

**Project title**                    **Control of soil-borne diseases by the biofumigation effect of *Brassic***

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Timescale:                         1<sup>st</sup> March 2003- 1<sup>st</sup> March 2006 (extended until 31<sup>st</sup> October'07).  
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## **Background**

Over the last years, in the search for a more environmental friendly pest and disease control, efforts have been directed towards a better understanding of the biological effects of natural products and the transformation products thereof. Plant extracts and crop residues have also been considered to have a potential role in sustainable agriculture, controlling pests and diseases, while minimizing dependence on artificial inputs such as pesticides. Special focus has been made on members of the *Brassicaceae* family, which have been shown to act as suppressors of pests and disease organisms. This effect is generally attributed to a range of biocidal compounds released into the soil when glucosinolates are transformed into bioactive compounds. Isothiocyanates have often been regarded as the most toxic among the various types of glucosinolate derived products, and they have been found to have nematocidal, fungicidal, insecticidal and herbicidal properties. However, the toxic properties of isothiocyanates can be seriously questioned when their high reactivity is taken into account. Disease control by Brassica species (termed as "biofumigation") has normally been achieved by either including these plants as sole crops in the rotation ("break-crop" effect) or by using them as green manure, while their use as extracts has not been broadly investigated. However, before Brassica species could be used effectively, either as a sole crop in a rotation, as green manure or as extracts in formulations, more knowledge is required about their composition, the factors influencing their effectiveness in disease-control and their optimal frequency, temporal sequence and spatial distribution when included in crop rotations.

## **Objective**

This PhD project is aimed at the achievement of knowledge on the processes involved in the biofumigation potential of Brassicas. Its overall approach is to study the glucosinolates produced by the Brassica plant, the glucosinolate-hydrolysis products and the effect of these compounds on soil-borne pathogens. The specific objectives can be defined as follows:

- To study the timing and the compartmentalization of the production of glucosinolates in certain Brassica species.
- To determine the type of products produced in enzyme catalysed hydrolysis of *Brassica* glucosinolates using active enzymes from these plants and evaluating the physico-chemical properties of products produced at different assay conditions.
- To study the biofumigation potential of the selected Brassica cultivars on specific pathogen targets using different methods.
- To determine the relative contribution and toxicity thresholds of the different glucosinolate-hydrolysis compounds in the biofumigation effect of the selected Brassica cultivars.
- To check the real applicability of biofumigation in an already established sustainable rotation (in collaboration with a Spanish agricultural institute).

## Progress - 2007

### PhD Courses:

SOAR Summer School 2007.

### Experiments:

Glucosinolates and degradation products (cont.): Experiments were conducted by Capillary Electrophoresis in order to identify the type of compounds produced in enzyme catalysed hydrolysis of different glucosinolates from *Brassica* species at different degradation conditions.

### Conferences:

Bellostas, N., Bjerregaard, C., Jensen, S.K., Sørensen, H. Sørensen, J.C., Sørensen, S. 2007. Nutritional value of cruciferous oilseed crops in relation to profile of accumulated biomolecules with especial regard to glucosinolates transformation products. In: Proceedings of the 12<sup>th</sup> International Rapeseed Congress, 26-29 March 2007, Wuhan, China, Vol. V, 25-28.

Bellostas, N., Hansen, L. M., Jørgensen, L. N., Kudsk, P., Madsen, P. H., Sørensen, J. C., Sørensen, H. 2007. Biological activity of glucosinolate derived compounds isolated from seed meal of Brassica crops and evaluated as plant and food protection agents. In: Proceedings of the 12<sup>th</sup> International Rapeseed Congress, 26-29 March 2007, Wuhan, China, Vol. V, 98-101.

Bellostas, N., Sørensen, J. C., Sørensen, H. 2007. Influence of pH and type of myrosinase complex on the products obtained in the myrosinase catalysed hydrolysis of glucosinolates – a MECC study. In: Proceedings of the 12<sup>th</sup> International Rapeseed Congress, 26-29 March 2007, Wuhan, China, Vol. V, 113-115.

Bagger, C., Bellostas, N., Jensen, S. K., Sørensen, J. C., Sørensen, H., Sørensen, S. 2007. Processing-bioprocessing of oilseed rape in bioenergy production and value added utilization of remaining seed components. In: Proceedings of the 12<sup>th</sup> International Rapeseed Congress, 26-29 March 2007, Wuhan, China, Vol. V, 315-317.

### Teaching:

Supervision of two Master and one Erasmus students (January-September) in the projects “The reactivity of phenethylisothiocyanate in free and glutathione-conjugated form”, “Broccoli glucosinolates and derived products and their relevance to xenobiotic metabolism” and “Glucosinolates in *Raphanus sativus* and *Barbarea vulgaris*”. Supervision during the experimental part and the writing process.

## Plans – 2008

The Thesis will be submitted before the end of October 2007.

## Publications

11395: Glucosinolate profiling of seeds and sprouts of <i>B. oleracea</i> varieties used for food.	Deposited 01 October 2007
11397: Nutritional value of cruciferous oilseed crops in relation to profile of accumulated biomolecules with especial regard to glucosinolates transformation products.	Deposited 01 October 2007
11398: Biological activity of glucosinolate derived compounds isolated from seed meal of Brassica crops and evaluated as plant and food protection agents.	Deposited 01 October 2007
11399: Influence of pH and type of myrosinase complex on the products obtained in the myrosinase catalysed hydrolysis of glucosinolates – a MECC study.	Deposited 01 October 2007
11400: Processing-bioprocessing of oilseed rape in bioenergy production and value added utilization of remaining seed components.	Deposited 01 October 2007

<a href="#"><u>9267: Glucosinolate types and concentrations in seedlings of different Brassica species used for food</u></a>	Accepted 18 September 2006
<a href="#"><u>9266: Glucosinolate hydrolysis products for weed control</u></a>	Accepted 18 September 2006
<a href="#"><u>9263: Effect of ascorbic acid and glutathione on the production of nitriles by myrosinase</u></a>	Accepted 18 September 2006
<a href="#"><u>9261: In vitro screening of the effect of three glucosinolate derived nitriles on soil-borne fungi</u></a>	Accepted 18 September 2006
<a href="#"><u>9260: Micellar electrokinetic capillary chromatography—Synchronous monitoring of substrate and products in the myrosinase catalysed hydrolysis of glucosinolates</u></a>	Accepted 18 September 2006
<a href="#"><u>7501: Glucosinolate hydrolysis compounds for weed control</u></a>	Accepted 09 May 2006
<a href="#"><u>5611: Qualitative and quantitative evaluation of glucosinolates in cruciferous plants during their life cycles</u></a>	Accepted 21 September 2005