



## Annual Status Report 2001 and Application for Continuation in 2002

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The Directorate for Food, Fisheries and Agro Business  
under the Danish Ministry of Food, Agriculture and Fisheries

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### 1. Research program

Research in organic farming 2000-2005 (DARCOF II)

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### 2. Project title and number

I.11 Clover and Grass Seed – production of high quality organic seed for forage mixtures  
(CLOGS)

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### 3. Head of project

Birte Boelt  
Danish Institute of Agricultural Sciences  
Department of Plantbiology  
Research Centre Flakkebjerg  
DK-4200 Slagelse  
Tlf: 53 11 34 25  
Fax: 53 11 33 01  
Email: Birte.Boelt@agrsci.dk

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### 4. Participating institutes

The Royal Veterinary and Agricultural University  
Department of Agricultural Science  
Agrovej 10  
2630 Taastrup  
Tlf: 35 28 23 83

Danish Institute of Agricultural Sciences  
Research Centre Flakkebjerg  
4200 Slagelse  
Tlf: 53 11 33 00  
Fax: 53 11 33 01

Department of Plantbiology  
Dept of Plant Protection,

Danish Institute of Agricultural Sciences  
Research Centre Foulum  
8830 Tjele  
Tlf: 89 99 13 34

The Danish Seed Council  
Vesterbrogade 4A, 1.sal  
1620 København V

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## 5. Contact persons

WP1: Vibeke Langer, The royal Veterinary and Agricultural University, Department of Agricultural Science, Agrovej 10, 2630 Taastrup, Tlf: 35 28 23 83, email: [vl@kvl.dk](mailto:vl@kvl.dk)

WP2: Birte Boelt, Danish Institute of Agricultural Sciences, Department of Plantbiology Research Centre Flakkebjerg, 4200 Slagelse, Tlf: 53 11 34 25, email: [Birte.Boelt@agrsci.dk](mailto:Birte.Boelt@agrsci.dk)

WP3: Birte Boelt, Danish Institute of Agricultural Sciences, Department of Plantbiology Research Centre Flakkebjerg, 4200 Slagelse, Tlf: 53 11 34 25, email: [Birte.Boelt@agrsci.dk](mailto:Birte.Boelt@agrsci.dk)

WP4: Lars Monrad Hansen, Danish Institute of Agricultural Sciences, Department of Plant Protection, Research Centre Flakkebjerg, 4200 Slagelse, Tlf: 53 11 34 38, email: [LarsM.Hansen@agrsci.dk](mailto:LarsM.Hansen@agrsci.dk)

WP5: Birte Boelt, Danish Institute of Agricultural Sciences, Department of Plantbiology Research Centre Flakkebjerg, 4200 Slagelse, Tlf: 53 11 34 25, email: [Birte.Boelt@agrsci.dk](mailto:Birte.Boelt@agrsci.dk)

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## 6. Other project staff

WP1: Benjamin Rohde, The royal Veterinary and Agricultural University, Department of Agricultural Science, Agrovej 10, 2630 Taastrup, Tlf: 35 28 35 27, email: [ber@kvl.dk](mailto:ber@kvl.dk)

WP2: Lise C. Deleuran, Danish Institute of Agricultural Sciences, Department of Plantbiology Research Centre Flakkebjerg, 4200 Slagelse, Tlf: 53 11 34 27, email: [Lise.Deleuran@agrsci.dk](mailto:Lise.Deleuran@agrsci.dk)

WP3: Rene Gislum, Danish Institute of Agricultural Sciences, Department of Plantbiology Research Centre Flakkebjerg, 4200 Slagelse, Tlf: 53 11 34 77, email: [Rene.Gislum@agrsci.dk](mailto:Rene.Gislum@agrsci.dk)

Frank Vigh-Larsen, Danish Institute of Agricultural Sciences, Department of Animal breeding and Genetics, Research Centre Foulum, 8830 Tjele, Tlf: 89 99 13 34, email: [FrankV.Larsen@agrsci.dk](mailto:FrankV.Larsen@agrsci.dk)

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**7. Start of project:** 1 June, 2000

**End of project:** 31 December 2004

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

### **A. Objectives and expected achievements (from application)**

The objective is to develop and optimise cultivation and management techniques to increase the production of high quality clover and grass seed for forage mixtures.

The project focuses on the species / cultivars that are important constituents of forage mixtures, but which are not yet organically produced, i.e. white and red clover, timothy, meadow fescue, cocksfoot and smooth stalked meadow grass.

The expected achievements are to provide guidelines for organic growers on how to optimise establishment techniques, increase nutrient utilisation, minimise pest damages and utilise excessive clover and grass growth as forage. A substantial part of the project is implementation of the results, which will be achieved by a number of demonstration trials in farmer fields or in the organic crop rotation at Research Centre Flakkebjerg. Focus for these trials will be a rapid dissemination of results, which will support the incorporation of seed crops in organic crop rotations.

Due to favourable climatic conditions, long tradition, and expertise in the specialised seed production it is expected that Danish seed growers will be able to supply a considerable proportion of the total organic production of clover and grass seed in Europe. By that they will contribute to the solution of EU regulation 2092/91 which states that as from 1 January 2004 only organically produced seed can be used in organic farming systems.

### **B. Project summary (from application)**

From January 2004 only organically produced seed can be used in organic farming systems within the EU. Optimal forage production relies on the access to improved cultivars of high quality clover and grass seed for forage mixtures. Currently the supply of organic forage seed in Europe is scarce. In Denmark a production of one of the main constituents of forage mixtures, perennial ryegrass (*Lolium perenne* L.) is established, however, another main constituent, white clover (*Trifolium repens* L.) is still in request.

This project will identify the main obstacles in the production of organic seed for high quality forage mixtures and conduct investigations to improve management techniques. To optimise production (quality and yield) research is carried out to provide guidelines for organic growers on how to optimise establishment techniques, increase nutrient utilisation, minimise pest damages and utilise excessive clover and grass growth as forage. A substantial part of the project is implementation of the results, which will be achieved by a number of demonstration trials. Focus for these trials will be a rapid dissemination of results, which will support the incorporation of seed crops in organic crop rotations.

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**Table 1: Work package list (from application)**

No.	Work package title	Participants*	Budget (1.000 DKr)	Start	End	Deliverable No:
1	Main obstacles – organic grass, clover and legume seed production	<u>VL</u> , BR	280	2000	2004	D1, D2, D3, D4
2	Crop establishment techniques – row cultivation	<u>BB</u> , LD	800	2001	2004	D5, D6, D7, D8
3	Mixed cropping – utilisation of by-products	<u>BB</u> , RG, FVL	1.120	2001	2004	D9, D10, D11, D12
4	Pests – alternative cropping techniques to minimise damage in clover	LMH	1.120	2000	2004	D13, D14, D15, D16
5	Optimisation of crop rotation - incorporating seed crops	BB	430	2000	2004	D17, D18, D19

\* Responsible participants are underlined

## • Progress

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

#### WP1

Timothy, meadow fescue, red fescue, smooth stalked meadow grass and rough stalked meadow grass are grass species still in request in organic forage seed mixtures. An interview to Danish seed companies shows that some production of timothy and meadow fescue already took place in 2000 and in 2001 also organic red fescue seed has been harvested. Among the remaining two species smooth stalked meadow grass is probably the most difficult in organic seed production since it is very slow establishing and has a poor competition against weeds. Field trials is established at research centre Flakkebjerg, and in 2001 the first seed yield was harvested. However the seed is not yet cleaned and therefore the final result is not known.

The monitoring data from 2000 clover seed fields has been analysed. The main results are:

- weevil in white clover are found in all organic white clover fields, with the highest densities in traditional seed producing areas. Mean density was 10,3, ranging from 9 to 29 weevils per flower head.
- in white clover dissection of flowers revealed that weevil larvae damage 12 – 77% of the seed pods with a mean of 33%. Available data from the previous year on density and damage are of the same magnitude: 9,6 weevils per head resulting in a mean reduction of 26% of the seed pods (1999).
- in contrast to white clover, weevil free fields with red clover seed are found in regions with no tradition for seed production. Mean weevil density is lower in red clover ranging from 0,2 to 6,5 weevils per head.
- in white clover, unpollinated flowers amount to approx. 10% (range 2 to 18%) of the total flowers in a head
- yields in white clover do not correlate well with the seed yield in fields harvested under suboptimal conditions. Our data suggests that harvest loss may constitute a yield reducing factor of the same magnitude as weevil damage in these fields.

As planned, monitoring of clover seed weevils was continued in 2001 with the aim of confirming factors of importance for weevil density and weevil impact on yield. Nine organically managed white clover fields and three red clover fields with different characteristics regarding regional and local density of clover seed production, presence of and distance to previous seed fields and relevant field operations. Data analysis is in progress but preliminary results confirm that weevils are found in all white clover seed fields whereas for red clover it is possible to find weevil free zones. Analysis of yield components by flower dissection will be done in three fields selected on the basis of weevil density results.

#### WP2.

In two types of *Festulolium* (one type assembling the fast growing, Italian ryegrass and another type assembling the slow growing, tall fescue) three row distances and three seed rates have been evaluated in 2000. In the fast growing type no effect of either row distance or seed rate was found. In the slow growing type the highest row distance (36 cm) affected seed yield negatively. The trial has also been performed in 2001, but seed are not cleaned yet. A third and final field trial is established.

In row fertilisation with degassed slurry has been performed in one grass species. Application of slurry decreased seed yield, however, the application was performed five days later than the artificial fertiliser in the control plot – which could be the reason for this effect. The trial is continued.

Smooth stalked meadow grass has been established at 12 and 24-cm row distance, at two seed rates and in two cover crops (field pea and Persian clover). This investigation focus on the ability of the crop to compete weeds, and in the first trial-year there were many weeds. In general the lowest row distance and the highest seed rate has less weeds but the seed yield in this combination is not yet known. Mechanical weed control has not been performed yet.

The results with intercropping white clover and four repellent plant species show no effect on the white clover. However the clover is a very strong competitor to the repellent plants.

### **WP3.**

Seven green manure plant species have been evaluated mixed cropped with perennial ryegrass. Much variance in the growth habit of the green manure plants has been observed and some very promising species has been found. The trial is now continued.

Mixed cropping of red clover and forage grass species are found to provide relatively large forage yields at low nitrogen application levels. In the slow establishing grass species such as tall fescue, cocksfoot and meadow fescue this intervening year (forage cuts) provides a longer establishment period and seed yield is increased compared to seed harvest in the first year after establishment (without forage cuts). The trial is continued.

In one field of perennial ryegrass sheep grazing at different time intervals has been tested. Seed yield data from 2001 show no effect of a late grazing (mid-December). The daily gain was 78 g/day pr sheep and the total forage yield was equivalent to 87 kg/ha. The forage value was not as high in perennial ryegrass as previously found in red fescue. The trial is continued.

### **WP4.**

Field trials to evaluate the importance of the clover weevil, different defoliation strategies and the effect of plants with a strong scent in the flowers are established. Clover weevils are sampled and parasitoid reared, but the final statistical work has not yet been finished.

There has been a heavy attack of clover weevil in the trials. The preliminary result shows that the weevil is an important pest and that delayed defoliation seems to decrease the number of weevils that are found in the clover. Apparently, there was no effect of strong smelling flowers.

### **WP5.**

Activities in this workpackage will predominantly take place in the last part of the project. However, already now the planning of demonstration trials is started and contact to organic growers is being established.

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

(To be completed for each work package)

<b>WP1: Main obstacles-grass, clover and green manure / catch crop seed</b>	Time schedule according to application	Deviations, if any*
1: Grass species, which are important constituents of high quality grass / clover seed mixtures, and in which no organic seed production has been established has been identified. In one species, perennial ryegrass cultivars have been identified.	06/2000	
2: In accordance with the plans, clover seed weevils have been monitored in 15 organically managed clover fields, and data expected to be of importance for weevil occurrence have been registered: field history, distance to the previous seed field and relevant field operations. Processing of samples leading to weevil density, weevil damage and potential seed yield are in progress.	06/2000	
3: Field trials in 11 cultivars of white clover and 4 cultivars of red clover have been seed harvested in 2000 and data will be analysed during winter.	06/2000	
4: Field trials for screening of seed yield potential in four species of green manure / catch crops in Denmark are established. Seed will be harvested in 2002.	04/2001	
<b>Milestones</b>		
1: Interviews with seed companies	09/2000	
2: Monitoring farmers fields of organic clover seed	06/2000	
4: Establishment for screening trial in green manure / catch crops	04/2001	
<b>Deliverables</b>		
1: A list of organic grass species in request	03/2001	
3: Most important yield reducing factors in organic clover seed production	05/2001	
4: Seed production potential of green manure / nitrogen catch crops	11/2000	*

<b>WP2: Crop establishment techniques</b>		
5: Field trials are established to determine the optimal combination of row distance and seed rate in two types of a grass species, which is representative of a number of species used for forage.	04/2001	
6: Injection of degassed slurry close to the grass seed crop row is evaluated (spring 2001) – seed crops have been harvested in 2001.	08/2001	
7: Smooth stalked meadow grass has been established at two row distances, two seeding rates and in two cover crops in order to evaluate establishment techniques and the need for / possibility to perform mechanical weed control.	04/2001	
8: Examination of the effect of row cultivation in clover intercropped with repellent plants or plants that attract parasitoids to the clover seed weevil (wp4).	04/2001	

<b>Milestones</b>		
5: Establishment of the third and final experimental year	04/2001	
6: Screening prevalent farm equipment	08/2001	
<b>Deliverables</b>		
<b>WP3: Mixed cropping – utilisation of by-products</b>		
9: To evaluate green manure crops as nutrient sources in grass seed crops. Results from seed harvest 2000 is evaluated.	01/2001	
10: Field trials are established (third and final year) to evaluate cropping system with grass and clover for seed production is grown in the same field. The system will be evaluated both for seed yield and for utilisation of by-products for forage.	04/2001	
11: The possibilities of growing other plant species in seed fields of clover have been tested in 2000. Results from seed harvest 2000 is evaluated.	01/2001	
12: Sheep grazing has been performed autumn/winter 2000 and the effect has been evaluated in spring and summer 2001. The trial is replicated in 2001/2002 in a second year crop.	05/2001	10/2000
<b>Milestones</b>		
11: Advices on intercropping in clover	10/2001	
<b>Deliverables</b>		
9: Preliminary results on potential green manure crops in perennial ryegrass	12/2003	10/2001
10: Mixed cropping of grass and clover for seed	07/2001	
11: Repellent plants in clover for seed production	07/2001	
12: Sheep grazing grass seed fields	12/2001	09/2001

<b>WP4: Pests – alternative cropping techniques to minimise damage in clover</b>		
13: Different defoliation strategies have been tested, and some variation in seed yield is recorded. These experiments will be carried on.	07/2000	
14: Field experiments with possible 'repellent' plants have been established for seed harvest in 2001.	07/2000	
15: Explore ways of biological control of clover seed weevil	06/2000	
16: Evaluate alternative cropping techniques	05/2001	
<b>Milestones</b>		
16: Establish demonstration trials concerning clover seed weevil	04/2001	
<b>Deliverables</b>		
<b>WP5: Optimisation of crop rotation</b>		
17: Implementation of improved cultivation techniques	12/2000	
<b>Milestones</b>		
18: Report on the amount of forage and forage quality	04/2001	
<b>Deliverables</b>		

\* 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 progress according to the planned activities. One deliverable (D4) has not yet been presented – seed yield of potential green manure / nitrogen catch crops. The reason for this is that only one green manure crop was harvested for seed in 2000 and seed yields were relatively low. So far there are no other experience on this crop and it has therefore been decided to delay publication. Three deliverables has been advanced for the original time schedule.

The main obstacle in organic forage seed production is white clover seed production. When this project was initiated it was not know to what extent the pest, white clover seed weevil, caused lower yields in organic seed production. Investigations in this project has prevailed that in 2000 the damage from this insect accounted for 33% of the seed yield reduction (ranging from 12 to 77%), and that the weevils are found in all organic white clover seed fields. These findings are in accordance with 1999 results. It is therefore concluded that the white clover seed weevil is one of the major yields reducing factors in organic seed production of white clover. However, average organic seed yields were in 2000 deceased by 75% compared to conventionally grown fields. The project will therefore intensify the investigations of cultural techniques to optimise seed yield in organically grown white clover seed fields – besides to continue investigation on minimising the effect of the weevil.

Optimising crop establishment techniques reduce the infestation of weeds and optimise the crop competitiveness. Therefore the slow establishing grass seed crop, smooth stalked meadow grass is tested in different systems (row distance, seed rate and cover crop). Increasing the row distance allows for more weeds to establish, and the results from practise show that cleaning this crop by mechanical means is very difficult. Hopefully this project will be able to present results from improved establishment techniques after seed harvest 2002.

Another obstacle for organic seed production is the limited supply of animal manure in East-Denmark where a number of grass seed crops normally are grown. The preliminary results of the screening of different green manure crops are very promising, however it is still too early to conclude after only one year results. The investigations are continued for another two establishment years.

Utilisation of by-products has already provided promising results of sheep grazing in autumn on grass seed fields. Sheep grazing 'substitute' a mechanical defoliation, the animals 'remove' the excessive growth and they gained 87 kg/ha in 2000. Therefore the system can be beneficial both to the seed grower and to the sheep farmer. However, the trial is continued to investigate the effect of a late grazing – in order to avoid any risk to the seed crop.

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

The plans and future work are in accordance with the original plan.

Partner 1 and 3 continue field trials at research centre Flakkebjerg and besides the planning of demonstration trial will start.

Partner 2 will finish processing of samples collected in 2001 and produce the final report for WP1 task 2 and 3.

Partner 4 is involved in sheep grazing trials, and they continue.

Results have already been published in farmer magazines and this will continue throughout the project. In February 2001 the preliminary results from the project were presented for approximately 45 farmers and advisers. A similar meeting will be held in 2003.

## **E. Project publications**

### **1. Articles in international, scientific journals with review procedures**

#### **2. Presentations at congresses, symposiums etc.**

Boelt, B., Deleuran, L. C. & Gislum, R. 2001. Organic forage seed production in Denmark. Newsletter, The International Herbage Seed Production Research Group (in press).

Deleuran, L. C. & Boelt, B. 2001. Forage Cuts as a By-product in Organic Seed Production. Newsletter, The International Herbage Seed Production Research Group (in press).

Boelt, B. & Deleuran, L. C. 2000. Organic forage seed production. Proceedings 13<sup>th</sup> International IFOAM Scientific Conference, Basel, Schweiz. pp. 228-229.

Deleuran, L. C. & Boelt, B. 2000. Utilization of forage cuts in organic grass seed production. Proceedings of the 18<sup>th</sup> General Meeting of the European Grassland Federation Aalborg, Denmark. pp. 552-555.

#### **3. Articles in agricultural journals etc.**

Boelt, B. 2001. Afgræsning af frøafgrøder med får. Dansk Frøavl 8:140.

Boelt, B., Clausen, D., Gislum, R. & Hansen, L. M. 2001. Aktuelt nyt fra Danmarks Jordbrugs-Forskning, 2001. Tidsskrift for Frøavl 2, 7-10.

Boelt, B. 2000. Samdyrkning af græs og kløver. Dansk Frøavl 9, 150-151.

Gislum, R., Boelt, B. & Jensen, E. S. 2001. Grøngødningsafgrøder kan medvirke til et højt frøudbytte i økologisk dyrket almindelig rajgræs. Forskningsnytt om økologisk landbrug i Norden 5:4-5.

Rohde, B., V. Langer & L. Monrad Hansen 2000. Økologisk hvidkløver – hvordan kan det lade sig gøre? Dansk Frøavl 9, 148-149

Rohde, B. 2001 Tjek bestøvningen. Dansk frøavl 84 (5)

#### **4. Other presentations at meetings, field days etc.**

In February, 2001 a meeting for organic farmers and seed advisers were held at research centre Flakkebjerg (45 participants).

In June, July there has been 2 field days in the organic crop rotation at Flakkebjerg.

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

None

## **G. National and international co-operation**

Nationally the participants in the project co-operate with advisers from the seed companies.

## **H. Possible elaboration of project and achieved results**

None yet.

