

Etude de l'efficacité de deux insecticides non homologués (Sulfoxaflor et Diflubenzuron) pour la lutte contre la cochenille du Figuier de Barbarie

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Effectiveness study of two unregistered insecticides (Sulfoxaflor and Diflubenzuron) against *mealybugs* of prickly pears

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Outline

Introduction

Importance of Opuntia

Objectives of the study

Materials & Methods

-  Efficiency trials

-  Field treatments

-  Sampling

-  Extraction and Analysis

Results & discussions

Conclusion & perspectives

INTRODUCTION

Cactacea

☂️ **6** Origin: native in America, but worldwide dissemination

☂️ About 1600 species,

☂️ The most known genus:

☂️ **Opuntia** Species: *Opuntia ficus indica*

Cultivated in more than 20 countries

☂️ Prickly pear trees were found along the Lebanese coast, especially in the northern and southern parts

☂️ up to 900m of altitude.



INTRODUCTION

Astonishing plant

- ☁ Ability to reproduce directly from pad to new plant.
- ☁ A low cost to establish and to maintain
- ☁ A drought tolerant and adaptable to a wide variety of soils and climates
- ☁ A long live plant,
- ☁ A producer of a large biomass, instant availability
- ☁ An evergreen plant: almost the only green plant in arid environment and prolonged drought



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Opuntia – Prickly Pear


Ⓟ Socio - Cultural values:

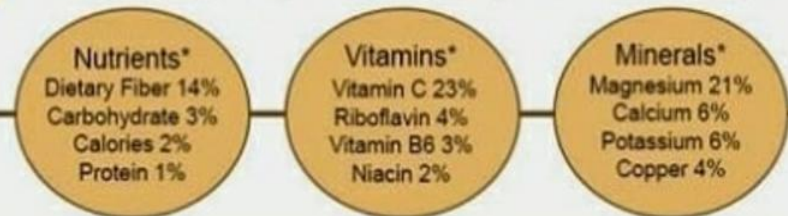
- Ⓜ Not an expensive production, doesn't require a lot of maintenance and attention,
- Ⓜ considered as a new source of income to small farmers
- Ⓜ contribute to the biodiversity of the farms
- Ⓜ Ideal for agricultural and economic development in areas affected by desertification and climate change

Ⓟ Nutritional values:

- Ⓜ High content of nutrient, vitamin, biochemical components, especially phytochemicals,
- Ⓜ high anti-oxidant properties such as vitamin C, flavonoids and betalains

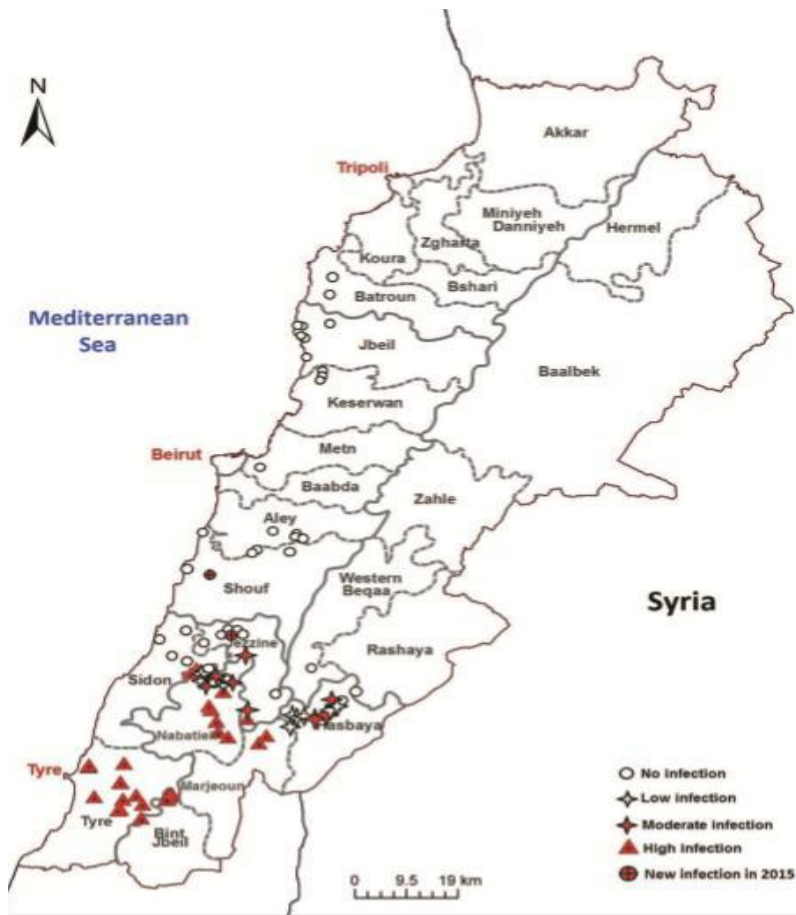
Health Benefits of Prickly Pear

- 
- Ⓜ Boosts immune system
 - Ⓜ Helps in managing weight
 - Ⓜ Aids in preventing cancer
 - Ⓜ Helps to prevent dental issues
 - Ⓜ Gives relief from arthritis, gout & muscle strain
 - Ⓜ Reduces appearance of premature aging symptoms
 - Ⓜ Helps to prevent atherosclerosis & coronary heart diseases
 - Ⓜ Reduces risk of age-related bone disorders like osteoporosis
 - Ⓜ Aids in eliminating constipation, bloating & gastrointestinal issues
 - Ⓜ Beneficial in improving vision & reducing risk of macular degeneration



*% Daily Value per 100g. For e.g. 100g of prickly pears (raw) provide 23% of daily requirement of vitamin C

Dactylopius opuntiae



Map of distribution of *Dactylopius opuntiae* (Cochineal) in Lebanon and level of infestation on *Opuntia ficus-indica* (L.) Mill. for 2014 and 2015 (Moussa *et al*, 2017)

Morphology of *D. opuntiae*

Egg of *D. opuntiae*



L1 of *D. opuntiae*



Wax secretion of *D. opuntiae*



L2 of *D. opuntiae*

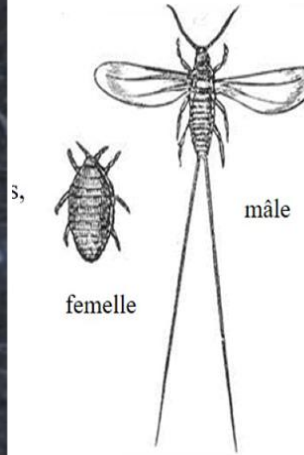


Morphology of *D. opuntiae*

Adult of *D. opuntiae* (female)



Adult of *D. opuntiae* (male)



Damaged plant by *D. opuntiae*



Situation/Problems

Despite the many damage caused by *Dactylopius opuntiae* on the prickly pear:

- ☁️ **No insecticide** has been registered so far in Lebanon/Index phytosanitaire/ACTA,
- ☁️ Random use of pesticides by the farmers,
- ☁️ Lack of surveying of their residues,
- ☁️ **No MRLs list**,
- ☁️ No evaluation of Pre-harvest Interval,
- ☁️ No risk assessment study (Human Health),
- ☁️ Technical Barrier Trade (TBT) & Sanitary and Phytosanitary (SPS) to trade exchange .

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☁ Conclusion & perspectives

Objectives

Efficiency

Sampling

Dissipation

Data base

Contribute to the
establishment of
norm, MRLs

ntiae

ers and
minimize

of
orders.

Unregistered pesticides - MRLs



↻ Unregistered pesticides.

↻ absence of MRLs.

↻ Minor crops, (Consumption < 0.5%)

Ⓟ Codex Alimentarius

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FI 0356 - Prickly pear

There are currently no MRLs for the selected commodity.

[Pesticides](#)

[Functional Classes](#)

[Commodities](#)

Assorted Tropical and Sub-Tropical Fruit - Inedible Peel

Unregistered pesticides - MRLs

- ↻ Minor crops
- Ⓟ European Commission



PLANTS

EU Pesticides database

European Commission > Food Safety > Plants > Pesticides > Pesticides Database

HEALTH FOOD ANIMALS **PLANTS**

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Prickly pears/cactus fruits

Part A - Main product of the group or subgroup

Code number	Name	Scientific name
0162040	Prickly pears/cactus fruits	Opuntia ficus-indica
Part of the product to which MRLs apply		

Footnotes

No scientific data Ⓟ MRL set at detection limit
Ⓟ Technical barrier to commercialization Ⓟ SPS

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Efficiency trials

A1. Pesticide treatments *in vivo*

1. Water

2. Diflubenzuron

3. Sulfoxaflor

4. Sulfoxaflor + Mineral Oil

5. Diflubenzuron + Mineral Oil



Dissipation trials

A2. Field Pesticide treatments

1. Diflubenzuron (**contact**)
2. Diflubenzuron Mineral Oil
3. Sulfoxaflor (**systemic**)
4. Sulfoxaflor Mineral Oil



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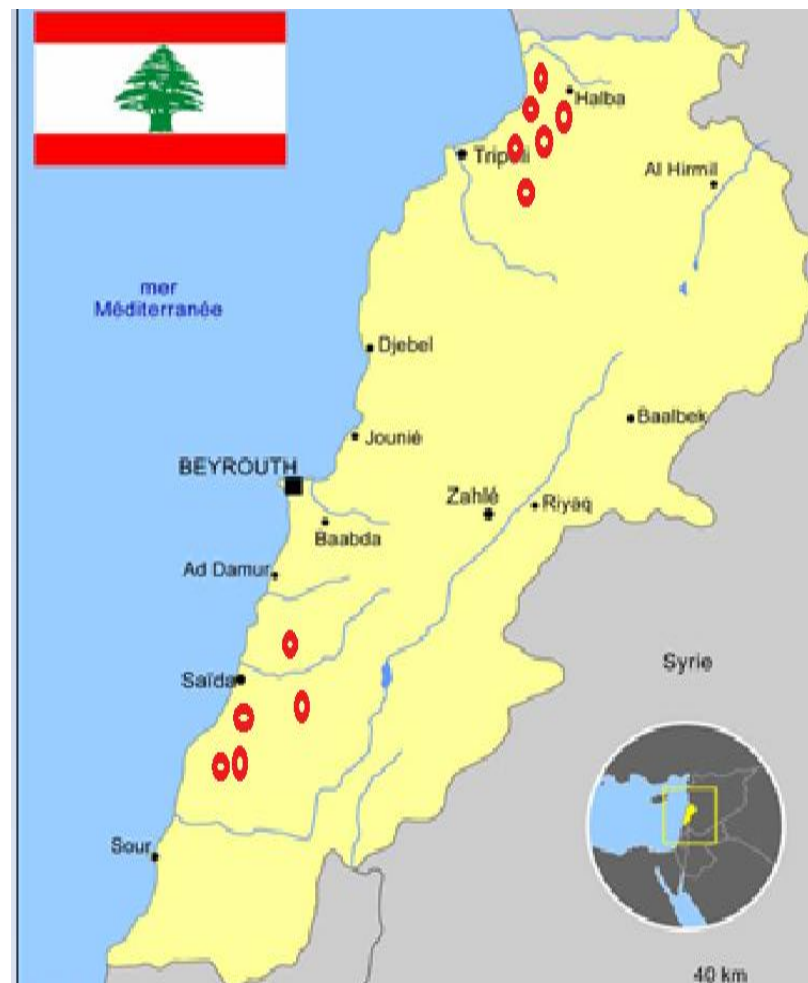
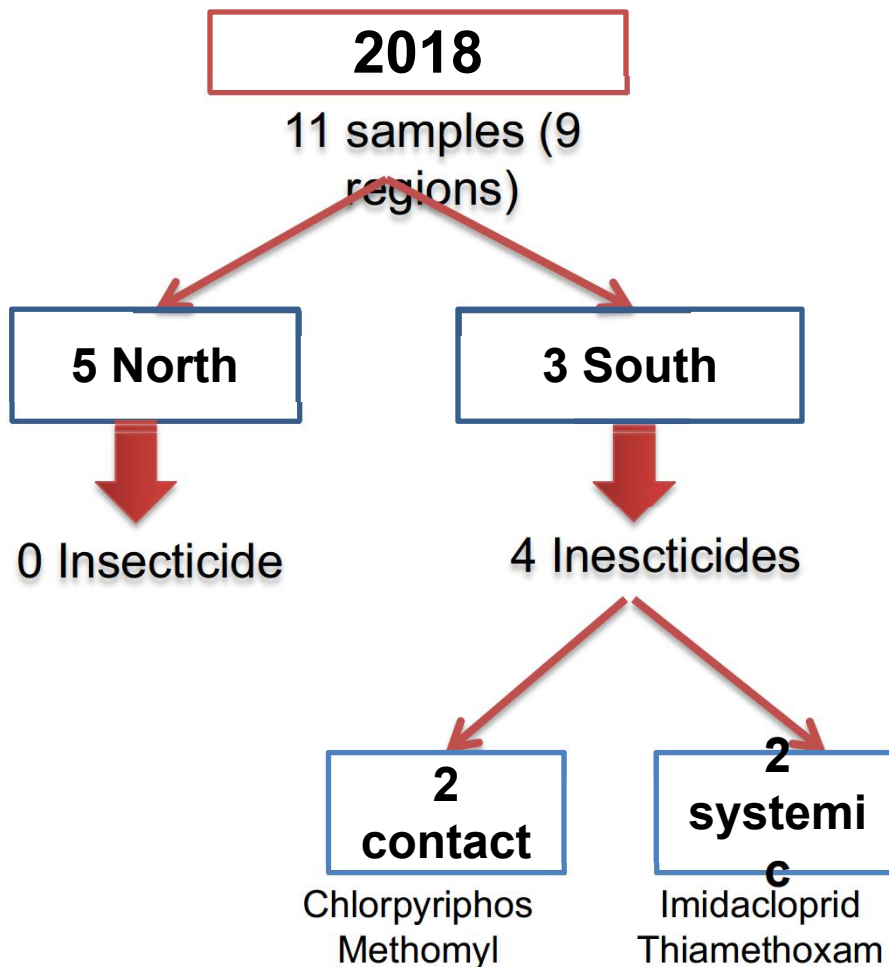
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Material & Methods

B. Sampling from the Lebanese market



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Extraction & Analysis

Extractions performed according to **QuEChERS EN 15662**
(*Anastassiades M.*)

Weight 10g
Sample

10ml
Acetonitrile

Vortex 1min

4g MgSO_4 +
1g NaCl

0.15g MgSO_4 +
0.025g PSA +
0.05g C18 +
0.05g GCB

1ml
supernatant

Centrifuge 3000
rpm for 10min

Vortex 30sec

Centrifuge
3000 rpm for 1
min

Filtering with
PTEE (0.2 μm)
LCMSMS

LCMSMS: Thermo Scientific™ Q
Exactive™ Hybrid Quadrupole-Orbitrap
Mass Spectrometer



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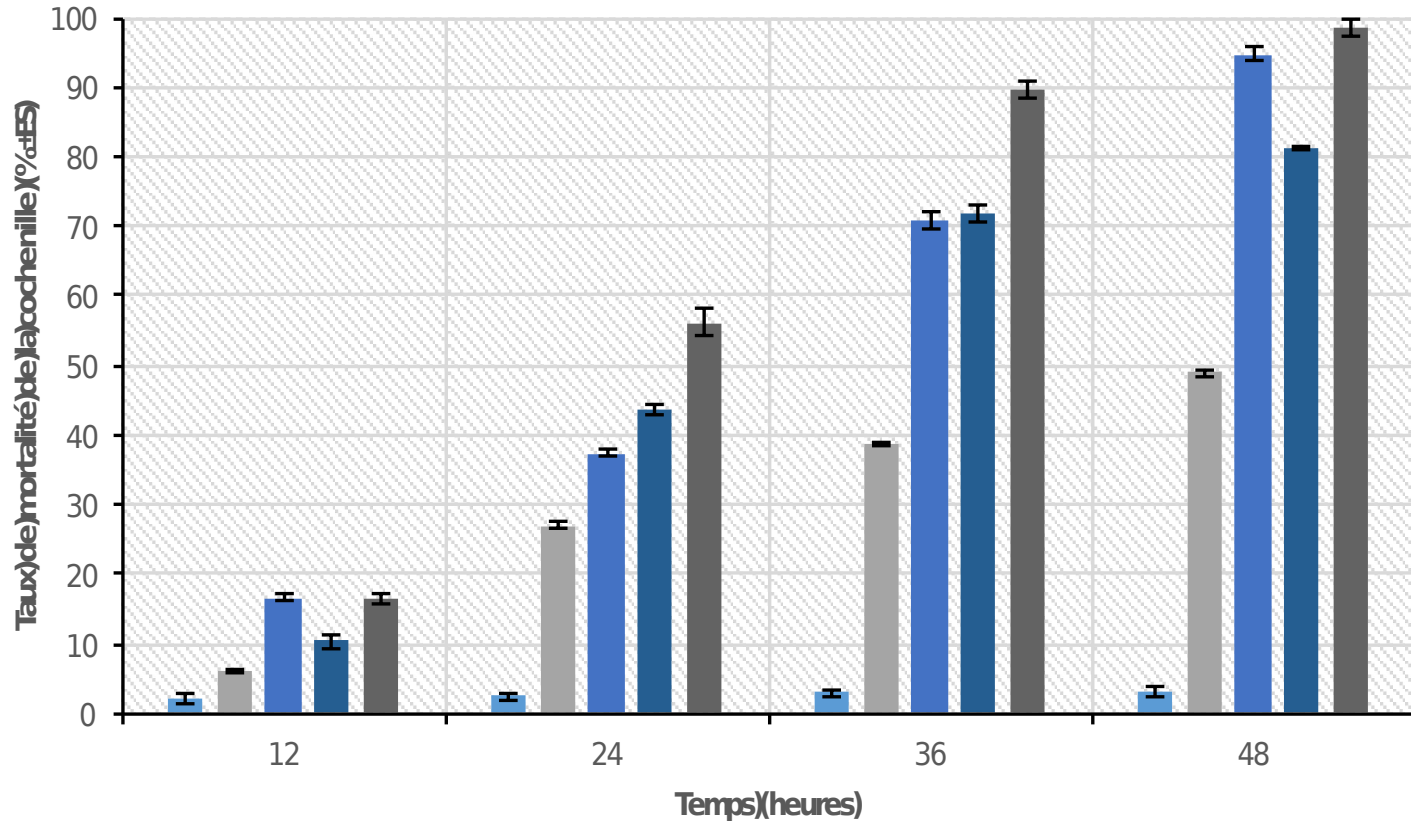
☁ Extraction and Analysis

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Results & discussions

A. Efficiency results



■ Eau ■ Diflubenzuron ■ Diflubenzuron+Huile)minérale ■ Sulfoxaflor ■ Sulfoxaflor+Huile)minérale
Mean mortality of cochineal (% ± ES) after 12, 24, 36 and 48 hours of treatment with diflubenzuron and sulfoxaflor. Results represent the efficiency of the 5 treatments; average of 4 replicates. The values are significant $P \leq 0.05$.

Results & discussions

A. Efficiency results

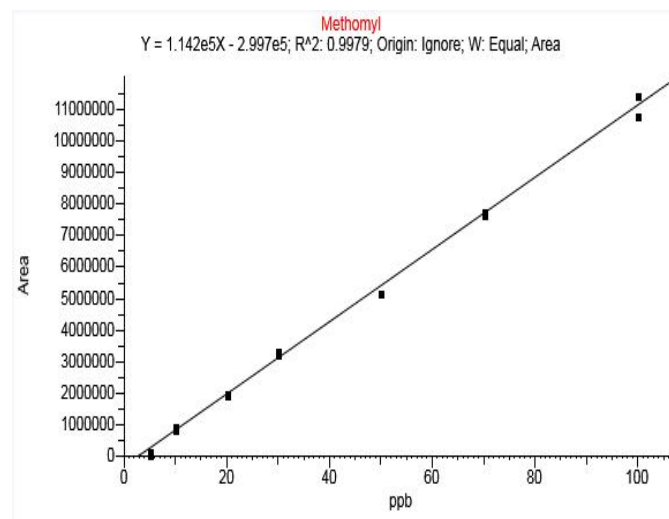
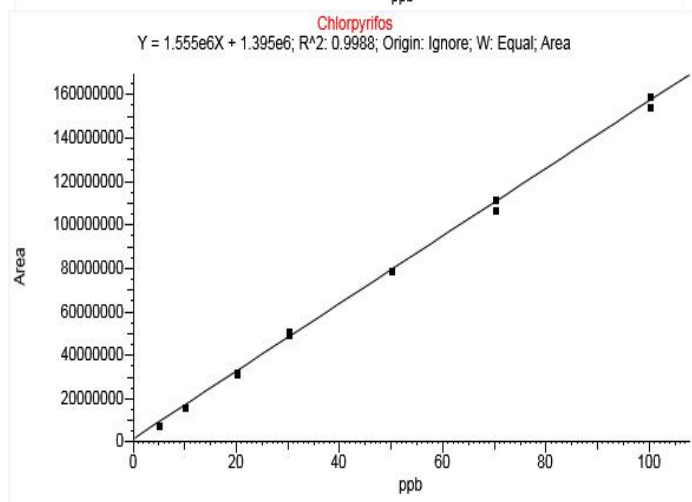
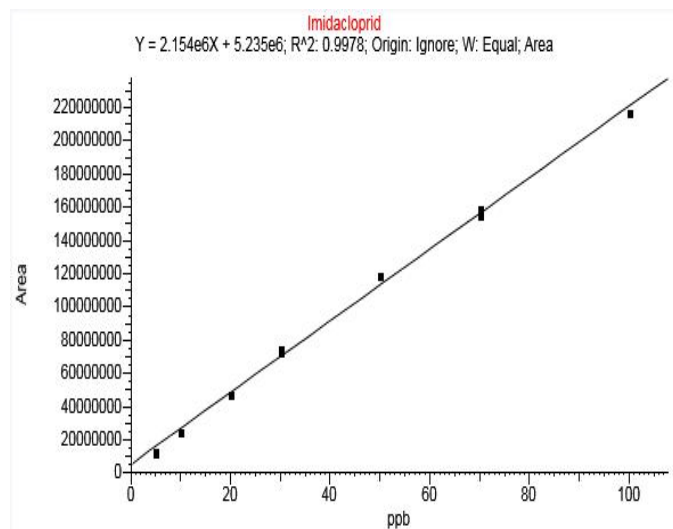


Cladodes infected with mealybugs before and after spraying Sulfoxaflor + mineral oil

Results & discussions

Standards calibration curves:

7 levels of concentrations 5, 10, 20, 30, 50, 70 and 100 ppb

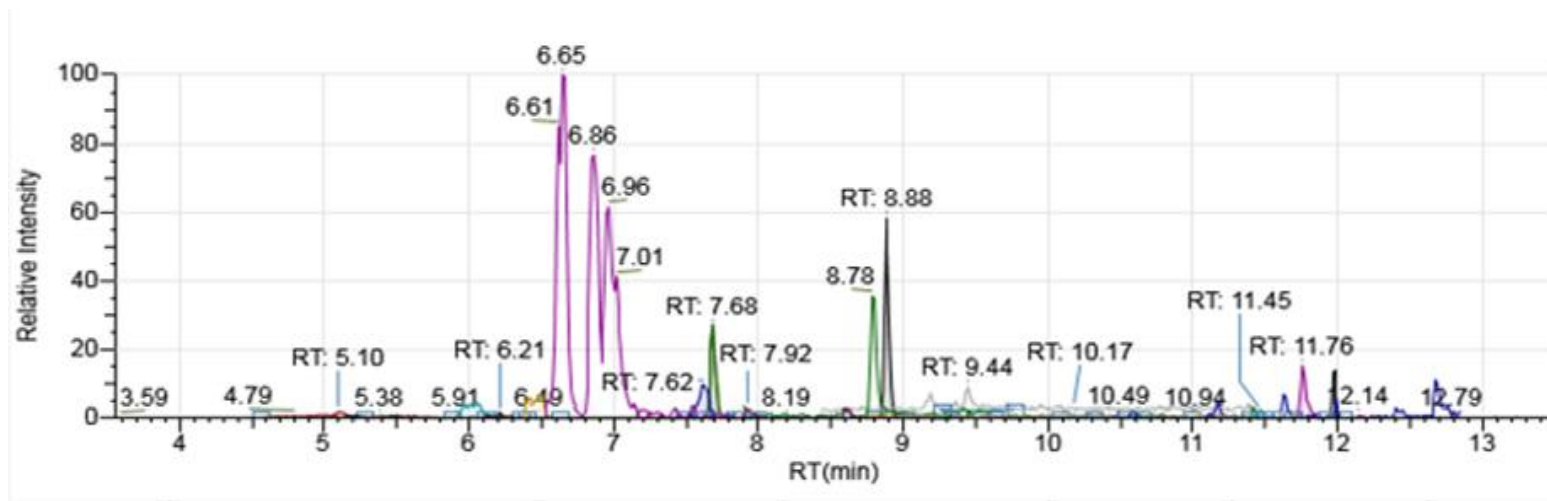


Results & discussions

B. Pesticide detected in the market samples (vs MRLs)

Pesticides	Families	MRL *(mg/kg)	Quantity detected (ppb)
Chlorpyrifos	Organophosphorous	0.05	19.05 <
Methomyl	Carbamate	0.01	19.96 ~
Imidacloprid	Neonicotinoid	0.05	61.71 ~
Thiamethoxam	Neonicotinoid	0.01	79.48 >

* EU Pesticides database (LOD)



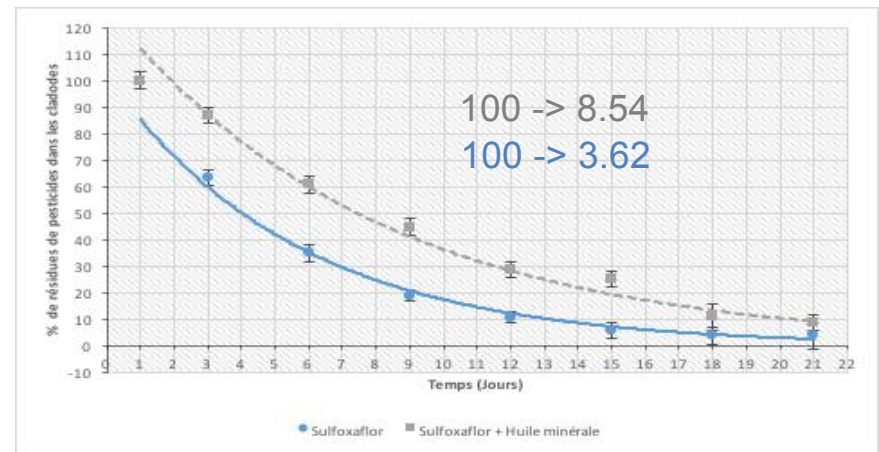
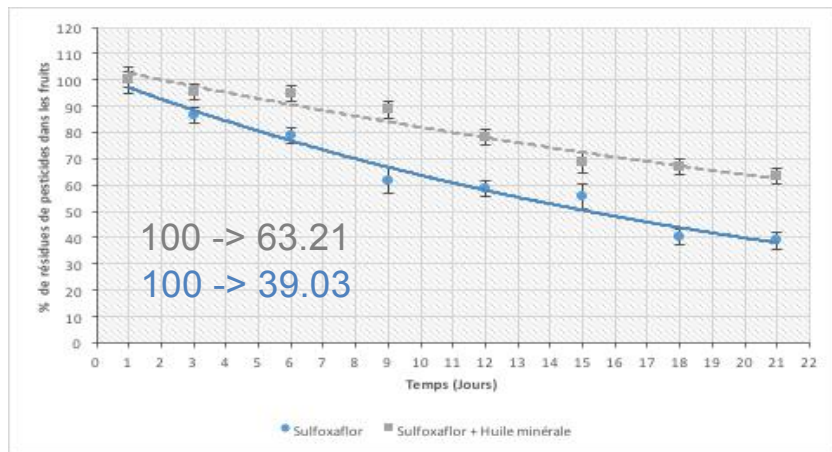
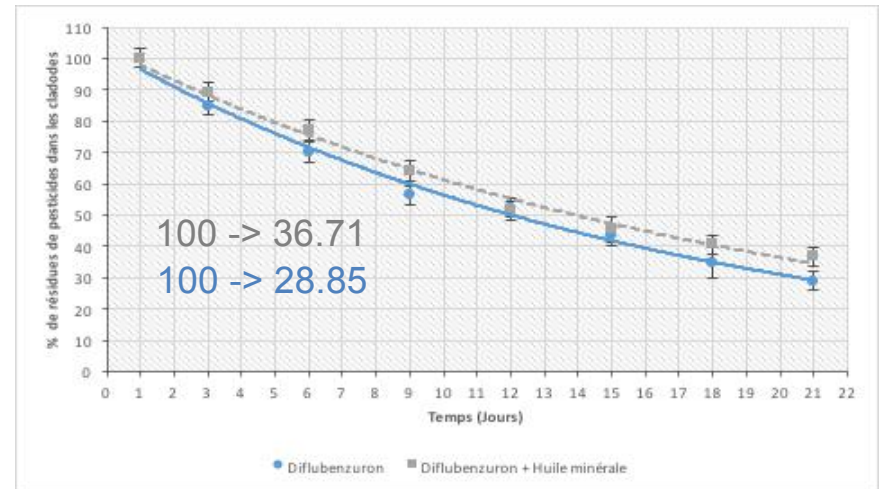
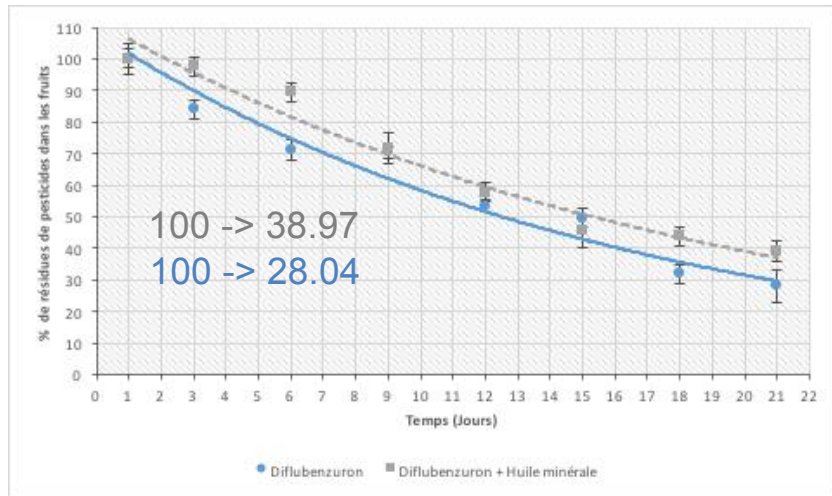
Results & discussions

B. Samples from the Lebanese Market

Family	Molecules	Sampling (2018)									T*	
		A	B	C	D	E	F	G	H	I		
Neonicotinoid	Imidacloprid	61.7 1	-					-	-		-	1
Neonicotinoid	Thiamethoxam	79.4 8	-	-	-	-	-	-	-	-	-	1
Organophosphorou s	Chlorpyrifos	-	16. 2	19.05				-	-	-	-	2
Carbamate	Methomyl	-	-		19.69						-	1
Number of insecticides/sample		2	1	1	1							
* Total Nb of Samples												

Results & discussions

D. Dissipation rate of pesticide residues:



Results & Discussion

☁️ Diflubenzuron residues after **24 hours** and 21 days of treatment

Matrix	Pesticides	Concentration $\mu\text{g}/\text{kg}$ (after 24hrs)	Dissipation rate (%)	Residues (%)
FRUIT	Diflubenzuron	767.93	71.95	28.04
	Diflubenzuron + mineral oil	383.11	61.03	38.97
CLADODE	Diflubenzuron	2694.95	71.15	28.85
	Diflubenzuron + mineral oil	1685.69	63.29	36.71

For both fruits and cladodes (24 hrs):

Diflubenzuron residues are higher when the insecticide is applied **alone** than mixed with **mineral oil**.

Spraying droplets content of the diflubenzuron and diflubenzuron with mineral oil

Results & Discussion

☁️ Diflubenzuron residues after **24 hours** and 21 days of treatment

Matrix	Pesticides	Concentration $\mu\text{g}/\text{kg}$ (after 24hrs)	Dissipation rate (%)	Residues (%) (after 21 days)
FRUIT	Diflubenzuron	767.93	71.95	28.04
	Diflubenzuron + mineral oil	383.11	61.03	38.97
CLADODE	Diflubenzuron	2694.95	71.15	28.85
	Diflubenzuron + mineral oil	1685.69	63.29	36.71

Level of insecticide residues in cladodes was always higher than in fruit after 24 hrs:

Diflubenzuron is a contact insecticide: the deposition of the active molecule is more important on the surface of the cladodes whereas the small and circular shape of the fruits retains less.

Results & Discussion

☁️ Diflubenzuron residues after 24 hours and **21 days** of treatment

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Level of insecticide residues remains higher when mixed with mineral oil for both matrices **after 21 days:**

Diflubenzuron ($\log K_{ow}$) = 3,89 :

Insecticide become more stable in the presence of the added mineral oil, thus protected against volatilization and / or photodegradation

Results & Discussion

☁ Sulfoxaflor residues after **24 hours** and 21 days of treatment

Matrix	Pesticides	Concentration µg/kg (after 24hrs)	Dissipation rate (%)	Residues (%)
FRUIT	Sulfoxaflor	7024.77	39.03	60.97
	Sulfoxaflor + mineral oil	7884.57	63.21	36.79
CLADODE	Sulfoxaflor	6232.43	3.62	96.38
	Sulfoxaflor+ mineral oil	7065.15	8.54	91.46

Level of insecticide residues are almost similar in fruit and cladode after 24 hrs:

Sulfoxaflor is a systemic insecticide

Results & Discussion

☁ Sulfoxaflor residues after 24 hours and 21 days of treatment

Matrix	Pesticides	Concentration µg/kg (after 24hrs)	Dissipation rate (%)	Residues (%)
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CLADODE	Sulfoxaflor	6232.43	96.38	3.62
	Sulfoxaflor+ mineral oil	7065.15	91.46	8.54

Level of insecticide residues in cladode was always less than in fruit after 21 days:

Sulfoxaflor ($\log K_{ow}$) = 0,802

Cladodes are more rich in water, the Sulfoxaflor hydrolysis is relatively faster than in fruits

Results & Discussion

☁ Sulfoxaflor residues after 24 hours and 21 days of treatment

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CLADODE	Sulfoxaflor	6232.43	96.38	3.62
	Sulfoxaflor+ mineral oil	7065.15	91.46	8.54

For both fruits and cladodes (21 days):

Sulfoxaflor residues are less when the insecticide is applied **alone** than mixed with **mineral oil** especially in fruits.

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Conclusion & perspectives

Efficiencies/Mortality:

☁ The sulfoxaflor proved more effective than diflubenzuron, **48 hrs** 81% against 49% of the population, respectively.

☁ Mixed with Mineral Oil: enhanced their respective efficiencies **48 hrs:**

Mortality exceeded 90%

Conclusion & perspectives

Pesticide Residues:

Residues	Diflubenzuron (contact, Kow 3.89)	Sulfoxaflor (Systemic, Kow 0.82)
24 hrs	Alone > Mixed Mineral Oil	Similar
	Fruits < Cladode	Similar
21 days	Alone < Mixed Mineral Oil	Alone < Mixed mineral Oil
	Fruits ~ Cladode	Fruits > Cladode

Recommendation

☁ More studies on Sulfoxaflor and Diflubenzuron are needed to:

📖 determine the half-life DT_{50}

📖 establish list for the **MRLs** according to an appropriate **PHI**

☁ 📖 Registrations → authorities
Our next research is to:

📖 prove the effectiveness of **other pesticides**,

📖 prove their **proper use** with **adequate doses** with less pesticide residues in fruits.

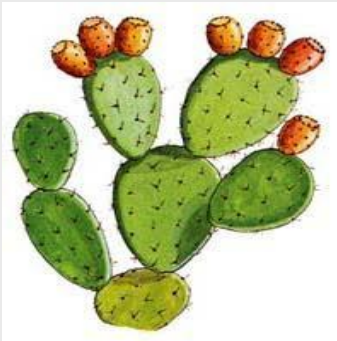
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Thanks for your Attention



Questions??

