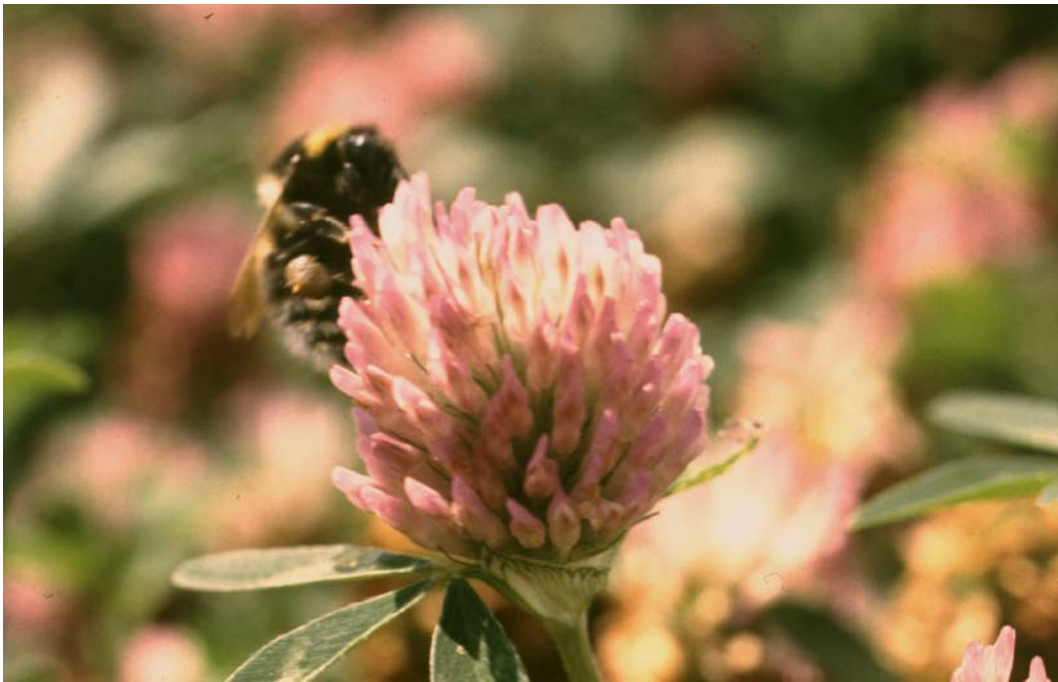


I.11

CLOGS

CLOver and Grass Seed

– production of high quality organic seed for forage mixtures



Application

to

Danish Research Centre for Organic Farming

CLOGS

CLOver and Grass Seed

– production of high quality organic seed for forage mixtures

Application made by

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Title: CLOver and Grass Seed – production of high quality organic seed for forage mixtures

Acronym: CLOGS

Date: 25 February 2000

1. Summary

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.

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.

2. Research group

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The research group CLOGS comprises expertise within plant and animal sciences, agroecology and entomology as well as commercial seed production. Collaboration is already established between partner 1, 2, 3 and 5 and between partner 1 and 5.

3. Introduction

EU regulation 2092/91 states that as from 1 January 2001 only organically produced seed can be used in organic farming systems, however, due to insufficient supply this deadline has been prolonged to 1 January 2004. Organic forage production for ruminants is based on mixtures of various grass and clover species with main constituents being perennial ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens* L.). To obtain a high degree of on farm produced forage the composition of these mixtures must be optimised in relation to soil conditions, climate, and end products (grazing, silage and haymaking). To fulfil these demands the natural properties of various species must be utilised (preference for soil type, nutrient utilisation, and growth rhythm). Forage plant breeders are continuously releasing improved cultivars in terms of quality, palatability, resistance and yield. Optimal ruminant production and welfare are only reached when the organic grower has access to the full range of improved varieties and diverse species.

A mixture of grass and clover species is only considered organic when each constituent are organically produced. Therefore much strain is placed on the European seed growers to ensure an adequate supply of organically produced high quality cultivars of grasses and clovers. Additionally large quantities of seed are required for green manure and nitrogen catch crops. It is estimated that the EU-demand for

organic forage seed in year 2000 is 2-3000 tonnes of grass seed, and 8-900 tonnes of clover and other legume seed.

Danish seed producers hold a considerable proportion of the total EU grass and white clover seed production due to favourable climatic conditions, long tradition and expertise in this specialised production. On average 40% of the total EU production of grasses are grown in Denmark and 80% of the total white clover production. It is a great challenge to the Danish seed growers to supply an equivalent proportion of the required organic seed, and Danish seed companies are currently establishing an organic forage seed production in order to supply organic growers within the EU with high quality seed of recognised forage cultivars. Approximately 900 – 1100 tonnes of organic forage seed are required in Denmark in year 2000. This requirement is almost fulfilled with respect to perennial ryegrass, however, of white clover a very limited amount of seed is available.

4. State of the Art

Due to intensive advisory support the requirement for organic perennial ryegrass seed is expected to be fulfilled in 2000 and marketing in other European countries have started. At the moment perennial ryegrass is mainly produced by dairy or pig farmers with access to adequate quantities of animal manure. However, the proportion of organic feed for ruminants must be increased from the current 85% to 90 % in August 2000, increasing to 100 % in 2005. It is expected that organic dairy farmers must intensify forage production and therefore seed production might not be attractive.

Other grass species than perennial ryegrass, that is timothy (*Phleum pratense* L.), meadow fescue (*Festuca pratensis* Huds.), cocksfoot (*Dactylis glomerata* L.) and smooth stalked meadow grass (*Poa pratensis* L.), are constituents of forage mixtures since they possess out-standing properties. Timothy extends the production season in autumn, cocksfoot is drought resistant, meadow fescue and smooth stalked meadow grass has a high persistency. Most of these grass species and especially also white clover have their traditional production area in Eastern Denmark, due to milder climate and fertile soils. In Eastern Denmark most farmers are arable farmers, which means that the country, although small, are divided into two strains of agriculture:

- Western Denmark with a high proportion of dairy farmers, poorer soils and more precipitation
- Eastern Denmark with a high proportion of arable farmers, better soils and less precipitation.

Until now the highest proportion of Danish organic farmers has been dairy-farmers and only recently arable farmers have started converting to organic production. This ought to be very promising for the production of especially white and red clover, but also cocksfoot and smooth stalked meadow grass – species that are at request. However, organic seed production is facing severe obstacles due to weeds, the lack of animal manure and pests. To optimise production (quality and yield) investigations are necessary within the following cultivation techniques:

Establishment	enhancement of seed crop competitiveness against weeds enabling mechanical weed control with minor crop damage
Mixed cropping	intercropping with green manure crops
Pests	cultivation techniques reducing <i>Apion</i> damage alternative management techniques increasing seed yield
Utilisation of by-products	control of excessive grass and clover growth

Establishment

Grasses for seed production establish very slowly compared to a cereal crop and for most species a satisfactory seed yield is not obtained until their second growth season. Therefore more than 90% of the grasses for seed production are established in a cover crop. The slow establishment results in weak competitiveness against weeds. Perennial grasses for seed production are normally established at low plant densities which encourages higher seed. Organic seed has to meet EU quality standards of germination and purity as a minimum, but often higher demands are requested. Due to the above mentioned factors (slow establishment rate and low plant densities) weed control in seed crops is one of the most essential management aspects.

Recent investigations have shown that perennial ryegrass can establish well in the same seeding row as the cover crop, spring barley, and by using this establishment method mechanical weed control can be performed in the establishment year without damaging the undersown grass. However, preliminary results show that grasses establishing more slowly than perennial ryegrass does not establish satisfactorily using this method and investigations are needed to develop new techniques in smooth stalked meadow grass and cocksfoot.

Ongoing research in conventional seed fields of perennial ryegrass and red fescue (*Festuca rubra* L.) show that establishment at wider row distances (up to 24 - 36 cm) does not effect seed yield compared to establishment at 12 cm row distance. These findings are very interesting since wider row spacing will allow for mechanical weed control between the rows in the seed production year. Inter-row competition against weeds are increased due to a constant seeding rate which means that by increasing the row distance from 12 to 24 cm twice as many seeds are sown at 24 cm. These experiments have not yet been conducted in organic seed fields, however they might be very promising.

In row cultivation systems a higher nutrient utilisation might be achieved when in row application of nutrients is conducted. This cultivation method has in spring barley increased crop competitiveness against weeds and similar effects are expected in grasses for seed production. In organic arable farming systems nutrient supply are often inadequate due to the lack of animal manure. Preliminary results obtained by *partner 1* indicate that green manure crops can contribute to nutrient supply when intercropped with a seed crop. In respect to other cultivation problems mixed cropping might prove beneficial (repellent plants against pests, catch crops for natural enemies against pests etc.). If mixed cropping are to be performed successfully row cultivation systems must be developed and optimised in the seed crops.

Mixed cropping

Natural biotopes are more complex than crops grown in a pure stand. A management tool in organic seed production might be to combine plant species, which provide regulation methods on various cultivation problems (inadequate nutrient supply, pest etc.). Examples of advantageous crops mixed with a seed crop are:

green manure crops	→ nutrient production
nitrogen catch crops	→ nutrient preservation against leaching
repellent crops	→ disorganising pests
parasitoid catch crops	→ attract natural enemies against pests

However, combining two crops will always create competition against one of the following factors: light, water or nutrients. Mixed cropping is managing this sensitive balance in crop development and growth. In addition maintaining the seed purity is a essential in seed production. If mixed cropping is performed seed of the two different crops must be separated in the cleaning process after harvest.

One of the most essential problems in organic seed production on arable farms in Eastern Denmark is inadequate nutrient supply and especially nitrogen. Besides the nitrogen amount, seed crops are also very sensitive to the timing of nitrogen application. Correct timing will stimulate reproductive development whereas excessive and poorly timed nitrogen application will be in favour of vegetative growth. If a nitrogen-fixating precrop provides nutrients, the grass seed crop will take up nitrogen as soon as it is mineralised which will most likely lead to excessive vegetative growth. Mixed cropping of a grass seed and a green manure crop provides an option on timing the nitrogen release.

Preliminary results obtained by *partner 1* indicate that satisfactory seed yields might be obtained when grasses for seed production are mixed with red clover (as a green manure crop). These findings are in accordance with recent Norwegian results. In the Danish trial red clover was cut and nitrogen was attempted released at the beginning of the elongation of the grass seed crop – the time where nitrogen support reproductive growth. This technique seems very promising and further investigations are necessary. Other legumes than red clover ought to be tested as green manure crops in perennial ryegrass for seed production. Furthermore the experiment should to be extended to include other grass species.

Pests

Clover seed weevils (*Apion* spp.), pea weevil (*Sitona lineatus*) and cloverleaf weevil (*Hypera nigriostris*) are pests in red and white clover crops, of which the clover seed weevils are the most serious and economically important. The status of clover seed weevils as important insect pests is a result of several traits in their biology and ecology. Clover seed weevils are able to reduce the seed yield up to 90% in a heavily infested clover crop. First, the beetles are mobile enough to prevent that crop rotation, at least on a normal spatial scale, can be utilised as a control method. Secondly, they occur in clover seed fields over an extended period from early summer to late fall, indicating that moving the sensitive crop stage in time cannot be expected to guard fully against damage. Thirdly, the beetles do not seem to be considerably limited by any single natural enemy, although parasitoids, entomopathogens and predators have been found on the species attacking clover. Therefore, the strategy must be to pursue a variety of roads, which may lower weevil damage to an acceptable degree when combined.

The proposed work focusing on clover seed weevils are based upon knowledge acquired through studies carried out by the research group (*partner 1, 2, 3, and 5*). In 1999 potential seed yields and yield reducing factors were assessed in more than half of all organic clover fields in all parts of Denmark. Although organic seed production is of immediate interest, recent European investigations on this topic are scarce, and the aim of the work was to create a sound basis for future research. Therefore, the development of a reliable method to estimate yield reductions due to clover seed weevil and inadequate pollination formed part of the work. In 1999 yields in white clover fields varied between 55 to 400 kg/ha, with highest yields in fields with high flower head density, large flower heads, low weevil damage and good pollination. In fields with low yields the reducing factors were large weevil damage or adverse harvest conditions, characterised by several weeks distance between swathing and threshing as well as several swath lifting. In 1999 an average of 28% of all seeds were eaten by weevils, ranging from 3 to 57% on different farms, and an average of 8 weevils (between 1 and 19) were hatched from each flower head in 15 white clover seed fields. Inadequate pollination only accounted for an average of 6% (2-15) seed loss in 1999.

Investigations dating from the time before pesticides were an option in pest management suggest a number of preventive or control methods to reduce weevil damage in clover fields.

- Swedish trials have shown less damage in larger inflorescences.
- Russian trials showed correlation between resistance to seed weevils and HCN content in the plant.
- Results from Danish and Swedish research indicate that defoliation reduces damage from seed weevils.
- Danish and Swedish investigations have shown that up to 10-20 % larvae were parasited.

Apion larvae are attacked by several species of parasitoids from the superfamily *Chalcidoidea*. Adult parasitoids are feeding on nectaries in flowering plants. It is probable that strips of early flowering plants grown together with clover crops will increase the early flowering strips and colonise the clover crop with parasitoids. Approximately 30% of the *Apion* population overwinters in the clover fields and the rest are flying to special overwintering sites. In spring they return to clover fields primarily attracted by the scent of clover. It is probable that strips of flowers with a strong scent grown together with clover crops will be able to disorganise ‘the landscape of odour’, for which reason the weevils have difficulty in finding the clover fields.

The management strategy towards insect pests with the above mentioned biological characteristics often include several complementary initiatives. This is also the strategy we wish to pursue in this project.

Utilising by-products for forage

Perennial grasses for seed production normally have an excessive leaf growth in autumn, and to prevent severe fungi-infestation during winter, this excessive growth is removed before the onset of winter. Traditionally this is done mechanically, which however, has some disadvantages: Regrowth is left on the ground often unevenly distributed and traffic with heavy machinery lead to structural soil damage. Alternatively sheep grazing in late autumn can remove this excessive growth. Sheep grazing pro-

vides a number of advantages: Regrowth is removed, no structural damages occur, and due to selective grazing volunteers and weeds are removed between the grass seed plants. Furthermore, circumstantial evidence suggests a 10% net increase in seed production after sheep grazing in autumn compared to mechanical defoliation, and finally the sheep farmer gains access to pasture at a time of year, when pasture is normally scarce. However, managing grass seed crops by sheep grazing requires skilled stockmanship, flexible fencing- and transport systems, high stocking rates (60 – 100 animals/ha) and short grazing periods (10 – 20 days).

A study carried out in 1997 – 1999 (*partner 1 and 4*) grazing seed crops indicates that the sheep thrives very well on red fescue in October – November. The figures in table 1 represent results from 30 – 50 day grazing periods and are typical for animals in medium body condition at the start of the grazing period.

Table 1 Daily gain and change in body condition score (range) in sheep grazing red fescue in October - November

	Daily gain, g. (days)	Body condition score
Mixed age ewes	150 - 320	0.5 -1.0
1-year old gimmers	100 - 160	0.2 - 0.7
Gimmer lambs	120 – 210	0.2 - 0.5
Wether lambs	120 - 180	0.3 - 0.6

The above mentioned growth rates and changes in body condition score are very attractive for the sheep producer and are fully satisfactory for flushing and fattening store lambs. Lush, leafy pasture is normally scarce in autumn. The leafy regrowth in grass seed crops apparently has a very high digestibility, and furthermore the pasture is not contaminated with parasites. Thus these pastures can be used for flushing without supplementary feed. Depending on the age of the crop, the autumn growth season and local conditions up to 780 sheep grazing days per ha can be achieved, making it attractive for the sheep farmer to move the fences and animals around. Access to clover grazing in autumn and early spring would further improve the ability of the sheep farmer to incorporate a sheep herd on arable farms and thereby create a more diverse farming system.

5. 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. 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.

6. Description of workpackages including methods

Table 1: Workpackage list

Work-package No	Work package title	Responsible participant	Budget	Start	End	Deliverable No
1	Main obstacles – organic grass, clover and legume seed production	VL	0.28 mill.	2000	2004	D1, D2, D3, D4
2	Crop establishment techniques – row cultivation	BB	0.80 mill.	2001	2004	D5, D6, D7, D8
3	Mixed cropping – utilisation of by-products	BB	1.12 mill.	2001	2004	D9, D10, D11, D12
4	Pests – alternative cropping techniques to minimise damage in clover	LMH	1.12 mill.	2000	2004	D13, D14, D15, D16
5	Optimisation of crop rotation - incorporating seed crops	BB	0.43 mill.	2000	2004	D17, D18, D19

6a Organisation of Work Packages

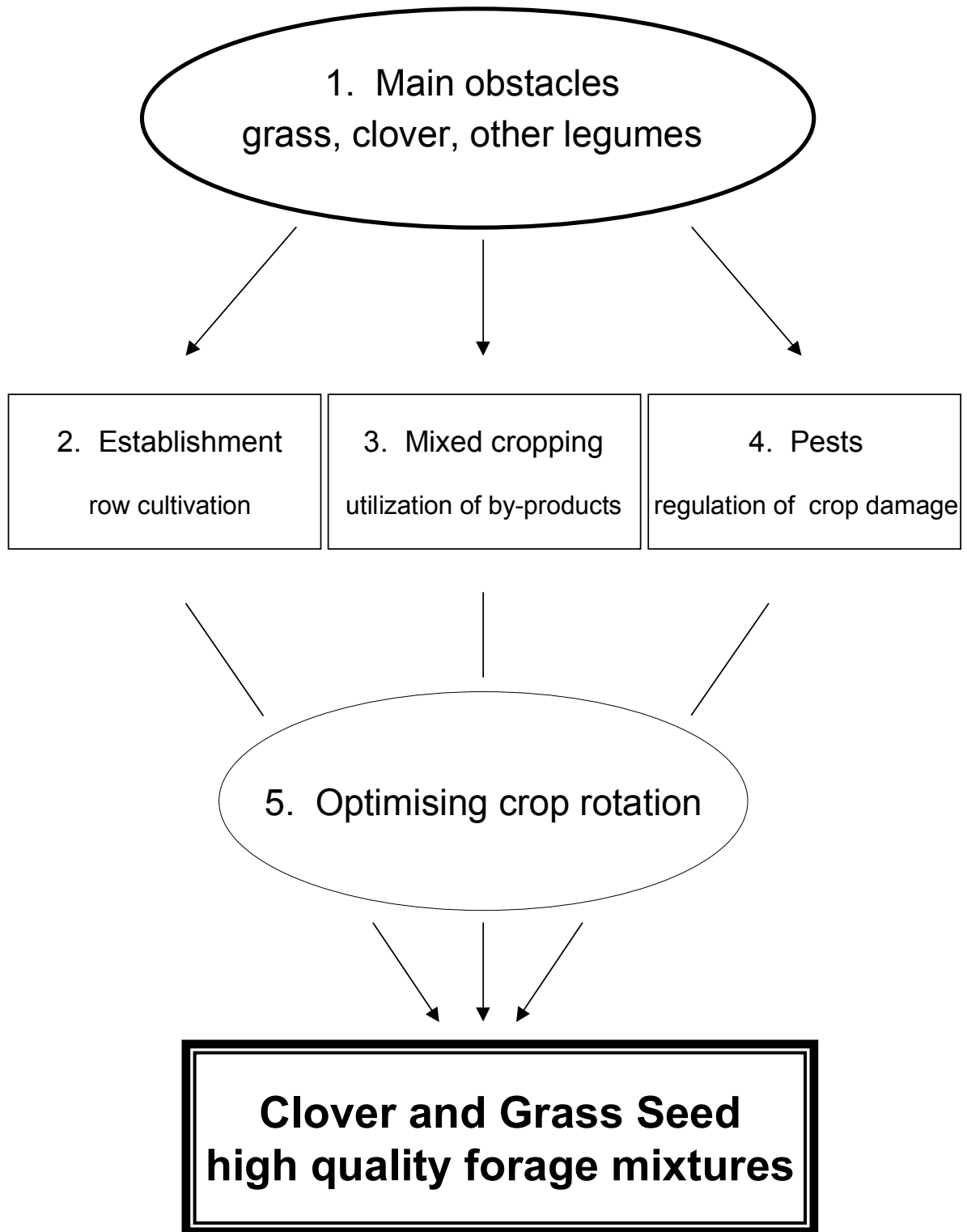


Table 2: Description of workpackages

WP1:	
Workpackage number: 1	Main obstacles - grass, clover and green manure / catch crop seed
Start date or starting event:	06/2000
Responsible person:	1
Contributing persons:	1, 2, 5
Person-months:	7
Objectives	
<ol style="list-style-type: none">1. Identify grass species / cultivars which are important constituents of high quality grass / clover seed mixtures but in which no organic seed production has been established.2. Identify factors determining the density of clover seed weevils in organic clover fields.3. Identify whether low clover seed yields are directly correlated to high clover weevil density or whether certain specific cultivation techniques may compensate for high weevil density and therefore reduce crop damage.4. Determine the potential for organic seed production of relevant green manure / catch crops in Denmark.	
Description of work	
<ol style="list-style-type: none">1. Seed companies involved in organic seed production is asked for information on the range of species grown organically. In high quality species where production is not already established relevant cultivation techniques are examined.2. A monitoring programme based on recently developed methods is carried out in organic clover seed fields to determine the density of clover seed weevils. Data on local density of clover weevil sources, i.e. last year's seed field on the farm as well as in the local area will be recorded.3. Within the above mentioned monitoring programme potential seed yield, weevil damage and pollination level will be estimated. Farm operations relevant for the interpretation of weevil occurrence and damage will be registered: flowering time, trimming date(s), grazing period.4. In an organic crop rotation relevant green manure / catch crops are screened for seed yield potential. Susceptibility to diseases and pests (especially clover seed weevils in other leguminous seed crops) is registered.	
Deliverables	
<ol style="list-style-type: none">D1. A list of grass species where no or only limited amounts of organic seed are available.D2. An evaluation of the importance of various field characteristics for weevil occurrence and damage.D3. A reliable list of the most important yield reducing factors in organic clover seed production, with an estimate of the approximate magnitude of each.D4. An evaluation of the possibilities of establishing seed production of new green manure / catch crops.	
Milestones	
<ol style="list-style-type: none">M1. Interviews with seed companies involved in organic grass seed production.M2. Monitoring a number of organic clover seed fields mainly in Eastern Denmark.M3. Establishment of demonstration trials in accordance with findings in the monitoring (D2 and D3).M4. Establishment of a screening trial in green manure / catch crops.	

WP1:

Workpackage number: 2	Crop establishment techniques – row cultivation
Start date or starting event:	01/2001
Responsible person:	1
Contributing persons:	1
Person-months:	20

Objectives

5. Determine 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.
6. Investigate the possibilities for in row fertilisation with organic manure and evaluate the effect of reduced nitrogen rates in grass seed crops.
7. Develop establishment techniques, which allow for mechanical weed control between rows in perennial grass species with rhizomes.
8. Examine the effect of row cultivation in clover intercropped with repellent plants or plants which attract parasitoids to the clover seed weevil (wp4).

Description of work

5. Two types of Festulolium are grown at three row distances (12, 24, and 36 cm) and three seed rates (6, 13, and 18 kg ha⁻¹). Due to the variability in growth habit within the two types, the results from this trial are extended to a wide range of grass species relevant in forage mixtures.
6. In row fertilisation is expected to reduce the optimal nitrogen rate. Furthermore weeds between the rows will not receive any nitrogen and are expected to be of minor crop damage. However, application techniques need to be tested.
7. In grass species with rhizomes, i.e. smooth stalked meadow grass mechanical weed control might not be possible without major crop damage. In these species new establishment techniques are examined.
8. Earlier research indicates that white clover may be established at 36 cm row spacing without yield reduction. Trials will be established where white clover is intercropped with repellent plants or plants which attract parasitoids to clover seed weevils.

Deliverables

- D5. Information on optimal row spacing and seed rate in two different grass types and recommendations for establishment techniques in related species.
- D6. An evaluation of in row fertilisation in grass seed crops.
- D7. Guidelines for optimal row density in grass species with rhizomes.
- D8. Evaluations of the effect of intercropping in white clover.

Milestones

- M5. Establishment of the third and final experimental year.
- M6. Screening prevalent farm equipment.
- M7. Investigations on new establishment techniques in smooth stalked meadow grass.
- M8. Determinations of white clover seed yield and yield components at different establishment techniques.

WP1:

Workpackage number: 3	Mixed cropping – grasses and nitrogen fixating crops
Start date or starting event: 01/2001	
Responsible person: 1	
Contributing persons: 1, 3, 4	
Person-months:	

Objectives

9. Evaluate green manure crops as nutrient sources in grass seed crops. Nutrient availability and timing is essential in obtaining high yields in grasses for seed production.
10. Examine a 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.
11. Evaluate the possibilities of growing other plant species in seed fields of clover (wp4).
12. Explore the possibility that grazing sheep can substitute mechanical defoliation in grasses and clover and thereby trim the seed crop and utilise by-products.

Description of work

9. A number of green manure crops are established in a grass seed crop of perennial ryegrass. Growth habits of the two crops are registered. Biomass production and nitrogen content in above and under-ground plant material of the green manure crops are determined. Green manure crops are under-cut in order to release nutrient in the seed production year.
10. In field trials red clover and a number of grasses for seed are intercropped. In one half of the experimental site seed yield is determined in the first year. In another part grass and clover are cut for forage in the first year and the following year seed yields of the grasses are determined.
11. Plants with a strong scent (repellent plants) and plants, which attract parasitoids to the clover seed weevil, are established in clover seed fields. The establishment and the competitive ability of each species are evaluated and clover seed yield is registered.
12. In farmer fields sheep grazing will be performed in autumn and spring to secure a satisfactory development of the grass seed crop.

Deliverables

- D9. A list of green manure crops that are beneficially intercropped with grass seed crops and information on the range of nutrients that can be released and utilised from the green manure crop.
- D10. 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.
- D11. Evaluation of the competitive ability between clover and repellent and parasitoid attractant plants.
- D12. Identification of the advantages / risks of sheep grazing grass and clover seed fields. Daily gain and body score are also determined.

Milestones

- M9. Report including results on the production of nutrient by the green manure crops when grown together with a grass seed crop.
- M10. An evaluation of the possibility to produce grass and clover seed in the same field (yield and quality).
- M11. Advice on intercropping in clover.
- M12. Report including results on daily gain and body score.

WP1:

Workpackage number: 4	Pests – alternative cropping techniques
Start date or starting event:	06/2000
Responsible person:	3
Contributing persons:	1, 2, 3, 4, 5
Person-months:	

Objectives

13. 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.
14. To explore ways of prevention of clover seed weevil damage.
15. To explore ways of biological control of clover seed weevil, which together with objective 2 may form a complementary strategy for organic farmers.
16. To evaluate alternative cropping techniques in farmer fields.

Description of work

13. In field trials different defoliation strategies are tested in white clover. Treatments will include no defoliation (control), defoliation when first flowerbuds appear, and a late defoliation approximately three weeks later. Weevil density is estimated by sweep net samples and counting of larvae in clover heads. The proportion of pollinated flowers is identified and the seed yield registered.
14. Plants with a strong scent either in flowers or in plant sap are identified.
15. Rearing parasitic weevil larvae in climate chambers identifies parasitoids against the clover seed weevil. In field trials established in wp2, parasitoid and weevil density as well as clover seed yield is registered.
16. Based on relevant monitoring results obtained in wp1 (*partner 2*) will explore potential management strategies more closely in a limited number of fields on organic farms. Work will consist of a whole field as well as other large-scale evaluations of trimming, grazing and catch crops, both as individual methods and in combination (e.g. using untrimmed field edges as a catch crop). On farm activities and plot trials (*partner 1*) will proceed concurrently and is planned to maximise the mutual benefits between activities.

Deliverables

- D13. Examination of the effect of late defoliation on clover seed weevil density and damage.
- D14. Examination of potential repellent plants does lower clover seed weevil density
- D15. Examination of potential plants that attract parasitoids.
- D16. Evaluation of the potentials of various preventive methods as elements in a management strategy for clover seed weevils on organic farms.

Milestones

- M13 Report on the effect of defoliation in white clover (Danish seed growers' magazines).
- M14 List of potential plant species that are repellent to clover seed weevils.
- M15 List of potential plant species that attract parasitoids.
- M16 Establishment of demonstration trials concerning clover seed weevils in white and red clover.

WP1:

Workpackage number: 5	Optimisation of crop rotation - incorporating seed crops
Start date or starting event:	06/2000
Responsible person:	1
Contributing persons:	1, 2, 3, 4, 5
Person-months:	10

Objectives

17. Implementation of improved cultivation techniques.
18. Evaluate the possibilities to utilise 'by-products' from seed crops.
19. Evaluate the incorporation of seed crops in the crop rotation.

Description of work

17. Establish demonstration trials for rapid implementation of results on improved cultivation techniques developed in wp 2, 3 and 4. This part of the project is conducted in order to maximise the mutual benefits between workpackages.
18. A production system based exclusively on feeds and by-products from seed production (data from wp 2 and 3) are described.
19. Data from wp 2, 3 and 4 are collected and evaluated in relation to incorporation of seed crops in the crop rotation.

Deliverables

- D17. Guidelines for optimising the production of high quality seed of organic grass and clover species.
- D18. Registrations of the amount of forage produced in seed crops.
- D19. Guidelines for optimal crop rotation with respect to seed crops.

Milestones

- M17. Establishment of demonstration trials.
- M18. Report on the amount of forage and forage quality.
- M19. Report on optimal crop rotation including seed crops.

7. Implementation and time schedule

Table 3: Deliverables list

Deliverable No	Deliverable title	Delivery date	Meeting	Nature
D1	A list of organic grass species in request	03/2001		O
D2	The role of various field characteristics for weevil occurrence and damage	02/2002		Re
D3	Most important yield reducing factors in organic clover seed production	05/2001		Pup
D4	Seed production potential of green manure / nitrogen catch crops	11/2000		Pup
D5	Optimal row spacing and seed rate in grass species for seed production	03/2002		Pu
D6	In row fertilisation in grass seed crops	10/2003		O
D7	Optimal establishment technique in smooth stalked meadow grass	11/2004		Pup
D8	Optimal row spacing in white clover	12/2004		Pu
D9	Potential green manure crops in perennial ryegrass	12/2003		Pu
D10	Mixed cropping of grass and clover for seed	07/2001		O
D11	Repellent plants in clover for seed production	07/2001		O
D12	Sheep grazing grass seed fields	12/2001		Pup
D13	The effect of defoliation in white clover on clover seed weevil damage	11/2004		Pup
D14	A list of potential plant species repellent to clover seed weevils	04//2002		Pup
D15	A list of potential plant species attracting parasitoids against clover seed weevils	04/2003		Pup
D16	Alternative cropping techniques reducing clover seed weevil damage	12/2004		Pu
D17	Guidelines for optimising production of high quality seed of organic grass and clover species	12/2004		Pu
D18	Forage production and quality from seed crops	03/2002		Pu
D19	Guidelines for optimal crop rotation with respect to seed crops			

Each year in June Seed Company and agricultural advisers are invited to an open field day where projects within seed production are presented. In January/February preliminary results from the previous seed harvest year are presented and distributed to advisers (confidentially). In a number of years *Partner I* has given oral presentations at seed growers meetings (5 - 10 per year) and lectures at the Royal Veterinary and Agricultural University.

Co-ordination meetings will be held approximately twice a year within the research group.

8. Collaborative partners

Internationally

'DOPMOS – Development of Organic Production Methods for Forage Seeds', application for The Fifth Framework Programme, EU.

Partners:

Dr. Athole Marshall, Institute of Grassland & Environmental Research, Plas Gogerddan, Aberystwyth, UK

Dr. Trygve S. Aamlid, The Norwegian Crop Research Institute, Division Landvik, Grimstad, Norway

Dr. Oiva Niemelainen, Agricultural Research Centre of Finland, Jokioinen, Finland

Dr. Bohumir Cagas, Grassland Research Station, OSEVA PRO LTD., Zubri, Czech Republic

Dr. Gerard Borm, Applied Research for Arable Farming and Field Production of Vegetables, Lelystadt, the Netherlands

Dr. Georges Sicard, Federation Nationale Des Agriculteurs Multiplicateurs De Semences, Brain sur L'Authion, France

Dr. Geroge Rijckaert, Ministry of Small Enterprises, Traders and Agriculture, Melle, Belgium

Mr. Chr. Haldrup, The Danish Agricultural Advisory Centre, Århus, Denmark

Collaborative national projects:

'Production of organic seed from cereals, grasses and clover', financed by Danish Directorate for Development 1998 – 2000.

'Mixed cropping of grasses for seed production and red clover', financed by the Danish Seed Council, 1998- 2001.

'Demonstration and development of organic plant production systems', financed by the Danish Directorate for Development, 1999 – 2004.

'Integrated weed control in grass seed crops', financed by the Danish Seed Industry, 1997 – 99.

'Seed production 2000 – 2005', financed by the Danish Seed Industry, the Danish Directorate for Development and the Danish Institute of Agricultural Sciences.

9. Budget

Institution 1

Danish Institute of Agricultural Sciences

Department of Plant Biology

Research Centre Flakkebjerg

DK-4200 Slagelse

Denmark

Institution 2

The Royal Veterinary and Agricultural University
 Dept. of Agricultural Science
 Agrovej 10
 DK-2630 Taastrup
 Denmark,

Institution 3

Danish Institute of Agricultural Sciences
 Dept. of Plant Protection
 Research Centre Flakkebjerg
 DK-4200 Slagelse
 Denmark

Institution 4

Danish Institute of Agricultural Sciences
 Dept. of Animal Breeding and Genetics
 Research Centre Foulum
 DK-8830 Tjele
 Denmark

(in 1,000 DKK)

Institution 1	2000	2001	2002	2003	2004
Salary (scientific)	0	200	200	200	340
Salary (technical)	0	240	260	260	128
Operation	0	80	80	80	58
Overhead	0	95	108	108	105
Total	0	615	648	648	631
Institution 2					
Salary (scientific)	62	196	35	0	0
Salary (technical)	15	22	0	0	0
Operation	0	10	0	0	0
Overhead	17	46	4	0	0
Total	94	274	39	0	0
Institution 3					
Salary (scientific)	0	36	41	41	46
Salary (technical)	0	36	65	65	37
Operation	0	28	28	28	13
Overhead	0	16	30	30	26
Total	0	116	164	164	122
Institution 4					
Salary (scientific)	0	39	39	75	0
Salary (technical)	0	0	0	0	0
Operation	0	11	11	25	0
Overhead	0	10	10	20	0
Total	0	60	60	120	0
Total	94	1065	911	932	753

Total 3,755 mill. DKK.

10. Relevant references

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