METHOD TO STUDY THE REPELLENT, IRRITANT AND TOXIC EFFECTS OF ESSENTIAL OILS ON *BEMISIA TABACI* FOR A COMBINATION WITH INSECT PROOF NET

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Introduction

Bemisia tabaci, a vector of the tomato leaf curl virus (Fig1), is a serious problem in tomato production in many parts of the world. In tropical countries, the use of netting to protect horticultural crops is an effective and sustainable tool against Lepidoptera but not against small pests on the contrary to the Mediterranean region [1]. In fact the net mesh are bigger in tropical region because of the crop micro-climate. A previous study showed the efficiency of a repellent net impregnated with alphacypermethrin against the whitefly [2].

The need to reduce the use of pesticide and resistance in population brings up the issue of finding a natural alternative to alphacypermethrin. The objective of this study was to evaluate the repellent, irritant and toxic effects of 10 essential oils on *B. tabaci* adults in laboratory.

Fig 1. Tomato plant infested by *Bemisia tabaci*

Irritant and toxic effect

An essential oil is irritant to insects when it causes an oriented movement away after contact with the product. An essential oil is toxic when it causes the insect death after contact with the product. The aim of irritancy or toxicity is to reduce the risk for *B. tabaci* population to cross a treated net and so to prevent the virus transmission. A no-choice tube bioassay was used to evaluate the irritant and toxic effect of a net treated with an essential oil [2]. The toxicity was recorded just after the test and 24h later. The irritant effect was expressed as the insect crossing rate through the net.

Fig 2. assembly design

Material

- *B. tabaci* adults (age and sex mixed) from a laboratory strain
- Nets in polyethylene 40 mesh were provided by A to Z Textile Mills
- Essential oils were provided by institut de biomolecules Max Mousseron.

Fig 3. A dead *Bemisia tabaci* on a treated net

Method

- Samples of net were dipped in essential oil solutions at 0.01%, 0.1%, 1% or methanol (control)
- The net treated with essential oil was placed between both tubes (Fig 2)
- 50 insects placed in dark tubes were attracted by the light in the lighted tube
- Each dose of essential oil and a control were tested with 6 replicates
- Number of insects dead and alive were recorded after 4hrs
- The insects that crossed the net were collected on tomato leaves and the mortality rate was recorded after 24hrs (Fig 3).

Data analysis

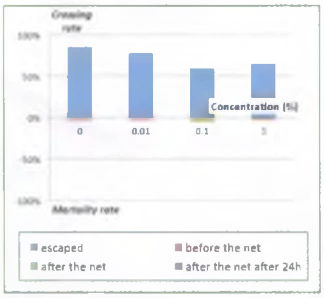
- Fisher test was used to compare the crossing rate and the mortality rate.

Results

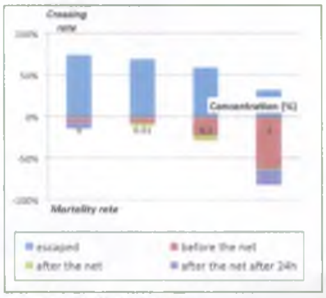
The bioassays of 10 essential oils showed that the responses varied according to oil type and dose. An oil can be irritant but not toxic (Tab 1). Lemongrass oil appeared to be the most toxic essential oil against *B. tabaci* while solidage was more repellent without toxicity (Tab 1,2,3). A 0.5% concentration for citronella, eucaplyptus and lemongrass could help to know if there is an irritant effect before a toxic response at 1%.

	Irritant effect	Toxic effect
Citronnella	+/-	+
Eucalyptus	0	0
Ginger	+	0
Lemon	+	0
Litsea	+/-	+
Lemongrass	+/-	++
Mint	0	0
Pepper	0	0
Solidage	++	0
Thyme	0	+/-

Tab 1. Result synthesis of the bioassays



Tab 2. Results for Solidage



Tab 3. Results for Lemongrass

Repellent effect

An essential oil has a repellent effect on insect when it causes an oriented movement away from the odour source. The modifying behaviour was expressed from a distance without there being a contact between the insect and the substance. The aim of the repellence is to decrease the risk that *B. tabaci* finds tomato plants thus preventing the virus transmission. To evaluate the repellent effect, we used a still-air vertical olfactometer. The repellent effect was expressed as the distance to essential oil [3].

Fig 4. olfactometer design

Material

- *B. tabaci* adults (age & sex mixed) from a laboratory strain
- Olfactometer, glass tubes (L 30 cm ; diam. 3 cm), were used under a extractor hood (Fig 4)
- Filter paper treated with essential oil was placed at the top of the tube
- A net with very fine mesh prevented the contact of insect with the essential oil

Method

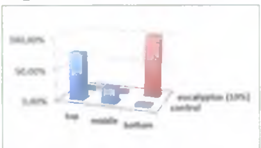
- Samples of filter paper (4 cm²) were treated with 40 µl of essential oil solution at 0.01%, 0.1%, 1% or ethanol (control)
- About 10 insects put in the low part of the tube were attracted by the light placed just over the tube
- There were 4 replications for each dose of essential oil and control
- After 1h the insect repartition was observed in three areas of the olfactometer.

Data analysis

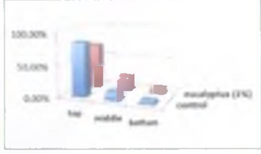
- A Fisher test was used to compare the insect distribution.

Result

The bioassays of 10 essential oils showed that the response varied according to oil type and dose (Tab 6). Citronella, Lemongrass, Litsea and Thyme oils appeared to be the most repellent essential oils against *B. tabaci* (Tab 4, 5). This olfactometer is adapted for screening, and it is used to test quickly large numbers of concentrations ,products and insects.



Tab 4. Repartition of B. tabaci in the olfactometer with eucalyptus oil at 10%



Tab 5. Repartition of *B. tabaci* in the olfactometer with eucalyptus oil at 1%

Essential oil	Repellent effect
Citronnella (*Cymbopogon flexuosus*)	++
Eucalyptus (*Eucalyptus globulus*)	+
Ginger (*Zingiber officinalis*)	+
Lemon (*Citrus limon*)	+
Lemongrass (*Cymbopogon citratus*)	++
Litsea (*Litsea cubeba*)	++
Mint (*Mentha pulegium*)	+
Pepper (*Piper nigrum*)	0
Solidage (*solidago canadensis*)	+
Thyme (*Thymus vulgaris*)	++

Tab 6. Analysis of the bioassay results

Conclusion

These bioassays showed that the three effects were dose dependent. But the effects appeared independent. So if one effect was showed for an oil It did not mean the oil would be another effect. For example an essential oil like mint can be repellent but not irritant so we could expect that the repellent mechanism is different from the irritant or toxic one.

Several essential oils or a combination with one repellent essential oil and one irritant could be an alternative to alphacypermethrin (Fig 5). The combination of two essential oils could have an effect from a distance repellent oil) and on contact (irritant oil) with *B. tabaci.*

Fig 5. Crop covered by a treated net in Africa.

References

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Cooperating institutions

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