



Annual Status Report 2001 and Application for Continuation in 2002

For research projects financed by grants from
The Directorate for Food, Fisheries and Agro Business
under the Danish Ministry of Food, Agriculture and Fisheries

1. Research program

Research in organic farming 2000-2005 (DARCOF II)

2. Project title and number

I.1 Organic production of cucumber and tomato grown in composted plant material from field crops.

3. Head of project

Kristian Thorup-Kristensen, Head of Research Group,
Danish Institute of Agricultural Sciences, Department of Horticulture, P.O.Box 102,
DK-5792 Aarslev.
Phone.: 63 90 41 28, Fax: 63 90 43 94
E-mail: ktk@agrsci.dk

4. Participating institutes

Danish Institute of Agricultural Sciences, Department of Horticulture, P.O.Box 102,
DK-5792 Aarslev.
Phone.: 63 90 43 43, Fax: 63 90 43 94
E-mail: kristian.thorupkristensen@agrsci.dk

5. Contact persons

Head of research unit Kristian Thorup-Kristensen, ktk@agrsci.dk, tlf.: 6390 4128
Senior scientist Kai Lønne Nielsen, kai.nielsen@agrsci.dk, tlf.: 6390 4225
Scientist Morten Nielsen, morten.nielsen@agrsci.dk, tlf.: 6390 4307

6. Other project staff

Senior scientist Jørn Nygaard Sørensen, jornn.sorensen@agrsci.dk, tlf.: 6390 4124
PhD student Dorte Beck Nielsen, dorte.becknielsen@agrsci.dk, tlf.: 6390 4136
Research technician, Jens Barfod, jens.barfod@agrsci.dk, tlf.: 6390 4343

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7. **Start of project: 2000**
End of project: 2004

8. **Annual report/Application for continuation in 2001**

A. Objectives and expected achievements (from application)

The overall project aim is to promote organic production of greenhouse vegetables by developing a method where easily available growth substrates can be used for the production. We want to compose growing media, which can supply all or most of the necessary plant nutrients, and limit the need for supplementary fertilisation. On the other hand, large excesses of nutrients should be avoided as such excesses may depress plant growth and yield quality. And third, the environment should not be contaminated with excesses of the supplied nutrients. This will be done by the development of production systems and by identifying and analysing the main obstacles for the fertilisation both with respect to agronomic and ecological performance:

1. The proposal aims at the following main achievements: To describe the nutrient dynamics and nutrient use efficiency of the current production systems.
2. To develop a production system for selected greenhouse vegetables with optimized nutrient use efficiency and thereby reduce the risks of nutrient leaching. The production system will be based on the utilisation of cheap and locally available composted plant material from field crops.
3. To evaluate the quality of the greenhouse vegetables from contrasting cropping systems.

B. Project summary (from application)

The overall aim of the project is to develop production systems for organically grown glasshouse vegetables of good quality, utilising cheap, easily available growth substrates. The substrates should, first of all, release sufficient nutrients for the plants through the cropping period, but large excesses of nutrients should be avoided. Furthermore, the environment should not be contaminated with excesses of the supplied nutrients.

In greenhouse vegetable production, large amounts of plant nutrients are needed, and e.g. a tomato crop will need approximately 20 times as much nitrogen as most field crops. In organic production this leads to two main problems. Plant nutrients is a limited resource in organic crop production, and it can be difficult to acquire the large amounts needed from organic sources. In organic production where the crops are grown directly in the soil, addition of such large amounts of manure or compost to the soil can lead to serious risk of nitrogen leaching and other losses of plant nutrients to the environment.

It is generally assumed that organically produced vegetables is of better quality than conventional products, though such differences are not well documented. As plant nutrition cannot be controlled as precisely as in conventional production, temporal quality problems can occur due to excess, deficiency or imbalance between plant nutrients.

Thus, there are potential problems with nutrient losses and possibly quality, but we know little about how serious these problems are in the present organic vegetable production systems. Therefore the first goal of the project is to study the present systems used in organic greenhouse vegetable production, study nutrient balance, potential for nitrogen leaching loss and quality of the products.

The problems discussed, in combination with large investments for converting greenhouses from conventional to organic production and the risk for build up of soil diseases and pests in the greenhouse soil, has led to an interest in organic production where the plants are grown in compost in limited beds, i.e. without contact to the soil in the greenhouse. Using this method, the crops can be grown in organically produced composts, but it is possible to combine this with some of the advantages from the conventional production methods. Leaching losses can be prevented as drainage water can be collected, and problems with nematodes and soil borne diseases are prevented as the compost is changed for each crop. At the same time, conversion of conventional greenhouses to organic production will be cheaper, as much less changes will be needed in the greenhouse.

However, growing the crops in limited beds is seen by many as being in conflict with the basic ideas behind organic farming, and growing the plants directly in the soil also has advantages which will be lost by changing to growing the crops in limited beds. Soil is a very diverse growth medium, which will supply all nutrients and trace elements to the crop. Further, when the plants are grown in the soil, it will allow them to explore a large soil volume, and thus exploit the reserves of water and many nutrients within the rooting zone of the crop will be bigger than in limited beds.

The conclusion is, that important problems and advantages are found with either of the systems, and a solution could be to develop a system which combines the most important advantages of the two systems. In the project we want to compare these two systems with a intermediate system, where most of the compost is added to a limited bed, but where the plants are allowed to develop their root system both in the compost and in the surrounding soil. The amount of compost added directly to the soil can then be reduced to much lower levels and thereby the leaching risk will be strongly reduced, the drainage water from the compost can be collected, and the compost will be changed before each crop, so at least in this part of the root zone of the crop it will not encounter soil-borne pests and diseases due to previous crops.

The objective of the project is to: 1) Study existing organic greenhouse vegetable production systems, e.g. nutrient balance, effects on soil organic matter and nitrogen leaching losses and on quality of the products, 2) Develop composts primarily based on clover-grass hay, straw and other plant materials which will be easy to obtain from organic farms, and 3) Develop and compare existing and alternative growing systems, study their effect on nutrient balance, leaching losses, crop production and quality. The results from the first part of the project will be used when deciding how much of the effort in the later part is to go into development of alternative systems, and how much is to be used for further development of the existing methods.

Table 1: Work package list (from application)

No.	Work package title	Participants*	Budget (1.000 DKr)	Start	End	Deliverable No:
1	The nutrient dynamics and nutrient use efficiency of the current production systems.	<u>Kai Lønne Nielsen</u> , Morten Nielsen	0.85	2000	2002	1-2
2	Development of plant based compost	<u>Kai Lønne Nielsen</u> , Dorte Beck Nielsen	1.0	2001	2003	3-6
3	Project co-ordination, development and comparison of production systems for tomatoes.	<u>Kristian Thorup-Kristensen</u> , Jørn Nygaard Sørensen	2.05	2001	2004	7-12
4	Quality evaluation of the greenhouse vegetables from contrasting cropping systems	<u>Morten Nielsen</u>	0.8	2002	2004	13-16

* Responsible participants are underlined

C. Progress

The project is now almost through the initial phase of evaluation of current practices of organic greenhouse vegetable production. The results show some of the problems of handling the very large quantities of nutrients that must be added to these very intensive production systems where crop rotation is not practicable. During this process we have had meetings with a group of producers associated to the experiment, two organic and one conventional producer, and discussed the work to be done, the results and the plans.

After this initial phase of studying existing systems we are now starting the development part of the project where we are going to work on development of composts and cropping systems.

During the year we have included two further researchers into the project; Dorte Beck-Nielsen who is employed as a PhD student to work with development of the plant based composts (WP2), and senior scientist Jørn Nygaard Sørensen to make the experiments on production systems (WP3). Unfortunately, Kai Lønne Nielsen have found another job, and will leave the project by the end of 2001. These changes in project staff does give some problems, but we do not expect them to change our project plans very much.

C.1 Annual description (resume) of main results and conclusions

WP1 The nutrient dynamics and nutrient use efficiency of the current production systems

The starting point of this project has been to describe the nutrient dynamics and nutrient use efficiency of the current production systems and to evaluate the quality of the greenhouse vegetables from contrasting cropping systems. By the end of the growing season 2000 (end of October – December) the first measurements of the nutrient status of two organic greenhouse operations took place as described below.

Two greenhouse nurseries were selected for the first samplings in the project: "Gartneriet Markhaven" growing organic tomatoes and "Narayana" where they grow organic cucumbers.

Soil were sampled to 250 cm depth and into layers of 50 cm for analysis and analysed for content of inorganic N (N_{min}) and dry matter percentage, Mg, P, K, pH, total-C, and total-N (tab. 1.1). The amounts of nitrate found in the soil at the end of the growing season can be seen in fig. 1.1.

Table 1.1. The concentration of plant available ammonium-N (NH_4-N), phosphorus (Pt) and potassium (Kt) and the amount of plant available NH_4-N , P and K expressed as kg per ha., measured in an organic nursery (Gartneriet Markhaven) in a "4 year old organic soil" under ungrafted tomato plants.

Depth (cm)	NH_4-N (mg/kg)	Pt (mg/100g)	Kt (mg/100g)
0-50	2.93	10.20	74.50
50-100	0.57	2.30	9.00
100-150	0.13	0.70	7.90
150-200	0.20	0.60	7.20
200-250	0.23	0.50	7.60
kg/ha	28	996	7406

At "Gartneriet Markhaven" we took soil samples in three greenhouses which had been changed to organic production at different times, 15 years ago, 10 years ago and 4 years ago, to test whether the large amounts of organic matter added for years led to an accumulation of organic N and thus lead to soils with very high mineralisation potential. Further, samples were taken within a subplot where the tomato plants had been grafted onto a supposedly more healthy root system rather than growing on their own root system (Fig. 1.1.).

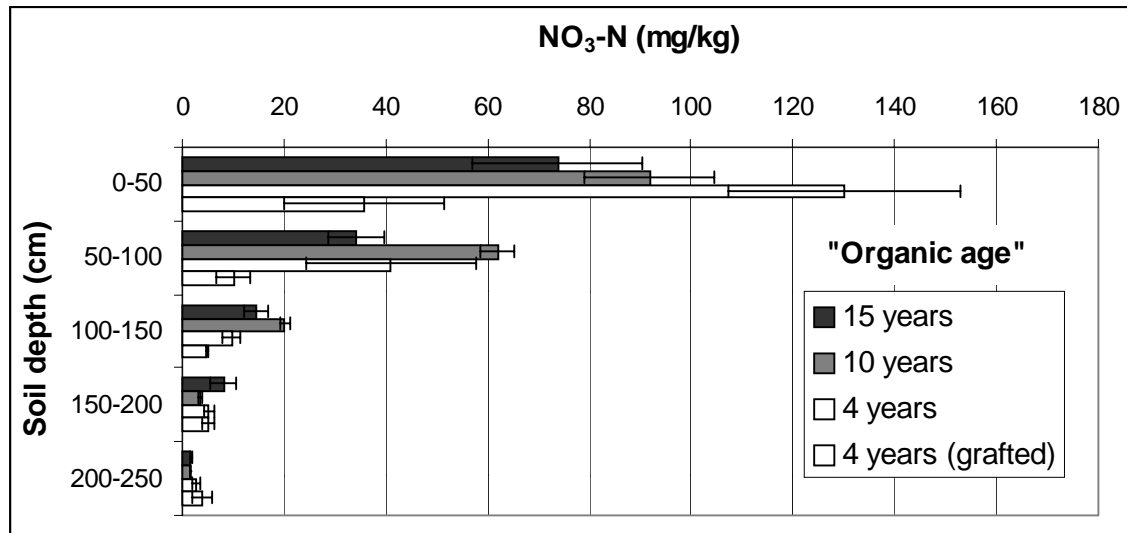


Figure 1.1. The concentration of nitrate in organic greenhouse soils (Gartneriet Markhaven) of differing organic age. The climatic conditions were similar in the different greenhouses and identical amounts of compost had been added to the soil prior to tomato planting in 2001.

There was no significant effect of “organic age” on nitrate concentration, but there was a highly significant difference in nitrate concentration between plants that were grafted on ‘Beaufort’ root-stock, compared to plants grown on their natural root. The total amount of nitrate from 0 to 250 cm was 421 kg NO₃-N/ha under grafted plants and 1319 kg NO₃-N/ha under ungrafted plants. In addition to this the soil contained 21 kg NH₄-N/ha under grafted plants and 28 kg NH₄-N/ha under ungrafted plants. The topsoil (0-50 cm) contained more than 10,000 kg N/ha (total-N) under both grafted and ungrafted plants, but the level was not affected by “organic age”. The pH, concentration of P, K and Mg was not significantly affected by “organic age”, but nutrient availability at the end of the growing season was reduced slightly when the plants were grafted.

Measurements of rooting depth and intensity has been made during the 2001 growing season in order to determine the capability of the crop to deplete the available resources in the soil, and to evaluate how much of the remaining nutrients can potentially be lost by leaching. Minirhizotron tubes were inserted in one of the greenhouses and rooting depth and intensity was monitored over the growing season. Results shown in figure 2.

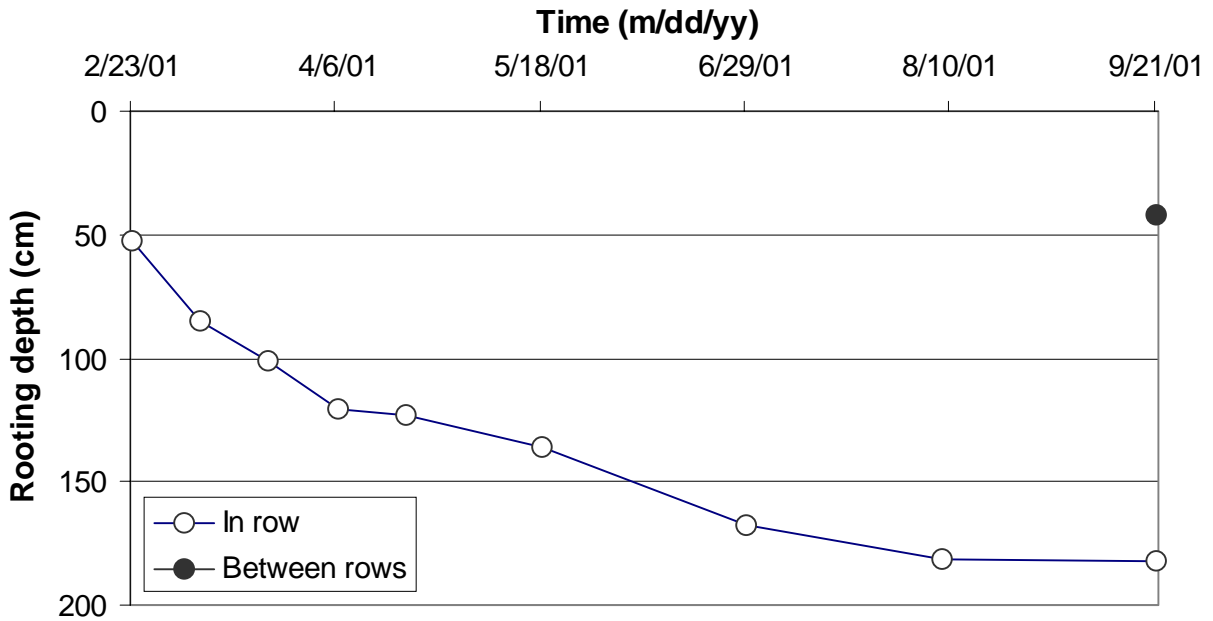


Figure 2. The rooting depth of tomato plants in organic greenhouse soil (Gartneriet Markhaven. measurements were taken every 14 days until depth penetration took place at a slower rate (beginning of May 2001), hereafter every 6 weeks. Rooting depth was measured in the middle of the row and between the rows (in the middle of the isle).

The rooting depth of tomatoes increased fast during early growth stages, but slower later on. Apparently, the ground water level was between 100 and 150 cm for a long part of the season, but whether this, or other factors such as an increasing fruit load made the root growth slow down is unknown. No roots were found between the rows before the end of september (40 cm). Rapid increase in rooting depth was observed until beginning of april (120 cm).

Generally it can be concluded that high amounts of especially nitrate were found in the soil at the end of the growing season. There were no effects of organic age, suggesting that little or no build up of organic matter and N occurs in these systems, even though very high amounts of organic matter is added. The results suggest possibilities for improved nutrient strategies with reduced nutrient surpluses, but also that improved nutrient utilisation may be achieved by improving the plant material as indicated by the drastic effects of grafting. The results confirm the need for evaluation of cropping systems in order to reduce the risk of environmental contamination with excesses of the supplied nutrients.

The quality evaluation carried out in 2000 evaluated in 2001 and the results have been published as a popular paper and presented oral at two occasions. The results showed that the variation in the different tomato samples was first of all influenced by difference in maturity and difference between varieties. In this sample, the difference between growers was of minor importance also the difference between organic and conventional growers.

The general impression of taste was determined by, sweetness, aroma and intensity of red colour. These taste characteristics was not fully described by analyses of soluble solids (sugar) and acids. The impression of firmness and crispness of the tomatoes were related to analyses of maximum force during penetration. It is expected that a better description can be obtained by including additional texture parameters.

WP2 Development of plant based compost

Dorte Beck Nielsen has been employed as PhD student from July to work on WP2. The initiation of the activities were postponed until she could start, and are thus somewhat behind the original plan. The work has been initiated with small scale experiments to test the effect of different ratios of wheat straw and clover grass hay in the compost. Further, strategies where not all of the N rich clover grass hay are added to the compost from the beginning are tested. The hypothesis is that addition of the N rich material should be postponed to avoid that the N which is released is immobilised by the early turnover of the wheat straw. Data from the analysis of the effect of these strategies on the N availability in the compost product are not ready yet, but should be ready within a few days. The measurements of CO₂ release during composting indicate that the composting process is strongly affected by the different strategies, thus we have reason to hope that also N release is affected. As soon as we have the N results, we will choose which treatments to use in a larger scale composting experiment. With little results from WP2 yet, the results from the initial testing in WP3 are giving rise to optimism (see WP3 below) about the possibilities for producing a good compost from wheat straw and clover grass hay, as all the growing media containing clover grass hay in various combinations with other materials seem to support good growth of tomatoes compared to other media.

It is likely that we do not get far enough with the activities in WP2 this year to allow that compost produced in this WP can be used for the experiments with growing systems (WP3) in 2002, but that should be possible in the second experiment which are to be grown in 2003.

WP3 Project co-ordination, development and comparison of production systems for tomatoes

In the spring 2001 a small-scale experiment was set up to investigate the design of an intermediate growing system. Transplants of tomato were planted in a closed bed and in an intermediate bed. In the intermediate bed, the compost was placed in a limited bed, but the roots were allowed to grow into the soil outside the beds. In this first test the compost consisted of partly composted farmyard manure. This manure was placed on wheat straw, 5 or 30 cm high.

Results showed that the plant roots could easily grow both inside and outside the limited beds. However, deficiency in nitrogen developed soon after transplanting. This deficiency could be due to low nitrogen availability or simply to poor conditions for root growth, i.e. uneven and poorly structured manure.

Due to this N deficiency, a new test was set up in the summer 2001. The aim of this experiment was still to compare the closed and the intermediate growing system. A further aim was to improve the compost. Farmyard manure was mixed with clover hay, wheat straw or coir (coconut) fibre. After transplanting tomatoes, the compost was kept moist initially by covering with plastic and later on by sprinkler irrigation. This experiment is still running, but the results so far are very promising, as all the treatments including clover grass in the growing medium have shown good growth right from the start. The treatments where only farmyard manure was used showed clearly nutrient limited growth during the early stages, even though clear improvements in the structure of the growing medium had been achieved by the physical treatments and mixture with e.g. coir fibre.

WP4 Quality evaluation of the greenhouse vegetables from contrasting cropping systems

During 2001 a literature survey have been done concerning flavour quality of fresh tomato. From the literature it is concluded that considering the amount of information now available on the composition and formation of flavour compounds in tomatoes, the relationship of these compounds to sensory quality and consumer acceptability is still not clear. From the literature the most reliable methods for flavour analyses have been found and during the months October and November the methods will be evaluated on samples of the variety "Aromata" from "Gartneriet Markhaven".

C.2 Fulfilment of tasks and deadlines in individual work packages

(To be completed for each work package)

WP1 The nutrient dynamics and nutrient use efficiency of the current production systems.	Time schedule according to application	Deviations, if any*
Task		
1 Monitor current organic cropping systems for their effects on the soil and nutrients		Ongoing
2 Monitor current organic cropping systems for their effects on product quality.		Ongoing
Deliverables		
1 Two popular paper in growers journals	2001	✓
2 Presentation at growers and advisors meetings		✓
Milestones		
1 Evaluation of nutrient availability with soil depth at the end of the growing season	2000	✓
2 Evaluation of the effect of organic cropping practice on soil organic matter	2001	✓
3 Evaluation of effect of existing cultivation conditions on tomato fruit quality	2000	✓
4 Evaluation of rooting density and depth potential for the tomato and cucumber crops, ultimo 2001	2001	Ongoing
5 Evaluation of potential for nutrient leaching with current cropping systems	2001	Ongoing

WP2 Development of plant based compost	Time schedule according to application	Deviations, if any*
Task		
1 To develop plant based composts for organic production of greenhouse vegetables	2001/2002	Ongoing
2 To test the compost as a nutrient source for cucumber crops	2002	Not started
Deliverables		
1 At least 2 popular papers in growers journals	2002/2003	Not started
2 Paper on the effect of the effect of different compost compositions cucumber	2003	Not started
3 Paper on the significance of compost mixture and supplemental fertilisation for growth and temporal nutrient uptake of cucumber	2003	Not started
4 Presentation at growers and advisors meetings		Not started
Milestones		
1 Selection of the most suitable composition of field crop plant material for further work	Summer 2002	Not started
2 Determining composts to be used in WP3	2001	Delayed

WP3 Project co-ordination, development and comparison of production systems for tomatoes	Time schedule according to application	Deviations, if any*
Task		
1 To co-ordinate the project		Ongoing
2 To develop an "intermediate" growing system		Ongoing
3 To compare the intermediate growing system with growing in limited beds and directly in the soil		Not started
Deliverables		
1 Project homepage	2001	Delayed
2 Two popular papers on the testing and comparison of cropping systems	2003/2004	Not started
3 Paper on the comparison of tomato growth in soil, limited beds, and the intermediate system	2003	Not started
4 Paper on root growth and soil nutrient depletion of tomatoes	2004	Not started
5 Presentation at scientific meetings	2003/2004	Not started
6 Presentation at growers and advisors meetings		Not started
Milestones		
1 Selection of the most suitable composition of field crop plant material for further work	2002	Not started
2 Determining treatments to be used for the tomato experiment in 2002	2001	Ongoing
3 Determining whether growing directly in the soil or growing in the intermediate system should have first priority in optimisation of the growing methods	2002	Not started

WP4 Quality evaluation of the greenhouse vegetables from contrasting cropping systems.	Time schedule according to application	Deviations, if any*
Task		
1 To determine which of the compared cropping systems optimise sensory and nutritional quality of tomatoes		Not started
2 To determine how relevant nutrient imbalances influence taste and other quality aspects		Not started
3 To determine relevant objective quality characteristics of tomatoes		Ongoing
Deliverables		
1 At least 2 popular papers in growers or food trade journals	2002/2003	Not started
2 Paper on the significance of cropping system for the aroma composition of tomato	2003	Not started
3 Paper on the significance of compost mixture and supplemental fertilisation for quality of tomato	2003	Not started
4 Presentation at meetings for growers, advisors and others		Not started

Milestones		
1 Aroma analyses for tomato are established and validated	2001	Not started
2 Determining whether differences in cropping systems cause significantly different aroma compositions in tomato	2002	Not started
3 Determining whether the cropping system being tested produce tomatoes of a quality which is similar or superior to the standards generally found with the cultivar(s) in question	2002	Not started
4 Deciding whether and if so, how, the quality differences found among the tested cropping systems are so significant, that they partly determine which treatments will be tested at the commercial greenhouse installation	2002	Not started
5 Contribution to recommendation for cultivation programme for tomatoes and cucumber	2003	Not started

* *Deviations are to be further discussed at C3*

C.3 Discussion on the progress, incl. deviations and achievements in the project as a whole and in the individual work packages and

The project is generally going as planned. The above mentioned changes in project staff have led extra work to co-ordinate the project. This has led to a delay of producing the project homepage which was planned to be made during this year. There have also been delays in other tasks within the project, but as it can be seen from the tables above (C2), the delays have not been serious.

WP1 The nutrient dynamics and nutrient use efficiency of the current production systems

As planned, the work in this WP has given a number of results showing some of the problems which may be in the present organic productions systems for greenhouse vegetables, but also to pointed at some of the possible solutions.

It has come as a surprise that we did not in any of the soil measurements find any significant effects of "organic age", though some of the soil had received the very high amounts of organic matter during 15 years whereas others had only received it during 4 years. This shows that the long term build up of organic matter and N is not important, and that surplus N added to the system must be lost in some way or another.

The data on nitrate residues left in the soil are not too clear. There are high N levels in the topsoil, but quite low levels in the deeper soil layers. One reason for this may be, that the ground water level was found to be quite high at both sites, with water saturation of the soil in less than 100 cm depth during the early part of the season. This may be the reason for the low nitrate content found in deeper soil layers, as the water saturation gives very good conditions for denitrification. However, with the high nitrate contents found in the upper soil layers, it is clear that the risk of nitrate leaching is considerable, with any surplus irrigation, and that the ground water will come into direct contact with "topsoil nitrate" at periods when the ground water table is high.

The fact that both grafted and non-grafted tomatoes were grown at "Markhaven" gave us the chance to study the effect of another possibility to handle some of the problems which may occur in this very intensive system. The effect of grafting was very strong in this case, and it is certainly a method which would be relevant to work on in future research.

The results on tomato quality did not show much effect of organic compared to conventionally produced tomatoes, the main differences were found to be due to tomato maturity at harvest and to tomato variety. This result, indicates that good quality does not come automatically by growing the tomatoes organically, but is something which must be actively worked at both in organic and conventional systems.

We believe that the studies made nutrient relations, root growth, effects of organic production methods on the soil and on quality on the produced tomatoes have given us a much improved starting point for the development part of the project as planned.

WP2 Development of plant based compost

The work on developing composts in WP2 have been delayed, as we awaited Dorte Beck-Nielsen to start her employment. She is now well started, but no results are ready yet. One consequence is that the work in WP3 in 2002 cannot be based on compost developed in WP2. This is not expected to cause major problems in WP3 (see below).

WP3 Project co-ordination, development and comparison of production systems for tomatoes

During 2001 we have made initial tests of the design of the cropping systems to be studied in detail in 2002. We believe that based on the preliminary results we will be able to grow tomatoes successfully in both limited beds, directly in the soil, and in an intermediate system next year. As the composts from WP2 will not be ready for the experiment of 2002 we have also tested some alternative growing media which can then be used in the experiment. Though it would have been optimal to use compost from WP2, use of another growing media will not prevent us from testing the performance of the three proposed growing systems.

WP4 Quality evaluation of the greenhouse vegetables from contrasting cropping systems

Initial studies of methods of quality analysis of tomatoes have been made in 2001. Apart from this, the WP will not start until tomatoes are produced in the experiments of WP3.

D. Description of plans and future work in the project as a whole and in the work package (Including plans for publication and communication)

We plan to arrange one open house day in the project next year, for producers, advisors and others who are interested where they can see the experiments and here about the results until now. We will have at least two meetings with the group of producers associated to the project. It is the plan to make the first homepage during the summer 2002 when we will have the first results from our own experiments to present.

WP1 The nutrient dynamics and nutrient use efficiency of the current production systems

The work within this WP is almost finished, though a bit of work on the root growth of tomatoes and some soil analysis are still to be done. The results and conclusions from this work is planned to be published in growers journals during 2002.

WP2 Development of plant based compost

Based on results from the small scale experiments which have just been made, treatments for larger scale composting experiments will be made. One strategy to optimise the composts is to vary the composition of the material used for the composting, e.g. varying the ratio between straw and clover grass hay. Apart from this, we plan to work on two other strategies. One is not to add all of the nutrient rich material (clover grass) from the beginning, but to postpone the addition of some of it for some time. In this way we will attempt to reduce the break down of the structural material from the straw by adding too many nutrients, and reduce the immobilisation of N released from the clover grass by the early turnover of the C rich straw material. The other strategy is in the use of the compost, where it may be better to use two composts, than to try to produce one compost which have optimal structure as well as an optimal nutrient content. Then a nutrient rich compost can be added on top of a well structured compost with a lower nutrient content.

Composting experiments at a larger scale are about to start in November, and experiments with growing cucumbers in the composts will be made during 2002.

The plans for publication will have to be co-ordinated with the plans for the PhD study of Dorte Beck-Nielsen, but will include a presentation at an international workshop of the first composting and presentations to Danish producers in 2002.

WP3 Project co-ordination, development and comparison of production systems for tomatoes

There are no significant changes in the plans for this WP, though compost from WP2 cannot be used in the 2002 experiment. In 2002 an experiment will be made to compare cropping systems where tomatoes are grown either directly in the soil, in limited beds, or in an intermediate system. In 2003 a new experiment will be made, where we will try to optimise the cropping system. Based on results from 2002 we will select which treatments to use. No changes in publication plans.

WP4 Quality evaluation of the greenhouse vegetables from contrasting cropping systems

The effects of the cropping systems tested in WP3 on tomato quality will be tested during 2002 and 2003. There are no changes in the plans for this work or its publication.

E. Project publications

1. Articles in international, scientific journals with review procedures

None yet.

2. Presentations at congresses, symposiums etc.

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3. Articles in agricultural journals etc.

Nielsen M., 2001. Quality of Danish tomatoes (Kvalitet af danske tomater). *Gartner Tidende* 9, 4-5.

4. Other presentations at meetings, field days etc.

Morten Nielsen participated at the open house arrangement "taste tomatoes" ("Smag på tomater") 28 August 2001 at Lene Tvedegaard, Gartneriet Toftegaard with a presentation on "Quality of Danish tomatoes" ("Kvalitet af danske tomater").

Morten Nielsen participated 3 October 2001 in the annual general meeting of the Danish tomato growers with a presentation on "Quality of Danish tomatoes" ("Kvalitet af danske tomater").

F. Scientific education (ph.d. and post doc.), including visiting scientists and visits abroad

Dorte Beck-Nielsen will be doing her PhD on development of composts for organic greenhouse production. Her study is based on a combination of the OrcTom project and a project on organic production of potted flowers.

G. National and international co-operation

There are collaboration with the project on development of organic production of potted flowers at the department, as both projects deal with various aspects of growing media for organic production.

H. Possible elaboration of project and achieved results

We have few results yet, and it is too early to prepare elaboration of achieved results.