



Final Report

For DARCOF II research projects financed by grants from
The Directorate for Food, Fisheries and Agro Business
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1. Research program

Research in organic farming 2000-2005 (DARCOF II)

2. Project title and number

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

3. Head of project

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Slutrapporten sendes elektronisk til Forskningscenter for Økologisk Jordbrug
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Slutrapporten vedlægges et dansk resumé.

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6. Project period (month, year)

Start of project: June 1st, 2000
End of project: December 31th, 2004

7. Final report

A. Project summary

Table A.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, PB	1.120	2001	2004	D9, D10, D11, D12
4	Pests – alternative cropping techniques to minimise damage in clover	<u>LMH</u>	1.120	2000	2004	D13, D14, D15, D16
5	Optimisation of crop rotation - incorporating seed crops	<u>BB</u>	430	2000	2004	D17, D18, D19

* Responsible participants are underlined

B. Objectives and expected achievements

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 (WP 2). 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.

C. Progress and results

C.1 Description (summary) of main results and conclusions

The main obstacle in obtaining organic seed of grassland forage mixtures is lack of organic white clover seed, whereas seed of various types of ryegrass, which constitutes by far the highest proportion of grass species in mixtures, is available for export. Yield reducing factors in white clover seed production has been identified as pests (larvae of *Apion* and *Hypera nigrirostris* (Fabr.)), which account for 34% yield reduction (ranging 12-77%). This was not known earlier, since pests traditionally are controlled in conventional seed production. This finding has resulted in more focus on management techniques to reduce pest attack in the white clover seed crop, however, no management technique has been identified which could eliminate the yield reduction by pests.

When the project was initiated it was discussed to move white clover seed production to regions where it is not traditionally grown. Results from monitoring has revealed that there are no regions in Denmark free from white clover seed pests, and therefore it is not recommended to try and establish organic white clover seed production in regions which are known to be dis-favorable, due to less hours of sunshine and higher precipitation during summer.

Grass species, in which organic seed is still in request, is timothy (*Phleum pratensis* L.) and cocksfoot (*Dactylis glomerata* L.) and smooth stalked meadow grass (*Poa pratensis* L.). Since timothy and cocksfoot resemble perennial ryegrass, it was concluded not to focus on these two species, and experience from practice has proven this decision to be right. There seems to be no major problems in organic seed production in these species. Smooth stalked meadow grass establishes slowly and therefore competes poorly against weeds resulting in low yields and often too high content of impurities. The species only has a low constitution in grasslands mixtures, however, it is important in maintaining the persistence in the mixtures.

Improving establishment results in higher competition against weeds. Experiments in two types of festulolium (*Festulolium braunii*, K.A.) have identified the optimum seeding rate and row spacing in order to optimise seed yield. Festulolium is a hybrid between a fescue (*Festuca*) and ryegrass (*Lolium*). The crosses combine the fescues persistence with the palatability of the ryegrasses, and the new 'species' seems highly relevant in organic farming since it has a very high production and utilisation for the resources nitrogen and water. The cultivars *Paulita* and *Hykor* have been used in the trials on row spacing and seed rate. *Paulita* is tetraploid and resembles ryegrass. In general these types of festulolium give high yields, have high forage quality and endure frequent cuts. *Hykor* looks and behaves like tall fescue (*Festuca arundinacea*). The traits for these types of festulolium are high persistence and drought tolerance. The cultivars are especially selected because of these traits. For forage production both cultivars have a high potential and can be used in mixtures for forage grasses (Deleuran & Boelt, 2000). Festulolium is considered interesting in many European countries, especially where drought tolerance and high persistence is needed. In spring 2005 *Hykor* has been highly recommended in forage mixtures. The present results reveal that highest seed yield is obtained at 12-24 cm row spacings and a seeding rate of 8 kg/ha in *Hykor* and 16 kg/ha in *Paulita*. Placement of nitrogen did not increase seed yield in the two types. However, the obtained results are interesting, and a paper is in preparation.

Smooth stalked meadow grass has been established in field pea and in Persian clover. The amount of weeds have been very high in the first seed production year, however, due to a late field burning, weeds were reduced significantly in the second seed produc-

tion year, where yields of approximately 600 kg/ha have been obtained in the varieties *Compact* and *Oxford*. In comparison ten years average seed yield in conventional production is 910 kg/ha.

New establishment techniques allow for the simultaneous sowing of three crops. This technique has been used to establish spring barley with undersown perennial ryegrass for seed intercropped with a green manure crop. The plant development and yields of the three species (spring barley, green manure plants and perennial ryegrass) was satisfactory. The main crop, perennial ryegrass had very high yields in 2000 in both the reference treatments and when intercropped with green manure crops (figure 1). In the three following seed harvest years (2002, 2003 and 2004) the seed yields were more moderate. Results of seed yield in the four growing seasons showed that seed yield were significant ($P < 0.05$) higher in 2000 compared to 2002, 2003 and 2004 where there were no mutual difference. There were no significant ($P < 0.05$) difference in seed yield between 50N, 100N and the use of Black medick as green manure crop. There were furthermore no significant difference between 25N and the use of any green manure crops in the four experimental years. The findings show that green manure crops have a high potential to supply nitrogen for seed crops, and with an improved method of removing the green manure crop we expect nutrients to become available to enhance reproductive growth of the seed crop. A joint project with DIAS-Bygholm focusing on the development of an improved technique for removing the green manure crops was terminated in 2005. New equipment has been developed at DIAS-Bygholm, and overall the technique of removing the green manure crops was improved.

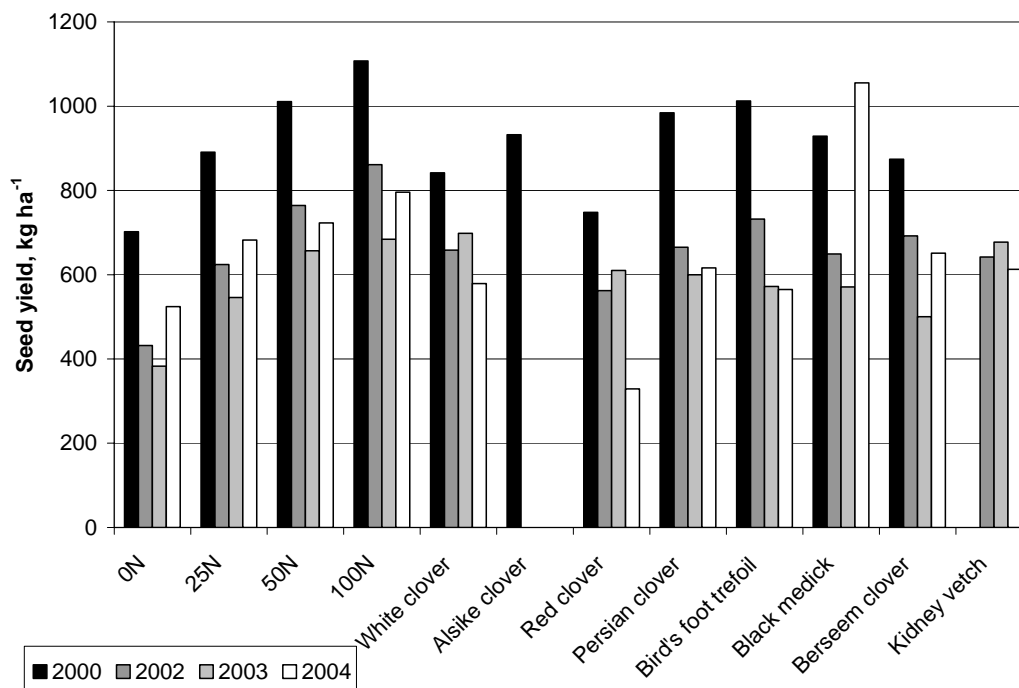


Figure 1. The effect of green manure crops in perennial ryegrass for organic seed production compared to establishment in a pure stand with different nitrogen application levels applied as manure. 0N, 25N, 50N and 100N refer to kg nitrogen per hectare applied as manure. 25N was applied when green manure crops were used. Notice that seed yield in 2004 is not yet corrected to 100 % of purity.

In organic farming green manure crops and catch crops play an important role in maintaining nitrogen in arable cropping systems. However, organic seed are in general not available in the species used. In the project we have analysed seed yield potential of chicory, kidney vetch and alfalfa in organic seed production, and all three species have been able to produce relatively high yields in organic seed production. These results may

prove relevant especially in alfalfa, which is primarily produced in France in conventional production, however, in organic production the French seed growers obtain only poor yields due to pests.

Similarly the Danish seed growers have high yield losses due to pests in organic white clover seed production. Therefore an important part of this project has been to develop a management-system where the occurrence of pests in white and red clover crops is reduced to a level where organic seed production is economically profitable. In all years damage threshold experiments have been carried out. The results show that one clover seed weevil or one clover leaf weevil per head can reduce the yield by 25 or 200 kg seed per hectare respectively. Because it is rather complicated to estimate number of weevils per head the damage effect from the weevils can be expressed as number of weevils per m². One clover seed weevil or one lesser clover leaf weevil per m² can reduce the yield by 1.3 or 11 kg seed per hectare respectively. Normally both species are present in the clover field and therefore the damage effects from the two weevil species are combined in a damage threshold model. Experiments with defoliation and "burning" have been carried out at Research Centre Flakkebjerg. The defoliation experiments shows, that if defoliation is postponed 2 weeks the number of weevils will be reduced significantly and their damage will only make up about 20%, in relation to areas where no defoliation were done. However, 2 weeks late defoliation means about 30 per cent lesser yield. Consequently late defoliation is only an economic advantage if the numbers of weevils have a high level. A model to calculate potential damage from weevils found in the field just after migration and the correlating time for defoliation is under construction and will be published in a scientific periodical. Additional funding (Fonden for Økologisk Jordbrug 2004 and Frøvækst Øst 2003-2006) has been raised to obtain more data for the model. A model for the yield reduction by each pest is constructed and presented to Danish and Nordic seed growers and advisers during the NJF-seminar on Herbage Seed Production, June 2006. Experiments where burning was compared to late defoliation shows, that numbers of weevils were reduced significant, but so was the yield, because "burning" is very hard to the crop. It can be concluded that "burning" is no economic attractive alternative control method for weevils in organic grown white clover.

In both white and red clover plants with a strong scent has been established in order to avoid pest damage by clover seed weevils. Of the four herbs (chive, caraway, oregano, thyme) tested in white clover none affected the number of clover seed weevils in the seed production year, and seed yields were not affected. The parasitisation from parasitoids varied from 3-5 pct. White clover has a strong vegetative development, and although the herbs established well (plant numbers were registered), their growth in the seed production year was very poor. In red clover plant species with a strong scent (chrysanthemum, crambe, coreander, lupins, euphorbia, rucola, tagetes) were established in spring of the seed production year. Although the red clover was established on wide row distances and it was defoliated before the establishment of repellent plants, none of the tested species established in the red clover. It is concluded, that repellent plants are very difficult to intercrop in white or red clover. Therefore further experimentation with various row spacing in white clover has not been performed.

White clover trials were established intercropping with buckwheat and tancy-leaf phacelia, plant species that are supposed to attract parasitoids. Number of clover seed weevil, the lesser clover leaf weevil and parasitoids monitored in the trial show no significant difference between buckwheat/phacelia-plots and the control. The parasitisation of the weevils varied from 10% to 18%.

Results generated during the project have been presented to advisers and farmers during field days at Research Centre Flakkebjerg and results have been presented during the winter following the seed harvest year also to advisers and seed growers. In this way

results have continuously been integrated into guidelines for optimising the production of high quality forage seed. There have especially been many meetings concerning organic white clover seed production. In addition to experiments at Flakkebjerg demonstration trials have been carried out in farmers fields – in collaboration with the organic advisor in Landbocentrum (now Økologisk Rådgivning) on white clover and in collaboration with Skive Landboforening on the utilisation of autumn regrowth by sheep grazing in perennial ryegrass. In 2004 the results were presented during 'økologiske feldage'.

Due to the activities and results generated in the project guidelines for optimal crop rotation with respect to seed crops have been generated and in general it can be concluded that organic growers are very interested in producing organic forage seeds. It is concluded that the size of organic grass seed production in Denmark is controlled by the request from the Danish home market and by the possibilities for export. In contrary, in white clover seed production there is at present a limitation to the size of organic seed production due to low yields, and the lack of white clover seed restricts the possibilities for export of grasslands forage mixtures.

Scientists engaged in the project have participated in a large number of field days in farmer fields and oral presentations during meetings (see E.2).

C.2 Fulfilment of deliverables and milestones

(To be completed for each work package)

WP1: Main obstacles-grass, clover and green manure / catch crop seed	Time schedule according to application	Deviations, if any*	Fulfilled
Deliverables			
1: A list of grass species where no or only limited amounts of organic seed are available. Meeting and report.	03/2001		During the project
2: An evaluation of the importance of various field characteristics for weevil occurrence and damage. Meetings and report, publication	02/2002		Evaluation 2002, paper 2005
3: A list of the most important yield reducing factors in organic clover seed production, with an estimate of the approximate magnitude of each. Meetings and report.	05/2001		2001
4: An evaluation of the possibilities of establishing seed production of new green manure / catch crops. Meetings and report.	11/2000		Once a year during the project – seed harvest 2002-04
Milestones			
1: Interviews with seed companies	2000		2000
2: Monitoring farmers fields of organic clover seed	2000 – 2001		2001
3: Establishment of demonstration trials in accordance with findings in the monitoring (D2 and D3).	2002 – 2003		2002
4: Establishment for screening trial in green manure / catch crops	2001- 2003		2003
WP2: Crop establishment techniques – row cultivation			
Deliverables			

5: Information on optimal row spacing and seed rate in two different grass types and recommendations for establishment techniques in related species. Meetings and publication*	03/2002	*	Results presented once a year 2000-2002. Paper submitted 2005
6: An evaluation of in row fertilisation in grass seed crops. Meetings and report – in addition we prepare a paper	10/2003		Results presented once a year 2000-2002. Paper in prep. 2005
7: Guidelines for optimal row density in grass species with rhizomes. Meetings and report	11/2004		2004
8: Optimal row spacing in white clover. Report. The project has changed to a broader focus and investigates different establishment techniques.	12/2004		Additional funding was raised and project ended 2005.
Milestones			
5: Establishment of the third and final experimental year.	2003		2003
6: Screening prevalent farm equipment.	2001 – 2003		2003
7: Investigations on new establishment techniques in smooth stalked meadow grass.	2002 – 2004		2004
8: Determinations of white clover seed yield and yield components at different establishment techniques.	2002 – 2004		2005
WP3: Mixed cropping – grasses and nitrogen fixing crops			
Deliverables			
9. A list of green manure crops beneficially intercropped with grass seed crops and information on the range of nutrients that can be released and utilised from the green manure crop. Meetings, reports and published in Ph.D-report, 2003. Publication presented at the IFOAM conference Adelaide, 2005.	12/2003		2003 09/2005
10: Results on seed yield in mixed cropping of grass and clover as well as information on the amount of forage produced when the first year is used for forage cuts. Meetings and report.	07/2001		Additional funding – 2003
11: Evaluation of the competitive ability between clover and repellent and parasitoid attractant plants. Meetings and report	07/2001		Evaluation and report 2001 + Poster at IFOAM/ISF, Rome 2004
12: Identification of the advantages / risks of sheep grazing grass and clover seed fields. Daily gain and body score are also determined. Meetings and report.	12/2001		2001 + 2002
Milestones			
9: Report including results on the production of nutrient by the green manure crops when grown together with a grass seed crop.	2003		2003

10: An evaluation of the possibility to produce grass and clover seed in the same field (yield and quality).	2002 – 2004		Results from the Advisory Service
11: Advice on intercropping in clover	2001 – 2004		2002
12: Report including results on daily gain and body score.	2001 and 2004		2002
WP4: Pests – alternative cropping techniques			
Deliverables			
13. Examination of the effect of late defoliation on clover seed weevil density and damage. Meetings and report, publication*	11/2004	*	Meetings and report 2002-2005. Publication including additional results from 2005 is in preparation
14: A list of potential plants species repellent to clover seed weevils. Meetings and report.	04/2002		2002
15: A list of potential plant species attracting parasitoids against clover seed weevils. Meetings and report.	04/2003		2003
16: Evaluation of the potentials of various preventive methods as elements in a management strategy for clover seed weevils on organic farms. Meetings, report and publication*	12/2004	*	Meetings and report 2002-2005. Publication including additional results from 2005 is in preparation
Milestones			
13: Report on the effect of defoliation in white clover.	2004		2002-2005
14: List of potential plant species that are repellent to clover seed weevils.	2004		2002
15: List of potential plant species that attract parasitoids.	2004		2003
16: Establishment of demonstration trials concerning clover seed weevils in white and red clover.	2001 – 2003		2003
WP5: Optimisation of crop rotation - incorporating seed crops			
Deliverables			
17. Guidelines for optimising the production of high quality seed of organic grass and clover species. Meetings, report and publication	12/2004	*	Meetings and report 2002-2005. Publication including additional results from 2005 is in preparation
18: Forage production and quality from seed crops. Meetings, report and publication	03/2002		Meetings and report 2001-2003. Paper 2005..
19: Guidelines for optimal crop rotation with respect to seed crops. Report.	12/2004		2004
Milestones			
17: Establishment of demonstration trials.	2001 – 2003		2003

18: Report on the amount of forage and forage quality.	2004		2005
19: Report on optimal crop rotation including seed crops.	2004		2004

* *Deviations are to be further discussed in D*

D. Description of deviations and subsequent adjustments of plans

As the project progressed, it appeared, that the production of organic grass seed increased and that the amount of organic grass seed was sufficient to cover the request from the home market – and in addition grass seed of various types of ryegrass became available for export. Ryegrass constitutes by far the highest proportion of high quality grassland forage mixtures. In contrast findings in WP1 revealed, that white clover seed yields remained low, that pests accounted for a high proportion of the yield reduction (up to 60%) and that no white clover seed fields were free from white clover seed weevils. Therefore work was focussed on white clover seed production, and more funds were attracted from 'Fonden for Økologisk Jordbrug' (2003) and Frøvækst Øst (2003, 2004, 2005 and 2006) www.froevaekst.dk. This extra funding has allowed to add yet another year of experimentation, and therefore the final publication including these results has not yet been submitted to a peer reviewed journal (D16 and D17). The intention is to prepare the papers autumn 2006. This extra year is expected to result in an additional publication (D13). Results have been presented in national journals and during the NJF-seminar on Herbage Seed Production, 2006.

D5: Two papers on 'optimal row spacing and seed rate' has been submitted to peer reviewed journals – however, both has been rejected with the argument, that the scientific area did not correspond with the scope of the journals. There is no longer a specific journal for papers on seed production, which of course is a quite narrow area, but combining it with organic production seems to make it even more specific. None of the referees has questioned the scientific work behind the publications, and we of course intend to find a journal, which will publish our papers.

The experiments with green manure crops have shown very promising results, but unfortunately one year of experimentation has a very poor plant establishment due to heavy rain immediately after sowing. An additional year of experimentation has been added and results were presented at the IFOAM conference, 2005.

E. Project publications and other products

1. Products from Organic Eprints archive

Affiliation: I.11 (CLOGS) Cultivation of organic clover and grass seed

Boelt, B. (2005) 1.000 kg hvidkløver pr. ha!. Paper presented at Plantekongres 2005, Herring; Published in *Plantekongres 2005*, page pp. 260-261.*

Boelt, B. (2005) Det sværeste ved hvidkløver er afpudsningen. *Agrologisk*:pp. 24-25.**

Boelt, Birte (2003) Fåreafræsning af græsfrøafgrøder. *Frøavleren*.

Boelt, Birte (2003) Frøproduktion af efter- og grøngødningsafgrøder. *Tidsskrift for Frøavl* 1:pp. 7-9.

Boelt, Birte (2003) Organic forage seed production. Paper presented at Fifth International Herbage Seed Conference: Herbage Seed in the New Millennium - New Markets, New Products, New Opportunities, The University of Queensland Gatton Campus, Queensland, Australia, 23-26 November 2003; Published in Loch, Donald S., Eds. *Proceedings Fifth International Herbage Seed Conference, Gatton, Australia, 23-26 November 2003. Herbage Seeds in the New Millenium - New Markets, New Products, New Opportunities*, page pp. 43-47.

Boelt, Birte (2003) Produktion af økologisk hvidkløverfrø. *Økologisk Jordbrug*.

Boelt, B. (2002) Intercropping as solution for organic grass seed production?. Paper presented at 1st International symposium on organic seed production and plant breeding, Berlin, 21st and 22nd November 2002; To be published in *Organic Seed Production and Plant Breeding - strategies, problems and perspectives*.

Boelt, B. (2002) Legume seed production and research in Europe. Paper presented at Canadian Alfalfa and Forage Seed Conference 2002, Winnipeg, Manitoba, Canada, 20-22 January 2002; Published in *Forage Seed* 9(1), page pp. 33-34.

Boelt, B. (2001) Afgræsning af frøafgrøder med får. *Dansk Frøavl* 8:pp. 140-140.

Boelt, B. (2000) Samdyrkning af græs og kløver. *Dansk Frøavl* 9:pp. 150-151.

Boelt, B.; Clausen, D.; Gislum, R. and Hansen, L.M. (2001) Aktuelt nyt fra Danmarks JordbrugsForskning, 2001. *Tidsskrift for Frøavl* 2:pp. 7-10.*

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Boelt, B. and Deleuran, L.C. (2000) Organic forage seed production. Paper presented at IFOAM 2000 - The World Grows Organic, Basel, Switzerland, 28-31 August 2000; Published in *Proceedings 13th International IFOAM Scientific Conference*, page 228.

Boelt, B.; Deleuran, L.C. and Gislum, R. (2002) Nyt fra Danmarks JordbrugsForskning. *Tidsskrift for Frøavl* 1:pp. 11-13.**

Boelt, B.; Deleuran, L.C. and Gislum, R. (2002) Organic forage seed production in Denmark. *IHSG Newsletter* 34:pp. 3-4.

Boelt, Birte and Gislum, René (2004) What are the limiting factors to seed quality in organic production of grass and clover seed and how to improve yield. Paper presented at First World Conference on Organic Seed: Challenges and Opportunities for Organic Agriculture and the Seed Industry, FAO Headquarters, Rome, Italy, July 5-7, 2004; Published in Lammerts van Bueren, Edith; Ranganathan, Radha and Sorensen, Neil, Eds. *Proceedings of the First World Conference on Organic Seed: Challenges and Opportunities for Organic Agriculture and the Seed Industry*, page pp. 149-153.

Boelt, B. and Hansen, L.M. (2006) Dyrkning af hvidkløver til frø [White clover seed production]. Paper presented at NJF seminar 395 Herbage Seed Production, Danish Institute of Agricultural Sciences, Research Centre Flakkebjerg, 4200 Slagelse, Denmark, 12-14 June 2006.*

Deleuran, L.C. and Boelt, B. (2006) Establishment Techniques in Grass Seed Production of Perennial Ryegrass. [preprint]*

Deleuran, L.C. and Boelt, B. (2002) Forage cuts as a by-product in organic seed production. *IHSG Newsletter* 34:pp. 5-7.**

Deleuran, L.C. and Boelt, B. (2002) Rækkedyrkning af frøgræs. Grøn Viden Markbrug no. 247.**

Deleuran, L.C. and Boelt, B. (2000) Utilization of forage cuts in organic grass seed production. Paper presented at EGF 2000 Grassland Farming. Balancing environmental and economic demands, Aalborg, Denmark, 22-25 May 2000; Published in *Proceedings of the 18th General Meeting of the European Grassland Federation*, page pp. 552-554.

Deleuran, L.C.; Gislum, R. and Boelt, B. (2006) Producing seeds of festulolium – a new component in forage mixtures. [preprint]

Gislum, R. and Boelt, B. (2005) Intercropped green manure legumes in perennial ryegrass (*Lolium perenne* L.) for organic grass seed production. Paper presented at 15th IFOAM Organic World Congress, Adelaide, South Australia, 20-23 September 2005; Published in *Congress Handbook of 15th IFOAM Organic World Congress, IFOAM Abstracts*, page 51.

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

Hansen, L.M. (2002) Økologisk hvidkløverdyrkning, kløversnudebillens betydning og bekæmpelsesmuligheder. Paper presented at NJF seminar nr. 341, Grass and clover seed production, Sweden, 24-26 June 2002; Published in *NJF-rapport nr. 341*, page pp. 87-93.

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Hansen, Lars Monrad and Boelt, Birte (2004) Organic clover seed production: Does intercropping with plant species with a strong scent distract the clover seed weevil and increase seed yield?. Paper presented at First World Conference on Organic Seed: Challenges and Opportunities for Organic Agriculture and the Seed Industry, FAO Headquarters, Rome, Italy, July 5-7, 2004; Published in Lammerts van Bueren, Edith; Ranganathan, Radha and Sorensen, Neil, Eds. *Proceedings of the First World Conference on Organic Seed: Challenges and Opportunities for Organic Agriculture and the Seed Industry*, page 180.

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Langer, Vibeke and Rohde, Benjamin (2005) Factors reducing yield in organic white clover seed production in Denmark. *Grass and Forage Science*.

Nielsen, G.C.; Hansen, L.M. and Boelt, B. (15. June 2005) Snudebiller i hvidkløver til frø. *Planteavlsorientering* nr. 09-718.

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Rohde, B.; Langer, V. and Hansen, L.M. (2000) Økologisk hvidkløver - hvordan kan det lade sig gøre?. *Dansk Frøavl* 9:pp. 148-149.

Rohde, Benjamin; Langer, Vibeke and Hansen, Lars Monrad (2000) Økologisk hvidkløver. Hvordan kan det lade sig gøre? [Organic white clover seeds. How is it possible?]. In *Dansk Frøavl*, No 9, page pp. 148-149. Danske Frøavlere.

2. Other products (oral presentations, public meetings, field days, etc.)

Boelt, Birte (2006). Growing of white clover, NJF-seminar Næsgaard Agerbrugsskole, 14. June, 2006. 50 participants.

Boelt, Birte (2006). 1000 kg vitklöver – hur gör man?. Conference on organic and conventional clover seed. 15 March 2006, Alnarp, SE. 45 participants.

Boelt, Birte. 2004. Dyrkningsteknik i hvidkløver. Økologiske feltdage, DIAS-Flakkebjerg. 22 participants.

Boelt, Birte. 2004. Udlægsmetoder, efterårsbehandling og snudebilleerfaringer. Kursus I økologisk frøproduktion. Økologisk Rådgivning, Jyderup. 15 participants.

Boelt, Birte. 2004. Status på forsøgsresultater med økologisk frøproduktion og markvandring. Kursister fra kurset 'økologisk frøproduktion'. DIAS-Flakkebjerg. 12 participants.

Boelt, Birte. 2004. What are the limiting factors to seed quality in organic production of grass and clover seed and how to improve yield. Paper presented at First World Conference on Organic Seed: Challenges and Opportunities for Organic Agriculture and the Seed Industry, FAO Headquarters, Rome, Italy, July 5-7, 2004; Published in Lammerts van Bueren, Edith; Ranganathan, Radha and Sorensen, Neil, Eds. *Proceedings of the First World Conference on Organic Seed: Challenges and Opportunities for Organic Agriculture and the Seed Industry*.**

Gislum, René. 2004. Samdyrkning af frøgræs og grøngødningsafgrøder. Økologiske feltdage, DIAS-Flakkebjerg. 22 participants.

Hansen, L. M. 2004. Kløversnudebiller – biologi og udbyttereduktion. Økologiske feltdage, DIAS-Flakkebjerg. 22 participants.

Hansen, L. M. (2005). Snudebiller i hvidkløver – forekomst og muligheder for bekæmpelse. Frødagen februar 2005. 50 participants.

Hansen, L. M. (2006). Seneste resultater fra forsøg med kløversnudebiller. Frødagen januar 2006. 55 participants.

Hansen, L. M. & Boelt, B. Skadedyr i hvidkløver – forekomst og muligheder for bekæmpelse Dyrkningsforsøg i hvidkløver – nåede vi de 1000 kg?

Hansen, L. M. (2006). Prognos- och varningssystem för vitklöverspetsvivlar. Conference on organic and conventional clover seed. 15 March 2006, Alnarp, SE. 45 participants.

Kristensen, Jørn L. 2004. Organic forage seed production. Kursus I økologisk frøproduktion. Økologisk Rådgivning, Jyderup. 15 participants.*

Kristensen, Jørn L. 2004. *Achieved quality in organic seed production of clover and grass in Denmark*. Paper presented at First World Conference on Organic Seed: Challenges and Opportunities for Organic Agriculture and the Seed Industry, FAO Headquarters, Rome, Italy, July 5-7, 2004; Published in Lammerts van Bueren, Edith; Ranganathan, Radha and Sorensen, Neil, Eds. *Proceedings of the First World Conference on Organic Seed: Challenges and Opportunities for Organic Agriculture and the Seed Industry*.**

Boelt, Birte. 2004. Co-existence with GMO's and organic seed production. Hearing in EU Towards a European Action Plan for Organic Farming. 287 participants.**

In February, 2003 a meeting for seed production advisers were held at research centre Flakkebjerg (app. 60 participants).

In June 2003 there has been 1 field day for seed production advisers in the organic crop rotation at Research Centre Flakkebjerg.

In July 2003 a group of Swedish advisers visited Flakkebjerg. Their special interest was organic forage seed production.

During summer 2003 Birte Boelt has participated in four field days/evenings.

Boelt, Birte. 2002. Erfaring med økologisk frøproduktion / *Experiences with organic seed production*. Agrogården Funen. Ca 30 participants

In June there has been 1 field day for seed production advisers in the organic crop rotation at Research Centre Flakkebjerg.

In June, 2002 Birte Boelt participated and presented experiences from trials with organic white clover seed production - in a field day with an interest group of organic farmers.

In March, 2002 Lars M. Hansen and Birte Boelt joined a meeting on organic white clover seed production. Optimal cultivation techniques were discussed with a group of farmers, and the programme for plant sampling in farmer fields was decided.

In February, 2002 a meeting for seed production advisers were held at research centre Flakkebjerg (app. 70 participants).

Boelt, Birte. 2002. Økologisk hvidkløverfrøproduktion / *Organic white clover seed production*. Field day – organic farming. Landbocentrum, Ringsted. Ca 50 participants

In June, 2002 Lise C. Deleuran, René Gislum, Lars M. Hansen and Birte Boelt participated in a seminar on seed production, arranged by The Society of Nordic Agricultural Scientists. The seminar included a session on organic forage seed production where Lars M. Hansen had an oral presentation and Birte Boelt was the chairman.

Boelt, Birte. 2001. Grøngødningsafgrøder i alm. rajgræs. Kornudbytter og N-mængder i halm / *Green manure crops in Lolium perenne. Yield of cover crop and N-content in straw*. Organic Seed Production DIAS-Flakkebjerg. 50 participants.

Boelt, Birte. 2001. Afgræsning af frøafgrøder med får / *Sheep grazing in seed crops*. Meeting with forage seed advisers DIAS-Flakkebjerg. 73 participants**

Boelt, Birte. 2001. Samdyrkning af kløver og græs / *Intercropping of clover and grasses*. Training course "Organic clover seed production" Landbocenteret i Rønnede. 16 participants

Boelt, Birte. 2001. Økologisk og konventionel dyrkning af markfrø / *Organic and conventional production of forage seed*. Growers group – Seed production, conventional and organic, DIAS-Flakkebjerg. 6 participants**

Boelt, Birte, 2001. Dyrkning af økologisk frøgræs og kløver. / *Organic production of grass and clover seed*. Training: Organic seed production Bornholmske Husmandsforeninger og Sjællandske Familielandbrug 12 participants.

In June, July, 2001 there has been 2 field days in the organic crop rotation at Flakkebjerg.

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

* 25-75% financed by DARCOF

** 5-25% financed by DARCOF

F. Scientific education

The present project is included as part of the Ph.D.-project of René Gislum, who defended his thesis in April 2003.

G. National and international cooperation

In winter 2004/2005 a meeting was held between the Danish Advisory service for organic farming and an organic adviser from Økologisk Rådgivning to discuss strategies for organic white clover seed production on the basis of results from CLOGS. A major finding, that pests appear in any organic white clover seed field, implies, that farmers need a guideline / tool to evaluate the severity of the attack by pests. If it is minor, management strategies should not be changed, if it is major a late defoliation is recommended and if the late defoliation does not reduce the attack it may not be beneficial to harvest the field. Instead it may be utilised as a forage crop (grazing animals or cut). Farmers need a decision support system to evaluate the severity of attack.

Nationally there is a very close cooperation with seed company advisers, staff in the Danish advisory service and seed growers. This cooperation has existed for many years and has resulted in at least two meetings a year – during summer, where seed production experiments are presented (field day) and during winter, where experimental results from the previous growing season are presented (meetings). Besides staff from DIAS participate in farmer field days.

Internationally we have contacts to scientific staff at Planteforsk, Norway and scientific staff at FNAMS, France specifically on the issue – organic forage seed production. International a contact to Växtskyddscentralen, Alnarp, Sweden is established and collaboration is continued.

H. Critical reflection on the project

Since the major obstacle in obtaining organic seed for grassland forage mixtures is lack of white clover seed, and that pests has been identified as the major yield reducing factor – and that pests appear in any organic white clover seed field, focus has been changed to focus even more on white clover. It has been possible to intensify the investigations due to the attraction of additional funding.

Progress in the project has been in accordance with the description. However, focus has been moved towards the problems in white clover, since this is the species where the problems in organic production are numerous and most severe. Registrations in farmer fields have provided useful information, and the interaction between registrations in farmer fields and replicated field trials in the organic crop rotation at Flakkebjerg is a very good combination, that provides a whole range of information.

The long tradition for and experience in field experiments by the project staff is of outmost value to this project. Experiments are carried out in accordance with farm practice, which is essential for the success in dissemination of results.

The objectives in this project are very applied, and results must be applicative for the farmers – right away. Since budgets were reduced according to the expressed interest more fundamental scientific investigations has not been possible within the allocated budget. It would provide much more information if, for example, a number of plant species could be analysed for chemical compounds in order to repellent clover seed weevils. The utilisation of green manure crops seems to possess a potential as nitrogen source and further it might be used in a strategy where nitrogen availability is timed in order to stimulate reproductive development. Fortunately it has been possible to include some investigations in a Ph.D.-project financed by the Danish Seed Industry.

Due to the applicative approach there has been a trend to focus more on national journals, meetings and conferences – and in combination with difficulties to find scientific journals to publish the papers, the deliverables ‘peer reviewed papers’ are not yet fulfilled. However, there’s been a substantial flow of information nationally and as technical support for our national government and to EU. There has been very much focus on organic seed production and co-existence between GM-, conventional and organic crop production and there has been a large contribution of papers, presentations and even organisation of seminars and conferences in this area.

8. Budget

A. Account for any change in budgets

B. Budget for the whole project (1.000 DKK)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months	91	49	23	20	92
Scientific personnel	35	19	7	7	33
Technical personnel	56	30	16	13	59

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	1550	842,3	317,5	324,3	1484,1
Technical personnel	1128	601	329,6	269,1	1199,7
Other operational costs	452	261,4	131,1	73,8	466,3
Equipment					
Others (travelling)	5		2,3	2,2	4,5
Direct costs					
Indirect costs (20% of direct costs)	620	331,1	156,1	133,1	620,3
Total	3755	2035,8	936,6	802,5	3774,9

Comments:

It has possible to allocate more funding (20.000 Dkr. DIAS funding) specifically to field trials in white clover for the establishment for trials for 2005 (funded by Frøværkst Øst).

9. Signatures and stamps

Name	Institute	Date	Signature
Head of project Birte Boelt	Danish Institute of Agricultural Sciences	March 31 th 2005 Revideret April 9 th 2006	

Appendix I. Detailed budget

A. Budget for each participating institute (1.000 DKr)

Name of Institute: Dept. of Genetics and Biotechnology (former Plant biology)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel					
Technical personnel					

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	940	400	200	244,3	844,3
Technical personnel	888	500	264,5	226,5	991
Other operational costs	298	160	80	58	298
Equipment					
Others (please specify)					
Direct costs					
Indirect costs (20% of direct costs)	416	203	109	105	416,9
Total	2542	1263	653,5	633,8	2550,2

Comments:

B. Budget for each participating department (1.000 DKK)

Name of Institute and department: Plant protection and Pests

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel					
Technical personnel					

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	164	77	41	52,6	170,6
Technical personnel	203	101	65	42,6	208,6
Other operational costs	97	56	25,7	15,8	97,5
Equipment					
Others (travelling)	5		2,3	2,2	4,5
Direct costs					
Indirect costs (20% of direct costs)	97	46	26,8	22,7	95,5
Total	566	280	160,8	135,9	576,7

Comments:

C. Budget for co-financing from each participating institute (1.000 DKK)

Name of Institute: KVL

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel					
Technical personnel					

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	293	306,7		27,3	334
Technical personnel	37				
Other operational costs	10	4,5			4,5
Equipment					
Others (please specify)					
Direct costs					
Indirect costs (20% of direct costs)	67	62,2		5,5	67,7
Total	407	373,4		32,8	406,2

Comments:

C. Budget for co-financing from each participating institute (1.000 DKK)

Name of Institute: Department of Genetics and Biotechnology (former Animal Breeding and Genetics)

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Man-months					
Scientific personnel					
Technical personnel					

Year:	Original budget	Consumption before 2003	Consumption 2003	Consumption 2004	Total
Salaries					
Scientific personnel	153	58,1	76,6		134,7
Technical personnel					
Other operational costs	47	40,9	25,4		66,3
Equipment					
Others (please specify)					
Direct costs					
Indirect costs (20% of direct costs)	40	19,8	20		39,8
Total	240	118,8	121,9		240,8

Comments: