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# Book of Abstracts for the 16<sup>th</sup> Nordic herbage seed production seminar

NJF - seminar 491. 20 – 22 June 2016, Grimstad, Norway

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# Preface

The 16th Nordic herbage seed production seminar takes place in Grimstad and Vestfold, Norway, from 20 to 22 June 2016. These seed production seminars, arranged by the Nordic Association of Agricultural Scientists (NJF), have a long tradition, with the first seminar being held in Denmark in 1964. Venue location normally rotates between Norway, Sweden, Denmark and Finland with 4–5 years intervals. The last time the seminar was arranged in Norway was in 1998. The objective of the seminar is to encourage communication between workers actively engaged in herbage seed production research and extension in the Nordic and Baltic countries.

The seminar programme includes 28 oral and poster presentations within the five sections: (1) Plant breeding / variety testing, (2) Plant protection, (3) New technology / knowledge sharing, (4) Useful and harmful insects in clover seed production and (5) Seed crop management. Abstracts from all papers presented at the seminar are included in this 'Book of Abstracts'. In addition, all the full-text papers are published in the Proceedings, which have been handed out to the seminar delegates as a pdf-file saved on a USB-stick. As there would have been no seminar without these scientific contributions, thanks are extended to the authors, both for their papers and for their oral or poster presentations at the seminar.

The seminar has been planned and arranged by an Organizing Committee consisting of Birte Boelt, Denmark, Gunilla Larsson, Sweden, Markku Niskanen, Finland and Lars T. Havstad, Norway. In addition, John Ingar Øverland, Trygve S. Aamlid and Elise K. Pedersen have been involved in the practical organization of the seminar and field excursions in Grimstad and Vestfold.

The Organizing Committee would also like to acknowledge Tollef Grindstad, Norsk frøavlerlag and the Norwegian seed companies Felleskjøpet Agri, Strand Unikorn and Felleskjøpet Rogaland Agder for their financial support of the seminar. Thanks are also extended to the seed growers in Vestfold who are hosting the field visits on the last day of the seminar.

Lars T. Havstad

Chairman of the Organizing Committee  
16<sup>th</sup> Nordic herbage seed production seminar

# Sponsors of the 16<sup>th</sup> Nordic herbage seed production seminar

20 – 22 June 2016, Grimstad and Vestfold, Norway



**Grindstad  
timotei**

**Norsk frøavlerlag**



**Strand Unikorn**



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NJF SEMINAR 491

16<sup>th</sup> Herbage seed production seminar  
 20 – 22 June 2016, Grimstad, Norway

PROGRAMME:

Day 1	Monday 20 June. Strand Hotel Fevik, Grimstad	
Time	Topic	Presenter / Institution
11:00	Registration and poster placement	
12:00	Lunch	
13:00	Opening of seminar	Lars T. Havstad, NIBIO Landvik, Norway Svein Bjerke, Norsk frøavlerlag, Norway
	<b>Session 1. Plant breeding / variety testing.</b> Chair person: Lars T. Havstad	
13:30	Genotype variation of perennial ryegrass grown for seed	Simon Abel, Aarhus University, Denmark
13:45	Seed yield potential in tetraploid red clover	Helga Amdahl, Graminor, Norway
14:00	Discussion	
14:15	Short coffee break / refreshments	
	<b>Session 2. Plant protection.</b> Chair person: Birte Boelt	
14:30	Framtidig tilgang på plantevernmidler i små kulturer / Future access to pesticides in minor crops	Anne Kraggerud, FK Agri, Norway
15:00	Use of IPM tools in weed control in grass seed production	Peter Kryger Jensen, Aarhus University, Denmark
15:15	Bekjemping av grasugras i frøeng av bladfaks og engkvein / Control of grass weed in seed crops of smooth brome grass and common bent	John Ingar Øverland, NLR Viken, Norway
15:30	Weed control in red fescue, perennial ryegrass and tall fescue	Barthold Feidenhans'l, SEGES, Denmark
15:45	Bekjemping av grasugras ved frøavl av engrapp / Control of grass weeds in seed production of <i>Poa pratensis</i>	Trygve S. Aamlid, NIBIO Landvik, Norway
16:00	Virkning av MCPA behandling til ulike tider på grobarhet av timotej, rødsvingel och ängsgröe / Effect of MCPA spraying dates on germination of timothy, red fescue and smooth meadow gras	Jörgen Persson, Skånefrø, Sweden
16:15	Discussion	



Time	Topic	Presenter / Institution
16:30	Poster presentations / Coffee break	
	Virkning av høstedata og tørkeforhold på spireevnen hos timotei / Effect of harvest date and drying conditions on germination of timothy seed	John I. Øverland, NLR Viken, Norway.
	Seed yields in organic seed production in Finland in relation to conventional production studied by herbage seed certification data	Oiva Niemeläinen / Markku Niskanen, LUKE, Finland
	Seed growing challenges and opportunities in Latvia	Martins Flaksis, Krastmali seklas Ltd, Latvia
	Effect of sowing rates and sowing methods on weed control and organic seed production of timothy, meadow fescue and red clover	Lars Havstad, NIBIO Landvik, Norway
	The evaluation of alfalfa varieties for forage and seed production in Latvia	Sarmite Rancane, Biruta Jansone, LLU Institute of Agriculture, Latvia
	Vekstregulering med Cycocel 750 eller Moddus M etter sprøyting med Hussar OD mot grasugras i frøeng av timotei (Phleum pratense): Virkning på frøavling og spireevne/ Growth regulation with Cycocel 750 or Moddus M after control of grass weeds with Hussar OD in seed crops of timothy (Phleum pratense): Effects on seed yield and germination	Trygve S. Aamlid, NIBIO Landvik, Norway
	Red clover seed harvest - Estimating the losses during harvest	Tore Dahlquist, Gunilla Larsson, Sveriges Frö- och Oljeväxtodlare, Sweden
	<b>Session 3. New technology / Knowledge sharing.</b> Chair person: Markku Niskanen	
17:15	Anvendelse af droner med kamera til bestemmelse af afgrødeindeks i græsfrø afgrøder / The use of drones with camera to determine crop index in grass seed crops	Rene Gislum, Aarhus University, Denmark
17:30	Development of organic ley seed production by participatory learning and action research 2005-2010	Ann-Charlotte Wallenhammar, Hushållnings-sällskapet, Sweden
17:45	Discussion	
19:00	Conference dinner, Strand Hotel Fevik	

Day 2	Tuesday 21 June. NIBIO Landvik, Grimstad	
08:15	Transport from hotel by bus to NIBIO Landvik	
08:45	Welcome to NIBIO Landvik	Erling Stubhaug, NIBIO Landvik,
	<b>Session 4. Useful and harmful insects in clover seed production.</b> Chair person: Gunilla Larsson	
09:00	Effect of insecticides on pollinating insects in red clover seed crops	Lars T. Havstad, NIBIO Landvik, Norway
09:15	Methods for improving pollination in red clover seed crops	Jens Åstrøm, NINA, Norway
09:30	An alternative management strategy towards weevils in white clover seed production – utilisation of natural enemies	Henrik Bak Topbjerg, Aarhus University, Denmark
09:45	Discussion	
10:00	Coffee break / refreshments	



Time	Topic	Presenter / Institution
	<b>Session 5. Seed crop management.</b> Chair person: Trygve S. Aamlid	
10:15	Nitrogen application of organic fertilizer in timothy (Phleum pratense L.) seed production	Eva Stoltz, Hushållningssällskapet, Sweden
10:30	Plant growth regulation in seed crops of perennial ryegrass	Birte Boelt, Aarhus University, Denmark
10:45	Vekstregulering og borgjødsling ved frøavl av rødkløver / Growth regulation and Boron fertilization in red clover seed crops	Silja Valand, NLR Østafjells, Norway
11:00	Improvement in timothy grass production with plant growth regulation and micronutrient fertilizers	Milla Välisalo, K-experiment farm, Finland
11:15	Seed production of late red clover depending on sowing rate and fertilisation of cover crops	Ants Bender, Estonian Crop Research Institute, Estonia
11:30	Coffee break / refreshments	
12:00	Effect of additional nitrogen fertilizer application, use of plant growth regulator and harvesting method on seed yield of meadow fescue	Markku Niskanen, LUKE, Finland
12:15	Tröskningens effekter på grobarhet i rödklöverfrö/ Red clover seed harvest - effects on germination	Tore Dahlquist, Sveriges Frö- och Oljeväxtodlare, Sweden
12:30	Tidigarelagd strängläggning och bladdödning i rödklöver / Early swath harvesting and Reglone treatment in red clover seed production	Gunilla Larsson, Sveriges Frö- och Oljeväxtodlare, Sweden
12:45	Discussion	
13:00	Lunch	
14:00	Excursion NIBIO Landvik (field trials etc.)	
17:00	Transport by bus to Grimstad harbour	
17:15	Boat trip along the coast of Grimstad / Dinner	
21:00	Back to hotel	

Day 3	Wednesday 22 June. Excursion, Vestfold	
08:00	Transport by bus to Vestfold (main seed producing area in Norway)	
10:30	Visit to local seed producers of various grass and clover species:	
	Ole A. Hotvedt, Tønsberg. Timothy and organic red clover seed production. Experimental trial: Use of Hussar in timothy. Effects of low temperatures before and after spraying. Topic: Weed problems.	
	Kjølsrød farm, Re. Red fescue seed production. Topic: Seed drying facilities	
	Lunch at Kjølsrød farm	
	Henning Solheim, Tønsberg. Smooth meadow grass seed production: Experimental trial: Use of Hussar and Atlantis in smooth meadow gras. Effects of low temperatures before and after spraying.	
	Thea Engelstad, Sandefjord. Meadow fescue seed production. Establishment of red clover seed crop. In addition to seed production, various local products are for sale on the farm. Refreshments and light meal.	
16:00	End of seminar. Bus back to Grimstad, via Torp airport, Sandefjord	

# List of participants

16<sup>th</sup> Herbage seed production seminar, 20 – 22 June 2016

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# Genotype variation of perennial ryegrass grown for seed

**Simon Abel, Rene Gislum, Birte Boelt**

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## Abstract

There is a large source of untapped variation within perennial ryegrass (*Lolium perenne* L.) populations that may increase seed yields. Understanding this variation starts with the development of potentials seed yield and how the length of this period may change with cultivar. Utilising 53 UPOV registered cultivars, heading date, anthesis and harvest timings were recorded. On the basis of strong linear relationships between these growth stages, critical photoperiods at secondary induction were calculated. Critical photoperiods for secondary induction occurred within 9 hour and 14.5 hour day lengths for the range of cultivars modelled. We show that in later secondary inducing cultivars, there is a reduced period for the development of seed yield potential.

The results have wider implications for seed production management systems, with research trials needing to comprehend if the varying inputs alter the development of seed yield potential, or the utilisation of seed yield potentials.

# Seed yield potential in tetraploid red clover

Helga Amdahl<sup>1,2</sup>, Trygve S Aamlid<sup>3</sup>, Petter Marum<sup>1</sup>, Åshild Ergon<sup>2</sup>, Muath Alsheikh<sup>1,2</sup>, Odd Arne Rognli<sup>2</sup>

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## Abstract

While tetraploid plants are taller, have thicker stems and broader leaves that altogether result in a higher forage yield compared to diploids, they generally have substantially lower seed yields than diploid red clover. Tetraploid red clover can be induced chemically by colchicine or nitrous oxide (N<sub>2</sub>O) and sexually by union of unreduced gametes. The average seed yield of tetraploid red clover in Norway is 60 % of the seed yield of diploids, while in Sweden it is 75 %. One objective of this research was to study whether there is a difference in seed yield among chromosome doubled tetraploids and crossed tetraploids. A second objective was to investigate differences in seed yield and seed yield components in Norwegian and Swedish tetraploid populations while the third objective was to study which seed yield component correlate the most with the seed yield per hectare.

Seed production experiments were established at Landvik and Bjørke in Norway and Svalöv and Lännäs in Sweden. Populations made by crossings of tetraploids gave significantly higher seed yield ( $P \leq 0.001$ ) compared to populations that were made by chromosome doubling. On average, Norwegian and Swedish varieties had equal yields in both experimental years. Norwegian and Swedish varieties differed mostly in earliness traits. Swedish populations began flowering on average four days earlier than Norwegian populations. Genotypic correlations showed that seed yield per flower head was the component with the highest correlation ( $r = 0.956$  and  $r = 0.977$ ) with the seed yield per hectare in both experimental fields.

# The evaluation of alfalfa cultivars for forage and seed production in Latvia

**Sarmite Rancane, Biruta Jansone, Aldis Jansons**

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## Abstract

The objective of this study was to compare domestic alfalfa cultivars with those created in the Baltic States as well as those commonly available in Latvian market, to evaluate their winter hardiness and suitability for forage and seed production in the conditions found in Latvia. The trials were conducted at the Latvia University of Agriculture (LLU) Institute of Agriculture in Skriveri (56°37 N and 25°07 E) in 2015 (the 1<sup>st</sup> year of use).

The results showed that there were no wintering problems for any alfalfa cultivars included in our trials conducted during a winter without lasting black frosts and rapid temperature fluctuations, which tend to occur every couple of years. The following faster-growing cultivars provided significantly higher dry matter yield (DMY) in the 1<sup>st</sup> year of use

if winter conditions had been favourable: Gea (10.98 t ha<sup>-1</sup>) and Eugenia (11.13 t ha<sup>-1</sup>) in total in four cuts; and Malvina (10.77 t ha<sup>-1</sup>), Birute (10.50 t ha<sup>-1</sup>) and SK Rasa (10.11 t ha<sup>-1</sup>) in total in three cuts. The best forage quality – higher crude protein content and ratio of relative feed value was ensured by pasture type cultivars: Karlu and Juurlu; as well as the hybrid lucerne Skriveru, all of them foliate well forming dense sward. The highest seed yields – over 600 kg ha<sup>-1</sup> were provided by Jogeva 118, SK Rasa and Skriveru, which are good results for climatic conditions found in Latvia. Alfalfa cultivars of southern origin have better regrowth intensity, they can provide an additional mowing in the growing season, but in some years their wintering may be risky, especially in the north-east of Latvia.

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# Framtidig tilgang på plantevernmidler i små kulturer / Future access to pesticides in minor crops

**Anne G. Kraggerud**

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## Sammendrag

1.6.2015 innførte Norge EUs regelverk på plantevernmiddelområdet. Innføring av Forordning (EF) 1107/2009 vil gi store endringer i godkjenningsprosessen i Norge. Kostnadene med å utvikle og registrere nye aktive stoffer og produkter har økt betraktelig. Det er strenge krav til godkjenning, og plantevernfirmaene vil være sikre på at det ikke blir avslag for å søke om godkjenning av et produkt/aktivt stoff. Utvikling av nye produkter vil først og fremst skje i store kulturer og markeder hvor det er mulighet for inntjening. Norge, som en del av den nordre sonen, er et meget begrenset marked. Muligheten til å søke om utvidet godkjenning for kulturer av mindre omfang (minor use) vil kunne hjelpe på tilgangen av plantevernmidler.

## Abstract

Norway implemented EU's Regulation (EC) 1107/2009 1st of May 2015. The implementation will affect the Norwegian approval process. Cost to research and development of a new active substances and plant protection product have increased. There are strict requirements for approval and authorization. The plant protection company will not risk a refusal of new active substances' or products. Development of new products will be in large crops and market with potential for good returns. Norway, as part of the Northern zone, is a very limited market. The opportunity to apply for minor use will solve some of the problems with limited access to plant protection products.



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# Use of IPM tools in weed control in grass seed production

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## Abstract

In grass seed production purity of the product is of main importance. Many annual grasses are difficult or impossible to control chemically in grass seed crops and at the same time seed characteristics make it difficult to separate the seeds from some of the cultivated grasses. At the same time crop rotations with a large proportion of winter cereals favour the development of these grasses. Different tools can be used to reduce the infestation level of grass weeds in the crop rotation. Further there also exist a number of options to reduce the possibilities of the annual grasses to develop and set seed in grass seed crops.

In a crop rotation with grass seed crops it is important to focus on control of annual grasses in all crops where it is possible to control them efficiently in order to keep infestations at a low level. A number

of options exist to reduce the infestation with annual grasses in grass seed crops. False seedbed technique can be applied prior to establishment to reduce the seedbank. Also at establishment a cover crop where germination of troublesome grass species is limited can be chosen. Changing the establishment method of red fescue from under sowing in a cover crop of winter wheat to a spring sown crop reduces the problems with *Vulpia* significantly.

During establishment of the grass seed crop and in the harvest years, annual grass weed problems can be reduced keeping the cover crop and the grass seed crop dense and competitive against weeds. This is obtained establishing the cover crop and grass seed in a way that secures a quick emergence and cover of the soil and especially to avoid gaps in the plant cover.

# Bekjemping av grasugras i frøeng av bladfaks og engkvein / Control of grass weed in seed crops of smooth brome grass and common bent

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## Sammendrag

Grasugras er den største ugrasutfordringen i grasfrøavl. Det er derfor svært viktig å gjennomføre feltforsøk for å finne tiltak for å bekjempe grasugraset. Et forsøk i 2012 med Axial (pinoxaden – 50 g/l) i bladfaks (*Bromopsis inermis* (Leyss.) Holub) med dosene 0.45, 0.9 og 1.8 L/ha, sprøytet om våren i frøåret, viste at Axial effektivt bekjempet markrapp (*Poa trivialis* L.) uten å skade frøenga. De to største dosene hadde noe bedre effekt enn minste dose og var klart bedre enn 0.1 l/ha av Hussar OD (jodsulfuron – 100 g/l). Axial og Hussar OD ble testet i to forsøk i 2013 i frøeng av engkvein (*Agrostis capillaris* L.). Dosene med Axial og Hussar OD var henholdsvis 0.45, 0.9, og 1.8 l/ha og 0.05, 0.1 og 0.2 L/ha. Axial førte til total skade i frøenga uansett dose. Hussar OD gav i et forsøk uten markrapp en sikker meravling hvor største avling ble høstet i ledd med største dose Hussar OD. I et forsøk med stort innslag av markrapp, ble markrappen ikke bekjempet ved bruk av Hussar OD uansett dose. I dette feltet var det heller en større andel markrappfrø i avlingen ved bruk av Hussar OD enn ubehandlet. Årsak til dårlig effekt kan være at behandlingen ble utført for seint.

## Abstract

Grass weeds in seed crops of grasses are the most serious weed challenges in this production. It is therefore important to carry out field trials with possible graminicides to find measures to control grass weed. In one field experiment in smooth brome grass (*Bromopsis inermis* (Leyss.) Holub) in 2012 Axial (pinoxaden – 50 g/l) was tested in doses of 0.45, 0.9 and 1.8 L/ha applied in spring in the ley year. This field trial showed that Axial can efficiently control *Poa trivialis* L. (rough meadow-grass) without

harming the seed yield. The two largest doses did not have better effect than the minimum dose and gave clearly better effect than 0.1 L/ha of Hussar OD (iodosulfuron – 100 g/l). Axial and Hussar OD were tested in two field experiments in 2013 in the ley year of common bent (*Agrostis capillaris* L.). The doses tested were 0.45, 0.9 and 1.8 L/ha of Axial and 0.05, 0.1 and 0.2 L/ha of Hussar OD. Axial led to a total damage whatever dose used. In one field, without *P. trivialis*, Hussar OD increased the seed yield and the highest yield was obtained where the highest dose of Hussar was used. In another field experiment with a high infestation of *P. trivialis*, Hussar OD was not able to control the grass weed even at the highest dose. Analyses of the yield revealed that Hussar OD in this field experiment was not able to reduce the content of seeds from *P. trivialis*, it was even higher for the two lower doses of Hussar OD than for untreated. The cause of lack of effect may be that the treatment was performed too late.

# Weed control in red fescue, perennial ryegrass and tall fescue

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## Abstract

Field trials testing the effects of various herbicides on weeds as well as their selectivity towards red fescue, perennial ryegrass and tall fescue were conducted in the period of 2012–2015. Based on evaluation of the seed products, the trials in 2015 show that in red fescue only the application of Atlantis at 0.8 l/ha has a satisfactory effect on annual meadow grass. Based on evaluation 14 days after application, the other herbicides also showed reasonable effect, but based on evaluation of weed seeds in the seed products, the other solutions did not prove effective. None of the tested solutions can control rat's tail fescue. In tall fescue, the herbicide Kerb 400 SC was tested as well as Hussar Plus OD and DFF. It is clear that tall fescue is intolerant to Hussar Plus OD. This is because tall fescue is very sensitive to the active substance iodosulfuron. Kerb 400 SC is an option for tall fescue, if there is a lot of annual meadow grass, but tall fescue is more sensitive to Kerb 400 SC than perennial ryegrass, so the maximum dosage should not exceed 0.3 l/ha and a late application around 1<sup>st</sup>. of March has proved to be most gentle.

The trials with perennial ryegrass are divided into: grown in cover crops typically spring barley, and grown in pure stand. Grown in pure stand, the trials are also divided into: control of ordinary grass weeds, and volunteers, which can be a major problem, especially when perennial ryegrass is established after winter crops. Kerb 400 SC is tested in perennial ryegrass grown in cover crops in the years of 2013–2015. A dosage of up to 0.4 l/ha is tolerated by the crop and has a good effect on annual meadow grass. Perennial ryegrass is intolerant to Kerb 400 SC when grown in pure stand. Probably because the crop is not sufficiently developed at the time of application. To control volunteers Agil is an option. The crop can take up to 0.15 l/ha without an additive. With an additive the maximum dosage is 0.1 l/ha.

# Bekjemping av grasugras ved frøavl av engrapp / Control of grass weeds in seed production of *Poa pratensis*

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## Sammendrag

I åra 2011–2014 ble frø av hver av artene markrapp (*Poa trivialis*), myrrapp (*Poa palustris*), tunrapp (*Poa annua*) og knereverumpe (*Alopecurus geniculatus*) påvist i 60–70 % av norske frøpartier av engrapp (*Poa pratensis*). For å bekjempe disse grasugrasa har norske frøavlere siden 2004 år hatt adgang til å bruke lavdosemidlet Hussar (jodsulfuron). Et nytt forsøk i 2014–2015 bekreftet at den nåværende formuleringa Hussar OD (100 g aktivt stoff/liter) kombinerer ugrasvirkning og skånsomhet overfor kulturgraset på bedre måte enn de alternative preparatene Atlantis WG (mesosulfuron + jodsulfuron, ikke godkjent i engrappfrøeng) og Boxer (prosulfocarb, godkjent om høsten i engåret og om høsten i veletablerte gjenlegg av engrapp). En annen fordel med Hussar framfor Atlantis og Boxer er en bredere virkning mot de fleste tofrøblada ugras. I Norge sås gjenlegg av engrappfrøeng vanligvis uten dekkvekst før midtsommer, og da anbefales to eller tre sprøytinger (4–5 ukers intervall) med Hussar OD i dosen 0.05 l/ha i gjenleggsåret, første gang når engrappen har 2–3 blad og er 1–2 cm høy. Sprøytinga i gjenleggsåret er viktigst, men bør i de fleste tilfeller følges opp av ei siste sprøyting med Hussar OD i dosen 0.10 l/ha om våren i engåret. For å oppnå best mulig virkning på tunrapp og markrapp bør denne vårsprøytinga utføres tidlig, men ikke i en periode med nattefrost. Virkningen av Hussar mot markrapp og særlig knereverumpe og er sikrere og mer stabil enn virkningen mot tunrapp, men virkningen mot myrrapp har vi foreløpig lite kunnskap om. Med unntak for første sprøyting på små planter i gjenleggsåret bør det ved sprøyting med Hussar OD tilsettes vegetabilsk olje (Renol, 0.5 l/ha) eller DP klebemiddel (0.05 % av væskemengden).

## Abstract

During 2011–2014, seeds of each of the species *Poa trivialis*, *Poa palustris*, *Poa annua* and *Alopecurus geniculatus* were identified in 60–70 % of Norwegian seed lots of *Poa pratensis*. Since 2004, Norwegian seed growers have permission to use Hussar (iodosulfuron) to control these grass weeds. A field experiment in 2014–2015 confirmed that the present formulation Hussar OD (100 g a.i./l) combines weed efficacy and seed crop safety in a better way than the alternative products Atlantis WG (mesosulfuron + iodosulfuron; not registered in *P. pratensis*) and Boxer (prosulfocarb, registered for use in the autumn of the seed harvest years and in well-established crops in the autumn of the seeding year of *P. pratensis*). Another advantage of Hussar compared with Atlantis and Boxer is a broader control of dicot weeds. Norwegian seed crops of *P. pratensis* are usually seeded without cover crop before midsummer, in which case two or three applications of Hussar OD (0.05 l/ha) at 4–5 weeks interval in the seeding year are recommended, the first when the seed crop has developed 2–3 leaves and has an average height of 1–2 cm. While these applications in the seeding year are most important, they should normally be followed by a final application of Hussar OD (0.10 l/ha) in the spring of the seed harvest year. Early spring applications are most efficient against *P. annua* and *P. trivialis*, but Hussar OD should not be sprayed during a period of night frost. The effect of Hussar against *P. trivialis* and especially *A. geniculatus* is better and more consistent than the effect against *P. annua*, but the effect against *P. palustris* remains to be documented. Except for the first application on small plants of *P. pratensis* in the seeding year, it is recommended to add rapeseed oil (Renol, 0.5 l/ha) or a wetting agent (0.05 % of application volume) when spraying Hussar OD.

# Virkning av MCPA behandling til olika tider på grobarhet av timotej, rödsvingel och ängsgröe / Effect of MCPA spraying dates on germination of timothy, red fescue and smooth meadow grass

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## Sammanfattning

Resultaten av undersökningen med MCPA behandling i frö vid olika stadier är lite av en sensation, i många år har det avrått för att behandla efter axgång, pga. av att det har försämrat grobarheten i fröet. Försöken 2013 visade inga större skillnader för rödsvingel och timotej. För ängsgröen var resultaten varierande. 2014 var det inga större skillnader i rödsvingel och timotej. I ängsgröen var det sämre grobarhet och mycket abnormala groddar vid behandling i axgång och i blomningen. Detta kan riskera att hela partiet blir kasserat. 2015 var det inga större skillnader i grobarheten på de olika fröslagen. Historiskt sett har man sagt att timotej inte tål MCPA men i försöket har vi inte sett någon påverkan på grobarheten, skörde-påverkan vet vi däremot inget om. I rödsvingeln har det varit en viss sänkning av grobarheten vid behandling vid axgång och blomning. Ängsgröen som är ett självbefruktande fröslag har reagerat något annorlunda med vissa år med upp till 10% grobarhets försämring vid behandling i axgång och i blomningen samt en förhöjning av antalet abnormala groddar. De år som grobarheten är låg kan det resultera att partiet går inte att certifiera. Sammanfattningsvis går MCPA att använda i fröodlingen men en viss försiktighet i ängsgröe och i rödsvingel. MCPA är ej registrerat i frö men vid ev. UPMA ansökan kan en punktbehandling vara ok men med stor försiktighet i ängsgröe och rödsvingel. Äldre försök har visat på skador av MCPA men doserna har då varit betydligt högre.

## Abstract

The results of the study with MCPA treatment of seeds at different stages is a bit of a sensation. For many years it has been advised not to treat after ear emergence, because of reduced germination of the seed. The trials in 2013 showed no major differences for red fescue and timothy. For smooth meadow grass the results were varied. In 2014 there were no major differences for red fescue and timothy. For meadow grass the germination was lower. Many plants were abnormal when treated at ear emergence and flowering. This could risk the whole party to be rejected. In 2015 there were no major differences in the germination of the various seeds. Historically, it has been said that timothy doesn't tolerate MCPA. In the trials we have not seen any effect on germination. About the impact on harvesting we don't know anything yet. For red fescue there has been some reduction in germination when treating at ear emergence and flowering. Smooth meadow grass, self-pollinating, reacted slightly different. Some year germination decreased with up to 10% and the number of abnormal seedlings increased when treated at ear emergence and flowering. The years with low germination, it may result in that the part cannot be certified. In summary, MCPA can be used when cultivating seed with some caution for smooth meadow grass and red fescue. MCPA is not registered for grass seed cultivation. If necessary, an application for minor use can be requested. Point treatment can be ok with great caution for meadow grass and red fescue. Older trials have shown MCPA damages, but doses were considerably higher.

# Anvendelse af droner med kamera til bestemmelse af afgrødeindeks i græsfrø afgrøder / The use of drones with camera to determine crop index in grass seed crops

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## Sammendrag

Kvælstof (N) er vigtig for at opnå høje frøudbytter, men N kan samtidig have en negativ indvirkning på det omgivne miljø. Mange forskere og firmaer arbejder på at udvikle metoder hvorpå man kan optimere udnyttelsen af N i landbrugsafgrøder. En af metoderne som testes i øjeblikket er anvendelsen af afgrøde indeks til at prædiktere frøudbytte eller bestemme mængden af N der skal tilføres for at opnå maksimalt frøudbytte. Afgrøde indeks kan bestemmes ved brug af sensorer blandt andet drone-monteret kamera. Foreløbige resultater fra Aarhus Universitet, Flakkebjerg viser, at dronemonteret kamera med en pixelstørrelse på ca. 5\*5cm er i stand til at bestemme 'normalised difference vegetation indeks' (NDVI) med stor præcision og nøjagtighed. Fordelene ved at anvende droner er, at metoden er langt hurtigere og langt mere detaljeret end metoden med traktor monterede sensorer. Ulempen er, at man er langt mere afhængig af vindstille vejr. Vi fortsætter arbejdet med at anvende drone monteret kamera til bestemmelse af NDVI i frøgræs afgrøder og fokusere blandt andet på at gøre billede proceseringen mere automatisk. Vi arbejder også på at fjerne randeffekten i parcellerne for at få et bedre estimat for gennemsnits NDVI værdierne på parcel niveau.

## Abstract

Nitrogen (N) is important to achieve high seed yields however N can at the same time have a negative impact on the surrounding environment. Many scientists and companies are working to develop a method that is able to optimise the utilisation of N in agricultural crops. One method that is current being tested is the use of crop index to predict seed yield or the N-application rate necessary to achieve maximum seed yield. Crop index can be determined by the use of sensors among them drone mounted cameras. Preliminary results from Aarhus University, Flakkebjerg shows that drone mounted cameras with a pixel size of 5\*5cm are able to measure normalised difference vegetation index (NDVI) with great precision and accuracy. The advantages of using drone mounted cameras are that the method is much faster and far more detailed than the method of using tractor mounted sensors. The disadvantage is that we are much more dependent of windless weather. We continue our work using the drone mounted camera to measure NDVI in grass seed crops and focus among other things on making the image processing more automatic. We are also working to remove the edge effect of plots to get a better estimate for average NDVI values on a plot level.

# Development of organic ley seed production by participatory learning and action research 2005–2010

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## Abstract

The production of organic ley seed has increased significantly in Sweden during the last decades. Ley seed production is complex and in addition has high standards for purity and germination in order to be approved for certification. The aim of this project was to identify and develop relevant questions, issues and measures for management schemes of production and trade of organic ley seed of timothy, red clover, meadow fescue, and white clover by using a participatory research approach for common learning and development. Furthermore, to define methods and analyses needed to reveal/answer the questions. The team of organic seed producers was expanded to a group of about 15 farmers in central Sweden. They worked together with an organic adviser, a researcher, and a researching facilitator to learn as much as possible from their discussions. The group met about 4 times per year, of which two

were out in the field and the two were planning or evaluating indoors. The evaluation of the group's work showed that the participants have increased their knowledge during the project. Evaluation of the measures implemented in the group showed that the majority were of great or very great importance for both the production of seed and for their own learning. The various measures were evaluated and analysed by the group and utilised when appropriate on the farmers own farms. The measures in seed production that the group considered to be most important are simultaneous seeding of seed and nurse crop, weed regulation by cutting in spring in red clover and white clover, knowledge of pollinators in clover production, windrowing prior to harvest and seed drying and cleaning.



# Effect of insecticides on pollinating insects in red clover (*Trifolium pratense* L.) seed crops

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## Abstract

The repellent effect of three insecticides on bumblebee and honeybee pollination activity was evaluated in a large scale on-farm trial with red clover seed crop in SE Norway in 2013. On average for 1, 2, 3, 4, 5 and 7 days after spraying, 17 and 40 per cent less honeybees and 26 and 20 per cent less bumblebees were observed on plots sprayed with the pyrethroids lambda-cyhalothrin and Alfa-cypermethrin, respectively, compared to non-sprayed control plots. No similar negative repellent effect on pollination activity was found on plots sprayed with the neonicotinoid thiacloprid. All insecticides reduced the predator density and had a positive influence on seed yield. Of the three insecticides, thiacloprid, which showed no repellency against pollinating insects and had the strongest positive effect on seed yield (22% over non-sprayed control plots), was regarded as the most promising for red clover pest management. In a follow-up study in 2014 and 2015, the long-term effect of thiacloprid on bumblebee (*Bombus terrestris*) colony development in nests set out in sprayed and non-sprayed red clover seed fields at various locations in SE-Norway, was carried out. Date of spraying varied between the two experimental years. In 2014, when spraying was performed during red clover flowering (23–43 % of all flower heads in full bloom), thiacloprid residues were detected in bumblebees two weeks after spraying. Also the bumblebee colony development was negatively affected. In 2015, when spraying was performed on the bud stage (before flowering), no similar thiacloprid residues in bumblebees or any negative effects on bumble bee development could be detected.

Although further experiments are required, this indicates that spraying should be restrained to the period before flowering to reduce the uptake of thiacloprid from nectar and pollen during pollination.

# Methods for improving pollination in red clover seed crops

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## Abstract

We investigated the importance of pollinator activity and community composition for seed yield in a total of 50 red clover fields (*Trifolium pratense*) in South-Eastern Norway, from 2013 through 2015. We also tested the effect of two local pollinator enhancing strategies; either 1) sowing flower strips of lacy phacelia (*Phacelia tanacetifolia*) or 2) adding commercially reared colonies of Buff-tailed bumblebees (*Bombus terrestris*) adjacent to red clover seed fields. Overall, the bumblebee communities within the fields was strongly dominated by the Buff-tailed bumblebee and members of the *Bombus lucorum* complex. This dominance was disproportionate to the community composition of the surrounding landscapes, suggesting a higher dispersal or competitive ability of these species in red clover fields. Bumblebee species richness had a strong positive effect on seed yield, interacting positively with overall flower visitation rates. Sowing of flower strips increased flower visitation rates but not species richness, and had a positive effect on seed yield in fields where more than two species of bumblebees were observed visiting red clover flowers, but not in more species poor fields. Thus phacelia flower strips can boost red clover seed yields in landscapes with healthy bumblebee communities.

Adding Buff-tailed bumblebee colonies decreased the species richness of the flower visiting bumblebees and did not increase seed yield. We saw no signs of competition between Honey bees (*Apis mellifera*) and bumblebees, and adding Buff-tailed bumblebee colonies instead increased the amount of honey bees in the fields. Flower visitation rates of honey bees had in general a negative effect on seed yield, and interacted negatively with bumblebee flower visitation. A hypothesis for this strong negative effect is that simultaneous high densities of both bumblebees and honeybees leads to increased levels of nectar robbing, where honey bees exploit holes in the flower corolla made by bumblebees.

# An alternative pest management strategy towards weevils in white clover seed production – utilisation of natural enemies

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## Abstract

A number of seed eating weevils reduce the yield in white clover seed production. Conventional control relies on the utilisation of broad-spectrum insecticides. In production of organic white clover seeds, little pest control can be enforced. However, the weevils have natural occurring enemies such as parasitic wasps. Currently, a novel approach combining inoculated biological control and conservation biology control is being developed. The overall aims are to decrease the use of insecticide in seed production and at the same time to enhance yields and yield stability. To achieve these goals the strategy utilises the functional biodiversity for pest control. In the long term, it is anticipated that the approach can be utilised in other agricultural and horticultural crops. Here the first step of evaluating the approach is described.

# Nitrogen application of organic fertilizer in timothy (*Phleum pratense L.*) seed production

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## Sammanfattning

Syftet var att ta fram ett rådgivningsunderlag för kvävegödsling i ekologisk timotejfrövall genom att undersöka effekten av fördelning av kvävetillförsel mellan höst och vår till vallar av olika åldrar på fröavkastning och risk för kväveläckage. I sex fältförsök undersöktes effekten av att fördela totalt 120 kg N/ha i Biofer 10-3-1 mellan höst och vår. Resultaten visar att kväve ska tillföras både höst och vår för en säker och hög timotejfröavkastning vallår 1-3. Vid total tillförsel av 120 kg N/ha som Biofer, ska 30-90 kg N/ha tillföras under hösten och resten under våren i en tidig timotejsort som Switch. Risken för kväveläckage var låg, endast en liten ökning av mineralkvävehalten i jorden under sen höst hittades i behandlingen med hela N-givan tillförd på hösten.

## Abstract

The objective was to develop N fertilization recommendations in organic timothy seed production by investigating the effect of different distribution regimes of N during autumn and spring on seed yield and N leakage in fields of various stand ages. The effect of distribution regimes of 120 kg N/ha in Biofer 10-3-1 between autumn and spring on seed yield and N leakage was investigated in six field trials. The results show that nitrogen should be applied in autumn and in spring for a safe and high seed yield in stands of seed year 1-3. Out of a total application of 120 kg N/ha as Biofer, 30-90 kg N/ha should be applied in autumn and the rest in the spring in early timothy varieties such as SW Switch. The risk for N leaching was low, only a small increase of mineral nitrogen in the soil in late autumn was found in the treatment with the all N applied in autumn.

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# Plant growth regulation in seed crops of perennial ryegrass (*Lolium perenne* L).

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## Abstract

Seed yield components were recorded in plants of perennial ryegrass cv. Calibra a medium late, forage type (4n) in a two factorial block design with Nitrogen (N) and plant growth regulator (PGR) application in 2014 and 2015 at Aarhus University (AU), Flakkebjerg. For each plant, reproductive tillers were categorized into three groups (T1-T3) according to time of development. N increased the number of reproductive tillers and the number of florets per tiller in both years, except for the early developed tillers (T1) in 2015. N increased the number of seeds per spikelet in 2014.

The results show the potential for increasing seed yield by increasing the number of seeds per spikelet in particular in the late developed tillers by the application of PGR (trinexapac-ethyl) and we suggest this as a possible explanation for the yield increases generally found in field trials where PGR are reported to increase the total number of seed per unit area.

# Vekstregulering og borgjødsling ved frøavl av rødkløver / Growth regulation and Boron fertilization in red clover seed crops

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## Sammendrag

Mikronæringsstoffet bor påvirker nektarinnholdet i rødkløverblomsten og er av den grunn viktig for pollinering, frøavling og frøkvalitet i rødkløver. I middel for åtte forsøk i 2012–2015 har bladgjødsling med 1,5 L/ha Bortrac (10.9 % B) i rødkløverfrøeng økt frøavlingene med 14 % og spireevnen med 5 prosentenheter. Optimalt tidspunkt ser ut til å være når plantene dekker ca 50 % av jordoverflaten, er minst 12 cm høye og i god vekst, uavhengig av sort. Vekstregulering har også vist seg å være positivt i norsk rødkløverfrøavl. Gjennomsnittlig har bruk av 1,0 L/ha Moddus M (25 % aktivt stoff trinexapac-etyl) gitt en avlingsøkning på 24 %, men ikke påvirket spireevnen signifikant. Sorten 'Yngve' har skilt seg ut fra de andre sortene ved at den har gitt størst frøavling ved vekstregulering ved knoppdanning i siste halvdel av juni. 'Lea', har derimot gitt best resultat ved behandling ved begynnende strekningsvekst i slutten av mai. Tankblanding av Bortrac og Moddus M har i denne forsøksserien ikke gitt større frøavling, enn ved sprøyting med Moddus M alene. Vi anbefaler derfor at de to produktene sprøytes hver for seg.

## Abstract

The micronutrient boron is important to the nectar content of the red clover flower, and thus also to pollination, seed yield and seed quality. In eight field experiments in Norway during 2012–2015, foliar fertilization with 1.5 l/ha Bortrac (10.9 % B) in red clover seed crops resulted in a 14 % yield increase and a 5 per cent unit increase in germination capacity. The optimal application time appears to be when plants are at minimum 50 % ground cover, at least 12 cm tall and showing vigorous growth, regardless of variety. Growth regulation has also proved to be positive in Norwegian red clover seed crops. On average for the eight trials, 1.0 l/ha Moddus M (25 % active ingredient trinexapac-ethyl) increased yields by 24 %, but had no significant impact on germination capacity. The variety 'Yngve' was different from the other varieties in that it showed the best results after application at bud formation. In contrast, 'Lea' had the best results if applied during stem elongation. The tank mix of Bortrac and Moddus M gave a weaker seed yield response application of Moddus M only. Separate applications are therefore recommended.

# Improvement in timothy seed yield with plant growth regulation and micronutrient fertilizers

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## **Abstract**

The influence of plant growth regulator (trinexapac-ethyl) and micronutrient fertilizer (Mn, Cu, Zn) to timothy (*Phleum pratense* L.) seed crops was evaluated in field trial in Hauho (61 N, 24 E), Finland. Timothy cultivars in trial were 'Grindstad', 'Rakel', 'Switch' and 'Tryggve'. Plant growth regulator and micronutrient fertilizer were used as a tank mix. Yield (kg/ha) increase was between 13 and 90 percent according to variety and was statistically significant with all of the cultivars. Number of earless stems or stems with ears did not differ between treated plots and untreated plots. More research is needed to separate the effect of plant growth regulator and micronutrients and to determine the optimal micronutrient amounts to timothy seed crops.



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# Seed production of late red clover depending on its sowing rate and fertilisation of cover crops

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## Abstract

Two field trials were carried out at Estonian Crop Research Institute in 2013–2014, where the potentiality of intermediate two-row barley ‘Maali’ and early spring wheat ‘Mooni’ for using as cover crops at the establishment of seed production field of tetraploid late red clover ‘Ilte’ was studied. The cover crops comprised four treatments with varying seeding and nitrogen rates. Red clover was sown at 2, 4, 6 and 8 kg pure live seeds ha<sup>-1</sup>.

The results affirmed that both barley ‘Maali’ and spring wheat ‘Mooni’ fit for the establishment of seed production field of tetraploid late red clover ‘Ilte’. The seed yields of clover attained 400 kg ha<sup>-1</sup>. In case of both cover crops the highest clover seed yields were obtained in the treatments where the seeding and nitrogen rates of cereals had been diminished by a third.

Similarly the economic calculations distinguished these treatments to be the most profitable in both cover crops. Use of spring wheat as a cover crop for late red clover had an economic advantage afore barley. Nitrogen application rate to the cover crops in the sowing year did not influence the seed quality of red clover in the first harvest year. Sowing rate of 4 kg ha<sup>-1</sup> turned out to be adequate for tetraploid red clover.

# Effect of additional nitrogen fertilizer application, use of plant growth regulator and harvesting method on seed yield of meadow fescue

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## Abstract

We investigated effect of additional nitrogen application, use of plant growth regulators (PGR) and harvest method on seed yield of Meadow fescue (MF) at the Luke Natural Resources Institute Finland in Ylistaro. Harvesting methods included two swathing times and direct combine harvesting. Nitrogen application included recommended normal spring nitrogen rate (80 kg N/ha) and an additional (40 kg N/ha) dose at the beginning of stem elongation with and without PGR (Moddus 0,8 l) treatment. Lodging of the stand ranged from 29 to 37%, when PGR was not used. Additional N application increased lodging compared to recommended N rate. With PGR treatment lodging remained at 10–15 % at both N rates. PGR shortened the length of the stem by 14 cm. The additional nitrogen application did not affect seed yield of Meadow fescue either without PGR 373 vs 384 kg ha<sup>-1</sup> or with PGR 455 vs 454 kg ha<sup>-1</sup>. PGR treatment increased the seed yield approximately by 20 % at both recommended (454 vs 384 kg ha<sup>-1</sup>) and at additional N rate (455 vs 373 kg ha<sup>-1</sup>). Both swathing

treatments decreased the seed yield by about 50 kg ha<sup>-1</sup> compared to direct combine harvest, however, the difference was not statistically significant. Obviously main reason for the seed loss was seed shattering, as seed moisture content at swathing was 25–30 %. In this trial the swathing did not have a clear effect on seed moisture content at harvest. After first swathing period (5 days) seed moisture content decreased from 28,5 % to 20,7 %. However, in harvest the moisture content was only 1,7 % unit lower in swathing treatment compared to direct combine harvest at the same date. In the second swathing treatment – swathing at direct combine date and 3 days drying on swath – the seed moisture content decreased from 24 % to 16%.

# Tröskningens effekter på grobarhet i rödklöverfrö / Red clover seed harvest – effects on germination

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## Sammanfattning

Rödklöver är en mycket betydelsefull art i fröproduktionen i Sverige och ingår de flesta vallfröblandningarna i Sverige. Grobarheten i fröpartierna har dock under åren varit mycket varierande och enstaka år har det varit svårt att uppnå certifieringsgränsen 80 %. I jämförelse med grobarheten för gräsarterna är grobarheten för rödklöver instabil. Målet med denna undersökning har varit att få mer kunskap om olika åtgärder för att producera rödklöverfrö med hög grobarhet

Två tester har gjorts i två fält med rödklöver. Sorterna var den diploida sorten SW Ares och den tetraploida sorten Vicky. 4 olika slagskoavstånd 3, 4, 5, 6 mm användes för att undersöka hur grobarheten påverkas. I varje försök gjordes en jämförelse med handtröskat material. Resultaten visar att grobarheten för diploid sort SW Ares påverkades minst. Denna varierade mellan 96% och 82% medan den tetraploida sorten Vicky visade klart lägre grobarhet vid slagskoavstånden som var under 6 mm från. Variation från 93% till 64%. Den tetraploida sorten fick också ett ökat antal abnorma groddar när slagskoavståndet minskades.

## Abstract

Red clover is a very important species in seed production in Sweden and is included in most forage mixtures. The germination, however, has over the years varied between individual years, and it has been difficult to meet the certification limit of 80 %. In comparison with the germination of grass species, the germination of red clover is more unstable. The aim of this study was to gain more knowledge about the various steps to produce red clover seed with a high germination

Two tests were performed in two fields of red clover with the diploid variety SW Ares and the tetraploid variety Vicky. During combining, four different concave clearances (3, 4, 5, 6 mm) were used to examine the effect on germination. The germination capacity from seed being combine harvested was compared to seed that had been threshed by hand. Of the two cultivars, the diploid variety, SW Ares was least affected by the different treatments, with a germination capacity between 96% and 82%. In the tetraploid variety Vicky, there was a significant reduction in germination capacity when the concave clearance was less than 6 mm (variation from 93% to 64%). Also the number of abnormal seedlings increased in the tetraploid cultivar when the concave clearance was reduced.

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# Tidigarelagd strängläggning och bladdödning i rödklöver / Early swath harvesting and Reglone treatment in red clover seed production

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## Abstract

A red clover seed grower has a few different harvesting methods to choose. If there has been a sunny and warm summer/autumn and the crop matures, it may be appropriate with direct combining. Normally, it takes 50–55 days from the optimal day for pollination until the crop is mature enough for direct combining. However, due to all the green leaf mass in the field, the crop must in most cases be desiccated with Reglone or swathed before combining. If we enter into a period of unstable weather, it might be worth to sacrifice some seeds and harvest the clover before the rain comes. The question is how early it is possible to use Reglone or swath the crop without risking an excessive drop in seed yield and seed germination. Early treatment means that a large proportion of seeds are poorly matured. However, although not fully matured, these seed may perhaps be viable and germinate well.

In 6 trials 2012–2015, both the treatment with Reglone and swathing showed to be useful options with regard to reducing the green mass of red clover before harvest. The highest seed yield was produced when swathing/Reglone was performed 35–45 days after optimal day for pollination. There was a tendency for reduced germination after early swathing/Reglone-treatment. Of the two treatments, germination was lower after swathing than after Reglone treatment in some years and in some experiments.

# Virkning av høstedato og tørkeforhold på spireevnen hos timotei / Effect of harvest date and drying conditions on germination of timothy seed

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## Sammendrag

Spireundersøkelser av timoteifrø hentet inn fra frøavlere ved høsting i 2012 og 2013 viste at spireevnen falt ved økende vanninnhold ved høsting. I 2012 da det var sein modning av frøengene, var reduksjonen i spireevne dramatisk og hadde store økonomiske konsekvenser for frøavlerne. En spørreundersøkelse viste at det særlig i år med lav varmesum er viktig å ta hensyn til at vekstregulering, og i mindre grad sopp sprøyting, forsinker frømodninga. I forsøk med forskjellig tørkeregime tålte timoteifrø med vanninnhold inntil 35 % tørking med varmluft som holdt 40°C. Forutsetningen var hyppig rulling av frøet under den raske nedtørkinga. Tørking med varmluft førte til økt spiretreghet, men ikke redusert spireevne.

## Abstract

Germination analyses of timothy seed collected from seed growers at the first direct combining in 2012 and 2013 showed decreasing germination capacity with increasing seed water content at harvest. The reduction in germination capacity was dramatic and reduced the income of many seed growers in 2012, when low temperature led to slow maturation of the seed crops. A survey among Norwegian seed growers highlighted the importance of taking into consideration that application of chemical growth regulators – and to a lesser extent fungicides – will postpone the optimal harvest date for timothy seed. Experiments with different drying regimes showed that timothy seed with water content up to 35% will withstand drying with heated air at 40 °C, provided that the seed is rotated frequently during the drying process. Drying with heated air causes increased seed dormancy but did not lead to reduced germination.

# Seed yields in organic seed production in Finland in relation to conventional production studied by herbage seed certification data

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## Abstract

Finnish seed certification data from years 2002–2011 of timothy, meadow fescue and red clover was used to study factors effecting variation in hectare seed yields. The data provided information of the total certified seed amount and total inspected acreage for each certified seed lot. Production site and year information was available but data of age of stand(s) and of production management issues (fertilizer and plant growth regulator application, establishment and harvesting methods etc.) was not available. However, organic and conventional production method was one classifying factor available. Most comprehensive data was available of timothy. Data of 3434 certified seed lots was available. Of those 219 (6.4%) were from organic production. During the study years 2002–2011 organic production percentage ranged from 5 to 10 of the certified seed lots. Mean certified cultivation acreage was 16.4 ha in conventional production and 14.0 ha in organic production. Each certified seed lot could consist of yield of one or more fields. Mean yield in conventional timothy seed production was 398 kg ha<sup>-1</sup> (s.e. 15.8 kg ha<sup>-1</sup>) and in organic production 254 kg ha<sup>-1</sup> (s.e. 18.7 kg ha<sup>-1</sup>). The yield difference was statistically significant ( $P < 0.01$ ). In timothy the production method explained 24.3 percent of the variation in seed yield in this data. In meadow fescue total number of certified seed lots were 970 of which 48 (5%) from organic production. Mean cultivation acreage for certified seed lot was 10.0 ha in conventional production and 10.8 ha in organic seed production of meadow fescue. The mean yield in conventional seed production of meadow

fescue was 294 kg ha<sup>-1</sup> (s.e. 28 kg ha<sup>-1</sup>) and in organic production 244 kg ha<sup>-1</sup> (s.e. 39). The yield difference was not statistically significant ( $P = 0.11$ ). In meadow fescue the production method explained only 0.01 percent of the variation in seed yield in this data. In red clover the share of organic production method was higher than in timothy and meadow fescue as 135 seed lots (43%) of the total 317 certified seed lots were from organic production. Mean cultivation acreage for one certified seed lot was 5.7 ha in conventional and 8.0 ha in organic seed production in red clover. Mean seed yield in conventional red clover seed production was 171 kg ha<sup>-1</sup> (s.e. 17.7 kg ha<sup>-1</sup>) and in organic production 132 kg ha<sup>-1</sup> (s.e. 17.9 kg ha<sup>-1</sup>). The yield difference was statistically significant ( $P < 0.01$ ). The production method explained from 3.4 to 5.0 percent of the total variation in red clover seed yield in this data. Evira (The Finnish Food Safety Authority) is acknowledged for kindly providing the seed certification data for this study.

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# Seed growing challenges and opportunities in Latvia

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Since year 1991 Latvia have become independent second time. From planed seed producing (breeding, growing, sales) it become a free market with three main players: breeding stations, farmers – seed producers and seed sales companies.

Change from Soviet times to free economical market give seed growers opportunities to have access to breeding station materials and information. That makes also challenges– a lot of breeding station have problems to defend they rights to varieties and they couldn't get royalties from seed growers.

Farmers have opportunities to have free access to Latvian varieties and they can grow any grass or clover they want. That makes also problems with overproduction in local market. Also farmers have to compete with all other farmers and seed companies from foreign countries – it is challenge to many Latvian seed growers. They don't have knowledge to do seed production so cost-effective.

Last 25 years increased number of seed sales companies in Latvia and that makes competition on seed sales more harder. Seed sales companies have they own suppliers – local seed growers, international companies or both. That is keeping our local producers at lower prices but still local farmers are not enough competitive in seed growing because there is no link between growing and sales.

Following years will make changes in way breeding stations and seed growers used to work for 25 years – they have to find solution together with sales companies to make local seed growing and market more competitive and predictable.



# Effect of sowing rates and sowing methods on weed control and organic seed production of timothy, meadow fescue and red clover

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## Abstract

Different establishing methods were evaluated in organic seed production of timothy (two trials with cv. Grindstad), meadow fescue (two trials with cv. Fure) and red clover (one trial with cv. Yngve) at NIBIO Landvik Research Station (58.2 °N) and on seed growers' farms in Vestfold county, Norway, during 2010–2013. The plan included three sowing methods, (1) broadcast sowing of grass/clover. Cover crop sown at 12 cm row distance, (2) sowing of cover crop and seed crop in crossed rows, both at 12 cm row distance and (3) sowing cover crop and seed crop in every other row. For each sowing method three sowing rates, either 5, 10 or 15 kg ha<sup>-1</sup> (timothy and meadow fescue) or 3, 6 or 9 kg ha<sup>-1</sup> (red clover) was combined. In the first seed harvesting year, the highest seed yield of all three species was harvested on plots sown with cover crop and seed crop in every other row. On average of sowing rates and all trials with timothy, meadow fescue and red clover, seed yield was 5–6, 20–25 and 19–25 % higher on these plots than on plots that had been broadcasted or sown in crossed rows (tr. 3 vs. 1 and 2), respectively. In the second seed year, only small and insignificant differences in seed yield between sowing methods were found. The different sowing methods had no significant effect on weed density in the field or weed contamination of the seed lot after seed cleaning. Increasing sowing rate normally had a negative influence on seed yield in the first year, but only minor influence in the second year. Weed density / weed contamination was normally not affected by the sowing rate. Economical calculations showed that sowing of cover crop and

seed crop in every other row gave the highest income in red clover and meadow fescue when sown at the lowest sowing rate (3 and 5 kg ha<sup>-1</sup>, respectively). In timothy, only small differences in economic income between the three sowing methods were found when sown at a optimal rate of either 5 or 10 kg ha<sup>-1</sup>.

## Vekstregulering med Cycocel 750 eller Moddus M etter sprøyting med Hussar OD mot grasugras i frøeng av timotei (*Phleum pratense*): Virkning på frøavling og spireevne

## Growth regulation with Cycocel 750 or Moddus M after grass weed control with Hussar OD in timothy (*Phleum pratense*) seed crops: Effects on seed yield and germination

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### Sammendrag

Både klormekvatklorid (CCC, i disse forsøka Cycocel 750) og trineksapak-etyl (i disse forsøka Moddus 250 EC fram til 2011, deretter Moddus M) er godkjent til vekstregulering i timoteifrøeng i Norge. Forsøk fra 1999 til 2007 viste (1) større gjennomsnittlig meravling (23%) og mindre variasjon i avlingsutslag, ved vekstregulering ved begynnende strekningsvekst med CCC (2.67 l/ha + klebemiddel) enn med Moddus (0.6 l/ha, 19% meravling), (2) i middel 2 og 3 enheters reduksjon i spireevnen ved sprøyting med henholdsvis CCC og Moddus, (3) større risiko for avlingsreduksjon hvis sprøyting mot grasugras med Hussar OD (jodsulfuron) ble etterfulgt av Moddus enn av CCC, og (4) mindre behov for soppssprøyting ved vekstregulering med Moddus enn med CCC. I 2014 og 2015 ble det gjennomført to nye forsøk der frøavling og spireevne ved to ulike tidspunkt for direktetresking ble sammenliknet i frøeng som var vårsprøyta med Hussar og deretter vekstregulert med CCC eller Moddus med og uten soppssprøyting med Proline 250 EC (prothioconazol, 0.8 l/ha). Resultatene viste (1) større meravling (23%) av Moddus enn av CCC (17%) i 2014 da det gikk 21 dager fra Hussar-sprøyting til vekstregulering, (2) 14% meravling for CCC, men 4% avlingsreduksjon for Moddus i 2015 da det gikk bare 12 dager fra Hussar-sprøyting til vekstregulering, (3) i middel for begge forsøk 5% (lønnsom) meravling for Proline etter CCC, men bare 0-1% (ulønnsom) meravling for Proline etter eller sammen med Moddus, og (4) at reduksjonen i spireevne etter vekstregulering (og soppssprøyting) i de fleste tilfelle kunne unngås ved 3-5 dager utsettelse av frøhøstinga, men at vekstregulert frøeng ikke bør direktetreskes dersom vanninnholdet i frøa er over 30 %.

### Abstract

Both chlormequate-chloride (CCC, in these trials Cycocel 750) and trinexapac-ethyl (in these trials Moddus 250 EC until 2011 and Moddus M after that) are registered growth regulators in timothy seed crops in Norway. Field trials from 1999 to 2007 showed (1) a higher average seed yield increase (23% over control) and less variation in seed yield response for growth regulation with CCC (2.67 l/ha + wetting agent) than with Moddus (0.6 l/ha, average increase 19%) at early stem elongation, (2) on average 2 and 3 per cent units reduction in germination capacity after regulation with CCC and Moddus, respectively, (3) a greater risk for reduced seed yield if grass weed control with Hussar OD (iodosulfuron) was followed by Moddus than by CCC, and (4) less need for fungicide in seed crops regulated with Moddus than with CCC. Two new trials in 2014 and 2015 compared seed yield and germination at two different times for direct combining in crops sprayed with Hussar in early spring before growth regulation with CCC or Moddus with and without subsequent application of the fungicide prothioconazol (Proline 250 EC, 0.8 l/ha). Results showed (1) a higher seed yield increase for Moddus (23%) than for CCC (17%) in 2014 which had 21 days between Hussar and growth regulation, (2) 14% seed yield increase for CCC but 4% seed yield reduction for Moddus in 2015 when the interval was only 12 days, (3) on average for both trials 5% (profitable) seed yield increase for Proline after CCC, but only 0-1% seed yield increase (not profitable) after Moddus, and (4) that the reduction in germination capacity after application of growth regulators (and fungicides) in most cases could be compensated by a 3-5 days delay in seed harvest, but that growth regulated seed crops should not be directly combined if the seed water content is higher than 30 %.

# Red clover seed harvest – Estimating the losses during harvest

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## Abstract:

Preliminary studies indicated that Swedish seed growers may have substantial seed losses (25 – 180 kg/ha) during red clover harvest. The objective of the present study was to measure the losses from different types of combine harvesters (straw-walkers/rotor types). In addition, the effect of driving speed (1, 2 and 3 km/h) was studied. The seed loss experiment was carried out in autumn 2014 in four red clover seed fields being directly harvested either after desiccation with Reglone (three fields) or after natural maturation (one field). In all four seed fields, seed loss increased when driving speed increased. The highest and lowest seed loss, after increasing driving speed from 1 to 3 km/h, was 83 and 20 kg/ha, respectively. Type of combiner also had a strong influence on seed losses. At a driving speed of 2 km/h, the seed loss between combiners harvesting seed fields desiccated with Reglone varied between 24 to 99 kg/ha, representing 7 to 25 per cent of saleable seed at harvest. With some few exceptions, the quality of the lost seed was good, and normally met the certification requirement of 80 %.

