



Intercropping of cereals and grain legumes in European organic farming systems

Intercropping, the simultaneous cultivation of more than one species or cultivar on the same piece of land, can increase organic cereal and grain legume protein production in Europe, enhance biodiversity in European farming systems and safeguard the organic farmers' earnings. Despite its advantages, intercropping has traditionally been neglected in research on plant production systems in temperate agricultural ecosystems, due to its complexity and because of the difficulties for its management and lesser relevance in cropping systems based on agrochemicals.

The INTERCROP project takes a unique multidisciplinary and integrated European approach to evaluate the potential of this technique and define intercropping strategies for sustainable plant production management in organic farming systems under different regional conditions in Europe.

Intercropping for an increased production, weed control, improved product quality and prevention of N-losses

Intercropping is defined as the growth of more than one crop species or cultivar simultaneously in the same field during a growing season. It is the practical application of ecological principles such as diversity, crop interaction and other natural regulation mechanisms. Intercropping has many advantages, mainly related to the complementary use of environmental resources by the component crops which results in increased and more stable yields, better nutrient recycling in the soil, better control of weeds, pests and diseases and an increased biodiversity. Cereals and legumes, both for forage and for grain, are the most common intercrops. The main advantage of the legume-cereal intercrop is the input of nitrogen to the system by the fixation of atmospheric N₂ by the legume, which results in improved use of renewable nitrogen sources.

Cooperation at the EU level

INTERCROP is composed by a multidisciplinary team of European scientists which work co-ordinately, conducting research on intercropping and facilitating the exchange and synthesis of existing knowledge in order to make recommendations for using intercropping under different regional conditions and farming systems.

INTERCROP objectives

The project's core experiment is a field trial in which pea and barley are intercropped in with spring sowing and compared with the respective crops in pure stands. To compare the performance of intercropping in organic farming situations across Europe, all INTERCROP partners have established this experiment at organic sites using the same cultivars.

INTERCROP consists of six inter-related work-packages (WP) made up of tasks that involve several partners:

WP1. Survey and demonstration on-farm

During 2004, almost 100 organic farmers across Europe were interviewed about intercropping. The survey of farms in different countries was based on a standard questionnaire covering subjects including farm structure, crop rotation, fertiliser use, plant protection methods and type of intercrop.

In the summer 2005, on-farm demonstrations have been carried out in order to increase awareness and provide advice on intercropping, especially cereal-grain legume systems, in organic farming.

WP2. Agronomic performance and yield stability

In the basic field trial, measurements such as leaf area index, dry matter production and grain yield have been taken each year by all partners in order to determine the agronomic performance of cereal-grain legume intercrops in terms of yield advantage and to study the yield stability compared with associated sole crops. At some sites, a series of extra designs within the basic field trial have allowed for the collection of additional information about specific strategies for optimising the use of environmental resources by the intercrop.

WP3. Nutrient acquisition, N loss and subsequent crop N

Total N acquisition and soil N have been determined annually in the intercrops and sole crops in order to estimate N balances, effects of intercropping on post-harvest N dynamics in the soil and the potential risks of N leaching. The N₂ fixed from the atmosphere and taken up from the soil have also been estimated using ¹⁵N isotope techniques. N accumulation in a following autumn-established cereal as influenced by the pre-crop has been determined and its economic effects estimated. The acquisition of other nutrients such as phosphorous, potassium and sulphur by the intercrop has also been monitored.

WP4. Intercropping for weed, pest and disease management

In the basic field trial, pests and diseases have been monitored at the key physiological stages of the crops and weed species, weed dry matter production and weed N content have also been determined every year. A glasshouse study on root elongation of spring pea, spring barley, white mustard and rye grass was also conducted, based on the hypothesis that the reduced weed pressure often observed in intercrops is due to increased root competition for nutrients.

WP5. Quality parameters in intercropped components and following crops

The different interaction mechanisms that occur between plant species when intercropped as well as the effect of the intercrop on the following crop in the rotation might influence grain quality. This has been studied by determining the effect of intercropping on a series of quality factors, such as physical grain quality, ratio of nitrogen and sulphur concentra-

tions, protein quality of wheat for bread-making and livestock feeding value of barley, wheat, pea and faba beans.

WP6. Modelling

An existing simulation model (STICS-monocrop) has been adapted for use with pea-barley intercropping with a special emphasis on nitrogen uptake by the crops. The parameterisation of STICS-intercrop has been based on a set of data obtained from a basic pea-barley experiment in which crops were grown in optimal conditions. The model has been validated with a set of data collected annually from the basic field trial by all partners. The STICS-intercrop model is now suitable for use with different crops, various crop management methods (including low input farming) as well as different pedoclimatic situations.

Dissemination activities

All of the INTERCROP partners have successfully gathered the required data for each WP and this has provided a wealth of interesting new information. During the duration of the project partners have been very active in the dissemination of information about the activities being conducted in INTERCROP.

Open field days to visit the different experiments have been organized yearly at the different sites, partners have frequently given talks at popular and scientific levels, and scientific articles either fully or partially based on the results have also been produced. Students have also been involved at different levels. The project is also publicized by presentation of posters at different congresses and symposiums.





Facts on INTERCROP

INTERCROP is a three-year project funded by the European Community under the 5th Framework Programme of RTD, Key Action no. 5.1.1 (Sustainable Agriculture – New and improved production and farming systems).

Project duration

The project was initiated in January 2003 and will finish in December 2005.

Partners

INTERCROP brings together scientists from eight institutions in Denmark, France, Germany, Italy and UK, who have complementary and internationally respected expertise in different aspects of the project, including crop ecology, plant nutritional physiology, nutrient cycling, grain quality, cropping systems research, crop modelling and organic farming.

The partners are:

<i>Denmark:</i>	Risø National Laboratory & Danish Institute of Agricultural Sciences.
<i>France:</i>	Ecole Supérieure d'Agriculture d'Angers & INRA Avignon
<i>Germany:</i>	Kassel University.
<i>Italy:</i>	Università "Mediterranea" di Reggio Calabria.
<i>UK:</i>	University of Reading.

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More information about INTERCROP

In November 2003 INTERCROP opened its own website (www.intercrop.dk). The site contains all the project information and is updated frequently with information concerning the project and partners' activities.

In May 2006, INTERCROP will participate in a major organic congress to be held in Odense, Denmark. The congress will be held in collaboration with other EU funded projects.

