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**ORIGINAL ARTICLE**

# *IN VITRO* AND *IN VIVO* EVALUATION OF SOME PESTICIDES AGAINST THE DUST INDIAN MITE *RAOIELLA INDICA* HIRST (ACARI : TENUIPALPIDAE)

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**Abstract:** *Raoiella indica* Hirst (Acari: Tenuipalpidae) is one of the important pests that attack poly hosts. In the present work, we have been trying to find out the best acaricide and the concentration. The experiments were applied in vitro (laboratory) and in vivo (field). Our in vitro results revealed that the Ortus Super was the best acaricide against the larvae of red mite by recording a mortality 77.76% compared to special that achieved 58.26%, predicting similar or superior outcomes in the field. In contrary, the efficiency of abamectin and Ortus Super were similar against R. indica in the field. The mortality % reached 63.94 and 63.91%, respectively. The adult control in the field, Ortus Super realised 77.76% mortality, followed abamectin 68.51% and the lowest was special (58.26%). Whereas the used concentrations and the timing of reading taken also were varied. The high concentration of each acaricide overcome on the two various concentrations. Furthermore, the mortality% time was different for both in vitro and vivo experiments. Overall, the last day of taking sample recorded the highest percent compared to the two various concentrations. The results indicated that the use of Ortus super and abamectin at high concentrations is important in combating red mite pests.

***Key words***: Chemical control, Date-Palm, *Raoiella indica* adults, *Raoiella indica* larvae, Acaricides.

**Cite this article**

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## 1. Introduction

Date palms are infested by various pests like a dust mite, *Oligoneychus afrasaiticus* [Al-Ealayawi *et al.* (2020)], *Batrachedra amydraula* [Oleiwi *et al.* (2021)], in addition, *Jebusaea hammerschmidtii* [Dias *et al.* (2021)], which leading to considerable quantity and quality losses. The red palm mite, *Raoiella indica* Hirst (Acari: Tenuipalpidae) is considered the common pests that attack Date Palm. This mite is also called the red palm mite, which is characterised as polyphagous hosts. It has reported in July 2009 in Brazil as an invasive mite, causing damages in bananas, coconut [Navia *et al.* (2009), AL-Bayati (2019)]. While, another study mentioned that *R. indica* has first recorded in India 1924. A previous study was carried out in Cancún, Mexico by Otero-Colina *et al.* (2016) has shown the ability of this mite to spread on the range of hosts, leading to various levels of infestation. For example, red ginger (*Alpinia purpurata*), lobster claw (*Heliconia bihai*), coconut palm (*Cocos nucifera*). Furthermore, another published studies have shown the economic importance of *R. indica* in the Caribbean region and America continent where causing significant injury in the American on coconut palms [Yeledhalli *et al.* (2012), Da Cruz *et al.* (2015)]. According to many in the field, different acaricidee were evaluated in the toxicity of *Raoiella indica*. de Assis *et al.* (2013) studied the evaluation of 10 acaricises, including formetanate hydrochloride, milbemectin, sulphur, abamectin, fenazaquin, propargite, bifenthrin, acequinocyl, fenpyroximate and dicofol. All acaricides achieved 0-100% mortality. Other authors, According

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to Rodrigues and Pea (2012), the spraying of milbemectin, abamectin, sulphur, and pyridaben with etoxanole in coconut lowered the population of R. indica in Puerto Rico. Furthermore, acequinocyl and spiromesifen were effective acaricides in lowering the population of R. indica..

Based on the information that provided, this mite is one of the most significant organism that can attack the date palm, causing many infestation and losing in the yield. This present study aimed to evaluate a wide range of pesticide *in vivo* and *in vitro*, using the adults and immature mites.

## 2. Materials and Methods

### 2.1 Pesticide preparation

Three different pesticides were used in this study. Those pesticides belong to various chemical groups as illustrated in Table 1. Each pesticide was used with three different concentrations.

### 2.2 The pesticides effect in the adult mortality of Date palm mite in the laboratory

A date palm frond was taken randomly from the field and put in the polyethylene bags. After removing the other types of mite by smoothly brush under the digestion microscope, the frond was cubed to 8 cm piece containing 10 adult mites. The mites were distributed into sterling petri dishes containing the filter paper above the saturated cotton piece to avoid the leaf dryness. The piece fronds were sprayed with the pesticides based on Table 1 using three various concentrations and three replications for each treatment, while the control sprayed by distilled water only (Orell and Schneide). The numbers of mortality mites were calculated after 24, 48 and 72 hours. Then the mortality percent was corrected according to the Schneider-Orelli's formula equation [Püntener (1981)].

**Table 1:** The pesticides used in the study.

| Pesticide | Active ingredient | Concentration used 100 mL $L^{-1}$ water |
|---|---|---|
| Ortus Super 5% EC | Fenpyroximate | 100, 125, 150 |
| Special 240 g $L^{-1}$ SC | Chlorfenapyr | 35, 42.5, 50 |
| Abamectin 1.8% EC | Abamectin | 30, 35, 40 |

$$\text{Mortality }\% = \frac{\text{Mortality in the treatment} - \text{Mortality in the control}}{100 - \text{mortality in the control}} \times 100$$

### 2.3 The pesticides effect on the population adult mites under the field conditions

The study was conducted in the district of Al-Haritha/Al-Mashab area in a field planted with palm trees. Palm trees were sprayed with chemical pesticides at a rate of three replicates (each replica represents a palm) for each concentration using a 20-liter dorsal sprinkler. As for the control treatment, palm trees were sprayed with distilled water only. The number of mites density was calculated in square per inch with three replicates, and for each replicate three fronds for each concentration separately a day before spraying. Then the live mite numbers were calculated over 1, 3, 7 and 14 days of treatment and an equation of Henderson-Tilton's formula was applied [Henderson and Tilton (1955)].

$$Relative\ efficiency = \left(1 - \frac{n\ in\ Co\ before\ treatment \; - n\ in\ T\ after\ treatment}{n\ in\ Co\ after\ treatment \; - n\ in\ T\ before\ treatment}\right) \times 100$$

where, n = Insect population, T = treated, Co = control.

### 2.4 Statistical Analysis

Data from laboratory and field experiments were analyzed according to a completely randomized design at the probability level of 0.01 and 0.05.

## 3. Results and Discussion

### 3.1 The effect of pesticides on the adult population and larvae in the laboratory

In order to assess the effect of different pesticides against the red mite, various-experiments to study the acaricide-effects were used. The results obtained from the laboratory experiment analysis for Ortus Super 5% EC, Special 240 g $L^{-1}$ SC and Abamectin 1.8% EC can be compared in Table 2. Table shows that there is a significant difference among the acaricide. The best acaricide recorded the highest mortality was Ortus Super, following abamectin and finally special. The mortality percent were 77.76%, 68.52% and 58.25%, respectively. While the effect of concentration revealed that there are no difference between the Ortus Super and abamectin in terms of concentration versus mortality. Meanwhile, they are differentiated with the special acaricide. This effect valued 77.76%, 68.52, and 58.26%, respectively. In terms of time, the highest

**Table 2:** The effect of pesticides on the adult population in the laboratory.

| Pesticides | Concentration | Adult mortality % per day | | | Effect of concentration | Effect of pesticides |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | | |
| Ortus Super 5% | 100 mL $L^{-1}$ | 46.67 | 76.67 | 100 | 74.44667 | 77.76[a] |
| | 125 mL $L^{-1}$ | 66.0 | 73.83 | 90 | 76.61 | |
| | 150 mL $L^{-1}$ | 66.67 | 80 | 100 | 82.22333[a] | |
| Abamectin 1.8% EC | 30 mL $L^{-1}$ | 40 | 53.33 | 73.33 | 55.55333 | 68.52[b] |
| | 35 mL $L^{-1}$ | 56.67 | 66.67 | 90 | 71.11333 | |
| | 40 mL $L^{-1}$ | 60 | 76.67 | 100 | 78.89[ab] | |
| Special | 30 mL $L^{-1}$ | 33.33[c] | 46.67[b] | 56.67[a] | 45.55667 | 58.26[c] |
| | 42.5 mL $L^{-1}$ | 46.67 | 56.67 | 73.33 | 58.89 | |
| | 50 mL $L^{-1}$ | 57.67 | 70 | 83.33 | 70.33333[c] | |
| Effect of time | - | 52.63[c] | 66.72[b] | 85.18[a] | - | - |

R.L.S.D. $_{0.01}$ of Effect of Pesticides % = 5.10
R.L.S.D. $_{0.01}$ of Effect of concentration = 5.10
R.L.S.D. $_{0.01}$ of Effect of time % = 5.10

**Table 3:** The effect of pesticides on the larvae population in the laboratory.

| Pesticides | Concentration | Adult mortality % per day | | | Effect of concentration | Effect of pesticides |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | | |
| Ortus Super 5% | 100 mL $L^{-1}$ | 53.33 | 66.67 | 76.67 | 65.55667[c] | 76.67[a] |
| | 125 mL $L^{-1}$ | 63.33 | 80.00 | 93.33 | 78.88667[bc] | |
| | 150 mL $L^{-1}$ | 70.00 | 86.67 | 100.00 | 85.55667[a] | |
| Abamectin 1.8% EC | 30 mL $L^{-1}$ | 46.67 | 63.33 | 76.67 | 62.22333[c] | 72.59[ab] |
| | 35 mL $L^{-1}$ | 56.67 | 73.33 | 90.00 | 73.33333[b] | |
| | 40 mL $L^{-1}$ | 63.33 | 83.33 | 100.00 | 82.22[a] | |
| Special | 35 mL $L^{-1}$ | 36.67 | 46.67 | 60.00 | 47.78[c] | 61.85[c] |
| | 42.5 mL $L^{-1}$ | 50.00 | 63.33 | 76.67 | 63.33333[b] | |
| | 50 mL $L^{-1}$ | 56.67 | 76.67 | 90.00 | 74.44667[a] | |
| Effect of time | - | 56.69[c] | 7.11[b] | 84.81a | | - |

R.L.S.D. $_{0.01}$ of Effect of Pesticides % = 5.10.
R.L.S.D. $_{0.01}$ of Effect of concentration = 5.10.
R.L.S.D. $_{0.01}$ of Effect of time % = 5.10.

mortality was achieved after three days by 85.18% compared to two days and one-day, which were 66.72% and 52.63%, respectively.

When the pesticides (Ortus Super and Abamectin) applied on the larvae in the laboratory, no significant difference in the number of larvae population mortality was detected (Table 3). The number of mortalities recorded for both were 76.67% and 72.59%, respectively. On the other hand, both insecticides were significantly impacted on the special, which achieved 61.85%.

The high mortality ratio in both Fenpyroximate and Abamectin is because that abamectin plays an enormous role by the impacting of channel allosteric modulator glutamate chlorine, whereas, the biological role of Fenpyroximate is because of its ability to inhibit electron transport in the mitochondrial complex [Sánchez-Vázquez *et al.* (2017)].

From this field assessment data, we can see that Ortus Super remains superior on the special 240% SC, while there is no significant difference with abamectin 1.8% EC. Both Ortus super and abamectin achieved a high mortality reached 63.91% and 63.91% compared to special that recorded 53.23%. Thus, the high

**Table 4:** The effect of pesticides on the larvae population in the field.

| Pesticides | Concentration | Larvae mortality% per day | | | | Effect of concentration | Effect of pesticides |
|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 7 | 14 | | |
| Ortus Super 5% | 100 mL $L^{-1}$ | 38.99 | 55.72 | 69.46 | 70.08 | 53.56[c] | 63.91[a] |
| | 125 mL $L^{-1}$ | 43.28 | 60.12 | 77.56 | 80.95 | 65.47[b] | |
| | 150 mL $L^{-1}$ | 50.83 | 65.04 | 85.15 | 89.78 | 72.7[a] | |
| Abamectin 1.8% EC | 30 mL $L^{-1}$ | 40.25 | 55.14 | 60.32 | 70.49 | 56.55[c] | 63.94[a] |
| | 35 mL $L^{-1}$ | 45.48 | 61.29 | 72.71 | 79.27 | 64.6875[b] | |
| | 40 mL $L^{-1}$ | 49.53 | 63.56 | 83.15 | 86.16 | 70.6[a] | |
| Special | 30 mL $L^{-1}$ | 31.63 | 41.56 | 49.62 | 57.27 | 45.02[c] | 53.23[b] |
| | 42.5 mL $L^{-1}$ | 35.72 | 48.76 | 63.05 | 68.35 | 53.97[b] | |
| | 50 mL $L^{-1}$ | 41.37 | 54.60 | 72.08 | 74.73 | 60.695[a] | |
| Effect of time | | 41.90[e] | 56.20[cd] | 70.34a[b] | 75.23[a] | | |

R.L.S.D. $_{0.05}$ of Effect of Pesticides % = 5.17 R.L.S.D. $_{0.05}$ of Effect of concentration = 5.17
R.L.S.D. $_{0.05}$ of Effect of time % = 5.17

**Table 5:** The effect of pesticides on the adult population in the field.

| Pesticides | Concentration | Nymphs mortality % per day | | | | Effect of concentration | Effect of pesticides |
|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 7 | 14 | | |
| Ortus Super 5% | 100 mL $L^{-1}$ | 33.63 | 50.76 | 59.67 | 61.16 | 74.44667[c] | 77.76[a] |
| | 125 mL $L^{-1}$ | 42.06 | 59.57 | 70.45 | 74.09 | 76.61b[c] | |
| | 150 mL $L^{-1}$ | 49.79 | 69.08 | 83.42 | 84.84 | 82.22333[a] | |
| Abamectin 1.8% EC | 30 mL $L^{-1}$ | 32.82 | 49.06 | 53.80 | 62.67 | 55.55333[c] | 68.51[b] |
| | 35 mL $L^{-1}$ | 38.57 | 63.88 | 70.30 | 75.41 | 71.11333[b] | |
| | 40 mL $L^{-1}$ | 46.77 | 64.54 | 82.46 | 82.63 | 78.89[a] | |
| Special | 35 mL $L^{-1}$ | 22.76 | 33.90 | 42.75 | 49.13 | 45.55667[c] | 58.26[c] |
| | 42.5 mL $L^{-1}$ | 32.68 | 43.68 | 57.47 | 66.26 | 58.89[b] | |
| | 50 mL $L^{-1}$ | 36.95 | 53.01 | 73.62 | 73.03 | 70.33333[a] | |
| Effect of time | - | 37.34[d] | 54.17[c] | 65.99[b] | 69.91[a] | - | - |

R.L.S.D. $_{0.05}$ of Effect of pesticides % = 2.97 R.L.S.D. $_{0.05}$ of Effect of concentration = 2.97
R.L.S.D. $_{0.05}$ of Effect of time % = 3.43

concentration of Ortus Super was the best, followed by abamectin and special, recording 72.7%, 70.6% and 60.6%, respectively. In addition, increasing the time of pest exposure to pesticide has increased the mortality%. And there is a significant difference between the days of pesticide-exposure. The mortality% was 75.23%, after 14 days from the application, and the lowest mortality was on the first day of pesticide application, which registered 41.90%. The results, as shown in Table 5, indicate that the efficiency of Ortus Super by 77.76% mortality against the red mite compared abamectin, which was 68.51% and the lowest special 58.26%. As can be seen from the table also, the high concentration has higher effects in recording significantly higher mortality compared to the rest of concentration for each acaricides. The most interesting aspect of this table is detected the ability of Ortus Super in achieving 77.6% rather than abamectin 68.51% and special 58.26%. Moreover, the 14 days of pest exposure have shown the high percent of mortality 69.91% and the lowest mortality was recorded on the first day of pesticide application by 37.34%.

In terms of the biological impact of different pesticides, no significant differences noted. For example, the effects of Ortus Super and Abamectin were different, when they carried out to control the larvae in the field. While they had similar effects against the adults. This might be the ability of the adult mites to move quicker than the larvae. However, the environmental factors play a vital agent to influence on the mite population. For instance, temperature, which reached in the Basrah area up to 50°C, while, other research had revealed that 39°C influenced on the mite populations on Areca catechu.

## 4. Conclusion

The present study was designed to determine the effect of three different acaricides, three various concentrations, and the study period on the decreasing number of mite population. Recent data pointed out that abamectin has a similar effect to Ortus Super, when they applied in the laboratory and field trials. Also, the study shows that the high concentration and the timing of collecting the sample after 14 days has crucial impact in decreasing mite population.

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