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Acaricidal Activity of Aqueous Extracts against the mite of date palm *Oligonychus afrasiaticus* Meg (Acari: Tetranychidae)

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Abstract

The use of chemical products to fight against insects raises several concerns related to the environment, human health, non-target species and development of resistant pest populations. The use of bio-pesticides may reduce the risks of pests and safeguard biodiversity. This experiment was conducted with the objective to study the effect of aqueous plant extracts from the southeast region of Algeria (*Zygophyllum album* L, *Cotula cinerea* Del and *Limoniatrium guyonianum* Del) on the mortality of the date palm mite (*Oligonychus afrasiaticus*).

The trial was conducted at the Laboratory of Plant Protection of INRAA. The five doses (1%, 2%, 3%, 4%, and 5%) were tested on adults of phytophagous. The results show that the extracts of plants and *C. cinerea* and *L. guyonianum* do not show an effect on the pest. Unlike, *Z. album* showed a very significant effect on the mite by a mortality rate of 76%.

Keywords: Dust mite, biological control, bio-pesticide, *Zygophyllum album*, *Cotula cinerea*, *Limoniatrium guyonianum*, Southeast of Algeria.

1. Introduction

The date palm mite *Oligonychus afrasiaticus* (McGregor) (Acari: Tetranychidae) commonly known Boufaroua, is one of the four major pests of date palms. When present, it can cause very serious damage to fruits. Feeding on the immature green dates causes severe fruit scarring continue throughout the fruit growth stage, sometimes so badly that the dates turn brown and have a scabbed appearance. Mites feed by sucking the sap from the plant tissue dates.

Immediately after fruit set, mite start its oviposition activity, laid eggs hatch into larvae, which feed on the fruits that are later covered with a web retaining fine particles [1]. The presence of mites on dates is revealed by the existence of white or grayish silken webs. The attacks begin with the stem, and then win all the fruit. Following numerous punctures the epidermis green fruit is quickly destroyed. Infested dates surround themselves with a silky filament fabric which retains the sand raised by the wind and do not complete their maturation and harden with an early fruit drop. When present, it can cause very serious damage to fruits [2, 3].

In order to find a biological solution as a control to the problem caused by the date palm mite, *Oligonychus afrasiaticus* we will try to use some aqueous extracts from spontaneous plants in the region of southeastern of Algeria against this pest.

Materials and methods

Presentation of the Experimental Site:

The study was carried out between 2013 and 2014 in the region of Sidi Mehdi, which is a large part of the oasis of Oued Righ valley. The area of Oued Righ is a valley situated in the Northeast of the Algerian Sahara (Fig 1). It is a saharian region with a temperate winter (Fig. 2) and a hot summer. It covers a South-North axis whose latitude is 32°54' to 39°9' North and longitude 05°50' to 05°75' East [4].



Fig 1: Study site

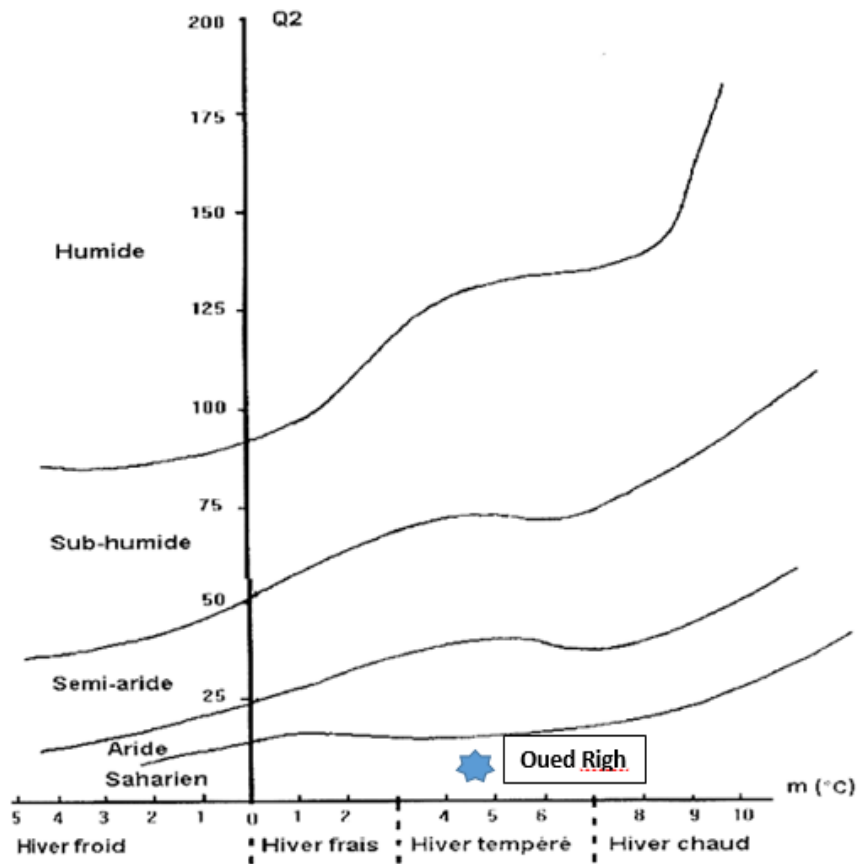


Fig 2: Climatic gramme of EMBERGER (2005-2014)

Sampling and rearing of *Oligonychus afrasiaticus* mite

Date fruits of Deglet Noor variety were used to assess seasonal attacks of *O. afrasiaticus*. Samples were collected from attacked regimes by this mite (Fig 3). Immature date Fruits were placed in a Petri dish filled by cotton soaked. Water saturated cotton wool was used to prevent mite escape and maintained leaf freshness. The cotton wool was maintained wet by adding distillate water when necessary.



Fig 3: Regime attacked by mites

Plant species choice

The choice of the plant to be tested is done according to their medicinal importance in our region.

Zygophyllum album (Fig 4) is used traditionally in Algeria for the treatment of different types of diseases such as skin diseases, its aqueous extracts are used in the treatment of diarrhea and diabetes; *Z. album* is carminative, anti-septic and stimulant [5].



Fig 4: *Zygophyllum album*

Cotula cinerea (Fig. 5) is used in tea for its aroma, condiment and especially medicinally to aid digestion. It is popular for grazing, particularly for goats [6].



Fig 5: *Cotula cinerea*

Leaf and gall infusions of *Limoniastrum guyonianum* (Fig. 6) are used in traditional medicine as anti-dysenteric against

infectious diseases or parasites that cause painful and bloody diarrhea [7].



Fig 6: *Limoniastrum guyonianum*

Preparation of plant extracts

Three spontaneous plants were collected locally from the experimental station of INRAA, *Zygophyllum album* L, *Cotula cinerea* Del and *Limoniastrum guyonianum* Del (tab. 1). Each plant material was dried under shade and powdered by using electric grinder and pass through a 4 mesh sieve and kept in a 500 g capacity polypropylene bag. 1 g of each powdered plant material were taken into a 200 ml of distilled water was added to it and then kept it for 24 h. The extract was separated using fine muslin cloth and then filtered.

Table 1: Plants evaluated for acaricidal activities against *Oligonychus afrasiaticus*

| Scientific name | Family | Parts used | Common name |
|------------------------------------|----------------|-------------|-------------|
| <i>Zygophyllum album</i> L | Zygophyllaceae | Whole plant | Agga |
| <i>Cotula cinerea</i> Del | Asteraceae | Whole plant | Shohia |
| <i>Limoniastrum guyonianum</i> Del | Plombaginaceae | Whole plant | Zita |



Fig 7: Aqueous plant extracts

Laboratory acaricidal test

For laboratory evaluation of plant extracts (Fig. 7), 30 healthy adult of yellow spider mite were released on a healthy detached on immature dates (6 dates/Perti dish, 5 mites/date) from the culture maintained in the laboratory (Fig. 8). Final count of mite population was taken for confirmation on number of mite after 4 h (after proper settlement of mite).

Dates were dipped in each concentration (1%, 2%, 3%, 4%, 5%) of the tested three plant extracts for 10 minutes, then left to dry. Each treatment was replicated five times for treated and control tests. Each concentration was sprayed on both the surfaces of dates using glass atomizer. The number of live spider mite was counted 24, 48 and 72 h until 10 days of treatment. Each treatment was replicated five times.



Fig 8: Acaricidal test

Mortality of *Oligonychus afrasiaticus*

For the determination of the effect of the tested plant extracts on the adults of *O. afrasiaticus*, we calculated the mortality

percentages of the treated date dust mites after 24 hour until ten days of incubation.

Statistical analysis

For the in vitro assays, the data were collected as mean acaricidal activity (mortality rate by an aqueous extract). These analyses were calculated by statistical software (STAT BOX 6.0.4., GRIMMERSOFT). The device is held in total uni-factorial randomization by Newman and Keuls test at 5% and 1% (P0.05 and P0.01). Different concentrations of three aqueous plants extract were tested against the dust mite of date palm trees *Oligonychus afrasiaticus*.

Results

Acaricidal effects of three plant extracts on the date palm dust mite *O. afrasiaticus* under laboratory condition

Different concentrations (1%, 2%, 3%, 4% and 5%) of aqueous extracts of *Z. album*, *C. cinerae* and *L. guyonianum* were tested to evaluate their toxic effect at 24 h until 10 days against adults of date palm spider mites and the obtained results have been summarized in Table 2.

Table 2: Acaricidal activity of aqueous plant extracts against *O. afrasiaticus* under laboratory condition.

| Treatment | <i>Z. album</i> | | | | | <i>C. cinerae</i> | | | | | <i>L. guyonianum</i> | | | | | Control (water) |
|---------------|-----------------|-------|-------|-------|-------|-------------------|---|------|---|---|----------------------|----|------|----|---|-----------------|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | |
| Mortality (%) | 3.33 | 76.66 | 53.33 | 76.66 | 16.66 | 16.66 | 0 | 3.33 | 0 | 0 | 0 | 10 | 3.33 | 10 | 0 | 0 |

According to the results showed in the table above, a least acaricidal action (1% and 5%) was noticed after 10 days at lower concentration (3,33% and 16,66% respectively) of the plant extracts of *Z. album*, followed by the third concentration (3%) which gave us an acaricidal action of 53,33%. Unlike the two other concentrations (2% and 4%), were exhibited an acaricidal activity against this mite with a rate of 76,66%.

The second aqueous plant extracts (*C. cinerae*), only two concentrations (1% and 3%) showed us an exhibition against *O. afrasiaticus* with 16,66% and 3,33%, respectively, whereas no mortality rates of the three other concentrations (2%, 4% and 5%) was noted.

Finally, with the third plant which is *L. guyonianum*, only three concentrations (2%, 3% and 4%) of this aqueous extract exhibited an acaricidal activity with 10%, 3,33% and 10% respectively. Different to the concentration of 1% and 5% of it, have no effect on the date palm mite *O. afrasiaticus*. So, the maximum mortality was attained in *Z. album*, followed by *C. cinerae* and *L. guyonianum*.

According to the table below, the statistical analysis showed that the aqueous extracts of *Z. album* have a significant effect on the dust mite of date palm. Unlike, the two other plants (*C. cinerae* and *L. guyonianum*) have no signification on this pest *O. afrasiaticus*.

Table 3: Statistical analysis of acaricidal effect of the aqueous extracts

| | F. Calculated | C. V. |
|----------------------|---------------|----------|
| <i>Z. album</i> | 8,908 * | 105,95 % |
| <i>C. cinerae</i> | 1,532 | 225,52 % |
| <i>L. guyonianum</i> | 4,259 | 153,23 % |

C.V.: Coefficient of variance; *: Significant.

Discussion

Most of the plants contain several compounds with insecticidal properties for protection against aggressor agents, especially microorganisms. Many species belonging to the genus *Zygophyllum* have been shown to cure various diseases and are used in folk medicine in several regions of the world.

The obtained data from our study showed that the aqueous extracts of *Z. album* were potent and exhibited acaricidal activity against the date palm dust mite, *O. afrasiaticus*, unlike *C. cinerae* and *L. guyonianum* plants, the maximum mortality was attained in *Z. album*, followed by *C. cinerae* and *L. guyonianum*. No reports are available on using of these plants and in controlling mites; so we recommend utility the plants extracts as effective eco-friendly agents for the pests control.

Several plant extracts were used to control the dust mite of date palms. According to Fetoh and Al-Shammery ^[8], the recorded results showed that all the tested plant extracts were effective on *O. afrasiaticus*; however Demsisa extract was the most virulent one. Furthermore, all the tested plant extracts exhibited ovicidal and repellent activities and showed significant effects on the reproduction and feeding behaviour of *O. afrasiaticus*.

Many studies try to obtain crude extracts carried out using water or organic solvents. In screening approach, scientists make generally a series of extractions for some plants using solvents with different polarities (methanol, ethanol, ethyl acetate, chloroform). Simplified crude extracts can also be prepared and obtained from crude one from which a group or a family of substances is isolated (saponins for example), also be used in insecticidal tests.

Several studies were made by researchers about the exhibition effect of plant extracts as a biological control against several pests; among these plants, we have the genus of *Zygophyllum* which is riche by many compounds of insecticidal activities like: *Zygophyllum fabago* ^[9]; *Zygophyllum album* ^[10];

Zygophyllum cornutum [11, 12].

Abdenbi *et al.* [13] have studied the phytochimic screening and the antibacterial activity of essential oil of *Cotula cinerea*. Also, Trabelsi *et al.* [7] and Hamidi [14] have studied the activity of *L. guyonianum*.

The discovery of acaricidal properties in native plant species can aid in future production of safer crops by small farmers, based on application of natural acaricides as a control method against phytophagous mites.

Conclusion

The in vitro study of pesticide properties of indigenous plants in the south region of Algeria (*Zygophyllum album* L, *Cotula cinerea* Del and *Limoniastrum guyonianum* Del) against the dust mite of date palm revealed that the species *Z. album* has a significant acaricidal activity by recording mortality rate 76%. However, extracts of *C. cinerea* and *L. guyonianum* showed a small effect on the mite because they presented a mortality rate not exceeding 16%.

The results obtained in this experiment interesting incite to conduct a detailed study on *Z. album* with research approaches to study these plants and their extracts and to identify a possible source of natural acaricides.

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