TRICYCLAZOLE-CLAY COMPLEXES AS POTENTIAL SMART DELIVERY SYSTEMS: RELEASE IN WATER AND ENVIRONMENTAL FATE IN ALLUVIAL AND SANDY SOILS

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INTRODUCTION

- Tricyclazole is a systemic fungicide used for the control of rice blast caused by Pyricularia oryzae
- After its application on paddy fields by aerial fumigation is frequently detected in surrounding waters
- The aim of this work was the modification of natural mineral clays with Fe⁴⁺ cation or a biopolymer to increase the adsorption capacity for tricyclazole and the preparation of tricyclazole-clay complexes to be used as controlled release formulations (CRFs).

MATERIALS AND METHODS

- **Fungicide**
  - MW 189.24 g mol⁻¹
  - Water solubility 5.96 mg L⁻¹
  - log Kow 1.4 (pH 7, 20 °C)

- **Mineral clays**
  - SWy (standard smectite, CEC 76 meq/100g)
  - SWt (smectite low content mineral, 30.33% smectite)
  - SH (CEC 44 meq/100g)

- **Adsorption-desorption isotherms**
  - Adsorption Cₜ = 1.2 ± 5.7, 10 μM
  - Freundlich equation Cₜ = Kₐ Cₜᵃᵇ
  - Desorption from initial adsorption at 10 mM Hysteresis index H = Nₑₓₑᵣₑ/Nᵣᵣₑ

- **Dissipation studies**
  - Formulation tₐₙₜ (d) K²
  - Commercial tricyclazole 150 (136-168) 0.936
  - SWch4 WC 131 (111-160) 0.835
  - CTIFe WC 141 (127-160) 0.925
  - *Numbers in brackets are standard errors of the mean

- **Leaching studies**
  - Sandy soil
    - Formulation % Leached % Extracted 0.5 cm % Extracted 1 cm % Extracted 15 cm Total removed
    - Commercial 75 ± 1 0 1 ± 0 3 ± 0 5 ± 1 84 ± 1
    - SWch6 WC 65 ± 2 3 ± 0 4 ± 0 5 ± 1 8 ± 1 85 ± 2
    - CTIFe WC 69 ± 3 2 ± 0 2 ± 0 3 ± 0 6 ± 0 82 ± 2

- **The tricyclazole-smectite complexes**
  - Fe⁴⁺ ions favor the pronation of tricyclazole, being adsorbed at the interface; render greatest adsorption
  - Chitosan modification increased tricyclazole adsorption only on SWch4 because the polymer enters in the interlayer making it available for tricyclazole

RESULTS AND DISCUSSION

- **Release kinetics in water**
  - Commercial tricyclazole 250 ml H₂O
  - Shaking Aliquot 2 ml (0-168 h)

- **Dissipation studies**
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- **The formulations favor the retention of the fungicide to the alluvial soil as compared to the commercial formulation**

CONCLUSIONS

- The adsorption of tricyclazole increased in the clays modified with cations. The greatest increase was observed on SWFe, which could be tested as filter to treat contaminated waters, due to its high capacity of adsorption
  - For sandy soils, SWch-tricyclazole complexes decreased the tricyclazole leached concentration