INTRODUCTION OF THE FATEALLCHEM PROJECT

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INTRODUCTION

In recent years there has been an increasing focus on the prospects of exploiting allelopathy as an alternative strategy for controlling in particular weeds but also insects and diseases. However, the consequences for the environment and to the consumer of growing cultivars with enhanced allelochemical properties should be investigated before such cultivars are introduced in agriculture. Recently, the search for genes involved in the production of allelochemicals has begun. This opens up for improving the allelopathic activity of crops either through traditional plant breeding or by genetical engineering. Such a development will increase the potential use of allelopathic crops not only in conventional farming systems, where such crops or extracted allelochemicals may replace the use of synthetical pesticides, but also in organic farming systems, where synthetical pesticides are not allowed, and the use of allelochemical crop varieties may compensate for some of the yield reduction caused by weeds and/or pests. Thus, in any farming system, indicators on new or increased levels of chemical compounds are needed to assess the progress in improving the sustainability of farming systems.

Wheat is one of the major crops in Europe and some of the allelopathic compounds in wheat have already been identified. Wheat is therefore a suitable crop for a study investigating the environmental and human risk associated with the widespread use of allelopathic crops.

The overall objective of our project is to perform an environmental and human risk assessment of exploiting the allelopathic properties of winter wheat in conventional and organic farming and to develop a framework for future assessments of allelopathic crops.

PART OBJECTIVES

Geo-environmental and climatic factors, such as the amount of nutrients in the soil, the type of fertiliser application (manure/chemical fertilisers), the temperature, the solar radiation, and the use of synthetic herbicides and/or insecticides may influence the content of allelochemicals.

The first part objective of the project therefore was to identify and quantify the amount of allelochemicals and their metabolites in a) wheat of different origins and grown under different climatic and environmental conditions (Denmark and Spain) as well as in different farming systems (conventional and organic) and b) in the surrounding soil environment under the above mentioned conditions.

The development of agricultural practices exploiting the allelopathic properties of crops as a control measure against weeds and insects requires thorough studies on the effects of the individual allelochemicals on target weeds and insects. Furthermore a thorough knowledge of the actual doses of allelochemicals required to control weeds, pest insects and fungi is a prerequisite for assessing the environmental and toxicological risks of exploiting allelochemicals.

The second part objective of the project therefore was to generate dose-response relationships of major wheat allelochemicals on the most important target weeds, pest insects and their predators/parasitoids and fungi.

The allelochemicals are usually not found in wheat grain but in the other parts of the plant (straw, leaves and root) which are ploughed under in the field. Studies of the fate and effects of the allelochemicals from the plant residues in the soil and water environment are practically non-existing. Allelochemicals are natural products and are generally expected to be biodegradable. However, the degradation routes and rates are unknown.

Water and soil organisms as well as human beings might have adapted to a certain exposure to naturally produced chemicals. However, many well-known cases have shown that adaptation did not always take place (i.e. toxic compounds from Solanaceae, nerve poison from *Lathyrus sativus* and cyanide from Cassava roots).

Consumers health is a matter of concern irrespectively of whether the drinking water comes from ground water or from surface waters. Toxicological evaluation of synthetic pesticides in relation to human health is well documented, as is the toxicological effects on humans of some highly toxic naturally produced chemicals , but the toxicological effects of allelochemical compounds on humans is not known at all.

The third part objective of the project therefore was to assess the risk to environment and consumers of wheat allelochemicals and their metabolites in comparison with risk evaluation of synthetic pesticides according to the methodology described in Annex VI to Directive 91/414/EEC, on the marketing of plant protection products – the Directive on Uniform Principles.

Rules-based systems for prediction of ecotoxicology and fate of chemical compounds, i.e. Quantitive Structure Activity Relationships (QSAR) are gaining importance as tools for evaluation of new chemicals. The same systems might be applied to allelochemical compounds. For a thorough evaluation of the sustainability of different farming systems including the use of synthetic chemicals, natural compounds with pesticide effects or allelochemicals, empirical studies are surely needed. For such complex systems however, where empirical studies cannot be performed for all possible scenarios, rules-based models for prediction of properties of chemical compounds must be considered and brought into use to be able to develop indicators for risk assessment.

The fourth part objective of the study therefore was to compare the empirical results with theoretical results using rules-based prediction of toxicity and rule-based prediction of environmental transformation.

Breeding programmes have been used differently in the Western and Eastern part of Europe in former time and the capacity of the wheat varieties for producing allelochemicals might differ for this reason.

The fifth part objective of the study therefore was to quantify wheat allelochemicals in old wheat varieties from Eastern Europe that have not been subjected to breeding programmes.

PARTICIPATING INSTITUTES

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WEB-SITE OF THE PROJECT

The abstracts published in this booklet will also be available on the web-site of the project, **http://www.fateallchem.dk** together with a number of other scientific publications. The web-site will be maintained even after the finalisation of the official project period.

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