Fate and behavior of polymeric based nanoformulations in aquatic media Poly(3hydroxybutyrate)(PHB) loaded with tebuconozole as case study

MUNI | RECETOX

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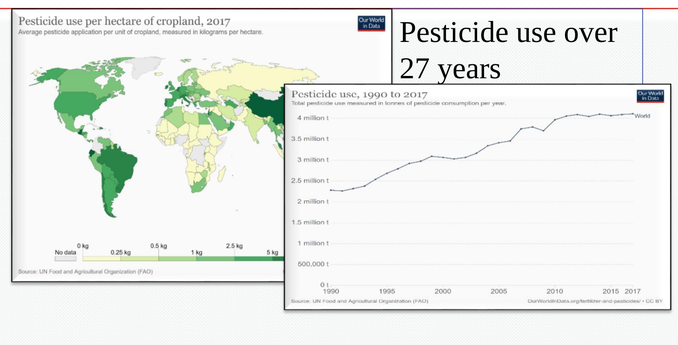
Introduction

- Huge use of pesticides in the world ➔ contamination of soil, water and air ➔ risks for ecosystem and human healt
- nanopesticides (e.g. polymer-nanoparticle carriers) = new technologies as potential alternatives to conventional pesticides: smaller amount needed, slow release, lower toxicity to non-target species etc.
- polymers such as PHB are completely biodegradable, inexpensive, easily produced, making them important for the production of release systems for bioactive materials
- polymeric nanocarriers for a variety of bioactive compounds allow altering the physico-chemical properties, employing coating techniques to modify the interactions of the particles with the target medium etc.



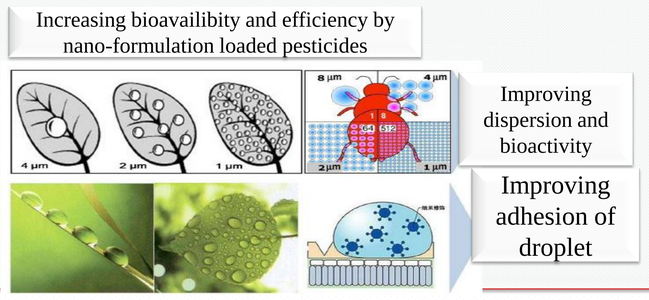
Pesticide use over 27 years

Hypoteses:

- PHB is stable duration by means of particle size and concentration, AI concentration and encapsulation efficiency.
- changing behaviour and bioavailability of the nanoformulated AI and pure AI in water
- the stabdiffe tebuconozole rentility is dramatically influenced when the dilution comes to solubility limit of AI.

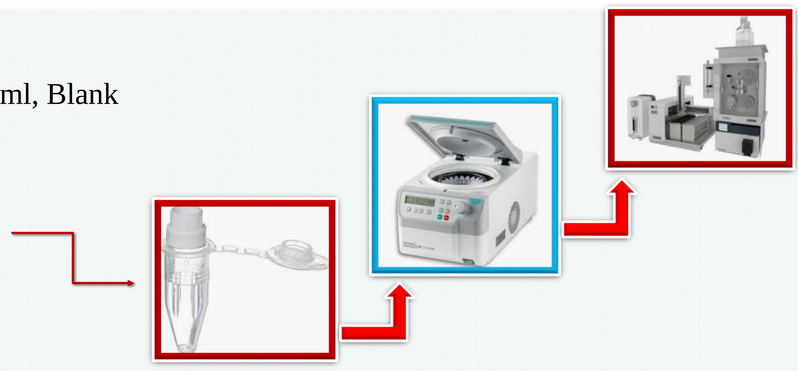
Objective:

Chemistry and physics characterization of NF-PHB-TBZ in different concentrations in aquatic media ,effect of dilution, time and medium properties, targeting ability and precise control release of nanocapsules of PHB containing fungicide over time



Method and material

- ❖ Nanoformulation was prepared through emulsion solvent evaporation method.
- ❖ 6 nano-formulation concentration; C1: 50000, 25000, 5000, 500, 50, 10 ng/ml and 2 AI concentration; C3: 5000, C4: 500ng/ml, Blank
- ❖ 7 sampling point; 0,4,8, 24.48, 240, 672h
- ❖ 2 different aquatic media: Reconstituted water (RCW), Mili-Q water (autoclaved mediums used)
- ❖ Chemical characterization:
  1. release: 0.5ml solution → microcon → 14000 rcf centrifugation for 30min → measuring free AI by LC- MS-MS
  2. Total concentration; dilution in acetonitrile → filtration through a 0.22 µ m Millipore membrane
- ❖ Physical characterization; Zeta average, concentration and polydispersity (PDI) by dynamic light scattering (DLS)



Ongoing expriments:

- ❖ Ecotoxicity assay: acute and chronic of Daphnia Magna, chironomids and algae test according to OECD guideline

Future exprimends:

- ❖ Evaluating of NF-PHB-TBZ in soil

Result

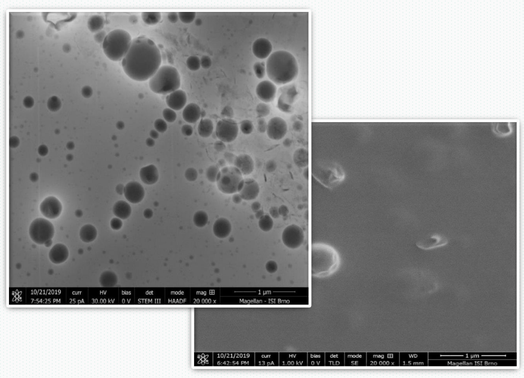


Fig2: SEM (scanning electron microscope) images showing no aggregation in NF-PHB-TBZ, spherical particles

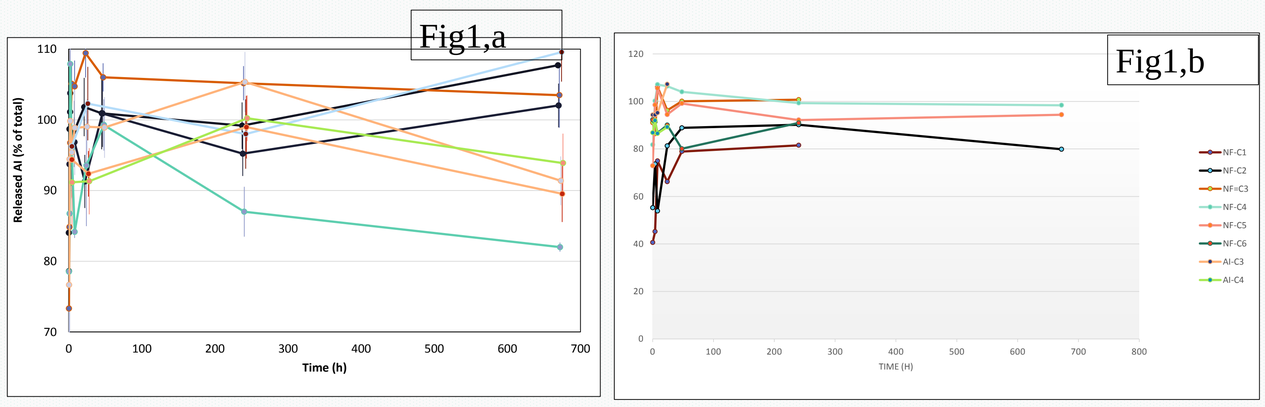
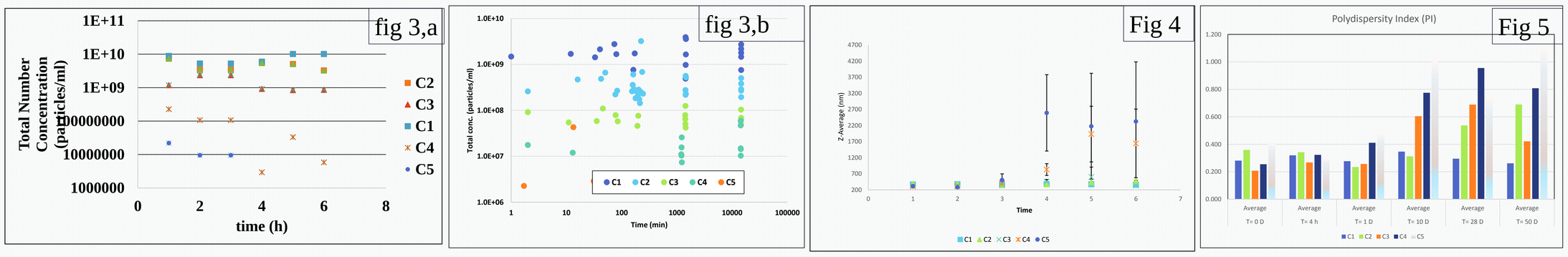


Fig 1,a: chemical characterization of NF-PHB-TBZ in mili-Q (a; percentage of release of AI) and RCW (Percentage of release of AI in RCW)



Physical characterization of NF-PHB-TBZ in RCW and mili-Q;

Fig3. total number concentration (a:RCW and b: mili-Q water) over 50 d were almost stable

Fig4. particle sizes over 50 d of study in RCW medium slightly changed despite in C5 showing possible aggregation.

Fig5. Polydispersity

Conclusion

- Dilution effect on release of AI over time was evaluated
- Higher dilutions seem to release faster than lower dilution and reaching the burst effect sooner
- Compared to RCW, release in mili-Q water seem to be faster
- slightly increasing the zetra average in higher diluted samples may be refered to PVA dilution as stabilizer in this NF.