nd trial		
LOCATION TYPE:	GREENHOUSE STUDY		
CITY:	CAÑADA DE GALLEGO	STATE:	MURCIA, REGION DE
COUNTY:	MAZARRÓN	ZIP:	30876
COUNTRY:	SPAIN		
ALTITUDE:	43.00 M	LATITUDE:	N 37:33:47.0300
		LONGITUDE:	E 1:33:11.0200
WEATHER SITE:	AL62 -- MAZARRÓN		
DISTANCE TO TRIAL:	2110.0 M		

ESP-15-400 / ESG-15-604

TRIAL #:	ES 604/15/01 ESI 03	ALTERNATE ID#:	ESG-15-604
PROTOCOL #:	ES 604/15/01	ALTERNATE ID#:	EMA-15-400
CREATED BY:	ES RUBIOA		
CREATED:	03/09/2015	REVISED:	07/24/2015
COMPLETED:	NOT COMPLETED		
TITLE:	OFFICIAL TRIAL No. 15049 SO Validation of IRM strategy for Tuta control / Greenhouse TOMATO (Tuta absoluta)		
COORDINATOR:	IT AB Andrea Bassi		
TRIAL TYPE:	INSECTICIDE OR INSECT GROWTH REGULATOR		
RESEARCHER:	Salvador Olivares Palmero		
CONFIDENCE:	HIGH CONFIDENCE IN TRIAL DATA		
REPORTED BY:	ES Contractor Anadiag And Adolfo Rubio		
COOPERATOR:	Jesús Escámez Gallurlt		
DATA SOURCE:	IN-HOUSE		
LOCATION:	Finca Los Cazadores		
LOCATION TYPE:	GREENHOUSE STUDY		
CITY:	Níjar	STATE:	ANDALUCIA
COUNTY:	Almería	ZIP:	04117
COUNTRY:	SPAIN		
ALTITUDE:	66.62 M	LATITUDE:	N 36.839369
		LONGITUDE:	W 2.169595

ESP-15-400 / ESG-15-604

MoA applications

Data Applications

15-feb	21-feb	28-feb	07-mar	14-mar	21-mar	01-abr	10-abr	20-abr	01-may	08-

FP. TRT#	OPT. TRT#	PART	TREATMENT COMPONENT	FORM TYPE	CONC UNIT	LOT #	RATE	UNIT	TIMING
0001	1	A	STEWARD (WG 30 PC)	WG	30.00 %		3.750	GAL	T1 AT THE BEGINNIGN OF FEBRUARY 2015
		B	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250	PMV	T1 AT THE BEGINNIGN OF FEBRUARY 2015
		C	STEWARD (WG 30 PC)	WG	300.00 GKG		3.750	GAL	1. 07-10 DD SPRAY INTERVAL
		D	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250	PMV	1. 07-10 DD SPRAY INTERVAL
		E	SPINTOR (SC 480 GL)	SC	480.00 GL		12.00	GAL	2. 07-10 DD SPRAY INTERVAL
		F	SPINTOR (SC 480 GL)	SC	480.00 GL		12.00	GAL	3. 07-10 DD SPRAY INTERVAL
		G	ALTACOR (WG 35 PC)	WG	35.00 %		4.200	GAL	4. 07-10 DD SPRAY INTERVAL
		H	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.25	PMV	4. 07-10 DD SPRAY INTERVAL
		I	ALTACOR (WG 35 PC)	WG	35.00 %		4.200	GAL	5. 07-10 DD SPRAY INTERVAL
		J	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.25	PMV	5. 07-10 DD SPRAY INTERVAL
		K	AFFIRM (SG 0.95 PC)	SG	0.95 %		1.42	GAL	6. 07-10 DD SPRAY INTERVAL
		L	BREAKTHRU S240 (EC 765.00 G/L)	EC	240.00 GL		200.000	GAH	6. 07-10 DD SPRAY INTERVAL
		M	AFFIRM (SG 0.95 PC)	SG	0.95 %		1.42	GAL	7. 07-10 DD SPRAY INTERVAL
		N	BREAKTHRU S240 (EC 765.00 G/L)	EC	240.00 GL		200.00	GAH	7. 07-10 DD SPRAY INTERVAL
		O	TUREX (WP 2.5 PC)	WP	25.00 GKG		9.60	GAL	8. 07-10 DD SPRAY INTERVAL
		P	TUREX (WP 2.5 PC)	WP	25.00 GKG		9.60	GAL	9. 07-10 DD SPRAY INTERVAL
		Q	STEWARD (WG 30 PC)	WG	300.00 GKG		3.75	GAL	10. 07-10 DD SPRAY INTERVAL
		R	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250	PMV	10. 07-10 DD SPRAY INTERVAL
		S	STEWARD (WG 30 PC)	WG	300.00 GKG		3.750	GAL	6. 07-10 DD SPRAY INTERVAL
		T	CODACIDE (EC 95.00 PC)	EC	95.00 %		0.250	PMV	11. 07-10 DD SPRAY INTERVAL
		U	TUREX (WP 2.5 PC)	WP	25.00 GKG		2.00	KAH	7A APPLY ONLY IF NEEDED FOR END SEASON(FOR MEDIUM INFEST.)
		V	SPINTOR (SC 480 GL)	SC	480.00 GL		12.00	GAL	7B APPLY ONLY IF NEEDED FOR END SEASON(FOR STRONG INFEST.)

Farmer standard

Data Applications

18-feb		07-mar	15-mar	01-abr	20-abr	04-may	10-may

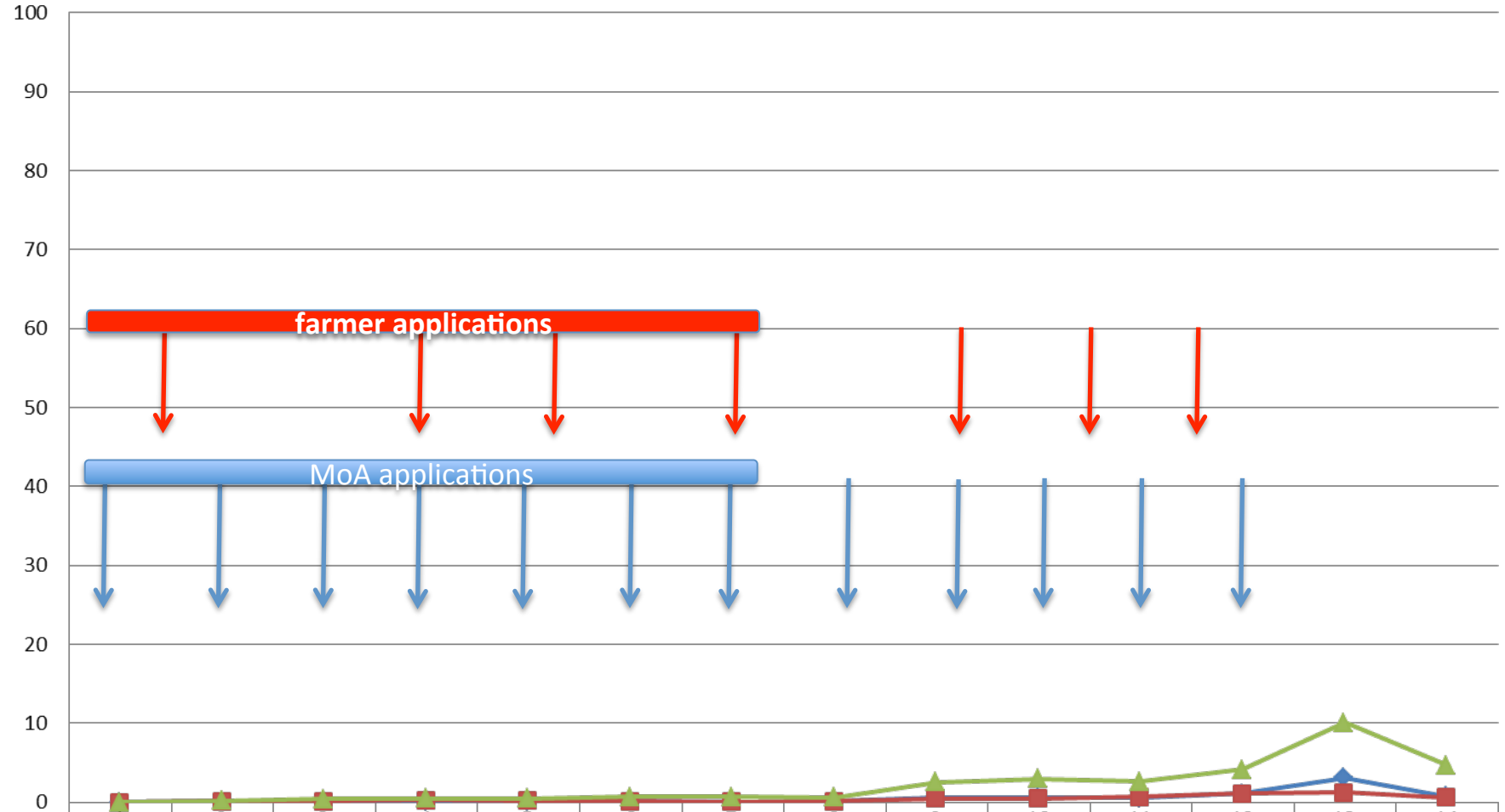
FP. TRT#	OPT. TRT#	PART	TREATMENT COMPONENT	FORM TYPE	CONC UNIT	LOT #	RATE	UNIT	TIMING
0001	1	A	ALTACOR (WG 35 PC)	WG	35.00 %		4.2	GAL	6 APPLICATIONS
	2	A	DIPEL DF (WG 3.2 P/P)	WG	32,00 GKG		0.5	KAH	1 APPLICATION ULTIMATE APPLICATION

Dipel DF = Bacillus Thurigiensis Kurstaki 32% (32 mill.de U.I./G)WG P/P from Kenogard

ESP-15-400 / ESG-15-604

Trial	ESG-15-604
Protocol	ESP-15-400

% leaf area damaged / 1 leaf

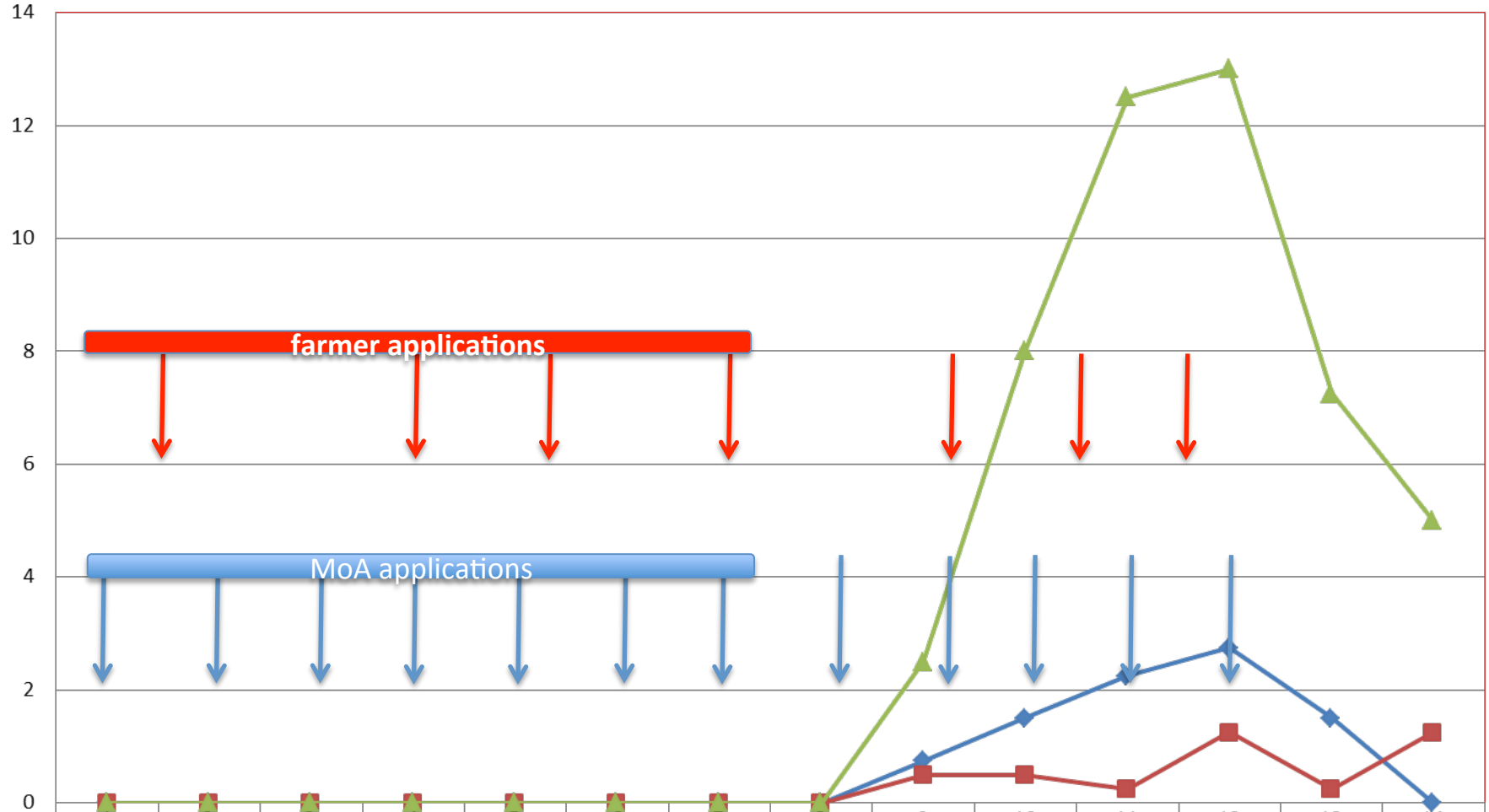


	1	2	3	4	5	6	7	8	9	10	11	12	13	14
MOA	0,0050	0,1400	0,1600	0,0950	0,1350	0,1100	0,0450	0,1250	0,6100	0,6350	0,5600	1,0850	3,0900	0,7800
STANDARD	0,0050	0,1250	0,1158	0,2750	0,2050	0,1300	0,0750	0,1450	0,4750	0,4600	0,6800	1,1000	1,2500	0,6400
Untreated	0,0200	0,1700	0,4250	0,5050	0,4550	0,6650	0,6900	0,5900	2,5450	2,9550	2,6000	4,1550	10,0500	4,7000

ESP-15-400 / ESG-15-604

Trial	ESG-15-604
Protocol	ESP-15-400

nº of fruits damaged



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
MOA	0,000	0,000	0,000	0,000	0,000	0,00	0,00	0,00	0,75	1,50	2,25	2,75	1,50	0,00
STANDARD	0,000	0,000	0,000	0,000	0,000	0,00	0,00	0,00	0,50	0,50	0,25	1,25	0,25	1,25
Untreated	0,000	0,000	0,000	0,000	0,000	0,00	0,00	0,00	2,50	8,00	12,50	13,00	7,25	5,00

Small Plot trials - Conclusions

- Resistance issue to chlorantraniliprole widely spread in Sicily, including Vittoria. Sensitivity still OK in other areas of Italy (data not presented).
- Although Diamide Resistance is present also in Crete (lab data, Ierapetra), diamides sensibility seems to provide standard performance in these trials.
- Sensitivity to diamides still very good in Spanish trials
- Efficacy of different MoA: only Indoxacarb+Codacide, spinosad and emamectine can provide > 90% of efficacy (Sicily), and should be the corner stones of the IRAC anti-resistance program against Tuta.
- Cyazypyr efficacy also was eroded, even if not as much as Chlorantraniliprole, but with differences between populations. Very fragile balance.
- Recomendation: warning on the labels about use of Cyazypyr against Tuta resistant populations to Diamides?

Large Plot trials - Conclusions

- In our trials IRAC program is working well, even under probable resistance situations (Italy). In spite of this a decrease of the efficacy is seen in correspondence of the use of chlorantraniliprole in the program.

- In a resistance situation (*e.g.* Sicily, Crete) the advice is to suspend the use of Diamides until sensitivity is restored (lab. assays).

- Where resistance is not detected still a good fit of Diamides in the correct way: promote IRAC resistance program.

- Repeated and exclusive use of diamides seems quite common in Spain: potentially high-risk situation if not discontinued. Same for other tomato production area across the Mediterranean.

Summary points

- IRM (reasoned MoA alternation) is not yet an integral part of IPM.

- In the Med. basin, for *T. absoluta* control, farmers so far could rely on 4 insecticidal MoA with medium to high efficacy. *They're seriously risking to lose a key one (MoA 28) if product misuse should continue*.

- Must break the directional selection of resistance alleles within the *T. absoluta* populations to avoid the fixation of resistant homozygous phenotypes, via extended adoption of MoA alternation and consistent IPM strategies.

John’s Slides

Lepidoptera Working Group
Company Team Members

10 Executive Company Members Represented

NAMES	COMPANY
Adeline Bertrand, Sebastian Coggiol	ADAMA
Werner Heck	BASF
Nigel Godley, Ralf Nauen	Bayer
Jim Dripps, Maria Torne	Dow
Luis Teixeira, John Andaloro, Andrea Bassi	DuPont
Eric Andersen	FMC
Nobuyuki Nonaka	Nihon Nohyaku
Brian Duggan	Nufarm
Robert Senn, Jan Elias	Syngenta
Daniel Zommick	Sumitomo

IRAC Tuta Task Team

Proposed

Overall Objective of the Tuta Task Team:

Provide cross-industry advice for best practice Tuta insect control in selected Europe, Middle East, and African countries by designing a regional Tuta pest control program that will be adapted, communicated and implemented locally to growers, influencers and the product supply chain.

IRAC Tuta Task Team – Leaders/Coordinators

Proposed

Individuals who will drive the Tuta Training process:
Creation of the Regional BMP's, Train The Trainers, Locally Adapt BMP's

Global:	**Core Team (Selected Executive Companies)**
Objective:	**Conduct regional Tuta IRM training session**
	Complete Tuta IRM BMP training package
	Achieve Industry Alignment
	Follow-through auditing of progress and issues
Regional:	**Company Reps (2-3 company members)**
Objective:	**Assist with regional training program**
	Liaison with country training teams
	Expert advisors to country trainers
Country:	**Company Rep/country + Key Officials/Influencers**
Objective:	**Coordinate/liaise with Industry expert influencers**
	Train-Communicate-Implement Tuta IRM BMP's
	Expert advisors

IRAC Tuta Task Team Attending Participants and Local Trainers

Organizations who should drive the local training and implementation process

IRAC Executive Companies

X ADAMA	? CHEMINOVA	? Nufarm
? BASF The Chemical Company	? FMC	X syngenta
? Bayer CropScience	? MONSANTO imagine	X SUMITOMO CHEMICAL
X DOW Dow AgroSciences	? Nihon Nohyaku	? VESTERGAARD IMPACTING PEOPLE
X DUPONT The miracles of science™		

Other Organizations

CropLife PHILIPPINES

Involved Distributors | Min of Ag | GH Experts

University Extension | Country Officials | Other Influencers | IPM Suppliers

IRAC

IRAC Tuta Task Team: Possible Countries Interested in the Tuta BMP Project

Existing Country Resistance Action Groups/ Country IRAC Groups In Tuta Project Geography

1	Spain	IRAC
2	France	CRAG
3	Italy	CRAG
5	Turkey	CRAG
6	Israel	CRAG
10	Morocco	CRAG
11	Rep S. A.	IRAC

IRAC Tuta Task Team
Possible 2016 Timeline of Events

Create a Global Core Team

Contact key players; ID Summit Venue; Set Mtg Date

Construct Tuta IRM BMP Training Package

Construct Tuta IRM BMP Training Package

May

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

June

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

July

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

August

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

September

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

October

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

November

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

December

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Tuta BMP Training Summit – Train the Trainers

Ensure local implementation process is active

2017: Audit progress and edit BMP if required

IRAC

IRAC Tuta Task Team Project

ADVANTAGES

- ✓ Plethora of training material and recommendations
- ✓ Enthusiastic local expert influencers & company reps
- ✓ Extensive field failures to motivate
- ✓ Opportunity to delay “R” in many countries

CHALLENGES

- ✓ Diverse countries with extreme varied expertise
- ✓ Long growing season - complex crop production system
- ✓ Some target countries
  - IRAC member companies not present (distributors)
  - Inadequate training network
  - Insufficient rotation product partners
- ✓ Changing grower habits (how to adopt IPM, IRM)