Field vegetables : Approaches to control cabbage root fly

Cabbage root fly is difficult to control

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OBJECTIVES

*The cabbage root fly (*Delia radicum *L.) is a major pest Brassica crops. Larvae feeding on and in plant roots can cause severe plant damages and losses. Control is difficult and only few insecticides are authorized. Especially in organic production alternatives for cabbage root fly control are urgently needed. Within the PURE project different approaches such as entomopathogenic fungi, nitrogen lime etc. were compared with broad spectrum insecticides. Furthermore new technologies, based on volatiles, were developed.*

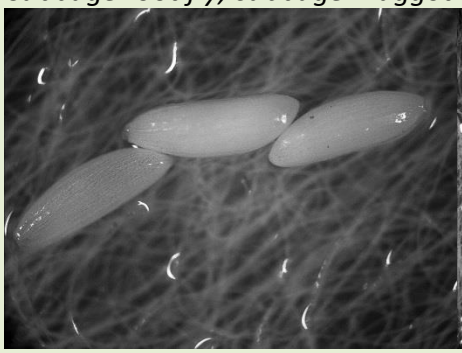
APPROACH (EXPERIMENTS, ASSESSMENT TOOLS, …)

The general approach was to create long-term solutions that combine tactics, new technologies and production methods to reduce reliance on pesticides. A range of tools were optimized and combined to create workable IPM solutions. The strategies studied included:

- *Testing alternative plant protection products, such as entomopathogenic fungi and nematodes, nitrogen lime, methyl jasmonate, etc.*
- *Investigating cabbage root fly behavior towards volatile compounds*
- *Exploiting ecological processes with push-pull strategies*

PESTS

*Cabbage root fly, cabbage maggot (*Delia radicum *L.)*



Eggs cca. 0.5 mm long.

Neonate larva.

Larva.

Larva in kohlrabi.

Pupa in kohlrabi.

Pupae in soil.

Cabbage root fly head.

Cabbage root fly.

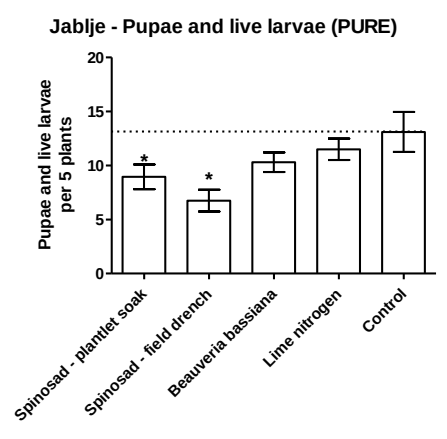
Cabbage root fly oviposition.

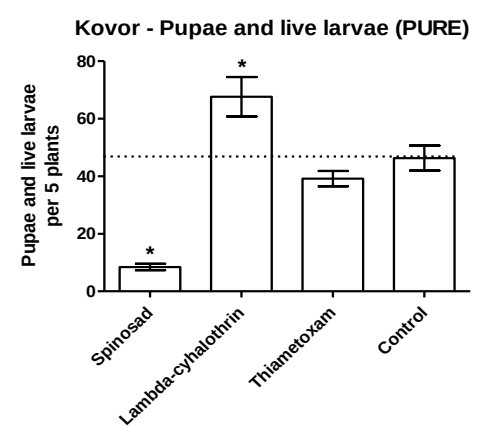
Cabbage root fly damage to broccoli.

TECHNICAL RESULTS

Results from Slovenia

The use of biological insecticide (spinosad) resulted in a pest reduction equal to one of broad spectrum insecticides (thiametoxam). Some broad spectrum insecticides (lambda-cychalotrin) resulted in an increase of pest pressure, probably due to elimination of pest's natural enemies. Treatments with PERLKA (lime nitrogen), Naturalis (entomopathogenic fungus Beauveria bassiana*) or straw did not achieve sufficient pest control.*

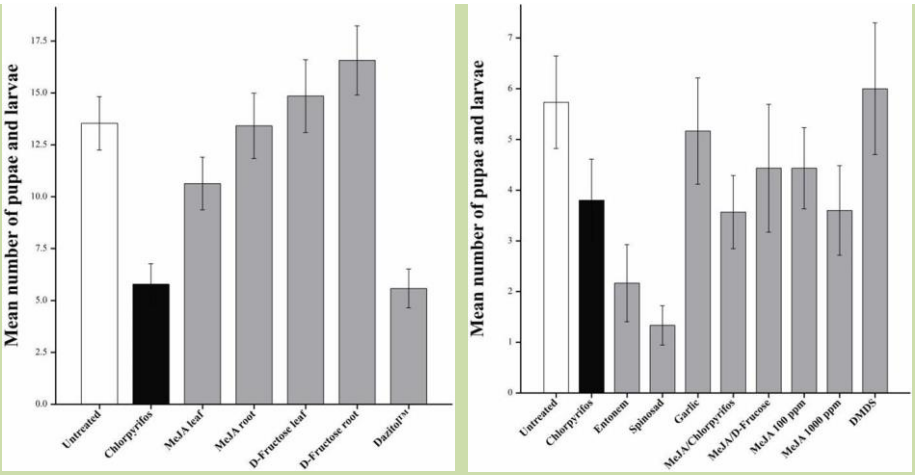




Number of cabbage root fly pupae and larvae per broccoli plant in the on-station trial in Slovenia.

Results from Scotland (HDC funded studentship)

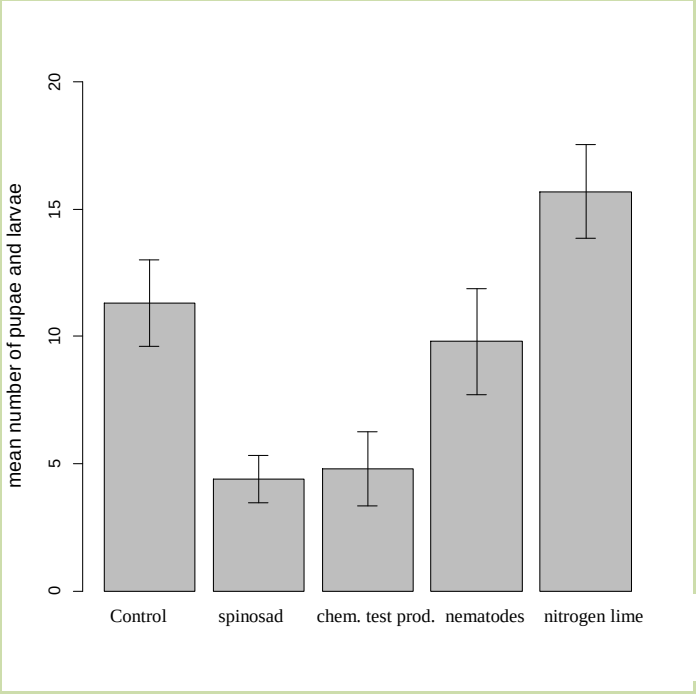
Results from on-farm field experiment 1 (2011) showed that Chlorpyrifos (Dursban WG) significantly reduced cabbage root fly feeding damage and the number of pupae/larvae recovered compared with untreated controls. MeJA leaf and D-Fructose leaf treatments marginally, but not significantly, reduced larval damage compared with untreated plants. Only MeJA leaf treated plants significantly reduced the number of pupae/larvae when compared with untreated plants, but numbers were still significantly higher than plants treated with Chlorpyrifos. MeJA leaf and root treatments inhibited plant growth and significantly reduced yield. Dazitol™ was severely phytotoxic which influenced results. Numbers of cabbage root fly pupae/larvae recovered at the end of field experiment 2 (2012) were lower than 2011. The lack of significant differences between treated and control plants for cabbage root fly larval root damage potentially reflected the low number of eggs and consequently larvae present. Despite this, results demonstrated that Entonem (Steinernema feltiae Filipjev), Spinosad (Tracer®), and a combination of the elicitor MeJA and reduced rate Chlorpyrifos showed some efficacy for controlling cabbage root fly larvae. At the concentrations tested, Garlic, MeJA on its own, DMDS (dimethyl disulfide), D-Fructose on its own and in combination, and Dazitol™ treatments were either inconsistent or reduced yield (phytotoxic) in comparison to plants treated with Chlorpyrifos and untreated control plants.



Number of cabbage root fly pupae and larvae on broccoli plants in Scotland 2011 (left) and 2012 (right).

Results from Germany

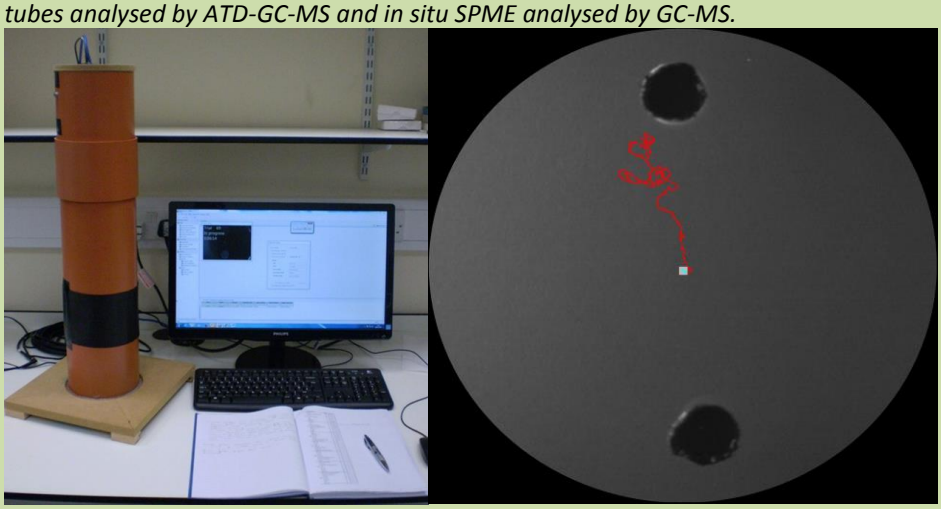
The application of spinosad and the chemical test product (not yet registered) resulted in a reduction of pupae and larvae by 50 %. Compared to the control nematodes had only slight pupae reducing properties, whereas with nitrogen lime even more pupae and larvae were found.



Number of cabbage root fly pupae and larvae on cauliflower plants in Germany in 2013.

SUSTAINABILITY OF IPM SOLUTIONS

In Denmark, France, Germany, Slovenia, The Netherlands and United Kingdom several on-station experiments were set up in countries with different growing and climate conditions. With the aim of reducing the dependency of chemical plant protection products, different IPM solutions were designed and tested for diverse Brassica crops. Therefore experiments for reducing insecticides used for controlling cabbage root fly were performed. Besides chemical insecticides, different alternative products

	(entomopathogenic nematodes and fungi, volatiles) were investigated. However those products still need further investigation under practical conditions and are at the moment too expensive for field applications.
INNOVATIVE METHODS"	*A novel non-invasive laboratory/glasshouse/field in situ solid phase micro extraction (SPME)-based root volatiles collection method and EthoVision® video-tracking choice-test bioassay method were developed in Scotland. Root volatiles analysis revealed marked differences in the emission rates of volatile compounds detected before and after mechanical and cabbage root fly larval feeding damage.* *EthoVision® bioassay results revealed that newly hatched cabbage root fly larvae were significantly attracted to host plant root volatiles. A major volatile constituent of broccoli roots, DMDS, was attractive to larvae, but toxic at the highest dose tested.*  *Root volatiles collection from glasshouse- and field-grown broccoli plants using Tenax TA tubes analysed by ATD-GC-MS and in situ SPME analysed by GC-MS.*  *EthoVision® video-tracking method and cabbage root fly larval tracks.* *In France the response of insects towards plant volatiles (DMDS, hexenyl acetate) was tested in the field. DMDS strongly decreased egg laying in the field while hexenyl acetate increased it. These two coumpounds would be interesting to consider in a push pull approach. DMDS is also attractive to predators such as staphylinids and carabid beetles and could be used to enhance natural control of the fly*

LIMITS AND CONDITIONS OF SUCCESS, ADAPTATIONS	*Current recommendation to farmers is the drench of plants with spinosad shortly before planting. Despite the positive results, in some countries (Slovenia) this substance is not registered for cabbage root fly control. Therefore action is needed to facilitate the registration process to enable such pest control. Additionally, more research is needed to find alternative products for cabbage root fly control, as some reports exist that spinosad can harm non-target organisms.*
REFERENCES	*RAZINGER, Jaka, LUTZ, Matthias, SCHROERS, Hans-Josef, UREK, Gregor, GRUNDER, Jürg M. Evaluation of insect associated and plant growth promoting fungi in the control of cabbage root flies. Journal of economic entomology, 2014, 107, 1348-1354.* *RAZINGER, Jaka, LUTZ, Matthias, SCHROERS, Hans-Josef, PALMISANO, Marilena, WOHLER, Christian, UREK, Gregor, GRUNDER, Jürg M. Direct plantlet inoculation with soil or insect-associated fungi may control cabbage root fly maggots. Journal of invertebrate pathology, 2014, 120, 59-66, doi: 10.1016/j.jip.2014.05.006.*