DECIS 25 EC toxicity to Algerian honeybees

D Nabti, M Achou, N Soltani

Abstract
Colonies of honeybees are susceptible to a number of pesticides whose damage has negative economic impacts on the beekeeping industry and agriculture. This paper aims at revealing "DECIS 25EC" phytosanitary product toxicity. Experiments were carried out in an apiary of honeybees derived from *Apis mellifera intermissa* during May-December 2013. The insecticide acute toxicity was evaluated by topical and oral application to calculate lethal concentration. Results showed a considerable toxic effect on topical application comparing to the oral one. The LC50 and LC90 estimated at 24 hours by topical exposure on bees thorax were of 10.40ppm and 28.89ppm. At 96 hours, they were respectively 4.23ppm and 10.44ppm. Corrected mortality was considerable after (24 hours) oral exposure of the same treatment by the following concentrations of (4ppm; 10ppm; 25ppm; 50ppm; 100ppm; 200ppm), it varies between 10% and 93.33% with the concentrations of 4ppm and 200ppm respectively. A significant difference (p≤0.001) was noticed.

Keywords: *Apis mellifera intermissa*; Toxicity, DECIS EC25, bees; LC50; LC90.

1. Introduction
Bees are essential pollinators of many plants in natural ecosystems and agricultural crops alike. However, in recent years, the decline and disappearance of bee species in the wild and the collapse of honeybee colonies have concerned ecologists and apiculturists in Algeria, who search for causes and solutions to this problem [1]. In the U.S.A, for the last five years, winter losses of managed honeybee colonies have been around 30% each year [2]. In addition, owing to the complex environment in which bees operate and the increasing of body scientific literature showing the potential multifactorial origin of bee losses and colony weakening, the need for transition towards an integrated environmental risk assessment for bees became apparent [3]. Pesticides are accumulating in hives, and bees are also being killed while foraging in fields [4] and finally lead to the contamination of honey, which becomes harmful for human health [5, 6]. Therefore, in recent years pesticide residues have been shown in the bread of bee and the trapped pollen of domestic bees (*Apis mellifera*) [7, 8]. Some pesticides, including Deltamethrin were shown by several works [9-11]. Most risk assessments have focused on direct acute exposure of bees to agrochemicals. This work was devoted to calculate lethal concentration LC50 et LC90 of chemical product DECIS EC25 widely used by our farmers that may pose a threat to the life of bees in their natural environment.

2. Materials and methods
2.1 Biological Material
This assessment is restricted to Algerian bees *Apis mellifera intermissa* [12], widespread species on a surface of distribution which extends along North Africa: Morocco, Tunisia and Algeria [13].

2.2 Used treatment
Decis EC25 of the Bayer firm is a synthetic pyrethroid insecticide, Deltamethrin is the active matter of this product. It is employed against many parasites in the cultures of full field. Decis EC25 acts by both contact and ingestion giving a fast knock down and residual and repellent anti-feeding effect. Each quantity of this treatment was prepared in 125ml of water, used different concentrations: 4; 10; 7; 25; 50; 100 and 200ppm respectively.

2.3 Topical application
The worker bees’ sampling was done by hand, using a plastic tube, on living organisms at hive entrance [14]. According to [15] OECDb current policy, as for chemical products testing, *Apis...
*Apis mellifera intermissa* picked bees were anaesthetized in the refrigerator from 1 to 2 min then exposed to testing substance: Decis EC25 whose active matter is deltamethrin 25 g/l (4 ppm, 10 ppm, 7 ppm, 25 ppm, 50 ppm). Each batch (280 workers). 1 μl volume of insecticide was directly applied to each worker’s thorax (Fig 1), then placed in separate plastic glasses of 6.5 cm width and 11 cm length. Control series were put into airy plastic cubic-form frames of (17x13x13 cm). After 1-2 hours of applied treatment, the bees had to be fed on 20 μl of healthy syrup [15]. The test lasts 96 hours (24h, 48h, 72h, 96h).

**2.4 Oral Application**

Before the treatment, Workers bees are too fast for two hours. They are kept in an air-conditioned chamber of 25°C temperature and from 50 to 70% humidity. Darkness is recommended to foster trophallaxis phenomenon (food exchange) and increase appetite. Each bee is nourished of 10 μl of sugar solution containing the product to be reviewed with different increasing concentrations (4; 10; 25; 50; 100; 200 ppm) respectively, then placed in easy-to-clean separate airy plastic glasses of 6.5 cm width and 11 cm length (Fig 2). Each batch (280 workers). After 1 to 2 hours treatment, the exposed ones had to be fed on 10 μl healthy syrup [16] (OECD1998a). The test lasts 96h (24h, 48h, 72h, 96h).

**3. Results and Discussion**

**3.1 Oral toxicity**

The results indicate that there exists a very highly significant concentration effect (p ≤ 0.001) at 24, 48 hours respectively. Thereafter a transformation of corrected mortalities into probits and the tested concentrations into decimal logarithms were carried out with determination coefficient of (R²=97) of the straight regression line. A death rate of 63.33% was recorded by the weakest concentration 4 ppm after an oral exposure at 96 hours and 100% for the highest concentrations (100; 200 ppm), (Fig 3).

**3.2 Topical toxicity**

Preliminary tests were carried out to determine the lethal concentration. On this basis, the following concentrations were used to determine the LC50 DEcies EC25: 4; 7; 10; 25 and 50 ppm respectively. The statistical analysis revealed a highly significant effect of p ≤ 0.001. Lethal concentrations LC50 and LC90 estimated at 24 hours: 7.40 ppm and 39.58 ppm. The topical application with same treatment on bees after 48 hours revealed a rate of 30.94% with the weakest concentration (4 ppm), and of 97.61% with the high concentration (50 ppm), (Fig 4). Lethal concentrations LC50 and LC90, are estimated starting from the equation of straight regression line whose coefficient of determination (R²=98.8) revealed a very strong correlation between probits and the decimal logarithms. Very highly significant effect (P ≤ 0.001) was noted at 72 hours (Table 4).
Several plant protection products are dangerous for honey bees (*Apis mellifera* L.) and other pollinators in many ways [20]. These social insects are widely affected by pesticides. For instance, around 50 incidents per year were associated to pesticide poisoning in England and Wales during the 1981–1991 period involving the active substances of 30 pesticides. Most honeybee losses from 1966–1979 were attributable to pesticide exposure [3]. Decis EC25 is a synthetic pyrethroid insecticide which is widely used in Algeria [21].

Experiments carried out in the laboratory confirm that DECIS EC25 has caused considerable mortality of adult workers even with very low dose. The results of our research is similar to those of Decourtye and Al. (2005) [23]. Who note more than 90% mortality of the bees nourished with a syrup containing 10 ppm [25]. Tomlin (2006) and Melisie et al. (2015) [9, 20] found also, Deltamethrin highly toxic to honeybees in contact toxicity tests. In conclusion, the DECIS EC25 harmful effect was confirmed by a toxicity study: the LC50 and the LC90 were given after an exposure topical and oral. Our results showed that its topical application to different concentrations (ppm), present a more important toxic effect compared to the oral application.

### Table 3: Lethal concentrations with topical application on *A. mellifera intermissa* after 24, 48, 72 and 96 hours

<table>
<thead>
<tr>
<th>Lethal concentrations</th>
<th>24h</th>
<th>48h</th>
<th>72h</th>
<th>96h</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50</td>
<td>10.40ppm</td>
<td>7.38ppm</td>
<td>4.99ppm</td>
<td>4.23ppm</td>
</tr>
<tr>
<td>LC90</td>
<td>28.89ppm</td>
<td>25.90ppm</td>
<td>22.00ppm</td>
<td>10.44ppm</td>
</tr>
</tbody>
</table>

### Table 4: Comparison of mean values by student’s t test after the topical application.

<table>
<thead>
<tr>
<th>Significance (P) level</th>
<th>24h</th>
<th>48h</th>
<th>72h</th>
<th>96h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fobs</td>
<td>118.59</td>
<td>7.99</td>
<td>6.88</td>
<td>29.16</td>
</tr>
<tr>
<td>P</td>
<td>0.000***</td>
<td>0.004**</td>
<td>0.006</td>
<td>0.000***</td>
</tr>
</tbody>
</table>

**Fig 4:** Mortality of *Apis mellifera intermissa* during topical application.

### References

13. Barour C, Tahar A, Radloff SE, Hepburn HR.


