

1. Publishable summary

The aim of the Nemasys project was to develop a cost-effective soil treatment as an alternative to conventional nematicides based on naturally occurring, non-toxic, essential oil (EO) based formulations delivered by a novel biodegradable time-release system.

This approach was based on initial work by Plant Impact which has shown a synergistic effect in neutralising Potato Cyst Nematodes (*Globodera sp*) activity with a mixture of EOs to give a significant (>30%) improvement in nematicide efficacy over individual EOs. The work within the *Nemasys* project has built upon this, optimised the formulations and developed the delivery vehicle of the EOs to the soil. During the first phase of the project very promising in-vitro experiments and pot tests results were obtained and the controlled release system was developed. During the final phase of the project the product has been manufactured at pilot-plant scale and field trials have been undertaken.

Nematodes or roundworms are one of the most common soil-borne parasites that feed on plant roots, stems, leaves, flowers and seeds - constituting a major contributor to agricultural crop losses. Yield losses due to the parasitic effects of nematodes vary significantly for different crops, however, it is estimated that over €1 billion/year of crop yield is lost in the EU and the figure is speculated to be between €10-20 billion/year world-wide. There are a number of existing solutions to prevent the huge losses due to nematode infestations, including; conventional nematicides, soil fumigants, solar heating/steaming and robust crop rotation. However, all of these solutions have significant problems such as very negative environmental impact, high-cost, or are geographically specific. The potential benefits of developing a more environmentally friendly, and safer, alternative would be significant, especially given the number of active substances (for use as pesticides) which have been recently withdrawn from the EC for health and safety reasons.

The overall objectives of the project are to:

1. Optimise the formulation of the EOs to maximise their effectiveness at killing/neutralising nematode activity.
2. Develop a suitable emulsifier to allow the EO formulation to come into contact with the nematodes in soil.
3. Develop a novel biodegradable soil delivery system.
4. Demonstrate prototype manufacturing line
5. Develop treatment and dosage regime
6. Run field trials to demonstrate 'proof-of-concept'
7. Assess the environmental impact

All the project objectives have now been achieved and the field trial has just been completed. Successes to date include:

- EO formulations & doses developed from in-vitro and pot tests

- biodegradable capsule system (from all natural ingredients) developed and manufactured at pilot plant scale
- commercial, economic and business plans developed
- field trial performed

While the laboratory trials have shown good efficacy of some EO formulations, the results from the field trial were less favourable. Further work will be carried out to understand these results before making any decision about whether a commercially viable product can be developed. Secondary product applications are also being targeted.

Nemasys project website can be viewed at <http://nemasys.uk-matri.org/>

The Industrial consortium consists of Plant Impact (UK), Aroma Praha (Czech Republic), Robinsons Brothers Ltd (UK) Jackdaw Polymeres (France) and Belchim Crop Protection (Belgium). Research activities on the project have been performed by the UK-MaTRI (part of the Pera Innovation Network) and PRI (Plant Research International, The Netherlands).

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Pictures from field test site in The Netherlands, summer 2011: *Globodera pallida* in debris (25x); *G. pallida* in egg; high infestation levels; low infestation levels; incorporation of capsules; field site scene.