

The project ATTRACT: Protection of crops from soil-borne insect pests with a novel attract-and-kill strategy

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INTRODUCTION AND OBJECTIVE

The project ATTRACT targets the development of a novel attract-and-kill strategy for the protection of crops from soil-borne insect pests.

Larvae of herbivorous insects (e.g. wireworms, western corn rootworm, black vine weevil) cause severe losses in many crops (potato, maize, strawberry). A control of these pests with soil insecticides is severely restricted or has recently been abandoned. The project ATTRACT aims at developing innovative attract-and-kill formulations which can be produced on technical scale and can then be used as novel control strategies against soil-borne insect pests in conventional as well as organic farming systems. By attracting larvae to the beads containing a kill compound (Fig. 1) insecticide applications or other control strategies can be replaced, the amount of insecticides can be minimized and the environment and health of farmers and consumers can be protected.

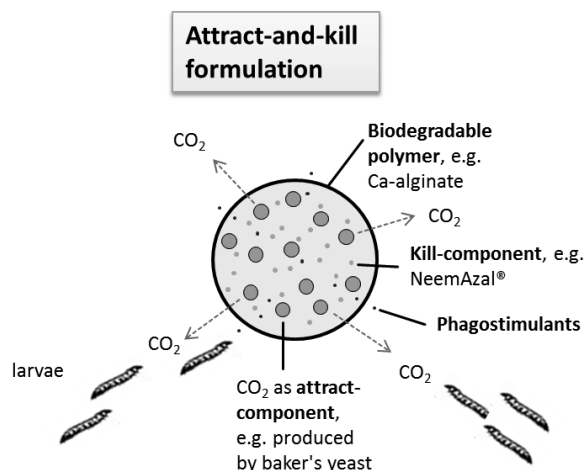


Figure 1: Attract-and-kill formulation. The bead consists of a biodegradable polymer and includes a CO₂-producing component (e.g. baker's yeast) and an environmentally friendly insecticidal compound, e.g. NeemAzal®. Released CO₂ and phagostimulants attract the larvae (not true to scale) towards the attract-and-kill formulation.

Baker's yeast has proved to be a suitable CO₂-releasing source (Vemmer 2011) and thus can be used as attract-component. The kill-component is represented by environmentally friendly insecticidal compounds, e.g. NeemAzal®, an Azadirachtin-enriched plant extract of the Neem tree (*Azadirachta indica* A. Juss.), resp. a plant extract of the Quassia-

tree (*Quassia amara*) named Quassia-Extrakt-MD (both TRIFOLIO-M, Germany). Neem products are used in traditional Indian medicine since many centuries and nowadays some of these products arouse much interest because of their insecticidal effects. Also the botanic Quassia-tree promises some interesting pest-control properties (Kleeberg 2006).

Organization and scheduling of the project ATTRACT Within the project ATTRACT four partners are cooperating at an interdisciplinary level. Beside the University of Applied Science Bielefeld, the Georg-August-University Göttingen and the SME's BIOCARE GmbH (Einbeck, Germany) and TRIFOLIO-M GmbH (Lahnau, Germany) are involved in the project (Fig. 2).

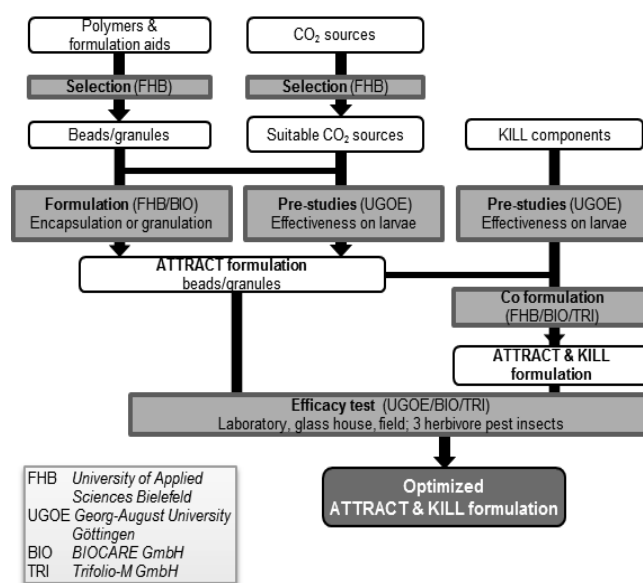


Figure 2: Flow diagram for the project ATTRACT with distribution of responsibilities.

MATERIALS AND METHODS

Encapsulation of *Saccharomyces cerevisiae* and Co-encapsulation with NeemAzal® or Quassia-Extrakt-MD Commercial baker's yeast mixture was encapsulated in moist Ca-alginate beads to serve as CO₂ source. The baker's yeast mixture was also co-encapsulated with the plant extracts NeemAzal® and Quassia-extract-MD (both TRIFOLIO-M, Germany).

Examination of the compatibility of *Saccharomyces cerevisiae* and NeemAzal®, resp. Quassia-Extrakt-MD Co-encapsulation and dissolving of beads:

After distinct times of storage at 25 °C alginate beads containing 20 % baker's yeast and different concentrations of NeemAzal® or Quassia-Extrakt-MD were dissolved in a solution consisting of 0.05 M Na₂CO₃, 0.02 M citric acid, pH 6.8. The dissolved beads were serially diluted in 0.9 % NaCl solution and defined volumes were plated on YPD-Agar. Following this, CFU was determined.

Filter disc assay:

Filter discs (Ø 9 mm) were dipped into solutions of different concentrations of NeemAzal® or Quassia-Extrakt-MD in 50/50 (v/v) EtOH/H₂O until complete saturation. After evaporation of the solvent the filter discs were placed on YPD agar plates, which had been inoculated with baker's yeast before. The plates were incubated for two days at 25 °C. A Dimetomorph containing solution was used as positive control and EtOH/H₂O served as negative control.

RESULTS AND DISCUSSION

Examination of the compatibility of Saccharomyces cerevisiae with NeemAzal® or Quassia-Extrakt-MD

Because the attract-component and the environmentally friendly insecticidal compounds as kill-components should be encapsulated together within the attract-and-kill formulation, the tolerance of baker's yeast for NeemAzal® or Quassia-Extrakt-MD had to be examined. After one week of storage baker's yeast co-encapsulated with high concentrations of NeemAzal® or Quassia-Extrakt-MD still displayed a high degree of viability (Fig. 3).

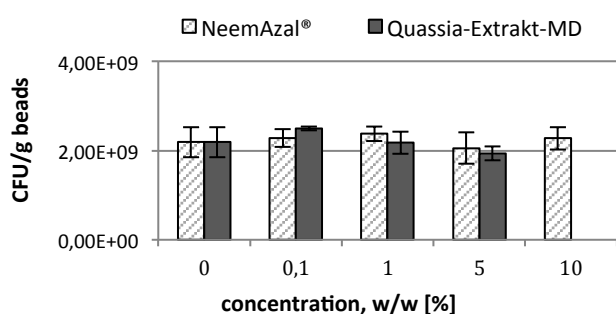


Figure 3: CFU per g beads for baker's yeast co-encapsulated with NeemAzal® and Quassia-Extrakt-MD after one week of storage. Initial CFU: 2.19×10^9 /g beads was nearly maintained for all tested concentrations of plant extracts (SD always $< 4.00 \times 10^8$).

The filter disc assay (Fig. 4) confirmed these results. For none of the tested plant extract concentrations a larger inhibition zone than for the negative control could be observed, indicating that NeemAzal® and Quassia-Extrakt-MD both had no negative effect on the growth of baker's yeast.

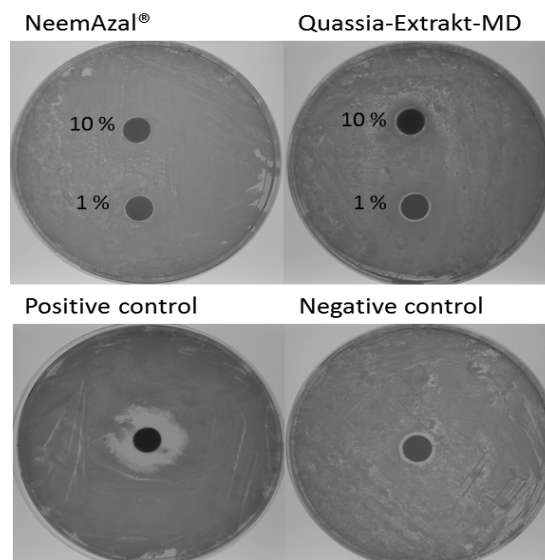


Figure 4: Filter disc assay for NeemAzal® and Quassia-Extrakt-MD concerning the growth of Saccharomyces cerevisiae.

CONCLUSIONS AND OUTLOOK

In the project ATTRACT novel formulations (beads, granules) based on CO₂ emitting sources and environmentally friendly insecticidal compounds such as neem and quassin will be developed and tested under practical conditions in order to lure larvae away from plant roots. The first data indicate compatibility of baker's yeast and NeemAzal®, resp. Quassia-Extrakt-MD, which allows further development of attract-and-kill formulations based on these compounds. These formulations will be optimized by screening for different CO₂ sources, polymers, beads and granules. Further developments include the incorporation of phagostimulants and additives and the use of different coatings. Subsequently the formulations will be tested in efficacy tests in lab, greenhouse and field experiments.

REFERENCES

- Vemmer et al. (2011) *Development of CO₂ releasing beads to control soil borne insect pests - first results.* in XIX International Conference on Bioencapsulation (Bioencapsulation Research Group - 5.-8.10.2011 – Amboise) pp 240-241.
- Kleeberg et al. (2006) *Quassia-extract-MD – a new botanical with interesting pestcontrol properties.* (1st Annual Biocontrol Industry Meeting ABIM – 23.-24.10.2006 – Lucerne).

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