Some of the main rationales behind organic farming are the production of food of a better quality and the protection of the soil and the environment. However, organic production is not well defined, and can be done in very different ways.

In this project we examine the effects of different organic cropping systems for product quality and environmental effects. We compare four cropping systems, one conventional and three organic. The rotation of vegetables and cereals is identical, but the three organic systems vary in their dependence on external inputs. One organic system is based on import of animal manure for fertilization. The two others are based on the use of fertility-building crops, and in one system vegetables are also intercropped with green manures to improve the conditions for natural regulation of insect pests.
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The project objectives:

- In this project, we study the effect of organic cropping methods on a number of aspects of product quality, on storability, on pest damage and natural regulation, and on nutrient balances and nitrate leaching losses.
- We compare three types of organic systems to one conventional system to get data showing general effects of organic production methods, but also to study whether there are significant differences among the organic systems in product quality or environmental impacts.
- A further objective is to contribute vegetable and cereal material to human and animal feeding studies comparing organic and conventional products.

Organic cropping Systems for Vegetable production

With organic farming the aim is to produce food of a better quality and to develop sustainable crop production systems, which protect our soil and our environment. This is the background for the increasing production and sale of organic products, and for the political support for organic farming.

However, organic farming can be performed in very different ways. The rules do not cover every aspect, and they are also often a compromise. The rules are strict in some respects to ensure that the main principles are followed, but in other respects, compromises are also accepted in order to ensure that the difficulties for the organic farmers do not become insurmountable. Some examples are the regulations allowing import of manure from conventional farms, the use of energy-intensive methods for weed control, or the use of copper compounds as fungicides. With the current growth in organic farming, it is often feared that organic producers exploit such possibilities within the rules to allow them to produce organic food and sell it at the high prices without really adhering to the principles and ideas of organic farming or achieving its main goals. If that were the case, organic farming could loose its support from consumers and politicians.

However, even when “exploiting the rules”, organic producers are not allowed to use synthetic pesticides or fertilizers. If the use of these inputs is really the main reason for the problems we see in conventional farming, then these less ideal organic systems may still be fully acceptable, even if they do not adhere to all the values promoted by the organic farming sector.
Investigations – six subprojects

The project is organized as six subprojects covering various aspects of the studies:

1. Field experiments
   The first subproject is responsible for the field experiments, growing the crops and documenting general results in terms of yield, general quality evaluation of products, and quantification of damage by major pests and diseases on the vegetables (onions, carrots, cabbages and lettuce). Products, field plots and general data are made available for studies within the other subprojects, and products are delivered for the feeding studies.

2. Vegetable quality
   In subproject 2, various aspects of vegetable quality are studied. Lettuce, cabbage and carrot are analyzed for aroma compounds and for other compounds responsible for taste. A tasting panel will study effects of the cropping systems on vegetable taste. Correlation studies are made to test how observed differences in taste may be correlated to some of the compounds quantified by analysis. Further, a number of secondary compounds, which are presumed to have beneficial effects on human health, are measured, in an attempt to study whether different production methods may affect the human health value of the vegetable products.

3. Protein expression
   In subproject 3, samples from the vegetables are analyzed by proteomic analysis, a method which allows us to quantify the content of several thousand proteins. By quantifying so many different proteins, we hope to be able to get a broad indication of how strongly the cropping systems affect plant physiology. Will the protein expression in the three organic systems be very similar, while the conventionally grown vegetables will be clearly different? Or will there be main differences among the three organic systems? If single proteins are found to differ strongly among systems, we will try to identify them and their function.

4. Storability of carrots
   In subproject 4 we focus on the storability of carrots from the different systems, and their susceptibility to diseases during storage. Some storage diseases will only attack when the carrots have been stored for some time, presumably when the ability to resist fungal attack has declined. We will study whether organically grown carrots have a higher disease resistance or have the ability to maintain their resistance for a longer time during storage than conventional carrots.

5. Natural regulation of insect pests
   In subproject 5 we study effects of cropping systems on natural regulation of insect pests in the field. The main system studied is insect pathogenic fungi. Are these fungi more frequent, important and diverse in the organic systems, which should in many ways give better living conditions for a range of insect species? Other aspects of natural regulation are also investigated, e.g. the occurrence of natural enemies to insect pests and survival of cabbage root fly during egg and pupae stages.

6. Environmental effects of different systems
   In subproject 6 we study environmental effects of the different systems. We study nutrient balances and the nitrogen dynamics in the system, employing soil and root studies to 2.5 m depth in the soil. This will give us data to quantify the significance of fertilization, of fertility-building crops, and of deep-rooted crops on nitrogen availability and losses. We will use a simulation model to get more quantitative estimates of e.g. nitrate leaching. We will try to integrate the results from the whole project into a broad analysis of advantages and disadvantages of the three organic cropping systems tested.
Organic cropping Systems for Vegetable production  
- product Quality, natural Regulation and Environmental effects  
(VEG-QURE 2007-2010)

Carrots grown among rows of intercrop meant to improve natural regulation in the field

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Links
www.vegqure.elr.dk/uk
www.icrofs.org

About ICROFS
The International Centre for Research in Organic Food Systems (ICROFS) is a “centre without walls” where the research is performed in interdisciplinary collaboration between research groups in different institutions. The centre is an expansion of the former research centre DARCOF, which the Danish Government in 2008 decided to give an international mandate and an international board.

The main purpose of ICROFS is to coordinate and monitor international research in organic food and farming systems in order to achieve optimum benefit from the allocated resources. Further, the aim of ICROFS is to initiate research and create impact of the research results through support and dissemination of high quality research of international standard.

More information at www.icrofs.org