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# Variability in the sensitivity of nematodes species towards imidacloprid and diuron

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## Introduction

To assess the lethal effects of diuron (herbicide) and imidacloprid (insecticide) on ubiquitous organisms at the basis of food webs, we performed multispecies toxicity tests using nematode species commonly found in soil and freshwater benthic ecosystems. These pesticides are amongst the most frequently detected pesticides in European rivers and both are known to affect many aquatic organisms<sup>1, 2, 3, 4</sup>. Free living nematodes are the most abundant and species-rich organisms of meiofauna in aquatic sediments and soils<sup>5, 6</sup>. In ecotoxicology, the model species *Caenorhabditis elegans* is widely used to assess and predict the risk of chemical substances towards ecosystems<sup>7</sup>. Single-species bioassays leave aside the existing variability of sensitivity between species<sup>8</sup>, potentially leading to an underestimation of the consequences of toxic exposure at the scale of the nematode community in nature. In fact, there are evidences of changes in nematode community structure after imidacloprid and diuron exposure that may be related to trade-offs between sensitivity to toxicants and changes in competitive abilities of the species<sup>9, 10</sup>.

### Recipe:

X 5 replicates/treatment (control, solvent control, D1, D2, I1, and I2)  
X 10 nematodes/microcosm  
Concentration C1 and C2 determined from ISO10872 (2010) on growth and reproduction of *Caenorhabditis elegans*<sup>11</sup>  
Medium : Volvic water

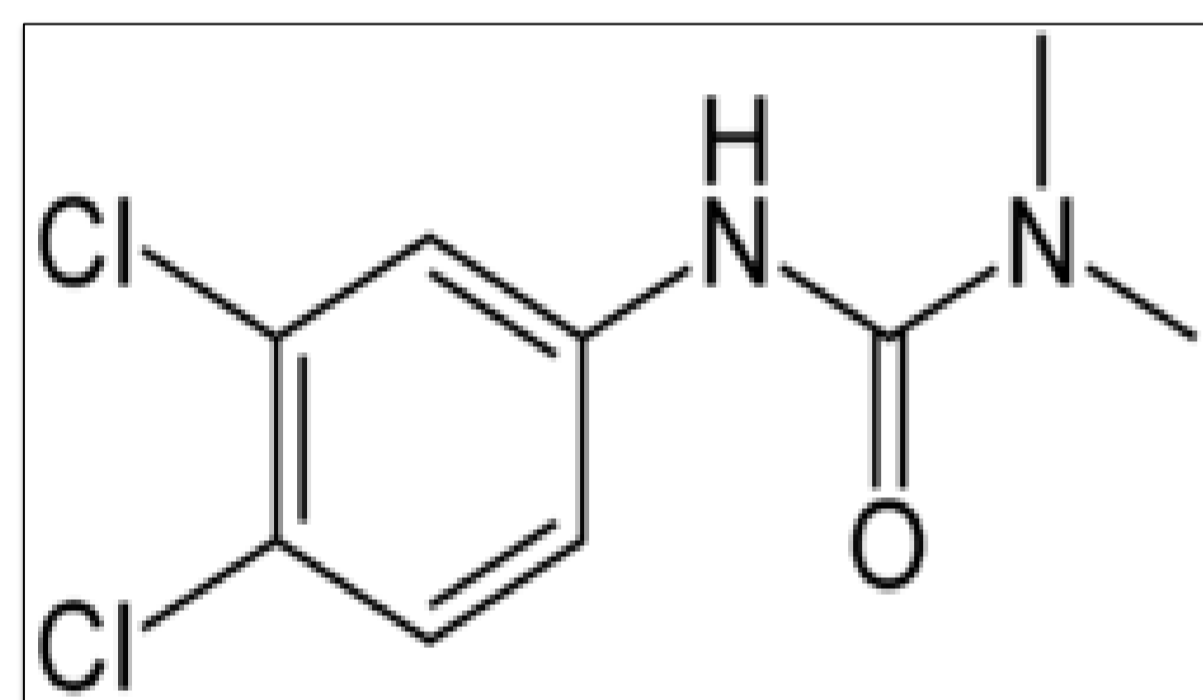
### Data acquisition:

Counting of dead and alive nematodes (mortality %)

### Data analysis:

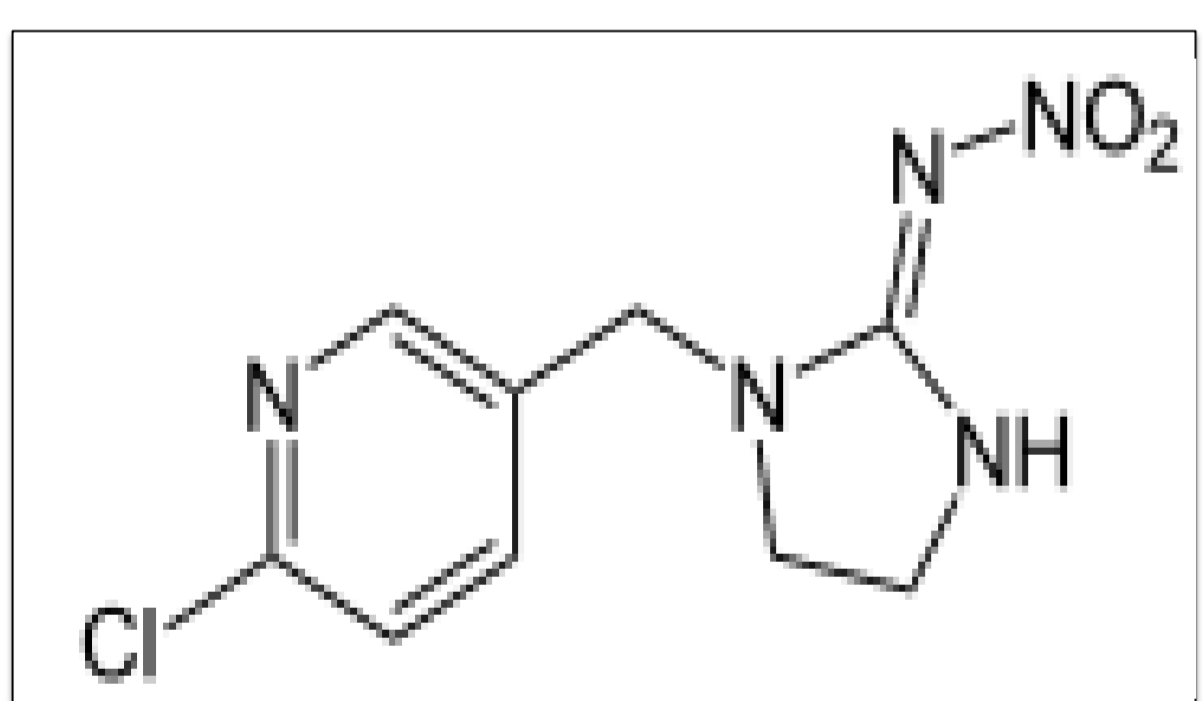
non-parametric Kruskal wallis test and posthoc (Tukey model).  
Package PMCMR (R)<sup>12</sup>

48h, Dark, 20°C,  
No food



### Diuron (D1, D2)

Substitute urea  
Priority substances  
Solubility: 35mg/L  
DT50 in sediment: 30 days  
**Target:** Photosynthesis apparatus



### Imidacloprid (I1, I2)

Neonicotinoids  
« Watch list »  
Solubility: 610mg/L  
DT50 in sediment: 130 days  
**Target:** Insect nicotinic receptors

	<i>Caenorhabditis elegans</i> (Model organism)	<i>Diploscapter coronatus</i> (Soil)	<i>Pristionchus pacificus</i> (Soil)	<i>Rhomborhabditis regina</i> (Soil)	<i>Plectus velox</i> (Freshwater)	<i>Plectus acuminatus</i> (Freshwater)	<i>Plectus opisthocirculus</i> (Freshwater)	<i>Aphelenchoides</i> sp (Freshwater)
<b>Solvent control</b>	7.3 ±5 %	4.9 ±3 %	0.0 %	21.7 ±5 %	13.6 ±3 %	8.0 ±9 %	0.0 %	5.0 ±3 %
<b>D1 = 10mg/L</b>	1.8 ±2 %	15.3 ±8 %	13.5 ±7 %	50.0 ±16 %	9.2 ±5 %	10.2 ±3 %	13.4 ±4 %	4.0 ±3 %
<b>D2 = 100mg/L</b>	0.0 %	47.6 ±11 %	13.5 ±5 %	37.7 ±13 %	13.2 ±7 %	10.2 ±6 %	28.0 ±11 %	0.0 %
<b>I1 = 35mg/L</b>	2.2 ±2 %	25.2 ±12 %	7.5 ±7 %	30.3 ±12 %	6.3 ±5 %	14.0 ±6 %	20.6 ±8 %	0.0 %
<b>I2 = 350mg/L</b>	0.0 %	27.1 ±6 %	9.1 ±4 %	38.3 ±6 %	14.9 ±8 %	13.0 ±4 %	51.1 ±7 %	14.4 ±10 %

## Discussion

- Rhomborhabditis regina* need huge amounts of bacteria in culture<sup>14</sup> → Mortality ++ even in the control.
- Pristionchus pacificus* is an entomopathogen nematode. It is not sensitive to imidacloprid because entomopathogen nematodes are regularly used in combination with imidacloprid against beetles in field<sup>15</sup>.
- Diploscapter coronatus* and *Plectus opisthocirculus* are significantly more sensitive to diuron and imidacloprid than the six other species.
- Insect nicotinic receptors are different than those of nematodes. Differences also exists between nematode nicotinic receptor<sup>16</sup>. Imidacloprid affect diversely nematodes species according to their nicotinic receptors.
- Sensitivity to chemical substances can depend on nematodes cuticle thickness and ornamentation. Diuron and imidacloprid are large hydrophilic molecules which cannot penetrate easily through nematode cuticle<sup>17</sup>.
- Sensitivity is not connected with environmental distribution because one terrestrial species and one freshwater species are affected by diuron and imidacloprid.

## Conclusion

- Variability in nematode sensitivity against diuron and imidacloprid in natural ecosystem can disrupt species diversity and competitive capacities.
- Nematodes are usually less impacted by these chemical substances than other meiofauna organisms<sup>18, 19</sup>. At the long term, that can unbalance structure community.

### References:

- 1) Soes 2015; 2) Münze, R., et al. 2015; 3) Masiá, A., and al. 2015; 4) Christoffels, E., and al. 2016; 5) Traunspurger and al. 1996; 6) Duffy and al. 2007; 7) Hägerbäumer and al. 2015; 8) Artigas and al. 2012; 9) Hayasaka and al. 2012; 10) Gallucci and al. 2015; 11) Traunspurger and al. 1997; 12) Pohlert 2014; 13) OECD 1992, 2004; 14) Schulte and al. 1991; 15) Koppenhofer and al. 2001; 16) Tornøe 1994; 17) Fonseca and Fehlauer-Ale 2012; 18) Alsterberg and al. 2007; 19) Mahmoudi and al. 2005